



**CALCULATIONS OF ENERGY LOSS, RANGE,
 PATHLENGTH, STRAGGLING, MULTIPLE
 SCATTERING, AND THE PROBABILITY
 OF INELASTIC NUCLEAR COLLISIONS
 FOR 0.1-TO 1000-MEV PROTONS**

Joseph F. Janni
 1Lt USAF

TECHNICAL REPORT NO. AFWL-TR-65-150

September 1966

AIR FORCE WEAPONS LABORATORY
 Research and Technology Division
 Air Force Systems Command
 Kirtland Air Force Base,
 New Mexico

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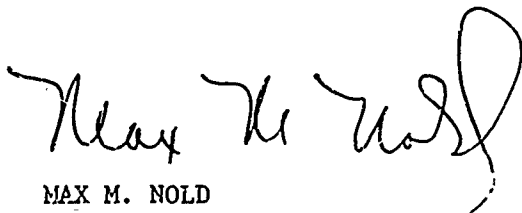
FOREWORD


This research was performed under Program Element 61.44.50.14, Project 8803. Inclusive dates of research were 1 September 1964 to 1 May 1966. The report was submitted 27 May 1966 by the Air Force Weapons Laboratory Project Officer, Lt Joseph F. Janni (WLRB).

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This technical report has been reviewed and is approved.


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ABSTRACT

Theoretical calculations have been made of the mean energy loss, pathlength, range, multiple scattering, and pathlength straggling of protons in 74 materials, including materials regularly used in radiation shielding and dosimetry. Emphasis has been placed on obtaining accurate results, especially for heavy materials and protons of very low energy. Values of the energy loss between 0.1 and 1.0 Mev were obtained by smoothing and interpolating experimental information. Above 1.0 Mev, the Bethe equation with all the necessary shell corrections has been used. The polarization effect has been calculated in detail for each material. Ranges have been obtained from the pathlengths by use of detailed multiple coulomb scattering theory. Comprehensive tabulations of the range straggling and multiple scattering have been presented for each of the materials. The energy loss and range calculations have been compared with the available experimental data and the mean deviation is usually within 1.0 percent. Deviation rarely exceeds the estimated error of the experimental data. The theoretical approach is also discussed in detail, and the method used to obtain the K, L, M, N, and O shell corrections is presented. A first-order correction has been made which compensates for the molecular binding effects occurring in compounds. The probability that a proton will undergo an inelastic nuclear interaction throughout its entire pathlength is also tabulated.

AFWL-TR-65-150

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CONTENTS

<u>Section</u>		<u>Page</u>
I	INTRODUCTION	1
II	ENERGY LOSS CALCULATIONS	5
	Proton Energy Loss	5
	The Bethe Equation	5
	The Polarization Effect	7
	The Adjusted Ionization Potentials	10
	Discussion of the Energy Loss Below 1.0 Mev	18
	Shell Corrections	21
	The Assumption of Additivity	30
	Minimum Ionization Point	31
III	PATHLENGTH AND RANGE CALCULATIONS	33
	Integration of the Energy Loss to Determine the Pathlength and Range	33
	Pathlength Straggling	34
	Multiple Coulomb Scattering	36
	The Number Distance Expression, Bragg Ionization Curve, and Extrapolated Pathlength	40
IV	PROBABILITY OF INELASTIC NUCLEAR INTERACTIONS	44
V	COMPARISON WITH SELECTED EXPERIMENTAL DATA	47
VI	COMMENTS PERTINENT TO DATA PRESENTATION AND FORMAT	54
	APPENDIX	57
	REFERENCES	430

ILLUSTRATIONS

<u>Figure</u>		<u>Page</u>
1	Illustration of the Relationship Between Average Pathlength, Mean Range, and Pathlength Straggling	3
2	A Comparison of the Polarization Effect Corrections Calculated by Sternheimer, Hill et al., and This Report	8
3	The Effective Charge of a Low Energy Proton	19
4	The K Shell Correction	23
5	The L Shell Correction	23
6	A Comparison of the M Shell Corrections Obtained from the Theoretical Calculations (Ref. 68) and by Scaling of the L Shell	25
7	The K, L, M, N, and O Shell Corrections for Gold	29
8	The Minimum Ionization Loss for Protons in Aluminum	31
9	The Number Distance Curve for 72.6 Mev Protons in Copper Under the Gaussian Approximation	41
10	The Number Distance Curve for 110 Mev Protons in Copper Under the Gaussian Approximation	42
11	The Inelastic Scattering Cross Sections for Aluminum, Silver, and Lead Which Have Been Used to Determine the Probability of an Inelastic Nuclear Interaction	45
12	A Comparison of the Experimental and Calculated Energy Loss for Aluminum	49
13	A Comparison of the Experimental and Calculated Energy Loss for Copper	51
14	A Comparison of the Experimental and Calculated Energy Loss for Gold	53

TABLES

<u>Table</u>		<u>Page</u>
I	Typical Values for r and r^2 Obtained from Equations (8) and (9)	10
II	A Survey of Adjusted Ionization Potentials	11
III	Adjusted Ionization Potentials	15
IV	Limiting Values of Shell Corrections in the Extreme Relativistic Limit (Ref. 12)	16
V	Differences in the Percent Multiple Scattering Resulting from Use of the Proton Mass Compared to the Reduced Proton Mass	38
VI	Comparison of the Percentage Multiple Scattering Obtained Through Use of the Nigam and Molière Screening Factor Using the Reduced Proton Mass	39
VII	A Comparison of Experimental Energy Loss in Mev/gm/cm ² with the Tabulations of This Report for Aluminum	48
VIII	A Comparison of Experimental Energy Loss in Mev/gm/cm ² with the Tabulations of This Report for Copper	50
IX	A Comparison of Experimental Energy Loss in Mev/gm/cm ² with the Tabulations of This Report for Gold	52

AFWL-TR-65-150

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SECTION I
INTRODUCTION

The energy loss, range, pathlength, pathlength straggling, and multiple scattering of protons in absorbing media are of considerable importance to many research groups. In the past, the demand for such information has been generally limited to the practical requirements of nuclear physics research; however, the parameters which govern the energy loss mechanism are now being studied with interest by shielding groups, geophysicists, and biophysicists.

The express purpose of this report is to provide an accurate set of tables which contain the significant parameters pertinent to the interaction of protons with matter. These tabulations have been provided for a large number of materials in an energy grid which is fine enough to permit simple linear interpolation in obtaining intermediate numbers with no loss of accuracy in the significant figures.

Although proton pathlength and energy loss have been presented in several other reports (References 1 through 10), no comprehensive set of calculations has been published which considers energy loss, pathlength, range, straggling, multiple scattering, and the probability of an inelastic nuclear interaction.

The results of such calculations have many practical uses. It is common practice at many proton accelerator facilities to rely upon tables such as these for values of the proton range and energy loss. The beam energy is frequently estimated by measuring the particle transmission through a known thickness of degrader. When this is done, reliable values of the multiple scattering are essential to the accuracy of the results. This information has not been previously available over a wide energy range for a sufficient number of materials.

The interest of the biophysicist in protons is a result of the large amount of energy transferred by such protons to an absorbing medium composed of living cells. Low energy protons transfer much more energy per unit pathlength than do protons of high energies. Biological experiments indicate that a rapid increase in the energy transferred results in a sharp increase in the cell lethality. In addition, the recovery probability of living cells appears to be

directly related to the energy transferred per unit pathlength by the incident radiation. Exploration of the energy loss of protons is therefore of biological significance, and requires that the energy loss of a proton traversing an absorbing medium be known accurately.

The interest of the geophysicist engaged in space radiation research is akin to that of the shielding groups. Many organizations involved in manned or unmanned spaceflight, as well as those involved in reactor and accelerator technology, have developed computer codes which are capable of solving shielding problems by using radiation transport techniques. The primary proton penetration and energy loss are usually obtained from tables within these codes. The input data for these tables usually are obtained from the literature, such as those in references 1 through 9.

It appears that there have been some misuse of these data, since all but one of the above references provide the pathlength, not the range. The shielding problem usually requires the range, and not the pathlength. These terms appear to have been used almost interchangeably in the past. The pathlength and range should not be considered identical, as they differ in some cases by several percent. It should be emphasized that the straggling and multiple scattering of protons are not negligible if accurate results are required.

Since the terminology used in this report is somewhat different from that suggested by Fano in a recent review (Ref. 11), it is felt that some preliminary definition of terms is called for here, even though all of the important quantities will be mathematically defined in later sections. The terminology of reference 11 is indicated in parentheses whenever a difference exists.

PATHLENGTH (Continuous Slowing Down Approximation Range, CSDA) is the total mean distance traveled by protons from the point at which they enter the material with a definite kinetic energy to the point at which this energy is nearly zero and no additional displacements are observed. Protons which undergo inelastic nuclear interactions suffer abrupt energy losses; this definition does not apply to them.

RANGE (Projected Range) is the mean depth of penetration measured along a straight line from the point at which the protons enter an absorbing medium to the point at which additional displacement is no longer detectable. The range is always less than the pathlength by a small but finite amount. This is a result of the multiple scattering process, which has been calculated in detail for all energies and each material.

PATHLENGTH STRAGGLING is primarily the result of the statistical process involved in the proton energy loss mechanism. Protons lose kinetic energy in small discrete amounts as they undergo a multitude of collisions with atomic electrons. Thus, an initially monoenergetic beam of protons will have an energy spread after passing through a finite thickness of absorber. This causes a small but definite straggling to exist about the mean total pathlength. This straggling has been graphically demonstrated with the pathlength and range in figure 1.

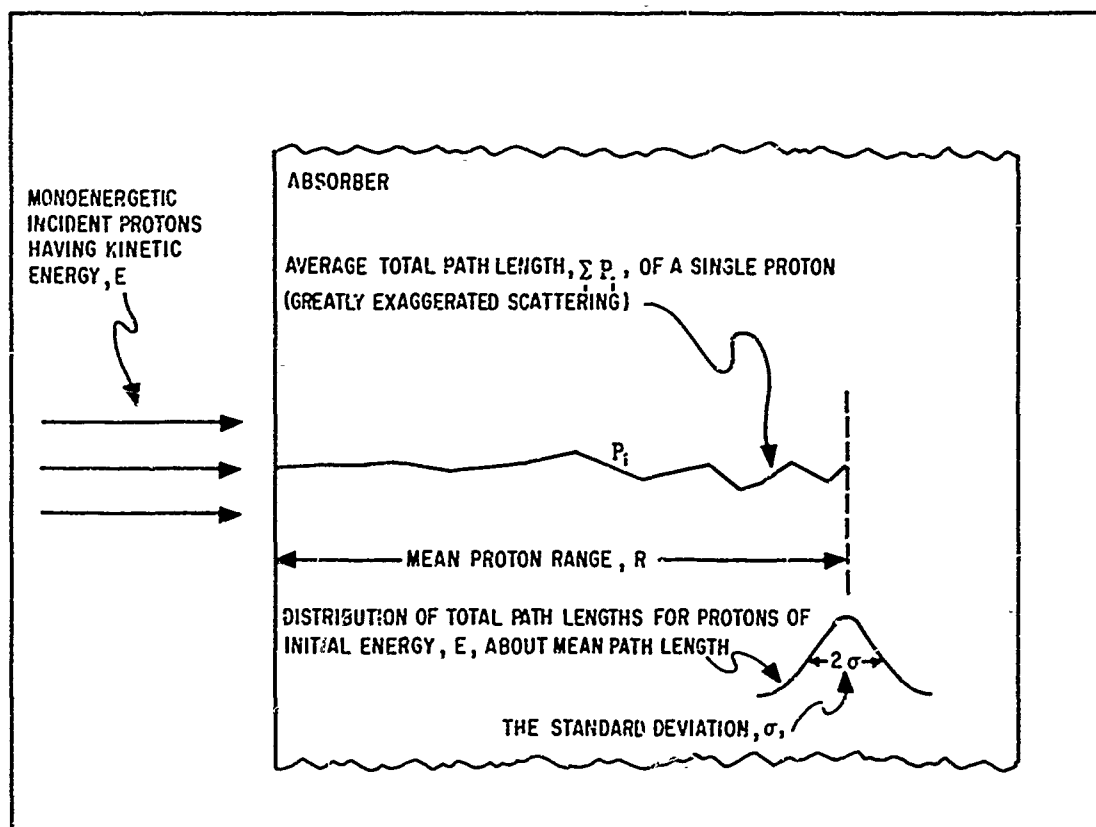


Figure 1. Illustration of the Relationship Between Average Pathlength, Mean Range, and Pathlength Straggling

MEAN EXCITATION ENERGY is the mean value of all the excitation and ionization potentials of the atom, and represents the average least energy that can be transferred to an atomically bound electron. This quantity can be rigorously defined in terms of the atomic absorption frequencies, E_i/h , and the oscillator strengths, f_i , by: $I = \exp[\sum_i f_i \ln E_i]$ (Ref. 11). In principle, this could be done for all elements; in practice such calculations have been carried out for only a few of the simplest cases. The numerical value of the mean excitation

energy must be defined in association with stopping power corrections for the nonparticipation of inner shell electrons which remain finite in the extreme relativistic limit.

ADJUSTED IONIZATION POTENTIAL (Adjusted Mean Excitation Energy) is related directly to the mean excitation energy, and is the "ionization potential" which is most frequently used in conjunction with charged-particle energy-loss equations. It is usually determined experimentally assuming that all corrections to the stopping power equation for the nonparticipation of the inner shell electrons are negligible at very high proton energies and that they are zero in the extreme relativistic limit. Although Fano and Turner (Ref. 12) have shown that the shell corrections do not actually vanish even at the highest energies, the assumption of vanishing shell corrections does yield accurate results if the adjusted ionization potentials are chosen with this assumption in mind.

Derivations of the equations which have been used are not presented or discussed in detail here, since these relationships are well known and may be found in the references.

SECTION II

ENERGY LOSS CALCULATIONS

1. Proton Energy Loss

Protons traversing matter may lose energy by any or all of the following interactions:

a. Excitation and ionization of the atoms and molecules of the absorbing material are the dominant mode of loss by moderate- and low-energy protons.

b. Inelastic nuclear collisions become quite significant at high proton energies and contribute heavily to the total energy loss.

c. Elastic interactions occur with atoms in which the incident proton transfers kinetic energy to the recoil nuclei.

d. Photon emission in atomic fields because of particle deceleration is the least important of the proton energy-loss processes. This interaction is commonly called bremsstrahlung.

The proton energy loss by ionization and excitation has been calculated using the well-known Bethe equation (Ref. 10), and has been corrected for the effects of nonparticipating inner shell electrons. The probability that a proton will undergo an inelastic nuclear interaction throughout the entire stopping process has been tabulated to estimate the significance of these collisions.

The contribution of elastic nuclear collisions to the total energy loss is less than one tenth of 1 percent at 0.1 Mev, and is even less significant at higher kinetic energies. For this reason such elastic collisions have not been considered.

When it is compared with the ionization and excitation energy loss, proton bremsstrahlung is completely negligible at the energies considered here and has not been included in the calculations. For example, emission of virtual photons and bremsstrahlung is only a fraction of 1 percent of the total energy loss for 10 Bev protons, drops sharply at lower energies, and is insignificant at the minimum ionization energy (Ref. 13). The minimum ionization energy is near 2 Bev and is the highest energy considered in this report.

2. The Bethe Equation

The Equation for the energy loss from atomic ionization and excitation is

$$\frac{1}{\rho} \frac{dE}{dX} = \frac{2\pi N_o z^2 e^4}{mc^2 \beta^2} \frac{Z}{A} \left[\ln \frac{2mc^2 \beta^2 W}{I_{adj}^2 (1-\beta^2)} - 2\beta^2 - 2 \frac{\Sigma_i C_i}{Z} - \Delta \right] \quad (1)$$

where

W is the maximum kinetic energy which can be transferred to an electron which is initially at rest.

ρ = density of the material.

z = effective charge of proton (unity above 0.5 Mev).

c = velocity of light in a vacuum.

e = electronic charge in esu.

m = rest mass of the electron.

A = the atomic weight of the stopping material

N_o = Avogadro's Number.

Z = atomic number of the stopping material.

I_{adj} = the adjusted ionization potential.

β = ratio of the incident particle velocity to the velocity of light; v/c.

$\Sigma_i C_i$ = the sum of the effects of shell corrections on stopping power.

Δ = the polarization effect correction term.

The maximum energy transfer W can be expressed as a function of proton energy or as a function of the particle velocity. In the interest of consistency, however, only the latter has been used:

$$W = \frac{2mc^2 \beta^2}{1 - \beta^2} \left[1 + \frac{2m}{M\sqrt{1-\beta^2}} + \left(\frac{m}{M}\right)^2 \right]^{-1} \quad (2)$$

where M is the proton rest mass.

When equations (1) and (2) are combined, the result is

$$\frac{1}{\rho} \frac{dE}{dX} = \frac{4\pi N_o z^2 e^4}{mc^2 \beta^2} \frac{Z}{A} \left\{ \ln \frac{2mc^2 \beta^2}{[I_{adj}(1-\beta^2)] \sqrt{1 + \frac{2m}{M\sqrt{1-\beta^2}} + \left(\frac{m}{M}\right)^2}} - \beta^2 - \frac{\Sigma_i C_i}{Z} - \frac{\Delta}{2} \right\} \quad (3)$$

The form of this equation published by Livingston and Bethe in 1937 (Ref. 10) neglects the small effects of the square root term within the logarithm. This term is quite close to unity except at very high energies. For example, omission of the term increases the energy loss at 1000 Mev by only 0.017 percent in aluminum. Nevertheless, it has been included in the calculations.

In order that the derivation which results in equation (1) be valid, the energy transferred to an atomic electron must in general be greater than the binding energy of that electron in its atomic shell. This condition can be partially removed by appropriate use of the shell corrections described in a later section. The incident proton must also be represented accurately by a point charge and a point mass. This is the case for all the energies presently under consideration. Although it is not a rigorous requirement, another useful indication of the low-energy validity of equation (3) is the numerical value of the logarithmic term, which should generally be greater than zero. This requires that the kinetic energy of the proton be

$$E > \frac{M}{m} \frac{I_{adj}}{4} \quad (4)$$

where M is the rest mass of the proton. This condition is always satisfied for 1.0 Mev protons.

3. The Polarization Effect

The perturbation of the field of the passing proton which is caused by the electric polarization of the surrounding atoms results in a reduction of the energy lost by the charged particle. This effect has been discussed in detail by several authors (Refs. 14 through 18). The energy loss is usually reduced by less than a percent at the energies calculated in this report. At 1000 Mev the stopping power is reduced by 0.8 percent in beryllium, 0.5 percent in copper, and is insignificant for very low density materials, such as gases, at standard temperatures and pressures. For elements having higher atomic numbers the medium is less strongly polarized because most of the atomic electrons are more tightly bound.

Although approximate corrections are available for a number of materials in references 16 and 17, the polarization correction has been calculated here for each material using the fundamental equations of the theoretical model proposed by Sternheimer in the aforementioned references. This correction has

been applied to all of the materials tabulated in this report. The result obtained for aluminum is compared to that of Sternheimer and the calculation of Hill et al. in figure 2.

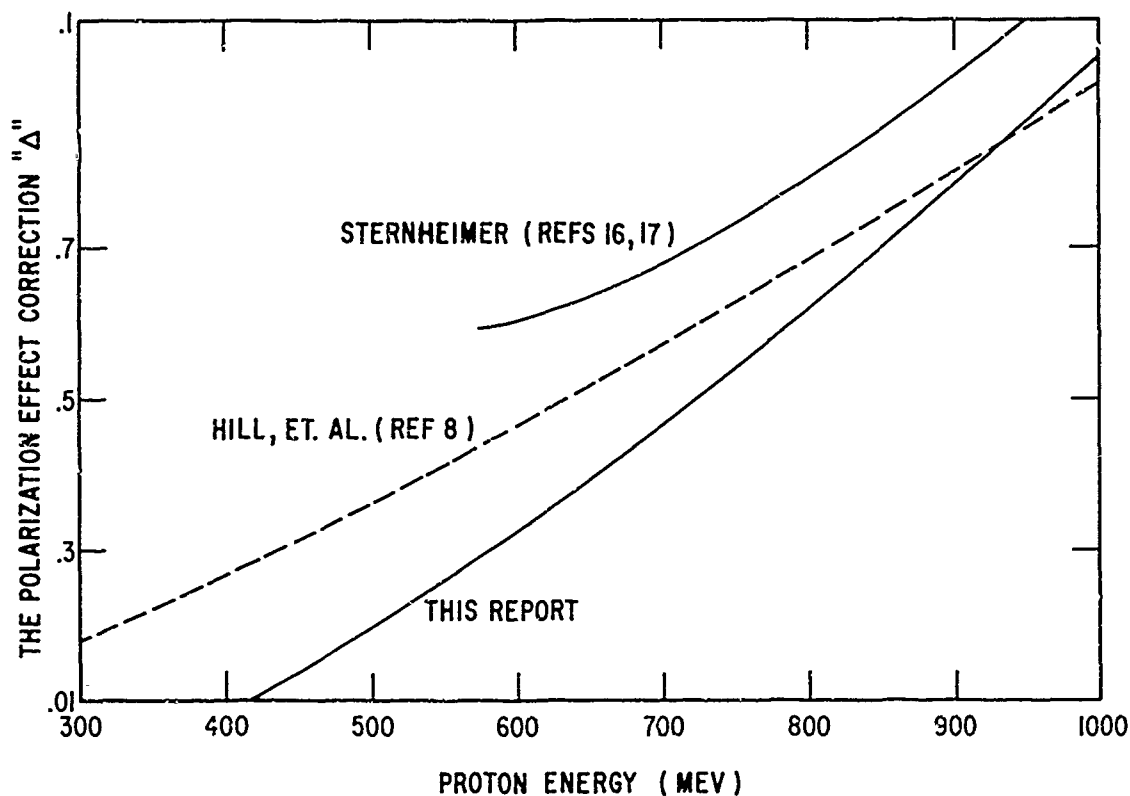


Figure 2. A Comparison of the Polarization Effect Corrections Calculated by Sternheimer, Hill et al., and This Report

The approach of this report provides sufficient accuracy in the determination of this effect by considering the electrons of each shell. The tabulation of Hill et al. includes the contribution of the electrons in each subshell, and thus should provide slightly more accuracy at low energies. However, this effect becomes less significant with decreasing proton energy, and minor errors in an already small correction can easily be tolerated.

The polarization effect has been calculated for each material in the tables by using the following procedure:

$$\Delta = \sum_i f_i \ln \left[1 + \frac{T^2}{(E_i^2 r^2 + E^2 f_i)} \right] - \frac{T^2(1 - \beta^2)}{E^2} \quad (5)$$

where T is an energy which is found by solving the following equation:

$$\sum_i f_i \frac{\bar{E}^2}{(E_i^2 r^2 + T^2)} = \frac{1}{\beta^2} - 1 \quad (6)$$

where \bar{E} is the energy associated with the plasma frequency of the medium, and is given by

$$\bar{E}^2 = \frac{4\pi n^2 N_o e^2 \rho Z}{mA} \quad (7)$$

The quantity f_i is the classical oscillator strength of the i 'th transition whose energy is E_i , and is found by dividing the number of electrons in the i 'th shell by the atomic number. The ratio, r , is a correction which normalizes the sum of the individual atomic ionization potentials calculated from the energy levels, E_i , and the classical oscillator strengths, f_i , to the values found experimentally. This ratio is greater than unity because the average of the states to which the electrons are excited lies above the ionization limit in the continuum (Refs. 16 and 17). For conductors this ratio is given with sufficient accuracy by

$$r = \exp \left[\frac{\ln I_{adj} - \frac{1}{2} \sum_{i=1}^{j-1} f_i \ln(f_i \bar{E}^2) - \sum_{i=1}^{j-1} f_i \ln E_i}{\sum_{i=1}^{j-1} f_i} \right] \quad (8)$$

where j is the dispersion oscillator for the conduction electrons. For non-conductors the required relationship is

$$r = \exp \left[\frac{\ln I_{adj} - \sum_i f_i \ln E_i}{\sum_i f_i} \right] \quad (9)$$

A few representative values of r and r^2 are listed in table 1.

A further correction is required if the adjusted ionization potential of a material is determined experimentally when that material is in a gaseous state, and the energy loss is calculated for the solid state. The converse is also true. This effect is very small and can be omitted with a negligible sacrifice in the accuracy of the energy loss.

The contribution of the $\bar{E}^2 f_i$ term in the denominator of the logarithmic factor in equation (5) has been included in all of the calculations, even though its contribution is small except for the conduction electrons where E_i^2 is zero. As a result, the polarization effect correction which has been obtained is slightly smaller than that of Sternheimer, who neglected the $\bar{E}^2 f_i$ term for all but the conduction electrons.

Table I

TYPICAL VALUES FOR r AND r^2 OBTAINED FROM EQUATIONS (8) AND (9)

<u>Element</u>	<u>Atomic number</u>	<u>r</u>	<u>r²</u>
Lithium	3	1.014	1.028
Beryllium	4	1.488	2.216
Aluminum	13	2.446	5.987
Copper	29	1.498	2.245
Silver	47	1.495	2.236
Gold	79	1.201	1.442
Lead	82	1.212	1.469
Uranium	92	1.161	1.347

4. The Adjusted Ionization Potentials

Most of the adjusted ionization potentials which have been used in performing the calculations were selected from the theoretical and experimental evaluations available from the literature (Refs. 19 through 40, 137 through 140; Table II). When elements having known adjusted ionization potentials bracket an element whose potential is unknown, linear interpolation has been used to obtain the unknown value. In the cases of manganese and tin, it was possible to estimate the necessary ionization potentials from the energy loss data at low energies. This is a highly dubious procedure, and the results appear to be a little low when compared with the I/Z values of the neighboring elements.

Theoretical estimates using hydrogenic wave functions and approximation techniques would be expected to give good results for very low atomic number elements. Such estimates have been made by Dalgarno (Ref. 22), and his numbers have been used for the adjusted ionization potentials for the atomic state of the first three elements, hydrogen, helium, and lithium. For the molecular state of hydrogen, the recent measurement by Martin and Northcliffe has been used (Ref. 23).

TABLE II
A SURVEY OF ADJUSTED ION

ATOMIC NUMBER	ELEMENT	HALLPERH HALL REF. 15	BICHSEL TSCHALAR REF. 19	WARSHAW REF. 20	BICHSEL REF. 21	DALBARNO REF. 22	MARTIN, NORTHCLIFFE REF. 23	ZRELOV, STOLETOV REF. 24	THOMPSON REF. 25	BICHSEL, UEMLING REF. 26	BAKAS VON FRIESEN REF. 27	BAKKER SEGRE REF. 28	HBS HROBK 78 REF. 29	
1	HYDROGEN (ATOMIC)					14.8								
1	HYDROGEN (MOLECULAR)						18.3 ± 2.6	15	18.2			15.6	19 ^a	
2	HELIUM	40				41.7							43 ^a	
3	LITHIUM					38.8						34.		
4	BERYLLIUM			64	64	66.1		61 ± 6				60.4		
6	CARBON (ATOMIC)	60						85 ± 8	70.2			76.4	67 ^a , 72 ^b	
6	CARBON (MOLECULAR)		90 ± 2.4						77.5					
7	NITROGEN (DIATOMIC)				92		79. ± 7						84 ^a , 91 ^b	
7	NITROGEN (COMPOUNDS)								76.3					
8	OXYGEN (DIATOMIC)								79.8				89 ^a , 104 ^b	
8	OXYGEN (COMPOUNDS)								86.3					
10	NEON				140								80 ^a	
13	ALUMINUM		163 ± 3.7	158						163		150	161 ^{b,c}	
14	SILICON		170 ± 5.1											
17	CHLORINE								153.7					
18	ARGON				205		190. ± 17						190 ^a	
26	IRON	430			287			273 ± 22				243		
28	NICKEL				312									
29	COPPER			320	323			305 ± 10			322	278	313 ^{b,c}	
32	GERMANIUM		350 ± 10.											
36	KRYPTON				360									
42	MOLYBDENUM				420									
45	RHODIUM													
47	SILVER		470 ± 14.	490	470							428		
48	CADMIUM				480			468 ± 35						
50	TIN				500							479		
54	XENON													
73	TANTALUM				720									
74	TUNGSTEN							440 ± 30				557		
79	GOLD			790	790								636 ^{b,c}	
82	LEAD				810						818	754		
92	URANIUM	1200									908	861		

^a CALCULATED IN THE REFERENCED SOURCE FROM THE DATA OF BROLLEY AND RIBE (REF. 63)
^b CALCULATED IN THE REFERENCED SOURCE FROM THE DATA OF REYNOLDS, ET AL. (REF. 59)
^c CALCULATED IN THE REFERENCED SOURCE FROM THE DATA OF KERN (REF. 54)
 * * * * * THESE DATA POINTS WERE TAKEN BETWEEN 625 AND 651 MeV, DIFFERENT VALUES WERE OBTAINED FOR LOWER ENERGIES

A

TABLE II
 LIST OF ADJUSTED IONIZATION POTENTIALS

BAKKER SEGRE REF. 28	NBS HNDK 79 REF. 29	BURKS, MACKENZIE REF. 30	CALDWELL REF. 31	HUBBARD MACKENZIE REF. 32	SIMMONS REF. 33	TURNER REF. 34	WATHER, SEGRE REF. 35	BICHSEL MOZLEY, ARON REF. 36	BLOEMBERGEN VAN HEERDEN REF. 37	ALLISON WALSH REF. 52	GARCIA REF. 136	SACHS RICHARDS REF. 157, 158	BOGFAROF KOUDIJS REF. 139	KRAZER-AGEYEV MASHKOVICH REF. 140****	SRAMOT REF. 40
											150			142.7	14.0
15.8	19°										1852.5		17.12.3		18.0
	43°										415		3522.7		
34.											35.23.5				38.0
60.4		64					59	63.42.5		57					60.0
76.4	67,72**						74.4						700	792.5	60.0
															71.0
	84,91**													7622.38	78.0
															90.0
	89,104**													9632.48	77.0
															98.0
	90°													13062.20	
150	181***	186.4	183.12.3	170	15523		147.9	186.421	182.5	182		168	151.2.3	1362.8	164.0
															183.0
	190°													226.1.2.3	
243		328.8													
			363.19									399			
279	313***	366	377.218				309.2	375.6220	370			435		300212	
			656246									799			
428		557	692150					585.140				796			
			854141									792			
479			708239									853		463223	
			962254									1148			
697		920.5													
	836***	997	1136200					1037.100				1383			
758		1070					810.7		970					753237	
821															

B

Selection of an ionization potential for beryllium is made somewhat arbitrary by the wide variance of values in the literature. The available estimates range from 57 ev to 64 ev. If beryllium ionization potentials are obtained from energy loss data near 1 Mev without application of a K shell correction, the results obtained from such a procedure are about 2 ev higher than would be expected otherwise. A value of 61 ev has been selected as a compromise (Ref. 24), and provides good agreement with the available data.

The carbon, nitrogen, oxygen, and chlorine values were obtained from the renormalized data of Thompson (Refs. 25, 29). The readjusted chlorine value seems to be low, but it is the only available experimental point. Since all of the other updated Thompson potentials produce excellent results, his experimental value has been used instead of the theoretical result of Brandt (Ref. 40).

Adjusted ionization potentials for a number of materials have been determined by Bichsel (Refs. 19, 21). His numbers have been used for neon, silicon, argon, germanium, nickel, molybdenum, tantalum, and gold.

For aluminum the recent data points strongly to 163 ev, and this value gives results which are in excellent agreement with several sets of experimental data.

Zrelov and Stoletov have made the most recent high-energy range measurements for iron and cadmium (Ref. 24). Their experiment was conducted using reliable techniques to determine the energy and estimate the multiple scattering, and gives 273 ev for iron and 468 ev for cadmium. Both of these results have been used.

The Subcommittee on Penetration of Charged Particles of the National Research Council has suggested that 314 ev be used for copper; however, when this was tried the resulting energy losses and ranges were not in sufficiently good agreement with the bulk of the experimental data. The value of 320 ev (Ref. 20) produces results which are in noticeably better agreement with the low energy experimental data than those obtained using 314 ev.

An inconsistency also exists in the various available adjusted ionization potentials for silver. Most of the values in the literature appear to be much too high. The linearly scaled value of 465 ev from the Bakker and Segre experiment (Ref. 26) produces results which are in very good agreement with the available experimental data.

Barkas and von Friesen have made high-energy experimental measurements of the copper, lead, and uranium ionization potentials, using a detailed Monte

Carlo technique to estimate multiple scattering and other effects. Their copper value of 322 ev is quite close to that which was finally selected for use in this report. Their lead and uranium values are the most recent available and have been used.

Many experimental determinations of the adjusted ionization potential are inaccurate because both the multiple scattering and nonparticipation of the inner shell electrons in the stopping process have not been accounted for with sufficient accuracy. These are significant effects in elements of medium and high atomic numbers. The error limits assigned by experimenters are also often underestimated and are not consistent with data from other sources.

The adjusted ionization potentials listed in table III were carefully selected to give results which are in good agreement with most of the available experimental data. In each case where a sufficient amount of experimental information was available, other values were tried and comparisons with the data were made. The final selection of an adjusted ionization potential for a given element was made on a pragmatic basis wherever possible.

The relationship between the adjusted ionization potential, I_{adj} , and that obtained from rigorous theoretical considerations, I' , depends upon the assumption of vanishing shell corrections in the extreme relativistic limit. The numerical value of I' can in principle be found by summing all of the electronic excitation and ionization levels over the entire electron population of the atom, while multiplying by the respective oscillator strengths of each individual electron. This proves to be quite difficult and has been done for only a few elements.

Nevertheless, I_{adj} and I' are related through the magnitude of the shell corrections at very high velocities. Fano and Turner (Ref. 12) have shown that the shell corrections do not actually vanish at high energies, but tend toward a finite limiting value, which they have calculated for several materials. Their tabulations are presented in table IV.

The relationship between I_{adj} and I' can be represented by

$$\ln I_{adj} = \ln I' + [\sum_i C_i/Z] \Big|_{\beta=1} \quad (10)$$

hence,

$$\ln I' = \ln I_{adj} - [\sum_i C_i/Z] \Big|_{\beta=1} \quad (11)$$

Table III

ADJUSTED IONIZATION POTENTIALS

<u>Reference</u>	<u>Element</u>	<u>Z</u>	<u>I/Z</u>	<u>I_{adj} (ev)</u>
22	H (Atomic)	1	14.80	14.8
23	H (Molecular)	1	18.30	18.3
22	He	2	20.85	41.7
22	Li	3	12.93	38.8
24	Be	4	15.25	61.0
Interpolated	B	5	13.60	68.0
25	C (Atomic)	6	12.52	75.1**
25	C (In compounds)	6	12.88	77.3**
29	N (Diatomic)	7	12.50	87.5 (Averaged)
25	N (In compounds)	7	14.21	99.5**
25	O (Diatomic)	8	11.11	88.9
25	O (In compounds)	8	12.31	98.5
Interpolated	F	9	13.41	120.7
21	Ne	10	14.00	140.0
26, 21	Al	13	12.54	163.0
19	Si	14	12.14	170.0
25	Cl	17	10.00	170.0**
21	Ar	18	11.39	205.0
*	Mn	25	10.12	253.0
24	Fe	26	10.50	273.0
Interpolated	Co	27	10.83	292.5
21	Ni	28	11.14	312.0
35	Cu	29	11.03	320.0
19	Ge	32	10.98	350.0
21	Mo	42	10.00	420.0
28	Ag	47	9.89	465.0***
24	Cd	48	9.75	468.0
*	Sn	50	9.70	485.0
21	Ta	73	9.86	720.0
20, 21	Au	79	9.87	780.0
21, 35	Pb	82	9.88	810.0
27	U	92	9.87	908.0

*Determined from the experimental energy loss data of Green, Cooper, and Harris (Ref. 41) using the shell corrections of Reference 73.

**These values were renormalized in Reference 29 and have been used here.

***Linearly rescaled to a value of 163 ev for aluminum.

Table IV

LIMITING VALUES OF THE SHELL CORRECTIONS IN THE EXTREME RELATIVISTIC LIMIT (Ref. 12)

<u>Element</u>	<u>Atomic number</u>	$\left. \frac{\sum_i C_i / Z}{\beta = 1} \right _{\beta = 1}$	$\left. \frac{\sum_i C_i}{\beta = 1} \right _{\beta = 1}$
Beryllium	4	0.000	0.000
Aluminum	13	0.002	0.026
Argon	18	0.003	0.054
Copper	29	0.007	0.203
Silver	47	0.014	0.658
Lead	82	0.039	3.198
Uranium	92	0.051	4.692

where $\left[\frac{\sum_i C_i / Z}{\beta = 1} \right]_{\beta = 1}$ is the value for the total shell correction in the extreme relativistic limit, and can be obtained for some materials from table IV.

It should be emphasized that the assumption of vanishing shell corrections has been made in all of the calculations which have been performed. As long as these corrections and the associated I_{adj} values are applied consistently, this approach provides final results equivalent to those obtained by using I' and nonvanishing corrections.

When no data concerning the adjusted ionization potential were available, the procedure which is discussed in the following paragraphs was used.

Using the Thomas-Fermi model of the atom, Bloch found that for elements with sufficiently large atomic numbers, the adjusted ionization potential should be proportional to the atomic number according to the following relation (Ref. 38):

$$I = kZ \quad k \approx 10 \quad (12)$$

While predicting the correct trend, this expression does not result in particularly accurate results when compared to the data of table III. Brandt (Refs. 39, 40) has shown that a more detailed theoretical approach results in an equation of the following form:

$$I = kZ \left[1 + \frac{a}{Z^{2/3}} \right] \quad (13)$$

This equation has been slightly modified and was used to fit the data of table III over two regions to provide the additional adjusted ionization potentials which were required.

$$I_{\text{adj}} = 10.11Z \left[1 + \frac{(Z - 27)^2}{148 Z^{2/3}} \right] \quad 10 < Z < 25 \quad (14)$$

$$I_{\text{adj}} = 9.78Z \left[1 + \frac{0.196}{Z^{2/3}} \right] \quad Z > 33 \quad (15)$$

The halogens and the noble gases tend to depart somewhat from these relationships, but all of the other adjusted ionization potentials listed in table III are fit quite well. The value of the constant "a" in equation (14) has been allowed to assume a residual dependence on the atomic number in order to improve the accuracy of the fit. All values not available from table III were calculated from the above equations with the exception of zinc, which was obtained using the I/Z ratio for copper.

Although the decrease of the ratio I/Z with increasing atomic number is evident, minor deviations are present. The binding effects of the valence electrons in conductors along with the polarization effect are both contributing factors. Some of the irregularities in the elements of low atomic number are undoubtedly the result of statistical effects bearing upon any averaging process which involves only a few atomic electrons.

The high I/Z values for helium and neon are probably the result of the tight electron binding due to the closed shells. This effect is not as pronounced in the other inert gases because the number of electrons which reside in the inner shells are not appreciably affected by the closing of an outer shell.

A small departure from the decreasing trend of I/Z occurs for the elements having atomic numbers between 26 and 42. Green et al. (Ref. 41) find evidence of a periodic fluctuation resulting from the order in which the atomic shells are filled. Electrons are added to the outer s and p shells from hydrogen to argon, but beginning with scandium, the 3d shell begins to be filled. Between copper and krypton, the 4s and 4p shells are being filled. The transition metals (21 < Z < 30) also have large electronic specific heats, and Bader et al. (Ref. 42) have suggested that this might be interpreted in terms of an increased "effective" mass of the electrons in the valence states. As a result, energy loss by protons to these electrons could be reduced if this effect carries over to charged particle interactions. The increase in I/Z for nickel and copper, in particular, has been reasonably well verified experimentally.

In the calculation of the energy loss in compounds and mixtures, the concept of an effective ionization potential for that compound or mixture has not been employed. This would have required that an "average" shell correction also be applied, which is not the procedure which yields the most satisfactory results. The energy loss in materials composed of both low and high atomic number materials cannot be properly determined using such an "average" shell correction. Although the approach used in this report depended on the additivity of the energy loss rather than on the existence of an effective additive ionization potential, it was felt that this quantity could be useful for high energy approximate calculations over a limited energy range. It has been calculated for both compounds and mixtures and printed at the bottom of the last data page. The following equation was employed in the calculation:

$$I_{\text{eff}} = \exp \left[\frac{\sum_i n_i Z_i \ln I_i}{\sum_i n_i Z_i} \right] \quad (\text{ev}) \quad (16)$$

where

n_i = the number of atoms per cubic centimeter of the i th element of the compound

Z_i = the atomic number of the i th element of the compound

I_i = the adjusted ionization potential of the i th element of the compound

As no molecular binding energy is associated with mixtures of elements, the additivity of the energy loss for such mixtures should be strictly correct.

5. Discussion of the Energy Loss Below 1.0 Mev

Equation (3) has been used to calculate the energy loss by protons above 1.0 Mev, which is always above the limiting energy given by equation (4). This is about 0.4 Mev for uranium and less for all other natural elements. Even at energies near 1.0 Mev in heavy elements the Bethe equation yields results which are in good agreement with the available experimental data if the equation is modified with the necessary shell corrections.

At very low energies a point is eventually reached where the proton capture cross section for atomic electrons becomes significant. The capture process is more probable for very low energy protons, while the electron loss cross section predominates at energies above 0.5 Mev. Hall (Ref. 43) has found that the ratio of the capture to loss cross sections remains relatively constant for most materials. Thus, a low-energy proton traversing matter may have a rapid exchange of electrons with the nearby atoms of the absorber. This has the net effect of reducing the effective charge of the proton to a value which is less than unity.

The relation between the effective charge, z_{eff} , and the ratio of the capture-to-loss cross sections for protons near electron exchange equilibrium can be shown to be

$$z_{\text{eff}} = \frac{1}{1 + \sigma_c/\sigma_L} \quad (17)$$

Kanner (Ref. 44) has made accurate experimental measurements on the electron capture-and-loss cross sections for protons passing through air, and finds that the following equations are a good fit to his experimental data:

$$\sigma_{\text{loss}} = (24.54 - 0.866 E/T_0) \times 10^{-17} \text{ cm}^2 \quad 40 < E < 325 \quad (18)$$

$$\sigma_{\text{capture}} = 41.4 \exp(-0.562 E/T_0) \times 10^{-17} \text{ cm}^2 \quad 31 < E < 122 \quad (19)$$

where E is the proton kinetic energy in Kev, and T_0 is 24.8 Kev.

The effective charge of a low energy proton can be readily determined from the above relations and equation (17), the results are illustrated in figure 3.

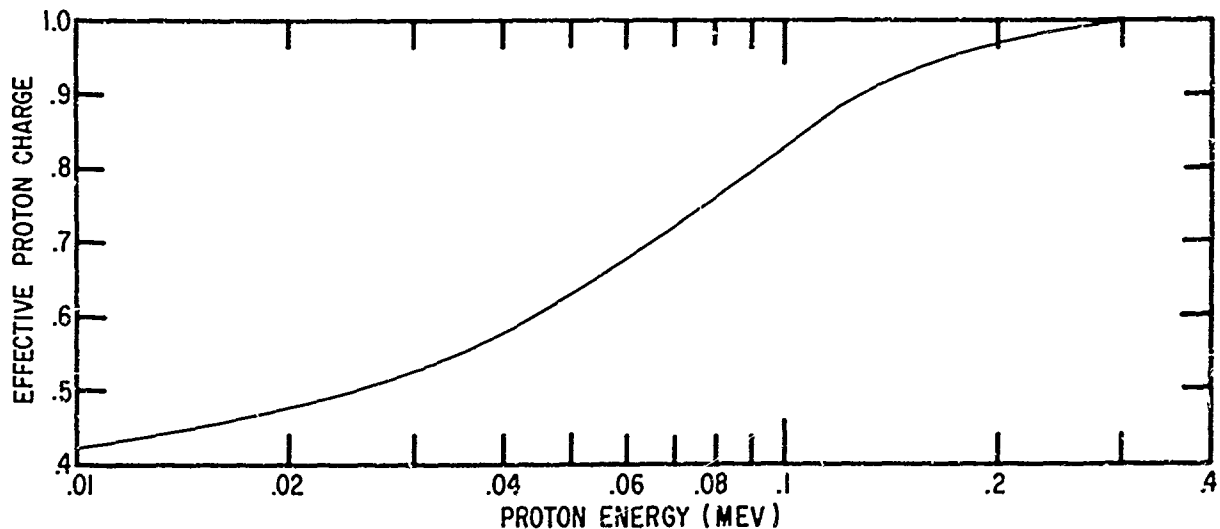


Figure 3. The Effective Charge of a Low Energy Proton

Although a considerable extrapolation has been required to obtain values of the effective charge above 0.3 Mev, the results indicate that protons above

0.5 Mev have a net charge of unity.

The shell corrections which must be applied to the Bethe equation are somewhat inaccurate in the heavier elements at these very low energies. When the shell corrections and the above relationships concerning the effective charge were applied to equation (3) below 1.0 Mev, the results were marginal for the light elements, but were in disagreement with the bulk of the empirical information which is available for the medium and heavy elements. These results were particularly disappointing at energies near 0.1 Mev. The appropriate shell correction functions were applied, but did not provide a sufficient improvement in the accuracy at these very low energies. As a result, final shell corrections were applied which yielded the most accurate and consistent results near and above 1.0 Mev, and no calculations using the Bethe equation were carried out below 1.0 Mev. The procedure described in the next paragraph allowed the low energy ionization to be determined in a much more reliable and accurate manner than did further extension of the Bethe equation.

The energy loss below 1.0 Mev has been found by smoothing, interpolating, and in some cases extrapolating the available experimental information. A sufficient amount of experimental data is available between 0.1 and 0.8 Mev to make this approach practical. The energy loss from 0.8 to 1.0 Mev has been determined by performing an interpolation in this region.

The excellent summaries and review articles which are available (Refs. 45 through 53) have been drawn upon as sources of some low-energy data and were used in conjunction with the published reports of the original experimenters (Refs. 54 through 64). Where several sets of experimental data were available and the results of each were within the estimated error of the other, the data were averaged. In those cases where two or more experiments were available and did not agree, a selection of the input data was made on the basis of consistency by comparing the shape and numerical value of the data in question with other sets of data for elements of similar atomic number. The scatter of the selected sets of data has been reduced by least squares smoothing techniques. The entire selection process usually favored the most recent experimental data.

After the final sets of experimental data were selected, curves were fitted through the experimental points to obtain a smooth relationship between proton kinetic energy below 0.8 Mev and the corresponding energy loss. These curves were obtained by again using the method of least squares. These curves were then used as input to the computer program to obtain the energy loss below

0.8 Mev for elements having the following atomic numbers: 1, 2, 3, 4, 6, 7, 8, 9, 10, 13, 18, 20, 23, 24, 25, 26, 27, 30, 32, 34, 36, 47, 50, 51, 54, 73, 79, and 82. In some cases, an "unusual" data point or some systematic error appeared to exist in some of the original input data. Such data were disregarded in favor of interpolation between the two nearest data points or elements for which reliable data existed. There are certain dangers in an approach of this type, nevertheless, the overall error at low energies is still much less than could have been legitimately obtained by use of the Bethe equation.

For elements having atomic numbers greater than 82, an extrapolation was performed by renormalizing the experimental energy loss data in lead at 1.0 Mev to the theoretical value obtained from the Bethe equation at 1.0 Mev, and then scaling the magnitude of this energy loss below 1.0 Mev in lead by using the following relation:

$$\frac{1}{\rho} \frac{dE}{dX} = \left[\frac{1}{\rho} \frac{dE}{dX} \Big|_{\substack{E < 1.0 \\ \bar{r}_b, \text{exp}}} \right] \left\{ \frac{\frac{1}{\rho} \frac{dE}{dX} \Big|_{\substack{E = 1.0 \\ Z_i, \text{calculated}}}}{\frac{1}{\rho} \frac{dE}{dX} \Big|_{\substack{E = 1.0 \\ \text{Pb, calculated}}}} \right\} \begin{matrix} Z > 82 \\ E < 1.0 \end{matrix} \quad (20)$$

where Z_i is the atomic number corresponding to the element in question. This procedure was adopted since no complete proton energy loss measurements over the energy range from 0.1 to 0.8 Mev were found in the literature for materials between lead and uranium, although some data is available for bismuth down to 0.4 Mev. Since the energy loss at a fixed energy is a slowly varying function of the atomic number in the heavy elements, this approach should provide realistic answers, although the absolute accuracy is difficult to determine.

6. Shell Corrections

Protons of moderate energy traversing heavy elements and of very low energy in lighter elements have velocities comparable to the velocities of the inner shell electrons. This velocity, and thus the binding energy of an atomic electron in a given shell, determines the participation of that electron in the proton stopping process. It cannot be assumed that such an electron will be ejected from an atom if the energy transferable by the incident proton is greater than the binding energy of the electron. Conversely, this electron will not always interact if the transferable energy is less than the binding energy.

The probability that a bound electron will participate is not a simple step function because of the statistical effects bearing upon all systems which require a quantum mechanical description.

Although such calculations are difficult, correction terms which represent the nonparticipation of the inner shells in the slowing down process have been presented by several authors (Refs. 65 through 73). These modifications must be applied to maintain the velocity independence of the atomic ionization potential. At low energies, these compensation terms reach a maximum and then decrease. A point is eventually reached where the corrections must actually become negative to compensate for the low energy behavior of the logarithmic term within the brackets of equation (3). This has been briefly discussed by Walske (Ref. 67) and by Peele (Ref. 71). When this occurs, the shell correction terms actually dominate the behavior of the stopping power relation, particularly for elements of large atomic number.

Bichsel (Ref. 21) has used a semiempirical approach coupled with the method given by Walske to determine the necessary shell correction terms. He has assumed that the higher order shell corrections can be obtained by scaling the L shell function both in energy dependence and magnitude. The expressions for the nonparticipation of K and L shell electrons used for the calculations of this report have been obtained through application of high-order least-square curve fits to the data of Walske as presented by Bichsel in reference 4. The detailed results which were obtained are presented for several elements in figures 4 and 5 to illustrate their magnitude and energy dependence.

The L shell correction is of dubious validity when applied directly to the lighter elements. As a result, moderate extrapolation and modification of the magnitude of the L shell correction has been performed to permit the use of an L shell correction in the light elements. Even though the shell corrections are not relativistic, they have nevertheless been applied to the heavy elements where such effects might be significant.

Moderate extrapolations of the L shell functions presented in reference 4 has allowed a correction term for aluminum to be established. Since these correction terms are not known exactly for all elements, a linear interpolation has been used to determine the correction for other elements. This also allows a moderate extrapolation to be made to elements having atomic numbers less than 13. The following equation was used for both the interpolation and extrapolations for all the shell corrections, where the L shell is used as an example:

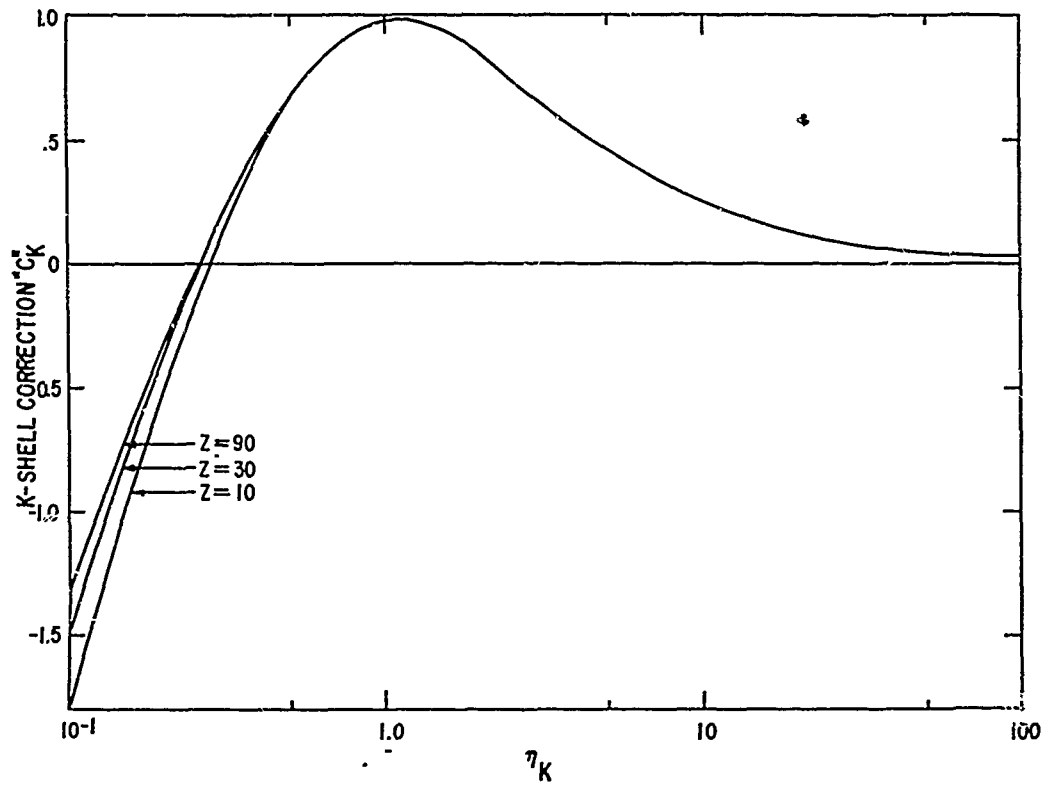


Figure 4. The K Shell Correction

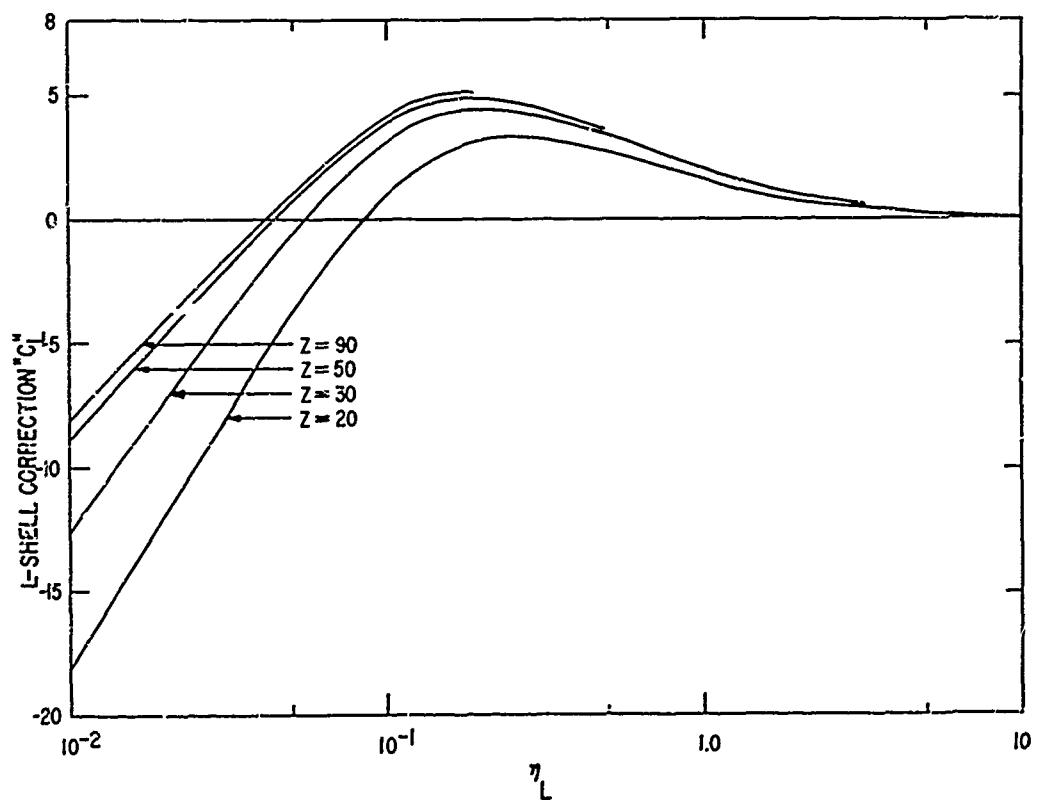


Figure 5. The L Shell Correction

$$C_L(Z') = \frac{[C_L(Z_1) - C_L(Z_2)][Z' - Z_1]}{Z_1 - Z_2} + C_L(Z_1) \quad (21)$$

When Z' is less than 13, Z_1 and Z_2 refer to atomic numbers 13 and 20, respectively. If Z' is greater than 13, Z_1 and Z_2 refer to the atomic numbers of the elements for which exact calculations are available, and whose atomic numbers bracket Z' .

There are two methods which can be used to determine the M shell correction term. A theoretical calculation of the M shell correction using a plane wave Born approximation form factor for collisions of the incident protons has been performed (Ref. 68). The M shell correction (and higher order corrections) may also be found by scaling the L shell correction both in magnitude and energy dependence. The magnitude of the scaled M shell correction should be proportional to the number of electrons in the M shell divided by the number of electrons in the L shell. The velocity dependence would be proportional to the ratio of the spectroscopic ionization potential of the M shell to that of the L shell.

When the M shell correction obtained from the scaling method is compared with the theoretical M shell correction calculated by Khandelwal and Merzbacher (Ref. 68), a serious difference is found in the magnitude and velocity dependence of the two corrections. The scaled correction results in energy-loss values which are usually in excellent agreement with experiment, while the theoretically calculated correction of Khandelwal and Merzbacher produces results which are noticeably different than those obtained with the scaling technique.

The scaled and theoretically calculated M shell corrections for $Z = 80$ have been compared in figure 6. Errors of 10 or 15 percent might possibly exist in the scaled correction, but such errors are not large enough to explain the difference in the two curves. Khandelwal has indicated that the validity of the theoretical results might have been compromised as a result of using hydrogenic wave functions for the M shell (Ref. 69). For such calculations, methods using the Hartree-Fock or other similar atomic models for the M shell electrons would probably be more accurate. Such calculations are under way (Ref. 69) and would be expected to produce realistic correction terms for the intermediate shells. In addition, calculations for each subshell would be better than could be obtained by averaging over the entire shell. The scaled M, N, and O shell corrections have actually been obtained by calculating the

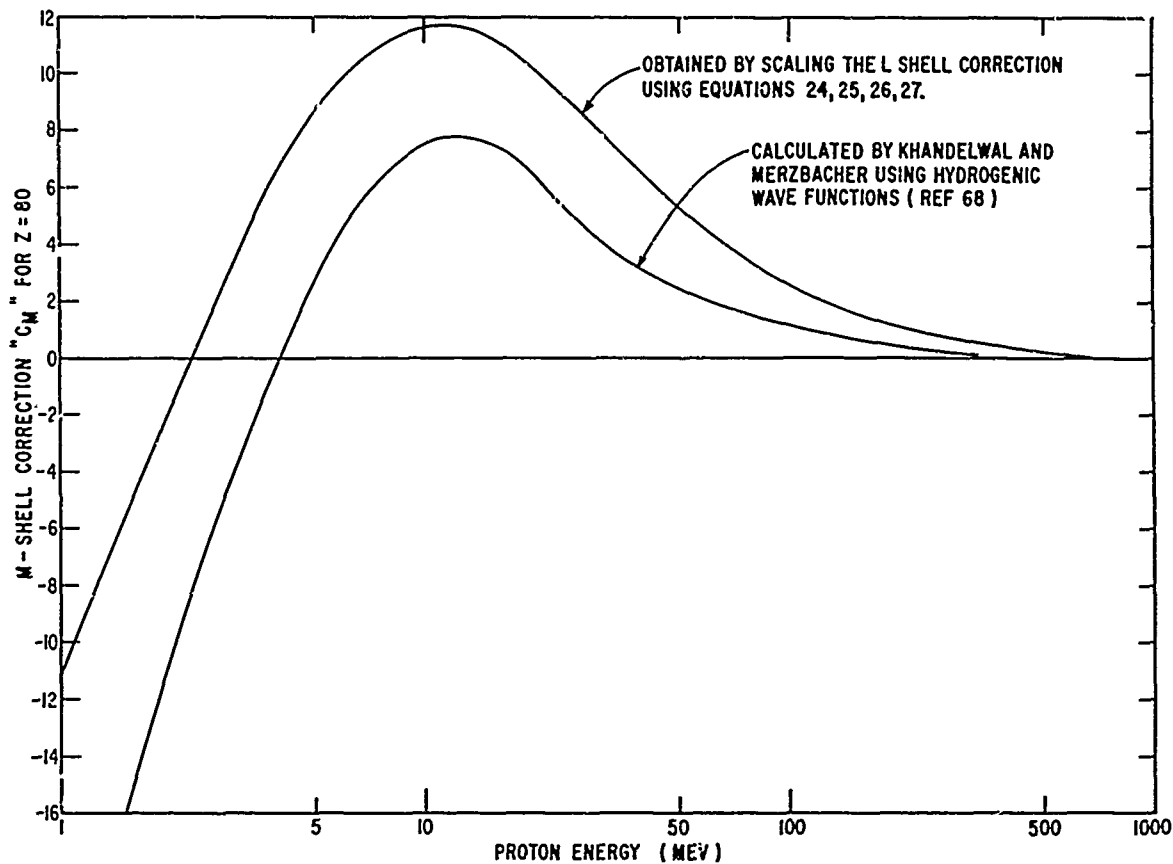


Figure 6. A Comparison of the M Shell Corrections Obtained from the Theoretical Calculations (Ref. 68) and by Scaling of the L Shell correction for each subshell, and then summing the results to obtain the total correction. The individuality of the subshells has been accounted for in this manner.

Since the scaled M shell correction produces results which are in quite good agreement with the bulk of the experimental data, it has been used instead of the theoretically derived functions of reference 68.

The approach and corrections used in this report are essentially those developed by Walske and evaluated by Bichsel. It should be noted that no artificial scaling of the magnitude other than that obtained by using the ratio of the electrons in each shell was required for the M shell. This may be a result of the method used to initially interpolate the L shell correction between elements of various atomic numbers. Such effects would be cumulative, since the higher order shell corrections depend directly on the numerical value and energy dependence of the L shell correction for a given element.

The higher order shell terms have been found by scaling the L shell correction of Walske both in magnitude and energy dependence in the following manner.

A separate correction has been applied to each of the three subshells in the M shell, to the four subshells in the N shell, and to each of the three filled subshells of the O shell. The two doublet energy levels of each subshell have been averaged to obtain a mean ionization potential for that subshell.

The quantities η_K and η_L are the parameters of Walske which are used in the computation of the K and L shell corrections:

$$\eta_K = \left[\frac{\hbar c}{e^2} \right]^2 \left[\frac{\beta^2}{(1 - \beta^2)(Z - 0.3)^2} \right] \quad (22)$$

$$\eta_L = \left[\frac{\hbar c}{e^2} \right]^2 \left[\frac{\beta^2}{(1 - \beta^2)(Z - 4.15)^2} \right] \quad (23)$$

The M shell correction is found by applying the following scaling relationships:

$$C_M = C_{M1} + C_{M2} + C_{M3} \quad (24)$$

$$C_{M1} = \left[\frac{1}{4} \frac{(1 - \beta^2)}{\left(1 - \frac{\beta^2}{F} \frac{I_L}{I_{M1}}\right)} \right] \left[C_L \left(\beta \sqrt{\frac{1}{F} \frac{I_L}{I_{M1}}} \right) \right] \quad (25)$$

$$C_{M2} = \left[\frac{3}{4} \frac{(1 - \beta^2)}{\left(1 - \frac{\beta^2}{F} \frac{I_L}{I_{M2}}\right)} \right] \left[C_L \left(\beta \sqrt{\frac{1}{F} \frac{I_L}{I_{M2}}} \right) \right] \quad (26)$$

$$C_{M3} = \left[\frac{Y_3}{8} \frac{(1 - \beta^2)}{\left(1 - \frac{\beta^2}{F} \frac{I_L}{I_{M3}}\right)} \right] \left[C_L \left(\beta \sqrt{\frac{1}{F} \frac{I_L}{I_{M3}}} \right) \right] \quad (27)$$

Likewise, the N shell correction is given by

$$C_N = [C_{N1} + C_{N2} + C_{N3} + C_{N4}] [1.2] \quad (28)$$

$$C_{N1} = \left[\frac{1}{4} \frac{(1 - \beta^2)}{\left(1 - \frac{\beta^2}{S} \frac{I_L}{I_{N1}}\right)} \right] \left[C_L \left(\beta \sqrt{\frac{1}{S} \frac{I_L}{I_{N1}}} \right) \right] \quad (29)$$

$$C_{N2} = \left[\frac{3}{4} \frac{(1 - \beta^2)}{\left(1 - \frac{\beta^2 I_L}{S I_{N2}}\right)} \right] \left[C_L \left(\beta \sqrt{\frac{1}{S} \frac{I_L}{I_{N2}}} \right) \right] \quad (30)$$

$$C_{N3} = \left[\frac{\gamma_6}{8} \frac{(1 - \beta^2)}{\left(1 - \frac{\beta^2 I_L}{S I_{N3}}\right)} \right] \left[C_L \left(\beta \sqrt{\frac{1}{S} \frac{I_L}{I_{N3}}} \right) \right] \quad (31)$$

$$C_{N4} = \left[\frac{\gamma_7}{8} \frac{(1 - \beta^2)}{\left(1 - \frac{\beta^2 I_L}{S I_{N4}}\right)} \right] \left[C_L \left(\beta \sqrt{\frac{1}{S} \frac{I_L}{I_{N4}}} \right) \right] \quad (32)$$

In each case, the quantity within the square brackets multiplies the L shell correction, which is found by assuming that the effective velocity of the incident proton is not given by β , but by the function of β which appears in parentheses immediately following C_L . I_L is the mean ionization potential of the L shell; I_{Mi} is the mean ionization potential of the i 'th subshell of the M shell; and I_{Ni} is the mean ionization potential of the i 'th subshell of the N shell. γ_3 represents the number of electrons which are in the third subshell of the M shell for any given element. Likewise, γ_6 and γ_7 are the number of electrons in the d and f subshells of the N shell, respectively. The O shell correction has been obtained in an identical manner.

Values of the required ionization potentials for each shell and subshell are available in the literature (Refs. 74 through 77). Those of reference 74 have been used throughout. Interpolation has been performed for those elements whose subshell ionization potentials are not known.

The factor F is a scaling factor which varies slowly with atomic number. It is

$$F = 0.00189Z + 1.8452 \quad (33)$$

The factor S is a similar scaling parameter for the N shell and is given by

$$S = 0.15625Z + 1.2654 \quad (34)$$

The scaling factor for the O shell has been set equal to 2.0 for all elements. It should be noted that the justification for this scaling factor is entirely pragmatic and has been applied for the purpose of improving the accuracy of the final tabulations. Multiplication of the subshell corrections for the N shell by the factor of 1.2 was necessary because the positive maximum of the scaled N shell correction is not sufficiently peaked at low energies. The correction term is too small in this region unless the factor of 1.2 is applied.

The experimental data, particularly for the higher atomic number elements, could have been fit much more closely by carefully choosing scaling factors for each individual element; however, the entire method of calculating the corrections for the M, N, and O shells then loses a degree of internal consistency. It would then be difficult to maintain confidence in the calculations which have been performed for materials having no experimental data available upon which to establish these scaling factors.

No M shell correction has been applied to elements with an atomic number less than 20, and no N shell correction has been used for elements having atomic numbers less than 37. An O shell correction has been applied to all elements with an atomic number greater than 57.

Although the scaling procedure described previously works quite well, a small but consistent deviation is apparent. There is a sufficient amount of experimental energy loss data available for copper to allow a detailed comparison of the scaled M shell correction with that which could be obtained by using the Bethe equation with only K and L shell corrections and working in reverse order from the experimental data to determine the M shell correction. When this is done, the following conclusions may be reached concerning the scaled shell corrections.

Although the velocity dependence seems to be satisfactory, it appears that the shape of the scaled correction is not quite correct. It is not properly peaked at the maximum and does not decrease with a sufficiently steep slope on the low-energy side of this maximum. The same effect, but more pronounced, appears to hold true for the scaled N shell, and presumably for the next higher order correction although there is insufficient experimental data available to establish this for the O shell term. This discrepancy is particularly noticeable for the energy loss in lead near 1.0 Mev. At this point the O shell correction is positive and is beginning to be significant, while the N shell

correction is decreasing rapidly. This rate of decrease is not sufficiently steep to obtain good agreement with the experimental data.

Although they are undoubtedly present, such effects are not overly important for elements having atomic numbers below lead where the rapidly decreasing portion of the N shell correction is not as significant. It was felt that a compromise in the uniform application of the O shell correction might be made in lead to improve the tabulated energy loss at low energies. This can be done by reducing the magnitude of the O shell correction in elements having atomic numbers greater than 81. This offsets the discrepancy caused by the faulty shape of the N shell correction near 1.0 Mev. This has been done for lead, bismuth, and uranium under the assumption that for these elements the O shell correction is approximate but nevertheless necessary.

All of the correction terms for gold have been presented in figure 7 to illustrate predominance of the higher order shell corrections at low energies.

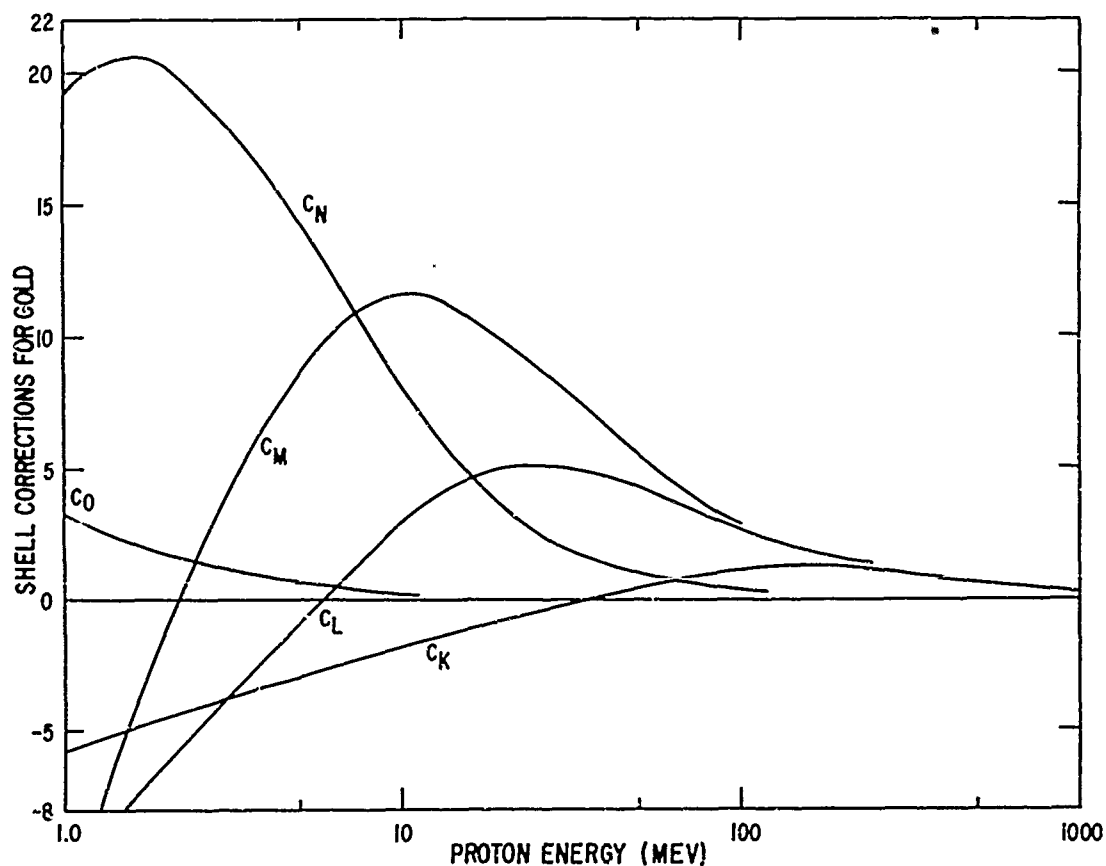


Figure 7. The K, L, M, N, and O Shell Corrections for Gold

7. The Assumption of Additivity

Inasmuch as chemical binding energies in compounds are usually very much smaller than the adjusted atomic ionization potentials, it has generally been assumed in previous calculations that the stopping power of a compound is the sum of the stopping powers of its individual constituents acting independently. Experimental studies by Thompson (Ref. 25) have shown that the stopping power of a compound can be approximated to within 2 percent under this additivity rule for 200- to 340- Mev protons in compounds containing hydrogen. This deviation decreased rapidly with compounds of increasing atomic number, becoming approximately 1 percent for the compounds which contained light elements other than hydrogen, and became negligible for atomic numbers greater than 17.

Reynolds et al. have used low-energy protons in gases to determine the validity of the additivity rule (Ref. 56). The materials tested were additive above 0.2 Mev with the exception of nitrous oxide, which had a stopping power about 4 percent higher than would have been expected assuming additivity.

For compounds containing significant amounts of low atomic number materials, especially compounds containing hydrogen, the small chemical binding effects of the additivity rule should be considered. For this reason, more than one ionization potential has occasionally been used for the same element, depending on whether the element is being discussed with reference to its atomic or its molecular state. This is admittedly an approximation procedure in that the ionization potential of any element in a compound also depends on the specific type and number of molecular bonds, but the results obtained by means of this procedure appear accurate enough to justify its use.

In general, the outer electrons are more tightly bound in compounds than they are in elements because of the molecular bonds. This has the effect of slightly raising the total adjusted ionization potential of each atom which is bound in the molecule. For mixtures of elements, no such binding occurs, and the additive rule should be strictly correct.

The comparisons which have been made in the appendix indicate that several comments concerning the additive rule be made. Water is a rather stringent test of the additive rule, since the water molecule is quite strongly bound. The adjusted ionization potentials which have been used for hydrogen and oxygen in their molecular forms are slightly higher than the ones used for the atomic state. This approach works very well for water, and for most of the other

compounds as well. However, the calculations for nuclear emulsion at high energies are 2 or 3 percent different from the high energy experimental emulsion data. The energy loss and pathlength for nuclear emulsion are known with accuracies on the order of 1 percent. It is apparent that the low energy results are very good, but that the high energy pathlengths are outside of the experimental error by 1 or 2 percent. This is puzzling in view of the excellent agreement in the other cases.

8. Minimum Ionization Point

The minimum value of the energy loss per unit pathlength occurs at proton energies near 2 Bev and is caused by relativistic effects, which are included in calculations using equations (1), (2), and (3). The minimum ionization has been illustrated for aluminum in figure 8. The shell corrections are very small in this energy region and change quite slowly so that they can be treated as constant over a limited energy range. Near the point of minimum ionization, the polarization effect is negligible for gases and is usually small for condensed media. Thus, these two effects have not been considered in obtaining the kinetic energy at which minimum ionization occurs, although they have been applied in determining the minimum ionization itself.

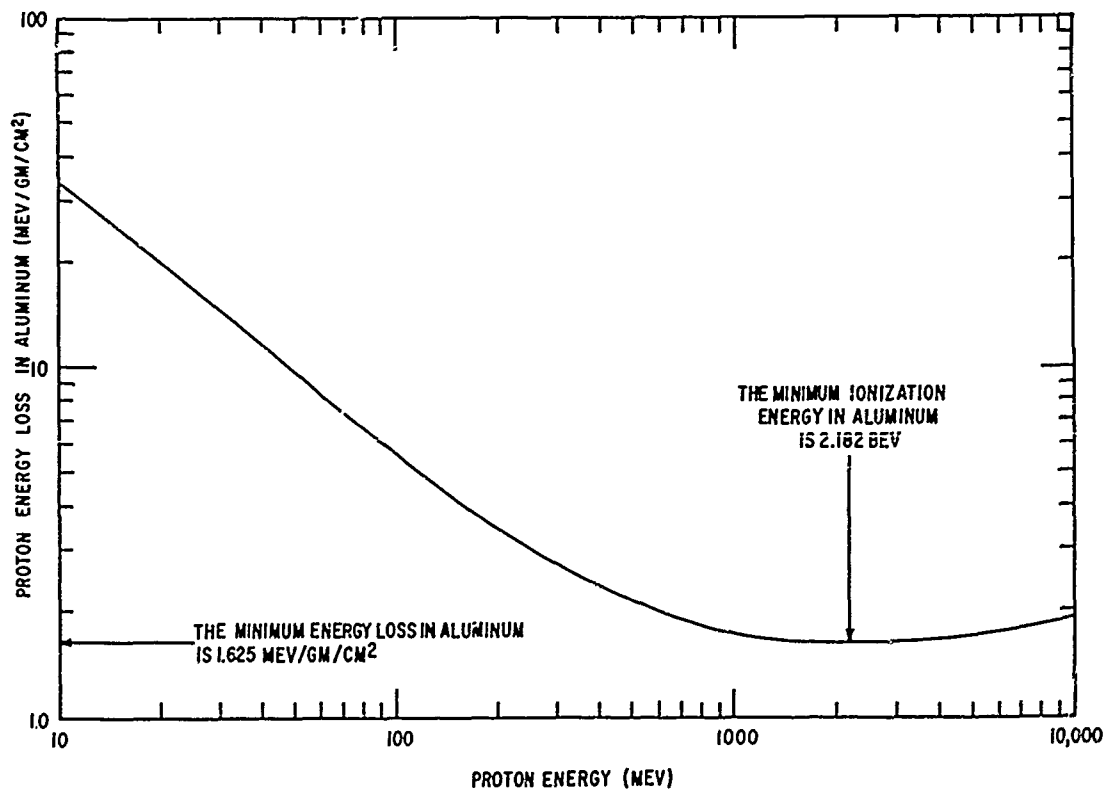


Figure 8. The Minimum Ionization Loss for Protons in Aluminum

In order to determine the point of minimum ionization, equation (3) has been differentiated with respect to the proton velocity, equated to zero and solved for that value of the proton velocity which minimizes the original Bethe equation. The shell corrections and polarization effect have not been considered in the differentiation.

The derivative of the Bethe equation with respect to particle velocity gives

$$\frac{d}{d\beta} \left[\frac{1}{\rho} \frac{dE}{dX} \right] = - \frac{8\pi m z^2 e^4 N Z}{m c^2 \beta^3} \left\{ \ln \frac{2m c^2 \beta^2}{I_{adj} (1-\beta^2) \sqrt{1 + \frac{2m}{M\sqrt{1-\beta^2}} + \left(\frac{m}{M}\right)^2}} - \frac{1}{1-\beta^2} - \frac{\left(\frac{m}{M}\right) \beta^2}{2 \left[1 + \frac{m}{M\sqrt{1-\beta^2}} + \left(\frac{m}{M}\right)^2 \right] (1-\beta^2)^{3/2}} \right\} \quad (35)$$

The above function was then equated to zero and solved for the velocity which minimized equation (3). The expression within the braces is the equation which must be actually solved. This equation cannot be solved using analytic methods when β is close to unity. It has been solved numerically on the computer using a Newton-Raphson iteration technique. The solution is presented on the bottom of the page of tabulations for each material.

The only factor within the braces which is characteristic of the absorbing material is the mean ionization potential. Since this equation is to be solved at an energy which is always near 2 Bev, the effective ionization potential (equation (16)) has been used to obtain the solution for both compounds and mixtures. This could not have been done were the minimum ionization point to occur in a region where both the shell corrections and the polarization effect could not be neglected in the differentiation. Since the solution varies very slowly with the atomic number of the material, the actual results should be quite accurate even with the aforementioned assumptions.

SECTION III

PATHLENGTH AND RANGE CALCULATIONS

1. Integration of the Energy Loss to Determine the Pathlength and Range

Determination of the mean pathlength is straightforward and can be made through the following numerical integration:

$$P(E_0) = P(0.1 \text{ Mev}) + \int_{0.1}^{E_0} \frac{1}{\rho} \frac{dE}{dX} \quad (36)$$

where $P(E_0)$ is the total mean pathlength for protons of initial kinetic energy " E_0 ," and $P(0.1 \text{ Mev})$ is the pathlength at 0.1 Mev. The integration has been normalized at 0.1 Mev because values of the dE/dX at very low energies are not known. The pathlength has been normalized to the data which are available at 0.1 Mev; the specific values which have been used were taken from the review article by Whaling (Ref. 53). In those cases where no experimental or other reliable data were available, an approximate first-order curve was fitted to the available data. This curve is

$$P(0.1 \text{ Mev}) = 0.06593 + 0.01586Z \quad (\text{gm/cm}^2) \quad (37)$$

Since the energy loss below 1.0 Mev is actually given by smoothed and interpolated experimental data, any discrepancies in the low energy pathlengths result from the value of the pathlength selected at 0.1 Mev if one assumes that the experimental energy loss is free from significant error. This assumption is usually justified, but the smoothing process which has been used cannot eliminate systematic errors, which may be present in some of the data. The pathlengths at high energies only have a small dependence on the value selected at 0.1 Mev. For example, if the pathlength in nitrogen at 0.1 Mev is set equal to zero, the pathlength at 1.0 Mev is decreased by 4.8 percent, at 10.0 Mev by only 0.095 percent, and at 100 Mev by the negligible percentage of 0.0015.

In calculating the pathlength at 0.1 Mev for compounds, the following equation was used:

$$\frac{1}{P} = \sum_{i=1}^n \frac{w_i}{P_i} \quad (38)$$

where w_i is the percent by weight of the i th element in the compound which contains n elements, and P_i is the mean pathlength of 0.1 Mev protons in the i th element.

The range of a proton in an absorbing medium will be somewhat smaller than the pathlength as measured from the original angle of incidence into the material, because the proton will undergo multiple coulomb scattering. The range can be calculated by means of the following relation:

$$R(E_o) = R(0.1 \text{ Mev}) + \int_{0.1}^{E_o} \frac{\langle \cos \theta \rangle}{\rho \frac{dE}{dX}} dE \quad (39)$$

where $\langle \cos \theta \rangle$ is the mean value of the cosine of the projection of the total scattering angle onto a plane which contains the original trajectory. Calculations of this quantity have been performed using equation (42), which is straightforward but extremely tedious and is discussed in a later section. The procedures outlined by equation (39) are also very time-consuming on the computer because a double integration must be performed using very fine increments of integration.

Although the proton straggling can be represented approximately by a gaussian distribution, the multiple scattering has an asymmetry which results from the contribution of the infrequent large angle scatterings. As a result, the average range is slightly different from the probable range, although such differences for protons are usually small in cases involving large energy losses.

No attempt has been made here to evaluate the most probable energy loss and pathlength even though the differences may be significant for protons passing through thin absorbers. Such calculations can be performed using the energy loss relationship given by Landau (Ref. 78). All of the calculations which have been tabulated here are average values, and are strictly applicable only when the protons have traversed a sufficient amount of material to make average values meaningful. This is the case for thick target shielding situations where protons lose most or all of their kinetic energy in the absorber.

2. Pathlength Straggling

Protons lose kinetic energy to an absorbing medium in small discrete amounts as they undergo a multitude of collisions with atomic electrons. Since this is mainly a statistical process, an initially monoenergetic beam of protons will

have a definite energy spread after passing through a finite thickness of absorber. A statistical distribution will therefore exist in the energy lost by protons which have traveled identical paths in the stopping material. There will also be a small but definite straggling about the mean pathlength (Refs. 79 through 81). The root mean square straggling (the standard deviation of the distribution) has been found using the expression given by Sternheimer (Ref. 79).

$$\sigma^2 = \frac{4\pi e^4 z^2 N_o Z}{A} \int_E^{E_o} \frac{(1-\beta^2/2)}{(1-\beta^2)} \frac{\left[1 + \frac{4\sum_i f_i E_i}{3mc^2\beta^2} \ln \frac{2mc^2\beta^2}{E_i} \right]}{\left[1 + \frac{2m}{M\sqrt{1-\beta^2}} + \left(\frac{m}{M}\right)^2 \right]} \left(\frac{1}{c} \frac{dE}{dX} \right)^3 \quad (40)$$

The value of $\sum_i f_i E_i$ depends upon the ionization potential of each atomic shell and the number of electrons in those shells which participate in the stopping process for low energy protons. This dependence becomes less significant at higher energies. The value of $\sum_i f_i E_i \ln \frac{1}{E_i}$ can be represented in equation (40) with sufficient accuracy by summing over the classical oscillator strength and shell binding energy of every electron in each atomic shell which is capable of participating in the energy loss process. This has been done in detail for each material at all energies.

A classical technique has been used to determine the possibility of incident protons ejecting electrons from atomic shells. If the maximum energy transfer given by equation (2) is greater than the binding energy of electrons in an atomic shell, then those electrons are assumed to be capable of participation in the energy loss process. If the maximum energy transferable is less than the binding energy of the shell, those electrons may not participate. These two assumptions have been applied only to equation (40), where this classical technique is more than satisfactory.

The summation indicated in the numerator of equation (40) does not produce a perfectly smooth function, but is slightly irregular because of the abrupt cutoff which occurs near the binding energy of each atomic shell. This termination point for a given shell corresponds to the region where the quantum mechanically derived shell correction for that shell reaches a maximum. In this case, the classical approach provides results for use in equation (40) which are quite adequate.

In the calculation of σ for compounds, it has been assumed that the pathlength straggling is due exclusively to the effects of each atom acting independently

of the molecular structure. Values of σ have been tabulated under the heading "Pathlength Straggling." Although equation (40) gives the straggling about the mean pathlength, the width of the distribution should not be much broader about the mean range since the straggling is essentially a function of the number of electrons encountered while the multiple scattering is mainly the result of deflections by atomic nuclei.

The percent pathlength straggling has also been calculated and has been defined by

$$\text{Percent pathlength straggling} = 100 \frac{\sigma}{P(E_0)} \quad (41)$$

where $P(E_0)$ is the value of the pathlength for a proton of kinetic energy E_0 .

3. Multiple Coulomb Scattering

The probability is quite small that a proton will undergo a complete reversal of direction in losing energy in other than inelastic nuclear interactions. Angular deflections resulting from the multiple scattering of protons usually deviate the incident protons only slightly from the original direction. For this reason, the relationship between proton pathlength and range can be reasonably well defined.

In coulomb scattering processes involving only a negligible energy loss, multiple scattering depends strongly on the product of the proton momentum and velocity. To a first approximation, the multiple scattering of protons can be represented by a gaussian distribution with a nonsymmetrical tail to account for the infrequent occurrence of large angle scattering.

It is generally more useful to consider the projection of the total scattering angle onto a plane which is defined by the original trajectory and angle of incidence, rather than the total scattering angle itself. Furthermore, the average value of the projected angle usually has only a minor dependence on the occurrence of large angle scattering.

Although the multiple scattering calculations have been performed for an unbounded medium, they can be applied to any case where the loss of protons out of the sides of an absorber is negligible compared to the number transmitted in the forward direction. Many of the pertinent publications concerning the multiple scattering of protons are given by references 82 through 112.

Lewis (Ref. 88) has shown that the average value of the cosine of the mean scattering angle can be written as

$$\langle \cos \theta \rangle \left| \begin{matrix} E_0 \\ E \end{matrix} \right. = \exp \left[- \int_E^{E_0} K_1 \frac{dE}{\rho \frac{dE}{dX}} \right] \quad (42)$$

This expression must be substituted into equation (39) and integrated over the entire pathlength of the particle which entered the absorber with an initial kinetic energy E_0 , and has now been degraded to energy E .

The K_1 term in the exponent can be represented by

$$K_1 = 2\pi N \int_0^\pi \sigma(\theta, E) \sin\theta (1-\cos\theta) d\theta \quad (43)$$

In terms of simplicity, the screened Rutherford and McKinley-Feshbach cross sections are straightforward to use. Both have the advantage that they can be analytically integrated over the scattering angle to give the total scattering cross section. Although the Rutherford cross section is quantum mechanically correct, except for proton-proton scattering where the particles are identical, it is not truly relativistic. It has been extended for use at high velocities by insertion of the correct relativistic terms for the momentum, energy, and velocity in place of the classical relationships. Although these approximations improve the high-energy validity, they must be considered as only first-order corrections.

The McKinley-Feshbach cross section is strictly valid only for very low atomic number elements and for very high velocity particles; however, it approaches the Rutherford cross section in the classical limit. For this reason it has been employed for hydrogen and helium over the entire energy range, although minor discrepancies are apparent at energies on the order of 1 Mev or less.

The screened Rutherford cross section is (Ref. 97)

$$2\pi N\sigma(E, \theta) = \frac{z^2 Z^2}{A} \frac{2\pi e^4 N (1-\beta^2)}{M_r^2 c^4 \beta^4 (1+2\eta-\cos\theta)^2} \quad Z \gg 3 \quad (44)$$

The McKinley-Feshbach cross section is (Ref 103)

$$2\pi N\sigma(E, \theta) = \frac{z^2 Z^2}{A} \frac{2\pi e^4 N (1-\beta^2)}{M_r^2 c^4 \beta^4} \left[\frac{1}{(1+2\eta-\cos\theta)^2} + \frac{\pi\alpha\beta}{\sqrt{2}(1-\cos\theta)^{3/2}} - \frac{\beta^2 + \pi\alpha\beta}{2(1-\cos\theta)} \right] \quad Z \lesssim 2 \quad (45)$$

where

$$\alpha = zZ \frac{e^2}{\hbar c} \quad (46)$$

And where M_r is the reduced mass of the proton in the scattering system and has been represented in the computations by

$$M_r = \frac{M}{(1+M/A)} \quad (47)$$

where M is the proton mass and A is the atomic weight of the scattering atom. If the reduced mass is simply set equal to the proton mass, a significant difference results for elements having very low atomic numbers, although this difference diminishes rapidly with increasing atomic weight. This is presented in table V.

Table V

DIFFERENCES IN THE PERCENT MULTIPLE SCATTERING RESULTING FROM USE OF THE PROTON MASS COMPARED TO THE REDUCED PROTON MASS

Element	Atomic number	10 Mev		100 Mev		1000 Mev	
		Reduced proton mass	Proton mass only	Reduced proton mass	Proton mass only	Reduced proton mass	Proton mass only
Hydrogen	1	0.085	0.021	0.072	0.017	0.062	0.015
Beryllium	4	0.115	0.092	0.095	0.077	0.083	0.067
Aluminum	13	0.350	0.328	0.277	0.258	0.248	0.231
Copper	29	0.803	0.780	0.603	0.589	0.543	0.529
Gold	79	2.37	2.33	1.66	1.64	1.48	1.44

The quantity η is a screening factor which is independent of the scattering angle, and has been given by Molière as (Ref. 106)

$$\eta = \frac{1}{4} \chi_0^2 \left[1.13 + 3.76 \alpha^2 / \beta^2 \right] \quad (48)$$

Nigam et al. (Refs. 104, 105) have performed a detailed evaluation of the screening parameter in the second Born approximation and have obtained a more consistent expression for the screening factor

$$\eta = \frac{1}{4} \chi_0^2 \left[1 - 2u \left\{ \frac{1 - \beta^2}{\beta} \ln \chi_0 + \frac{0.231}{\beta} + 1.448\beta \right\} \right]^2 \quad (49)$$

This expression has been used in the calculations instead of the relationship given by Molière.

The quantity χ_0 in the above expressions is defined by

$$\chi_0 = \mu \left[\frac{(m/M)}{pc} \right] \left[\frac{Z^{1/3}}{2 \left(\frac{3\pi}{4} \right)^{2/3}} \right] \left[\frac{e^2}{\hbar c} \right] \quad (50)$$

where p is the relativistic momentum of the proton. The quantity μ is indirectly

related to that of 1.13 in the theory of Molière and has been calculated by Mott (Ref. 107) to be 1.12. His value has been used throughout. The quantity μ should be set equal to unity for calculations using the Molière theory. The coefficient 1.13 in equation (48) results from Molière's use of three exponentials to represent the Thomas-Fermi potential. Nigam et al. have obtained 1.00 for this because they used one exponential to represent the screened atomic potential. Calculations have been performed using both screening factors, and the differences are summarized in table VI.

Table VI

COMPARISON OF THE PERCENTAGE MULTIPLE SCATTERING OBTAINED THROUGH USE OF THE NIGAM AND MOLIÈRE SCREENING FACTOR USING THE REDUCED PROTON MASS

Element	Atomic number	10 Mev		100 Mev		1000 Mev	
		Nigam	Molière	Nigam	Molière	Nigam	Molière
Hydrogen	1	0.085	0.093	0.072	0.075	0.062	0.063
Beryllium	4	0.115	0.141	0.095	0.105	0.083	0.086
Aluminum	13	0.350	0.469	0.277	0.332	0.248	0.263
Copper	29	0.803	1.14	0.603	0.765	0.543	0.596
Silver	47	1.33	1.95	0.969	1.27	0.874	0.978
Gold	79	2.37	3.63	1.66	2.23	1.48	1.68
Uranium	92	2.72	4.21	1.95	2.63	1.73	1.98

There is a noticeable difference between the results obtained from the two multiple scattering theories. The difference is most pronounced at low energies in high atomic number materials. There are some experimental proton data for low energy protons in silver and gold which are of very high accuracy (Ref. 36). The experimental error of this data is less than 0.2 percent. When the Nigam theory is used, the results are within this experimental error. The Molière results are outside the possible error by approximately 1 percent.

Substitution of the Rutherford and McKinley-Feshbach cross sections into equation (43) and integrating over the scattering angle yields the following expressions for K_1 , respectively:

$$K_1 = \frac{2\pi e^4 N_o z^2 Z^2}{M^2 c^4 A} \left[\frac{T+1}{T(T+2)} \right]^2 \left[\ln \left(1 + \frac{1}{\eta} \right) - \frac{1}{1+\eta} \right] \quad Z \geq 3 \quad (51)$$

$$K_1 = \frac{2\pi e^4 N_o z^2 Z^2}{M^2 c^4 A} \left[\frac{T+1}{T(T+2)} \right]^2 \left[\ln \left(1 + \frac{1}{\eta} \right) - \frac{1}{1+\eta} - \beta^2 + \pi \alpha \beta \right] \quad Z \leq 2 \quad (52)$$

where T is the kinetic energy of the incident proton in units of the proton rest mass

$$T = \frac{E}{Mc^2} \quad (53)$$

The procedure described above has been used to obtain the proton range which has been printed in the data tables under the heading "Proton Range." The percentage multiple scattering has also been tabulated since it is a useful way of expressing the results of the multiple scattering calculations.

$$\text{Percent multiple scattering} = 100 \frac{P(E_0) - R(E_0)}{P(E_0)} \quad (54)$$

where $P(E_0)$ and $R(E_0)$ are the pathlength and range, respectively, of protons having an initial energy E_0 .

4. The Number Distance Expression, Bragg Ionization Curve, and Extrapolated Pathlength

Most experimental measurements do not evaluate the mean pathlength or range directly. Variations of three techniques are commonly employed to obtain experimental proton range data. The first two result in range measurements, while the third actually gives the pathlength. In the first approach, a Faraday cup or similar device is used to determine the total number of protons which have passed through an absorber. The second employs a thin-walled ionization chamber to record the "Bragg ionization" of protons which have lost a large amount of kinetic energy in a given thickness of degrader. Nuclear emulsions have been used extensively and yield direct measurements of the pathlength and straggling because the particle tracks are visible. The results of these methods can then be used to determine the mean and extrapolated range and pathlength.

It is of interest to know the relationships between the number-distance curve, the Bragg curve, and the extrapolated pathlength. Approximate values for these quantities may be obtained in a straightforward manner under the following assumptions: (1) that the straggling distribution is exactly gaussian, (2) is not influenced by multiple scattering, and (3) the probability of inelastic nuclear interactions is negligible. These assumptions lead to the differential distribution of the number of protons which are distributed about the mean pathlength, given by (Ref. 86)

$$F(X)dX = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{[X-P(E_0)]^2}{2\sigma^2}} dX \quad (55)$$

The distribution about the mean range can be found by replacing the pathlength by the range in the above expression.

The probability $P(n \geq X)$ of finding n particles which have traveled a distance equal to or greater than X can be obtained from equation (55) by integration. The result is usually referred to as the fractional transmission or number distance expression.

$$P(n \geq X) = \int_X^{\infty} F(X) dX \tag{56}$$

The results obtained from equations (55) and (56) are compared with the experimental transmission data of Bloembergen and van Heerden (Ref. 37) in figures 9 and 10.

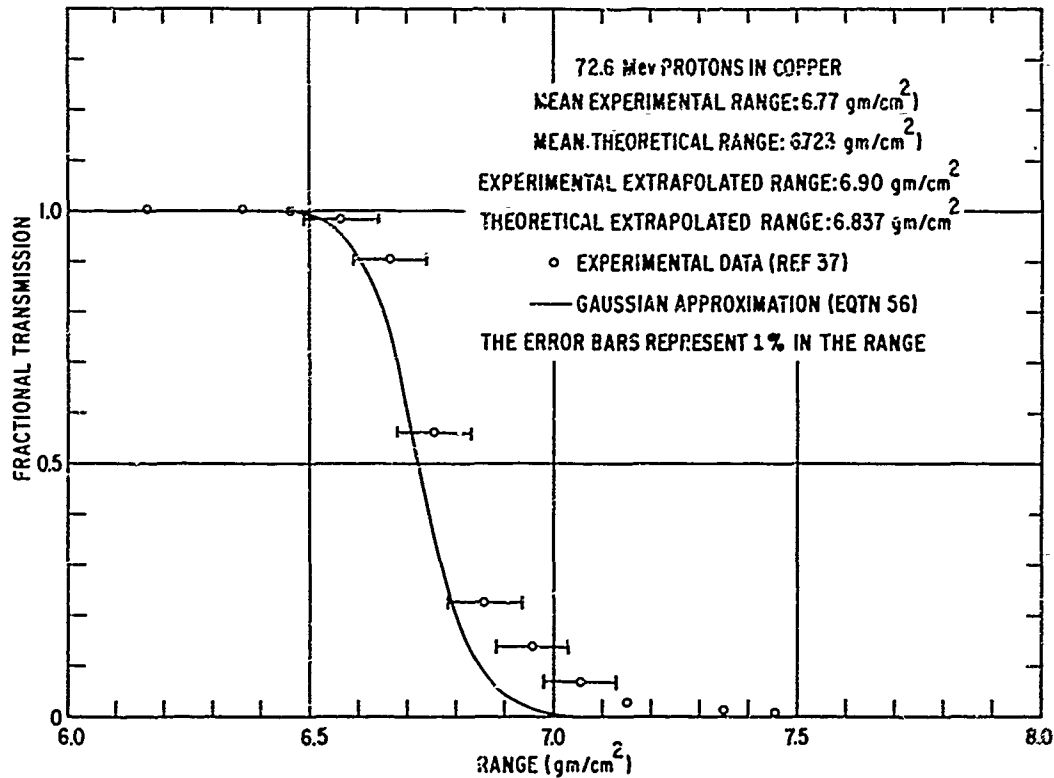


Figure 9. The Number Distance Curve for 72.6 Mev Protons in Copper Under the Gaussian Approximation

These relationships can also be used to obtain approximate values of the Bragg ionization curve. If proton straggling and scattering were truly negligible, the ionization as a function of pathlength for an initially monoenergetic beam of protons would be given simply by the differential energy loss at a given distance. However, there is a definite straggling of protons about the mean pathlength which causes a broadening of the width of the ionization curve. The shape of the Bragg curve can be obtained by folding the number distance

expression from equation (56) with the energy loss and pathlength relationships given by equations (3) and (36).

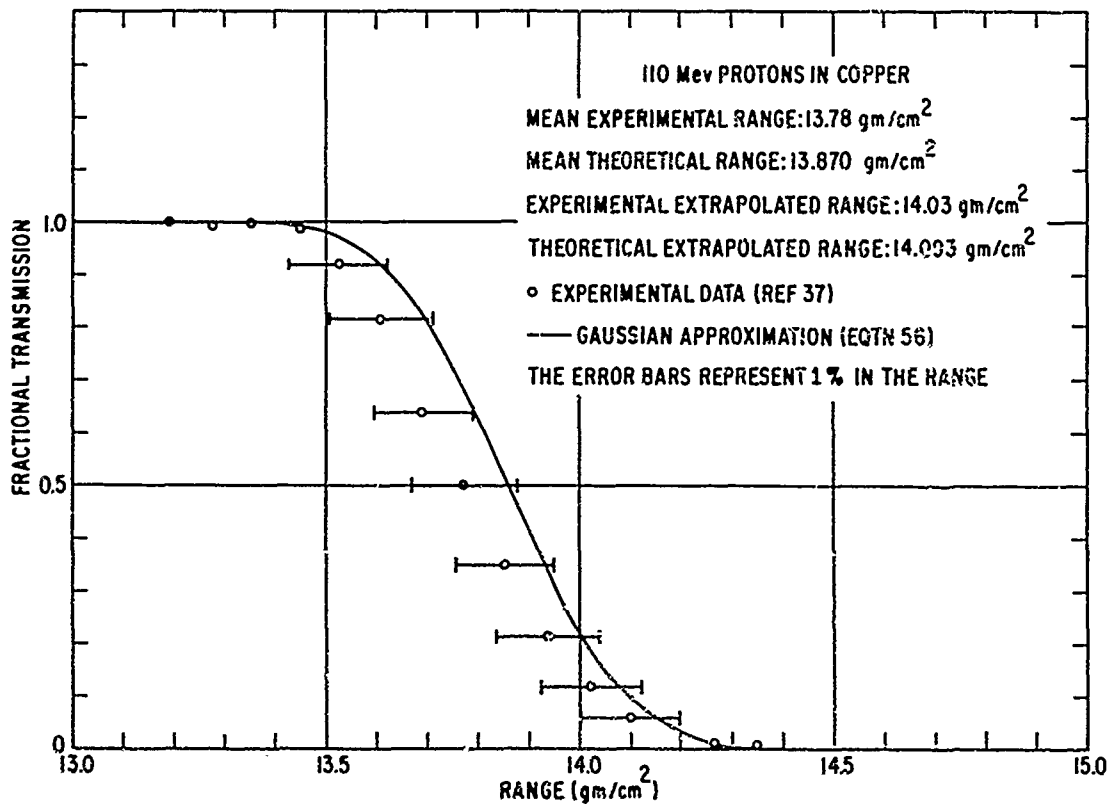


Figure 10. The Number Distance Curve for 110 Mev Protons in Copper Under the Gaussian Approximation

Further, the extrapolated pathlength can be obtained using the gaussian approximation if the mean pathlength is known.

$$P(E_o)_{extr.} = P(E_o)_{mean} + \sqrt{\frac{\pi}{2}} \sigma(E_o) \quad (57)$$

where $P(E_o)_{extr.}$ is the extrapolated pathlength, $P(R_o)_{mean}$ is the mean pathlength for protons of kinetic energy E_o , and $\sigma(E_o)$ is the pathlength straggling given by equation (40). The extrapolated range can be obtained by replacing pathlength by range in equation (57).

If it is assumed that both the pathlength fluctuation and the multiple scattering can be represented by purely gaussian distributions, the total fluctuation in the proton range can be determined from the information available in the tables. The summation of several gaussian distributions in this manner will also yield a gaussian distribution.

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It must be emphasized that the gaussian approximation is accurate only to first order, but the symmetry of such a normal distribution greatly simplifies the theory. Should more accurate distributions be required, the reader is referred to the comprehensive tabulations of Seltzer and Berger (Refs. 108, 109).

SECTION IV
PROBABILITY OF INELASTIC NUCLEAR INTERACTIONS

In the determination of the proton pathlength and range, no consideration has been given to the possibility that an incident proton might undergo an inelastic nuclear interaction. The range and pathlength calculations do not apply to such protons. Thus, some information about the probability that such an interaction would occur over the entire pathlength of the particle would be of value. This has been calculated assuming an exponential interaction probability and has been presented in the tabulations under the heading "Probability of Inelastic Nuclear Interaction." The following relationship has been employed:

$$P(N) = 1 - \exp \left[- N_0 \int_0^{P(E_0)} dX \frac{\sum_i r_i \sigma_i}{\sum_i r_i A_i} \right] \quad (58)$$

where

$P(N)$ is the probability of an inelastic nuclear interaction

N_0 is Avogadro's number

$P(E_0)$ is the total pathlength of the proton

r_i is the number of atoms per molecule of the i 'th element in the compound

σ_i is the total inelastic cross section of the i 'th element in barns

A_i is the atomic weight of the i 'th element

The integral over the pathlength is required because the energy of the proton changes as it passes through the absorber. The inelastic cross section is dependent upon proton energy, thus the increment of pathlength and the cross section must both be included in the integral. The summations are required to determine the inelastic cross section for compounds and mixtures.

The above equation is most easily evaluated by making a change of variable from the pathlength to the energy loss at a given kinetic energy; this gives the following equation:

$$P(N) = 1 - \exp \left[-N_0 \int_{0.1}^{E_0} \frac{dE}{\frac{1}{\rho} \frac{dE}{dX}} \frac{\sum_i r_i \sigma_i}{\sum_i r_i A_i} \right] \quad (59)$$

where E_0 is the initial kinetic energy of the proton when it entered the material. The integral has been carried down to 0.1 Mev, even though the cross sections become negligibly small at energies somewhat above this.

The inelastic cross sections below 25 Mev have been obtained from the information published by Shapiro (Ref. 113), and by Pollock and Schrank (Ref. 114). The required cross sections between 25 and 400 Mev were obtained from the work of Bertini (Refs. 115, 116). Above 400 Mev, the transparency values listed by Metropolis et al. have been used (Refs. 117, 118). In those cases where data were not available, interpolations have been made between the nearest elements where such data were available. It should be noted that the inelastic cross section for protons incident upon hydrogen is zero until an energy of several hundred Mev is reached. The inelastic cross section for hydrogen was taken from figure 4a of reference 119.

For low energies the probability of formation of a compound nucleus predominates, and it has been assumed that this is the significant inelastic proton-nucleus interaction which takes place below 16 Mev. The inelastic scattering cross sections for aluminum, silver, and lead which have been used are representative and have been presented in figure 11.

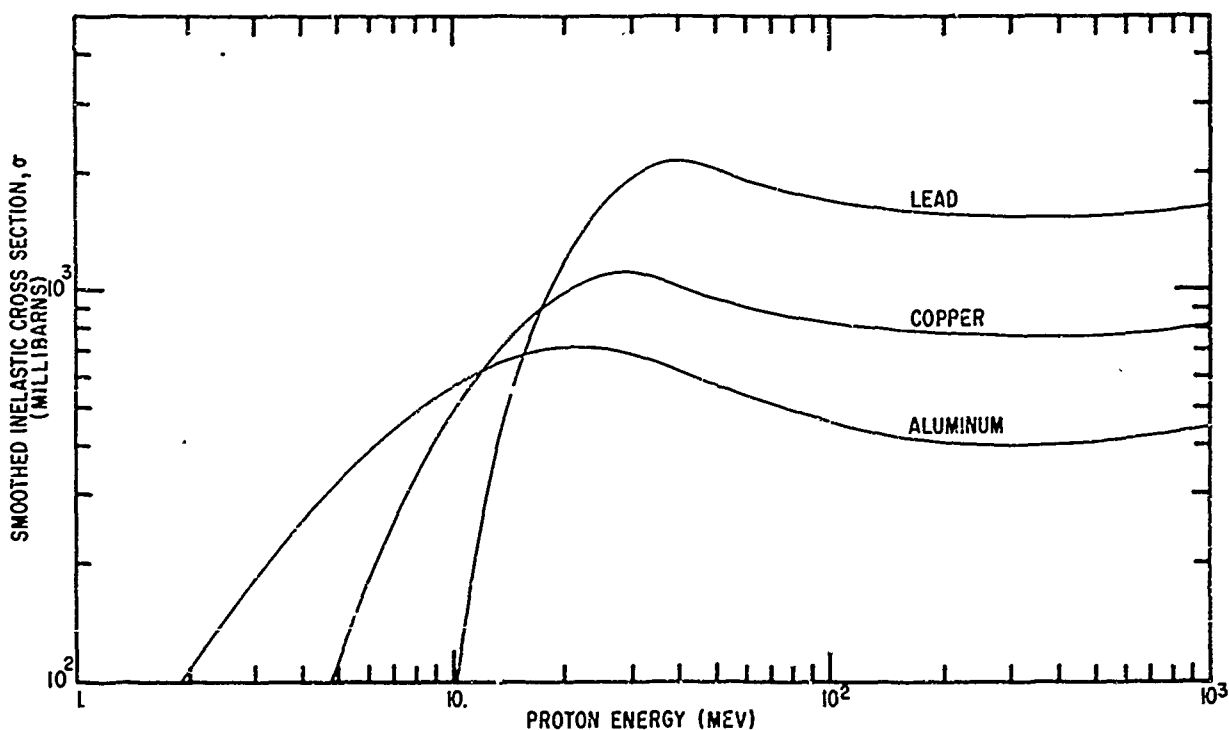


Figure 11. The Inelastic Scattering Cross Sections for Aluminum, Silver, and Lead Which Have Been Used to Determine the Probability of an Inelastic Nuclear Interaction

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The probability that a high-energy proton will undergo an inelastic nuclear collision is quite large. For this reason the high-energy calculations have not been extended beyond the minimum ionization point. Such high-energy calculations would be of little use, since range and pathlength values above 2 Bev are somewhat meaningless because of the predominance of nuclear interactions.

SECTION V
COMPARISON WITH SELECTED EXPERIMENTAL DATA

The tabulated values of the range and energy loss have been compared with the published experimental data for pertinent references listed in section VI. Comparisons for three representative elements (aluminum, copper, and gold) have been presented in tables VII, VIII, and IX and in figures 12, 13, and 14. These elements were selected because the data of several experimenters were available. Since the various experimental results are somewhat inconsistent, the use of several sets of data provides more insight into the accuracy of the calculations than does comparison with only one set of data. Excellent agreement between calculation and experiment has been obtained for most of the materials where the bulk of the data was internally consistent.

The measuring techniques used in each experiment also effect the error and final results, and consequently a certain amount of the inconsistency appearing in the experimental data is probably a result of experimental technique.

The reader is strongly urged to review the detailed experimental and theoretical comparisons which have been presented in the appendix. The experimental energy loss and range have been compared in considerable detail with the tabulations presented in this and other similar reports (Refs. 1 through 9). The percent difference from the experimental data of each report have been presented along with the experimental error, mean error, and relative standard deviations of the calculations for each set of experimental data. The experimental data of a given experimenter have been presented in the order of increasing atomic number.

The energy loss and range values tabulated in this report are usually within 1 percent of the experimental data or the error estimates of the experimenter, whichever is larger.

Table VII

A COMPARISON OF EXPERIMENTAL ENERGY LOSS IN Mev/gm/cm² WITH
THE TABULATIONS OF THIS REPORT FOR ALUMINUM

Proton energy	This report	Nielsen Ref. 130	Kahn Ref. 54	Warshaw Ref. 20	Wilcox Ref. 57	Summary of Bichsel Ref. 4
0.10	418.06			416.0	458	420.0
0.15	371.51			366.0	405	380.0
0.20	344.46			333.5	366	343.0
0.25	323.66		314.5		340	327.0
0.30	305.58		297.0	295.0	311	310.0
0.35	289.78		283.0			293.0
0.40	276.04		271.0	275.0		279.0
0.45	263.68		260.0			265.0
0.50	251.99		250.0			252.0
0.55	240.68		241.0			241.0
0.60	229.99		233.0			230.0
0.65	220.98		223.5			
0.70	212.01		217.0			212.0
0.75	204.50		210.0			
0.80	196.99		202.5			197.0
0.85	191.25		196.0			
0.90	185.51		189.5			185.0
0.95	179.77		183.0			
1.0	174.02	172.4	177.0			173.0
1.1	163.92		166.5			163.0
1.2	155.48		157.5			155.0
1.3	147.81		150.5			147.0
1.4	140.88					140.0
1.5	134.63	133.3				134.3
1.6	128.96					129.0
1.8	119.11					119.0
2.0	110.82	109.9				110.7
2.5	94.806	94.2				94.7
3.0	83.278	82.8				83.2
3.5	74.522	74.2				74.5
4.0	67.606	67.4				67.6
4.5	61.992	62.0				62.0
5.0	57.335	57.4				57.3
5.5	53.402					53.4
6.0	50.135					50.0

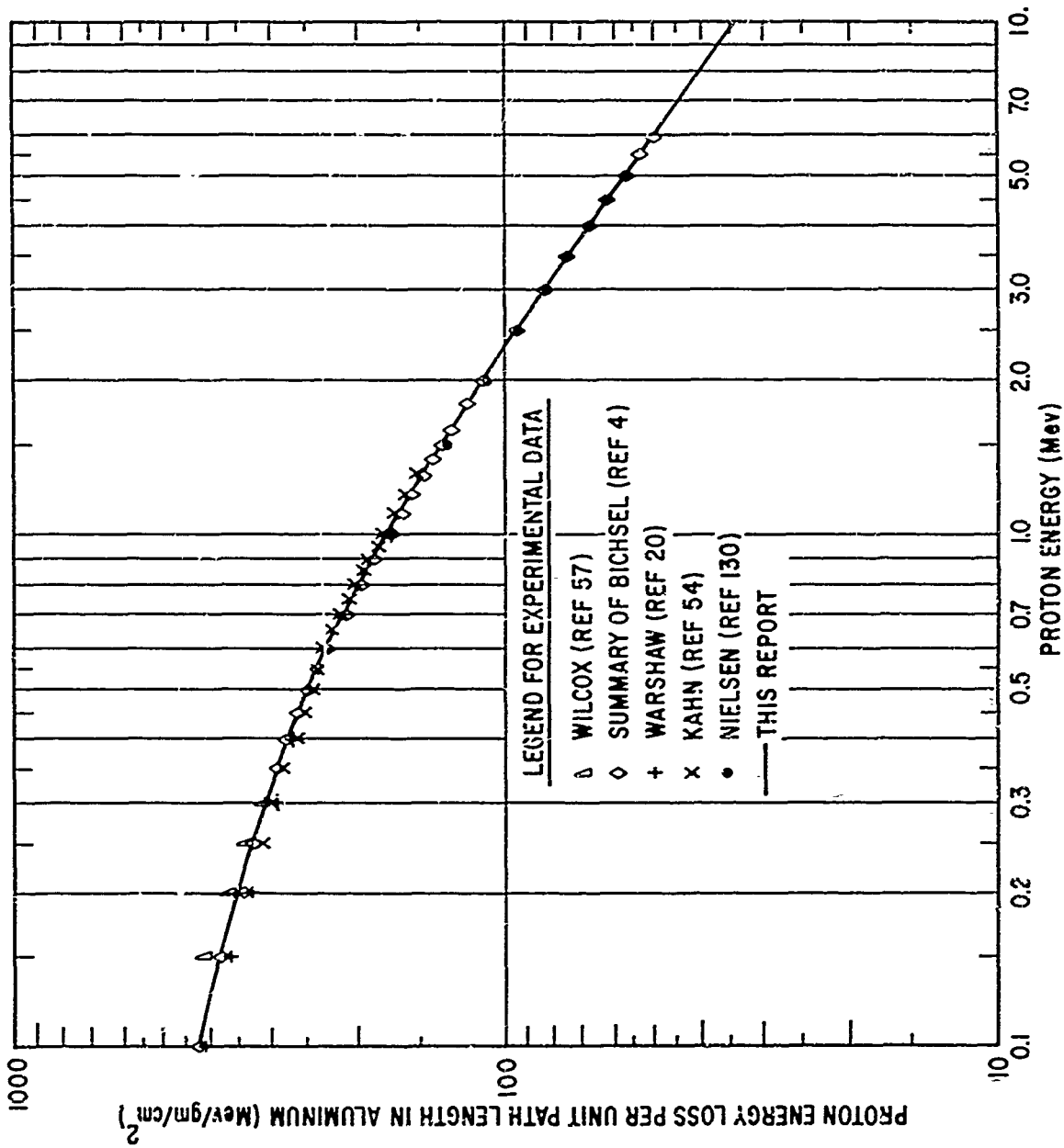


Figure 12: A Comparison of the Experimental and Calculated Energy Loss for Aluminum

Table VIII

A COMPARISON OF EXPERIMENTAL ENERGY LOSS IN Mev/gm/cm² WITH
THE TABULATIONS OF THIS REPORT FOR COPPER

Proton energy	This report	Bader et al. Ref. 42	Green et al. Ref. 41	Nielsen Ref. 130	Richsel, Summary of Rept. #3 Richsel Ref. 21 Ref. 4	Warshaw Ref. 20	Kahn Ref. 54
0.1	225.66	227.5			228	223.5	
0.15	227.21	227.5			228	228.0	
0.2	221.45	217.0			221	222.0	
0.25	211.34	205.7			211		212.0
0.3	200.95	199.0			201	201.0	200.0
0.35	191.12	191.5			192		189.5
0.4	182.31	181.8	179		188.0	183.0	180.5
0.45	174.49	178.2	172		175		172.5
0.5	167.45	171.6	165		166.0		166.0
0.55	160.94	165.8	158		161		160.0
0.6	154.86	160.1	152		157.0		154.0
0.65	149.45		147				148.5
0.7	144.04		142				144.0
0.75	139.65		137		144		140.0
0.8	135.27		133		135.0		136.0
0.85	131.85		128				132.0
0.9	128.44		125			128	128.7
0.95	125.02		122				126.0
1.0	121.60		119		121.0		122.0
1.1	115.15						117.0
1.2	109.47				111.0		112.5
1.3	104.40						109.0
1.4	99.834				104.0		
1.5	95.778			95.0			
1.6	92.062				94.5		
1.8	85.765				88.5		
2.0	80.408			80.0	83.5		
2.5	69.921			69.5	74.0		
3.0	62.325			62.2			
3.5	56.384			56.5			
4.0	51.618			51.7			
4.5	47.688			47.5			
5.0	44.381						
5.5	41.553						
6.0	39.105						
12.0	23.738				23.87		
20.0	16.236				16.22		
29.0	12.254				12.15		
267.0	2.5731				2.61		
300.0	2.4138				2.422		
615.0	1.7616				1.772		
651.0	1.7292				1.74		

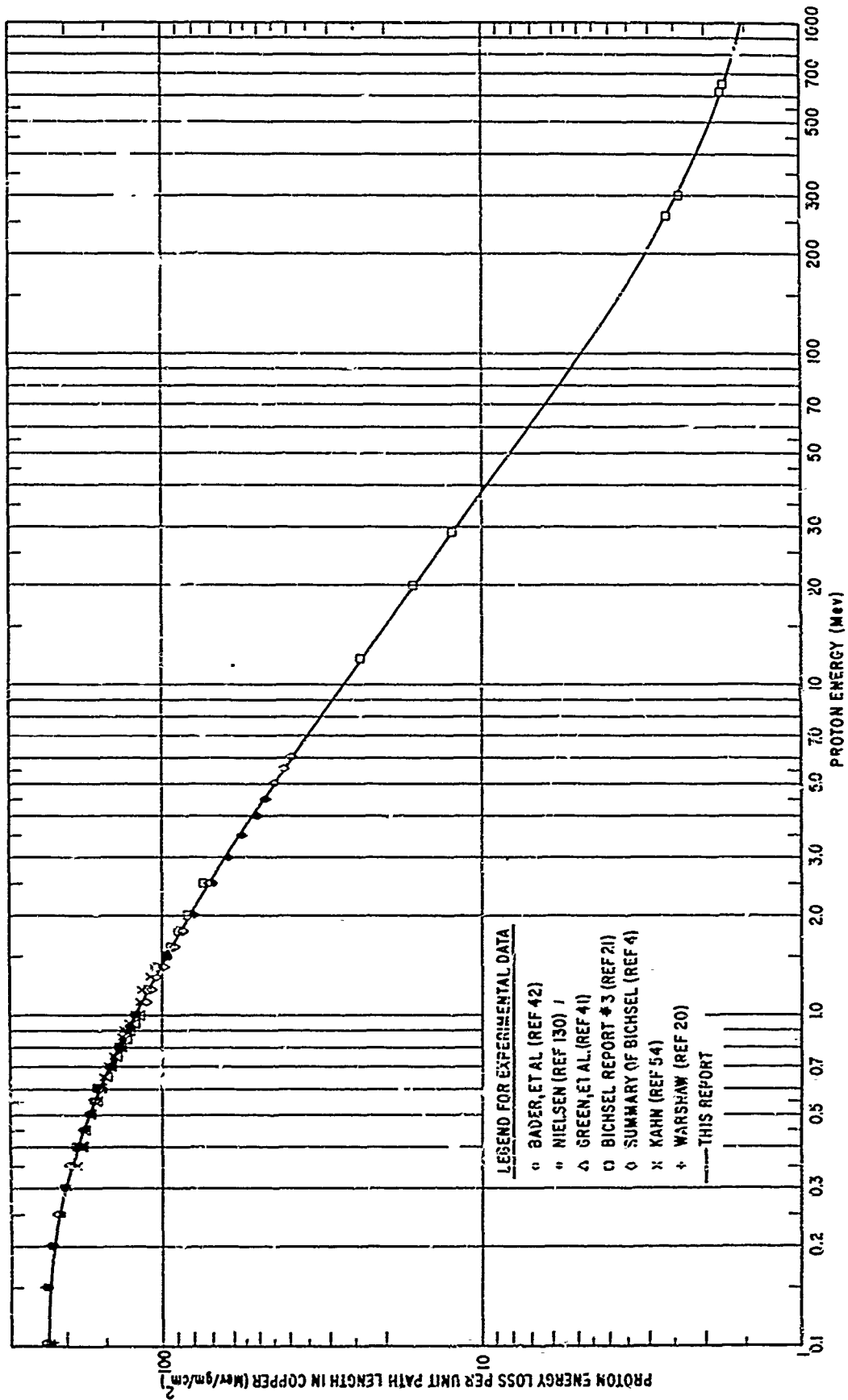


Figure 13. A Comparison of the Experimental and Calculated Energy Loss for Copper

Table IX

A COMPARISON OF EXPERIMENTAL ENERGY LOSS IN Mev/gm/cm² WITH
THE TABULATIONS OF THIS REPORT FOR GOLD

Proton energy	This report	Bader et al.* Ref. 42	Nielsen Ref. 130	Kahn Ref. 54	Green et al. Ref. 41	Bichsel, Rept. #3 Ref. 21	Summary of Bichsel Ref. 4	Wilcox Ref. 57
0.10	104.91	105.5		87.0			105.0	84
0.15	116.33	115.8		90.0			116.0	87
0.20	118.68	118.9		88.5			119.0	85
0.25	115.79	115.8		84.5			116.0	81
0.30	110.35	110.7		80.5			110.0	77
0.35	104.08	103.9		77.2			104.0	73
0.40	98.012	97.22		74.5	96	98.0	98.0	66
0.45	92.637	91.71		72.0	92		93.0	
0.50	88.077	86.82		69.5	88	88.0	88.0	
0.55	84.229	83.46		67.5	84		84.0	
0.60	80.891	80.40		66.0	80	81.0	81.0	
0.65	77.942			64.5	78			
0.70	74.994			63.5	75	75.0	75.0	
0.75	72.498			62.0	73			
0.80	70.003			60.2	71	71.0	70.0	
0.85	68.403			59.0	69			
0.90	66.803			58.5	67		66.0	
0.95	65.202			58.0	65			
1.0	63.601			57.0	64	65.0	63.0	
1.1	61.270			55.2			59.6	
1.2	59.084			54.0		60.0	57.0	
1.3	57.073						54.3	
1.4	55.155					56.0	52.5	
1.5	53.544						50.5	
1.6	52.023					52.0	49.0	
1.8	49.237					49.0	46.8	
2.0	46.761		44.0			46.8	44.0	
2.5	41.651		40.0			41.5	39.8	
3.0	37.679		36.5			38.0	36.4	
3.5	34.495		34.0			34.0	33.9	
4.0	31.882		32.0			31.4	31.6	
4.5	29.707		29.5			29.4	29.6	
5.0	27.849					27.8	27.7	
5.5	26.234						26.2	
6.0	24.861						24.8	
12.0	15.922					16.23		
20.0	11.240					11.38		
29.0	8.6618					8.61		

*These are not the units originally used by this experimenter.

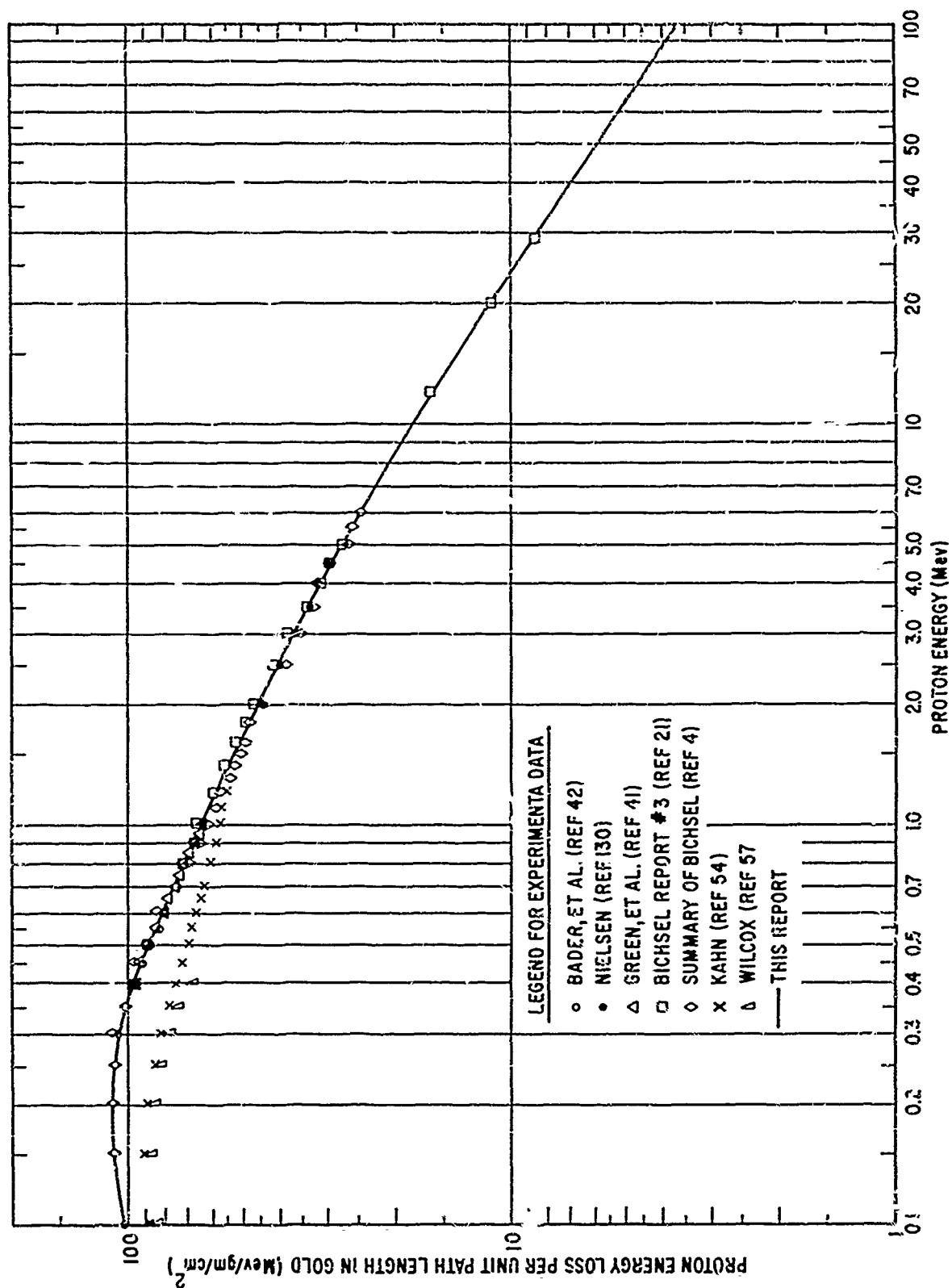


Figure 14. A Comparison of the Experimental and Calculated Energy Loss for Gold

SECTION VI

COMMENTS PERTINENT TO DATA PRESENTATION AND FORMAT

The physical constants which have been used were taken exclusively from the recent recommendations by Cohen and DuMond in reference 120. The system of atomic weights based on carbon 12 have been used throughout, and were obtained from reference 121.

The data have been divided into two groups. The elements are listed alphabetically in the first group, and compounds and mixtures are listed alphabetically under their most common name in the second group.

Pertinent information about each material has been listed at the top of the first page. This includes the adjusted ionization potential, the number of atoms per molecule, the percent by weight of each element in the compound or mixture, the atomic number, the atomic weight, and the density of the material. At the bottom of the last page the electron density, effective ionization potential, the energy at which minimum ionization occurs, and the minimum ionization have been tabulated.

All results have been presented using both density-dependent and independent unit systems. When grams per square centimeter or milligrams per square centimeter have been used as the unit of thickness, the calculations are independent of the density, except for the very small perturbation from the polarization effect term. However, when millimeters, centimeters, or meters were used, the numerical values are directly dependent upon the density which has been selected, and the tabulations are strictly correct only for that density.

When the material was a gas, meters and kilovolts per centimeter were used. In other cases, millimeters have been used on the first page and centimeters were used on all succeeding pages. The units which have been used for a given page have always been clearly listed at the top of each column.

The results have been presented using a fine energy grid to minimize the need for interpolation. Since the low-energy region is of interest to many groups, emphasis has been placed on careful presentation of the data in this area.

The electron density of a material is a useful quantity and has also been calculated. The following relation was used:

$$\text{Electron density} = \frac{\sum_i Z_i N_i r_i}{\sum_i A_i r_i} \quad (\text{electrons/gram}) \quad (60)$$

where the summation extends over all of the atoms within the molecule. The electron density in the above units appears at the bottom of the last page for each material. An E format has been used to represent these results. The E printed immediately after the digits indicates the power to which the factor of ten following the digits must be raised, thus:

$$1.234E 23 = 1.234 \times 10^{23}$$

When the material was a mixture and not a true chemical compound, the percent by weight of each element in the compound has been converted to a ratio which would be equivalent to the number of atoms per molecule had the mixture actually been a compound.

The unit of square centimeters has been consistently printed with the power on the same line as the alphabetical characters, as is indicated below:

$$\text{cm}^2 = \text{cm}2$$

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APPENDIX

This appendix contains the results from a selective survey of energy loss, range, pathlength, and straggling data for protons having energies greater than 100 kilovolts.

This collected experimental data has been compared to the calculations of this report, as well as with the tabulations of references 1 through 9. Extensive comparisons of the energy losses from all of the aforementioned reports have been made. Pathlength comparisons have been made only for emulsion, where proton track lengths may be observed directly. Since only the tables of Williamson and Boujot (Ref. 9) calculate the range, their results have been compared with experimental range data. All of the other reports in references 1 through 9 calculate only the pathlength, which must be corrected for multiple scattering effects in order that a valid comparison be made.

The comparisons of the experimental and calculated ranges also provide a certain amount of verification of the multiple scattering technique which has been used.

Error estimates have been displayed with the data wherever they were explicitly stated or could be readily estimated from the information given by the experimenter.

COMPARISON OF EXPERIMENTAL AND CALCULATED PROTON MASS
STOPPING POWER RELATIVE TO ALUMINUM

Element	19.8 Mev			20.6 Mev			28.7 Mev			34.0 Mev		
	Experi- mental Ref. 30	This report	Percent differ- ence	Experi- mental Ref. 124	This report	Percent differ- ence	Experi- mental Ref. 125	This report	Percent differ- ence	Experi- mental Ref. 28	This report	Percent differ- ence
H	1									2.634	2.614	-0.76
Li	3									1.062	1.056	-0.56
Re	4	1.073	1.090	1.58			1.089	1.079	-0.92	1.024	1.033	0.87
C	6									1.124	1.136	1.06
Al	13	1.000	1.000	0.00	1.000	0.00	1.000	1.000	0.00	1.000	1.000	0.00
Ca	20	1.008	0.9795	-2.82								
Ti	22	0.888	0.8884	0.04			0.8969	0.8939	-0.33			
V	23	0.860	0.8672	0.84			0.8605	0.8722	1.36			
Fe	26	0.856	0.8666	1.24						0.906	0.9046	-0.15
Co	27						0.8501	0.8489	-0.14			
Ni	28	0.863	0.8628	-0.02	0.859	0.8642	0.60	0.8691	0.8724	0.38		
Cm	29	0.821	0.8208		0.836	0.8222	-1.65	0.8233	0.8304	0.86	0.875	0.8682
Zn	30	0.819	0.8190	0.00								
Ag	47	0.715	0.7124	-0.36	0.717	0.7144	-0.36	0.7164	0.7272	1.51	0.789	0.7864
Sn	50	0.680	0.6813	0.19							0.751	0.7560
Ta	73	0.597	0.5844	-2.11	0.607	0.5867	-3.34	0.5981	0.6044	1.05	0.680	0.6786
W	74	0.590	0.5805	-1.61				0.5866	0.6005	2.37		
Pt	78	0.576	0.5682	-1.35	0.590	0.5705	-3.30					
Au	79	0.576	0.5679	-1.41	0.588	0.5702	-3.02	0.5838	0.5866	0.48	0.660	0.6567
Pb	82	0.556	0.5543	-0.30							0.630	0.6301
U												0.02

The error of Ref. 30 is from 0.3 to 2 percent.

The error of Ref. 124 is from 0.5 to 2 percent.

The error of Ref. 125 is from 0.2 to 1 percent.

The error of Ref. 28 is about 5 percent for hydrogen and 1 percent for the other data.

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BROLLEY AND RIBE (Ref. 63)

Material	E(Mev)	Experimental Data	Experimental Accuracy (percent)	This Report	Percent Difference
Hydrogen	4.44	202.0	2.1	204.61	+1.3
Helium	4.45	88.02	2.3	88.634	+0.7
Nitrogen	4.42	75.68	2.3	75.862	+0.2
Oxygen	4.40	71.82	2.1	75.654	-5.3
Neon	4.43	68.34	2.2	67.243	-1.6
Argon	4.43	56.09	2.2	54.855	-2.2
Krypton	4.41	43.84	2.5	43.142	-1.6
Xenon	4.44	36.97	2.1	35.099	-5.1
Air	4.42	74.53	2.2	75.217	-0.9
Methane	4.43	109.2	2.0	109.60	+0.4
Carbon dioxide	4.43	75.68	2.1	74.672	-1.3

THIS COMPARISON IS FOR MANGANESE

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF GREEN, COOPER, AND HARRIS (Ref. 41)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT* PRCT DIFF	HILL, ET AL* PRCT DIFF
.4000	218.0	221.75 1.72	
.4500	206.0	206.86 .417	
.5000	196.0	194.78 -.622	190.60 -2.76
.5500	186.0	185.08 -.495	
.6000	177.0	176.73 -.153	174.36 -1.49
.6500	169.0	168.55 -.266	
.7000	162.0	160.11 -1.17	160.89 -.685
.7500	156.0	152.89 -1.99	
.8000	151.0	151.71 .473	149.50 -.993
.8500	147.0	147.55 .374	
.9000	143.0	143.39 .273	139.75 -2.27
.9500	140.0	139.23 -.550	
1.000	136.0	135.06 -.691	131.26 -3.49

The mean percentage deviation of the tabulated data of this report from the above experimental data is -0.206 percent.

The percent relative standard deviation of the tabulated data of this report from the above experimental data is 0.895 percent.

The experimental error is approximately 2.5 percent.

THIS COMPARISON IS FOR COPPER

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF GREEN, COOPER, AND HARRIS (REF 41)

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*		HILL, ET AL*	
			PRCT DIFF		PRCT DIFF
.4000	179.0	182.31	1.85		
.4500	172.0	174.49	1.45		
.5000	165.0	167.45	1.48	177.41	7.52
.5500	158.0	160.94	1.86		
.6000	152.0	154.86	1.88	164.11	7.97
.6500	147.0	149.45	1.67		
.7000	142.0	144.04	1.44	152.51	7.40
.7500	137.0	139.65	1.93		
.8000	133.0	135.27	1.71	142.46	7.11
.8500	128.0	131.85	3.01		
.9000	125.0	128.44	2.75	133.77	7.02
.9500	122.0	125.02	2.48		
1.000	119.0	121.60	2.18	126.16	6.02

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.98 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 2.03 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 2.5 PERCENT

THIS COMPARISON IS FOR TIN

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF GREEN, COOPER, AND HARRIS (REF 41)

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*		HILL, ET AL*	
			PRCT DIFF		PRCT DIFF
.4000	142.0	145.09	2.18		
.4500	135.0	135.61	.452		
.5000	128.0	127.69	-.242	129.40	1.09
.5500	122.0	121.10	-.738		
.6000	116.0	115.61	-.336	116.33	.284
.6500	111.0	110.98	-.018		
.7000	107.0	106.97	-.028	106.28	-.673
.7500	103.0	103.36	.350		
.8000	100.0	99.919	-.081	98.263	-1.74
.8500	97.00	97.088	.091		
.9000	94.00	94.257	.273	92.129	-1.99
.9500	91.00	91.426	.468		
1.000	89.00	88.591	-.460	87.392	-1.81

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .147 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .696 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 2.5 PERCENT

THIS COMPARISON IS FOR GERMANIUM

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF GREEN, COOPER, AND HARRIS (REF 41)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*	HILL, ET AL*
		PRCT DIFF	PRCT DIFF
.4000	177.0	175.49 -.953	
.4500	168.0	166.76 -.738	
.5000	159.0	159.12 .075	162.75 2.36
.5500	153.0	152.58 -.275	
.6000	147.0	146.05 -.646	151.16 2.83
.6500	142.0	142.30 .211	
.7000	138.0	138.06 .043	141.17 2.30
.7500	133.0	133.89 .669	
.8000	130.0	129.32 -.523	132.38 1.83
.8500	126.0	124.41 -1.26	
.9000	123.0	119.51 -2.84	124.64 1.33
.9500	119.0	114.60 -3.70	
1.000	116.0	109.69 -5.44	117.82 1.57

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -1.17 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 2.07 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 2.5 PERCENT

THIS COMPARISON IS FOR SELENIUM

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF GREEN, COOPER, AND HARRIS (REF 41)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*	HILL, ET AL*
		PRCT DIFF	PRCT DIFF
.4000	168.0	168.14 .083	
.4500	160.0	159.83 -.106	
.5000	154.0	153.11 -.578	147.30 -4.35
.5500	148.0	147.61 -.264	
.6000	143.0	142.70 -.210	137.91 -3.56
.6500	138.0	138.76 .551	
.7000	134.0	134.66 .493	129.67 -3.23
.7500	130.0	130.29 .223	
.8000	126.0	125.27 -.579	122.36 -2.89
.8500	122.0	120.80 -.984	
.9000	120.0	116.33 -3.06	115.75 -3.54
.9500	117.0	111.85 -4.40	
1.000	115.0	107.37 -6.63	109.83 -4.50

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -1.19 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 2.40 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 4.0 PERCENT

THIS COMPARISON IS FOR SILVER

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF GREEN, COOPER, AND HARRIS (REF 41)

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*	HILL, ET AL*
		PRCT DIFF	PRCT DIFF
.4000	150.0	150.62 .413	
.4500	142.0	142.09 .063	
.5000	135.0	134.57 -.319	128.05 -5.15
.5500	128.0	127.81 -.148	
.6000	121.0	121.29 .240	115.92 -4.20
.6500	116.0	115.97 -.026	
.7000	111.0	110.90 -.090	106.53 -4.03
.7500	107.0	106.57 -.402	
.8000	103.0	103.26 .252	99.929 -2.98
.8500	101.0	100.60 -.396	
.9000	98.00	97.942 -.059	94.536 -3.53
.9500	96.00	95.283 -.747	
1.000	94.00	92.620 -1.47	89.902 -4.36

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -.207 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .516 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 2.5 PERCENT

THIS COMPARISON IS FOR ANTIMONY

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF GREEN, COOPER, AND HARRIS (REF 41)

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*	HILL, ET AL*
		PRCT DIFF	PRCT DIFF
.4000	146.0	146.54 .370	
.4500	138.0	138.57 .413	
.5000	132.0	131.42 -.439	123.18 -6.68
.5500	125.0	124.86 -.113	
.6000	119.0	118.77 -.193	110.96 -6.76
.6500	113.0	113.17 .150	
.7000	108.0	108.16 .148	101.86 -5.69
.7500	104.0	103.97 -.029	
.8000	101.0	100.95 -.050	94.627 -6.31
.8500	98.00	97.092 -.927	
.9000	96.00	93.234 -2.88	88.589 -7.72
.9500	93.00	89.376 -3.90	
1.000	91.00	85.514 -6.03	83.956 -7.74

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -1.04 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 2.17 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 2.5 PERCENT

THIS COMPARISON IS FOR GCLD

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF GREEN, COOPER, AND HARRIS (REF 41)

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*	HILL, ET AL*
		PRCT DIFF	PRCT DIFF
.4000	96.00	98.012 2.10	
.4500	92.00	92.637 .692	
.5000	88.00	86.077 .088	90.926 3.32
.5500	84.00	84.229 .273	
.6000	80.00	80.391 1.11	65.129 6.41
.6500	78.00	77.942 -.074	
.7000	75.00	74.994 -.008	79.976 6.63
.7500	73.00	72.498 -.688	
.8000	71.00	70.003 -1.40	75.985 7.02
.8500	69.00	68.403 -.865	
.9000	67.00	66.803 -.294	71.871 7.27
.9500	65.00	65.202 .311	
1.000	64.00	63.601 -.623	68.348 6.79

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .047 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .876 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 2.5 PERCENT

THIS COMPARISON IS FOR LEAD

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF GREEN, COOPER, AND HARRIS (REF 41)

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*	HILL, ET AL*
		PRCT DIFF	PRCT DIFF
.4000	100.0	99.802 -.198	
.4500	95.00	94.678 -.339	
.5000	90.00	90.308 .342	86.467 -3.93
.5500	86.00	86.326 .379	
.6000	82.00	82.632 .771	80.110 -2.30
.6500	79.00	79.850 1.08	
.7000	75.00	77.074 2.77	75.076 .101
.7500	73.00	74.032 1.41	
.8000	70.00	70.991 1.42	71.496 2.14
.8500	68.00	69.015 1.49	
.9000	67.00	67.040 .060	67.596 .890
.9500	65.00	65.103 .158	
1.000	64.00	63.087 -1.43	64.369 .577

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .608 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.18 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 2.5 PERCENT

THIS COMPARISON IS FOR BISMUTH

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF GREEN, COOPER, AND HARRIS (REF 41)

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*	HILL, ET AL*
		PRCT DIFF	PRCT DIFF
.4000	104.0	100.06 -3.79	
.4500	99.00	94.927 -4.11	
.5000	94.00	90.545 -3.68	85.967 -8.55
.5500	90.00	86.554 -3.83	
.6000	86.00	82.849 -3.66	79.617 -7.42
.6500	82.00	80.060 -2.37	
.7000	79.00	77.276 -2.18	74.528 -5.66
.7500	75.00	74.226 -1.03	
.8000	73.00	71.177 -2.50	70.994 -2.75
.8500	70.00	69.176 -1.18	
.9000	69.00	67.176 -2.64	67.044 -2.83
.9500	67.00	65.171 -2.73	
1.000	66.00	65.165 -4.30	63.821 -3.30

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -2.92 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 3.10 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 2.5 PERCENT

THIS COMPARISON IS FOR NEON

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF CHILTON, COOPER, AND HARRIS (REF 64)

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*
		PRCT DIFF
.4220	310.0	311.70 .548
.4240	290.0	310.56 7.09
.5170	280.0	279.03 -.346
.5190	269.0	278.44 3.51
.6380	256.0	238.72 1.15
.7300	217.0	227.24 4.72
.7330	217.0	226.67 4.46
.9290	186.0	199.40 7.20
.9300	191.0	199.28 4.34
.9380	175.0	192.60 10.1
.9920	188.0	192.26 2.27

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 4.09 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 5.08 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.5 PERCENT

THIS COMPARISON IS FOR NITROGEN

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF CHILTON, COOPER AND HARRIS(REF 64)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*	PRCT DIFF
.4080	400.0	394.65	-1.838
.4100	401.0	393.42	-1.39
.4540	371.0	376.43	1.46
.5020	362.0	378.88	4.66
.5030	351.0	343.92	-2.02
.5420	328.0	343.50	4.73
.6480	296.0	293.20	-.946
.7160	275.0	274.12	-.320
.7170	264.0	273.64	3.65
.7500	257.0	265.97	3.49
.8140	228.0	235.95	3.49
.9420	217.0	231.86	6.85
.9730	207.0	227.15	9.73
.9740	228.0	226.68	-.579
1.001	209.0	222.58	6.50

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 2.56 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 4.29 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 4.0 PERCENT

THIS COMPARISON IS FOR XENON

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF CHILTON, COOPER AND HARRIS(REF 64)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*	PRCT DIFF
.4370	121.0	136.38	12.7
.4410	121.0	135.73	12.2
.5360	111.0	122.68	10.5
.5380	115.0	121.91	6.01
.6790	93.00	106.04	14.0
.7480	87.00	102.01	17.3
.7500	93.00	101.61	9.26
.9430	78.00	85.668	9.83
.9690	77.00	83.426	8.35

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 11.1 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 11.6 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.5 PERCENT

THIS EXPERIMENTAL DATA DISAGREES STRONGLY WITH THAT OF REFS 4 AND 56

THIS COMPARISON IS FOR NICKEL

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF CHILTON, COOPER AND HARRIS(REF 64)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*	PRCT DIFF
.5270	172.0	176.68	2.72
.7040	149.0	151.54	1.70
.7100	150.0	149.35	-.433
.7390	143.0	146.56	2.49
.7410	142.0	146.32	3.04
.7550	145.0	145.04	.028
.7570	146.0	144.86	-.781
.9150	128.0	134.04	4.72
.9350	126.0	132.81	5.40
.9410	134.0	132.44	-1.16
.9490	126.0	131.95	3.09
.9510	132.0	131.82	-.136
.9770	129.0	130.22	.946
1.000	127.0	128.79	1.41
1.007	122.0	128.28	5.15
1.046	120.0	125.49	4.57
1.047	122.0	125.42	2.80
1.057	121.0	125.21	3.48

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 2.17 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 2.97 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR COPPER

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF CHILTON, COOPER AND HARRIS(REF 64)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*	PRCT DIFF
.4460	169.0	179.12	3.62
.5320	158.0	163.28	3.34
.6030	150.0	154.54	3.03
.7130	140.0	142.90	2.07
.7530	137.0	139.21	1.61
.8120	132.0	134.45	1.86
.9490	120.0	125.09	4.24
.9960	115.0	121.88	5.98
1.006	112.0	121.16	8.20
1.050	113.0	118.26	4.65

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 3.86 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 4.32 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 2.0 PERCENT

THIS COMPARISON IS FOR ARGON

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF CHILTON, COOPER AND HARRIS (REF 64)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*	PRCT DIFF
.4210	225.0	243.56	8.25
.4760	224.0	226.69	1.20
.5190	215.0	215.39	.181
.5670	207.0	205.39	-.778
.6620	176.0	190.06	7.99
.7130	187.0	182.32	-2.50
.7780	176.0	173.85	-1.22
.9290	154.0	155.36	.883
.9320	155.0	154.99	-.006
.9710	154.0	150.27	-2.42
.9890	149.0	148.09	-.611

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .997 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 3.68 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.5 PERCENT

THIS COMPARISON IS FOR KRYPTON

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF CHILTON, COOPER AND HARRIS (REF 64)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*	PRCT DIFF
.4200	163.0	155.09	-4.85
.5160	150.0	141.14	-5.91
.5270	154.0	139.84	-9.19
.6650	130.0	126.08	-3.02
.6750	129.0	122.95	-4.69
.7330	124.0	120.66	-2.69
.7430	122.0	119.97	-1.66
.9290	107.0	107.90	.841
.9410	107.0	107.54	.505
.9890	103.0	104.66	1.61

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -2.91 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 4.33 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 4.0 PERCENT

THIS COMPARISON IS FOR HYDROGEN

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF REYNOLDS, ET AL (REF 56)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT		HILL, ET AL	
			PRCT DIFF		PRCT DIFF
.1000	3484.	3480.7	-.095		
.1500	2808.	2807.7	-.011		
.2000	2330.	2330.8	.034		
.2500	1989.	1990.8	.090		
.3000	1729.	1743.1	.816		
.3500	1554.	1555.7	.109		
.4000	1404.	1407.2	.228		
.4500	1279.	1284.1	.399		
.5000	1177.	1179.7	.229	1180.1	.263
.5500	1087.	1091.2	.386		
.6000	1016.	1017.7	.167	1027.0	1.08

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .214 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .321 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 4.0 PERCENT

THIS COMPARISON IS FOR HELIUM

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF REYNOLDS, ET AL (REF 56)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT		HILL, ET AL	
			PRCT DIFF		PRCT DIFF
.1000	1098.	1096.1	-.173		
.1500	958.4	954.64	-.392		
.2000	835.1	832.61	-.298		
.2500	738.8	736.13	-.361		
.3000	663.5	661.65	-.279		
.3500	603.4	602.87	-.088		
.4000	555.2	554.41	-.142		
.4500	514.6	513.14	-.284		
.5000	478.4	477.81	-.123	468.95	-1.98
.5500	449.9	447.86	-.453		
.6000	422.8	422.19	-.144	412.74	-2.38

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -.249 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .275 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 4.0 PERCENT

THIS COMPARISON IS FOR CARBON

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF REYNOLDS, ET AL (REF 56)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*	HILL, ET AL*
		PRCT DIFF	PRCT DIFF
.1000	814.9	822.92 .984	
.1500	732.1	720.41 -1.60	
.2000	636.9	635.71 -.187	
.2500	565.6	566.14 .095	
.3000	511.5	509.25 -.440	
.3500	466.4	462.81 -.770	
.4000	428.2	424.35 -.782	
.4500	398.2	393.63 -1.15	
.5000	370.1	367.65 -.662	357.62 -3.37
.5500	348.5	345.65 -.818	
.6000	328.5	326.61 -.575	317.99 -3.20

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -.536 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .838 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 4.0 PERCENT

THIS COMPARISON IS FOR OXYGEN

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF REYNOLDS, ET AL (REF 56)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*	HILL, ET AL*
		PRCT DIFF	PRCT DIFF
.1000	646.4	669.76 3.61	
.1500	607.2	600.68 -1.07	
.2000	553.4	543.55 -1.78	
.2500	500.0	494.09 -1.18	
.3000	451.4	450.79 -.135	
.3500	414.4	413.32 -.261	
.4000	385.0	381.69 -.860	
.4500	355.8	355.72 -.022	
.5000	332.8	334.66 .559	322.73 -3.03
.5500	315.4	317.17 .561	
.6000	297.8	301.66 1.30	289.34 -2.84

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .065 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.41 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 4.0 PERCENT

THIS COMPARISON IS FOR NITROGEN

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF REYNOLDS, ET AL (REF 55)

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*	HILL, ET AL*
		PRCT DIFF	PRCT DIFF
.1000	769.6	774.81 .677	
.1500	692.2	693.26 .153	
.2000	610.4	606.52 -.636	
.2500	537.4	534.63 -.515	
.3000	481.6	478.65 -.613	
.3500	435.6	436.92 .303	
.4000	401.6	401.55 -.012	
.4500	370.6	370.91 .084	
.5000	347.8	344.76 -.874	340.04 -2.23
.5500	327.2	323.68 -1.08	
.6000	310.0	307.28 -.877	303.44 -2.12

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -.308 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .626 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 4.0 PERCENT

THIS COMPARISON IS FOR NEON

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF REYNOLDS, ET AL (REF 56)

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*	HILL, ET AL*
		PRCT DIFF	PRCT DIFF
.1000	435.7	435.87 .039	
.1500	435.7	438.74 .698	
.2000	420.8	417.72 -.732	
.2500	393.9	393.99 .023	
.3000	368.2	365.68 -.684	
.3500	343.2	341.18 -.589	
.4000	320.8	319.66 -.355	
.4500	302.9	300.71 -.723	
.5000	285.9	284.03 -.654	285.92 .007
.5500	271.3	269.32 -.730	
.6000	258.1	256.16 -.752	258.96 .333

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -.405 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .604 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 4.0 PERCENT

THIS COMPARISON IS FOR ARGON

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF REYNOLDS, ET AL (REF 56)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT* PRCT DIFF	HILL, ET AL* PRCT DIFF
.1000	491.6	487.80 +.773	
.1500	425.2	427.01 .426	
.2000	369.4	373.13 1.01	
.2500	325.7	328.22 .774	
.3000	290.4	294.13 1.28	
.3500	269.9	269.35 -.204	
.4000	250.3	250.37 .028	
.4500	234.5	234.16 -.145	
.5000	221.7	219.80 -.857	214.41 -3.29
.5500	209.6	208.20 -.668	
.6000	200.5	199.94 -.278	192.41 -4.03

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .054 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .699 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 4.0 PERCENT

THIS COMPARISON IS FOR KRYPTON

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF REYNOLDS, ET AL (REF 56)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT* PRCT DIFF	HILL, ET AL* PRCT DIFF
.1000	289.6	284.78 -1.66	
.1500	254.7	247.87 -2.68	
.2000	223.3	220.01 -1.47	
.2500	199.4	198.68 -.361	
.3000	182.6	182.07 -.290	
.3500	169.5	168.96 -.319	
.4000	160.0	158.48 -.950	
.4500	152.0	150.00 -1.32	
.5000	144.8	143.02 -1.23	140.32 -3.09
.5500	138.9	137.14 -1.27	
.6000	133.8	131.99 -1.35	130.96 -2.12

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -1.17 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.35 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 4.0 PERCENT

THIS COMPARISON IS FOR XENON

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF REYNOLDS, ET AL (REF 56)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT* PRCT DIFF	HILL, ET AL* PRCT DIFF
.1000	232.6	229.89 -1.17	
.1500	207.8	207.56 -.115	
.2000	192.2	190.99 -.630	
.2500	177.4	176.50 -.507	
.3000	164.6	163.39 -.735	
.3500	153.5	151.92 -1.03	
.4000	144.4	142.31 -1.45	
.4500	136.9	134.29 -1.91	
.5000	131.5	127.31 -3.19	117.89 -10.3
.5500	125.9	120.88 -3.99	
.6000	121.4	114.89 -5.36	106.66 -12.1

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -1.82 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 2.42 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 4.0 PERCENT

THIS COMPARISON IS FOR LITHIUM

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BADER, ET AL (REF 42)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT* PRCT DIFF	HILL, ET AL* PRCT DIFF	*WILLIAMSON* PRCT DIFF
.1000	754.9	751.84 -.405		
.1500	669.9	675.80 .881		
.2000	598.7	606.44 1.29		
.2500	546.7	546.29 -.075		
.3000	498.9	495.71 -.639		
.3500	458.2	453.72 -.978		
.4000	423.5	418.70 -1.13		
.4500	390.5	389.01 -.382		
.5000	360.1	363.27 .880	366.58 1.80	341.79 -5.08
.5500	338.4	340.59 .647		
.6000	316.7	320.54 1.21	327.09 3.28	302.20 -4.58
.7000	285.5	288.06 .897	296.13 3.72	272.43 -4.58
.8000	262.9	261.99 -.346	271.05 3.10	249.00 -5.29
.9000	242.1	253.44 4.68	250.18 3.34	229.94 -5.02
1.000	227.3	244.87 7.73	232.11 2.12	214.05 -5.83
1.200	208.2	214.46 3.01		188.85 -9.29
1.400	195.2	191.27 -2.01		169.62 -13.1

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .898 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 2.47 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR BERYLLIUM
 THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BADER, ET AL (REF 42)

EC(MEV)	EXPERIMENTAL DATA	THIS REPORT* PRCT DIFF	BARKAS, ET AL PRCT DIFF	**BICHSEL** PRCT DIFF	HILL, ET AL* PRCT DIFF	WILLIAMSON* PRCT DIFF
.1000	698.3	699.89 .228				
.1500	654.8	630.27 -3.75				
.2000	583.3	565.05 -3.13				
.2500	516.5	508.27 -1.59				
.3000	469.7	461.13 -1.82				
.3500	430.3	422.99 -1.70				
.4000	399.6	392.19 -1.85				
.4500	372.8	366.75 -1.62				
.5000	350.8	325.09 -7.33				
.5500	331.4	344.82 4.05				
.6000	317.4	306.87 -3.32				
.7000	289.3	275.56 -4.75				
.8000	267.3	255.05 -4.58				
.9000	247.2	237.68 -3.85				
1.000	229.2	220.28 -3.89				
1.200	201.8	194.53 -3.60				
1.400	180.4	174.56 -3.24				
1.600	164.4	156.60 -3.53				
1.800	151.7	145.54 -4.06				
2.000	138.9	134.63 -3.07				
2.300	128.3	121.26 -5.49				
2.600	123.6	110.50 -10.6				
			138.82 -.058	134.00 -3.53	134.22 -3.37	
						348.00 5.01
						305.81 -3.65
						273.83 -5.35
						248.78 -6.93
						226.58 -7.53
						211.92 -7.54
						185.93 -7.86
						166.43 -7.74
						151.16 -8.05
						138.80 -8.50
						128.55 -7.45
						116.04 -9.56
						105.99 -14.2

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
 OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -3.30 PERCENT
 THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
 OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 4.25 PERCENT
 THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR FLUORINE

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BADER, ET AL (REF 42)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*	PRCT DIFF	*WILLIAMSON*	PRCT DIFF
.3000	386.7	395.92	2.38		
.3500	361.4	363.29	.523		
.4000	339.1	336.41	-.793		
.4500	313.8	314.49	.220		
.5000	294.7	296.75	.696	304.69	3.39
.5500	278.9	282.41	1.26		
.6000	272.6	270.62	-.704	274.72	.778

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .512 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.15 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR ALUMINUM

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BADER, ET AL (REF 42)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*	PRCT DIFF	HILL, ET AL*	PRCT DIFF	*WILLIAMSON*	PRCT DIFF
.2000	390.6	344.46	-11.8				
.3000	328.1	305.58	-6.86				
.4000	279.0	276.04	-1.06				
.5000	256.7	251.99	-1.83	255.92	-.304	258.87	.845
.6000	241.1	229.99	-4.61	233.22	-3.27	236.89	-1.75

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -5.24 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 6.52 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR CALCIUM

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BADER, ET AL (REF 42)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*	HILL, ET AL*
		PRCT DIFF	PRCT DIFF
.2000	389.1	392.01 .748	
.3000	320.0	320.34 .106	
.4000	264.5	265.61 .420	
.5000	229.9	232.60 1.17	229.35 -.239
.6000	214.8	213.40 -.652	206.71 -3.77

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .359 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .714 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR VANADIUM

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BADER, ET AL (REF 42)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*	HILL, ET AL*
		PRCT DIFF	PRCT DIFF
.2000	353.4	354.49 .308	
.3000	299.0	298.33 -.224	
.4000	252.9	254.19 .510	
.5000	218.6	220.57 .901	196.57 -10.1
.6000	196.2	195.97 -.117	178.79 -8.87

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .276 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .496 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR CHROMIUM

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BADER, ET AL (REF 42)

E (MEV)	EXPERIMENTAL DATA	THIS REPORT* PRCT DIFF	HILL, ET AL* PRCT DIFF
.2000	338.1	337.99 -.033	
.3000	288.3	287.65 -.225	
.4000	247.8	248.17 .149	
.5000	213.0	218.01 2.35	198.44 -6.84
.6000	198.0	195.63 -1.20	180.87 -8.65

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .209 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.19 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR IRON

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BADER, ET AL (REF 42)

E (MEV)	EXPERIMENTAL DATA	THIS REPORT* PRCT DIFF	HILL, ET AL* PRCT DIFF
.2000	295.5	295.35 -.051	
.3000	263.1	263.65 .209	
.4000	227.5	227.15 -.154	
.5000	195.1	197.26 1.11	192.21 -1.48
.6000	181.1	179.80 -.718	176.18 -2.72

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .079 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .602 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR COBALT

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BADER, ET AL (REF 42)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*	PRCT DIFF	HILL, ET AL*	PRCT DIFF
.2000	262.6	264.16	.594		
.3000	231.9	232.36	.198		
.4000	201.3	200.93	-.184		
.5000	175.7	177.74	1.16	185.23	5.42
.6000	170.0	170.09	.053	170.30	.176

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .365 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .596 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR NICKEL

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BADER, ET AL (REF 42)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*	PRCT DIFF	HILL, ET AL*	PRCT DIFF
.2000	249.2	251.26	.827		
.3000	235.9	234.47	-.606		
.4000	205.1	206.16	.517		
.5000	180.5	181.60	.609	189.09	4.76
.6000	171.3	164.93	-3.72	174.37	1.79

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -.474 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.76 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR COPPER

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BADER, ET AL (REF 42)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*		HILL, ET AL*		*WILLIAMSON*	
		PRCT DIFF		PRCT DIFF		PRCT DIFF	
.1000	227.5	225.66	-.809				
.1500	227.5	227.21	-.127				
.2000	217.0	221.45	2.05				
.2500	205.7	211.34	2.74				
.3000	199.0	200.95	.980				
.3500	191.5	191.12	-.198				
.4000	181.8	182.31	.281				
.4500	178.2	174.49	-2.08				
.5000	171.6	167.45	-2.42	177.41	3.39	139.37	-18.8
.5500	165.0	160.94	-2.93				
.6000	160.1	154.86	-3.27	164.11	2.50	136.17	-14.9

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -.526 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.98 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR ZINC

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BADER, ET AL (REF 42)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*		HILL, ET AL*	
		PRCT DIFF		PRCT DIFF	
.2000	223.8	218.84	-2.22		
.3000	211.8	194.08	-8.37		
.4000	187.9	175.37	-6.67		
.5000	171.3	160.34	-6.40	174.03	1.59
.6000	162.1	146.93	-9.36	161.51	-.364

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -6.60 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 7.04 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR GOLD

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BADER, ET AL (REF 42)

E(MEV)	EXPERIMENTAL DATA	HILL, ET AL* PRCT DIFF	*WILLIAMSON* PRCT DIFF
.1000	105.5	104.91 -.559	
.1500	115.8	116.33 .458	
.2000	118.9	118.68 -.185	
.2500	115.8	115.79 -.009	
.3000	110.7	110.35 -.316	
.3500	103.9	104.08 .173	
.4000	97.22	98.012 .815	
.4500	91.71	92.637 1.01	
.5000	86.82	88.077 1.45	38.605 -55.5
.5500	83.42	84.229 .921	
.6000	80.40	80.891 .611	40.461 -49.7

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .397 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .719 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR LEAD

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BADER, ET AL (REF 42)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT* PRCT DIFF	HILL, ET AL* PRCT DIFF	*WILLIAMSON* PRCT DIFF
.1000	120.9	121.90 .827		
.1500	127.0	127.51 .402		
.2000	126.7	126.11 -.466		
.2500	121.2	120.48 -.594		
.3000	113.3	113.18 -.106		
.3500	106.1	106.01 -.085		
.4000	99.98	99.802 -.178		
.4500	93.88	94.678 .850		
.5000	88.94	90.308 1.54	86.467 -2.78	36.363 -59.1
.5500	84.86	86.326 1.73		
.6000	81.38	79.850 -1.88	80.110 -1.56	36.157 -55.1

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .185 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.00 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR HYDROGEN
THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*		**BARKAS**		*RICH,HADEY*		HILL, ET AL*		*WILLIAMSON*	
		PRCT	DIFF	PRCT	DIFF	PRCT	DIFF	PRCT	DIFF	PRCT	DIFF
.1000	3480.7	.020									
.1500	2807.7	-.082									
.2000	2330.8	.034									
.2500	1990.8	.040									
.3000	1743.1	.178									
.3500	1555.7	-.276									
.4000	1407.2	-.199									
.4500	1284.1	.320						1180.1	.008	1156.1	-.2.03
.5000	1179.7	-.025									
.5500	1091.2	.110									
.6000	1017.7	-.225						1027.0	.686	1015.0	-.490
.7000	910.67	.074						911.90	.209	906.61	-.373
.8000	814.0	-.011						821.92	.973	820.64	.616
.9000	736.0	1.75				690.76	2.17	749.42	1.82	750.65	1.99
1.000	676.0	1.15						689.65	2.02	692.48	2.44
1.100	628.0	.975								643.32	2.44
1.200	585.0	1.15								601.17	2.76
1.500	548.0	1.30								564.61	3.03
1.500	515.0	1.57								532.56	3.41
1.500	495.6	-.024								504.22	1.86
1.600	470.0	-.045								478.98	1.91
1.800	425.0	.475								435.88	2.56
2.000	393.0	-.249								400.41	1.89
2.500	328.0	-.418								334.02	1.84
3.000	282.0	-.323				283.40	.496	283.07	.379	287.64	2.00
3.500	248.0	-.230								253.28	2.13
4.000	222.0	-.252								226.73	2.13
4.500	201.0	-.129								205.55	2.26
5.000	183.82	-.098								188.23	2.30
5.500	169.72	-.165								173.79	2.23
6.000	157.77	-.146								161.56	2.25
						385.77	-1.84			394.96	.499
										220.39	-.725
										185.20	.652
										158.37	.234
										159.00	.633
										158.77	.487

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .202 PERCENT
THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .620 PERCENT
THE EXPERIMENTAL ERROR IS APPROXIMATELY 1.0 TO 10. PERCENT

THIS COMPARISON IS FOR LITHIUM

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICKSELS SUMMARY IN REFERENCE 4

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*		HILL, ET AL*		WILLIAMSON*		ARON, ET AL*	
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF		
.1000	752.0	751.84	-0.021	366.58	.986	341.79	-5.84		
.1500	675.0	675.80	.119	327.09	1.90	302.20	-5.86		
.2000	608.0	608.44	-.257	296.13	2.82	272.43	-5.91		
.2500	545.0	546.29	.237	271.05	3.45	249.00	-4.96		
.3000	496.0	495.71	-.058	250.18	2.95	229.94	-5.37	258.71	12.5
.3500	454.0	453.72	-.062	232.11	.917	214.05	-6.93		
.4000	418.0	418.70	.167			200.53	-8.85		
.4500	390.0	389.01	-.254			188.7	-10.9		
.5000	363.0	363.27	.074			178.54	-12.4		
.5500	340.0	340.59	.174			169.62	-13.0		
.6000	321.0	320.54	-.143			161.57	-14.1		
.7000	288.0	288.06	.021			154.34	-16.1		
.8000	262.0	261.99	-.004			141.86	-18.0		
.9000	243.0	253.44	4.30			131.45	-19.8		
1.000	230.0	244.87	6.47			111.54	-24.6	151.18	-7.82
1.100	220.0	228.56	3.89						
1.200	212.0	214.46	1.16						
1.300	204.0	202.14	-.912						
1.400	195.0	191.27	-1.91						
1.500	188.0	181.61	-3.40						
1.600	184.0	172.96	-6.00						
1.800	173.0	158.11	-8.61						
2.000	164.0	145.00	-11.1						
2.500	148.0	122.54	-17.2						

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -1.39 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 5.09 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 1.0 TO 10. PERCENT

THIS COMPARISON IS FOR BERYLLIUM

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*		BARKAS, ET AL		**BICHSEL***		*RICH, MADEY*		HILL, ET AL*		STERNHEIMER*	
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF
.1000	760.0	699.89	-0.16										
.1500	640.0	630.27	-1.52										
.2000	565.0	565.05	.009										
.2500	505.0	508.27	.640										
.3000	460.0	461.13	.246										
.3500	425.0	422.99	-.473										
.4000	390.0	392.19	.562										
.4500	367.0	366.75	-.068										
.5000	345.0	344.92	-.052							342.59	-.699		
.5500	327.0	325.09	-.584										
.6000	305.0	306.87	.613							305.80	.262		
.7000	276.0	275.56	-.159							277.18	.428		
.8000	255.0	255.05	.020							254.46	-.212		
.9000	236.0	237.68	.712							235.45	-.233		
1.000	220.0	220.28	.127					247.00	12.3	219.29	-.323		
1.100	209.0	206.53	-1.18										
1.200	198.0	194.53	-1.75										
1.300	187.0	183.95	-1.63										
1.400	179.0	174.56	-2.48										
1.500	170.0	166.16	-2.26										
1.600	161.0	158.60	-1.49										
1.800	148.0	145.54	-1.66										
2.000	137.0	134.63	-1.73	134.00	-2.19	145.90	6.50	134.22	-2.03	131.90	-3.72	128.55	-6.17
2.500	116.0	113.84	-1.86			113.20	-2.41						
3.000	101.0	99.024	-1.96			98.420	-2.55	106.00	4.95	98.909	-2.07	97.450	-3.51
3.500	90.00	87.879	-2.36			87.300	-3.00						
4.000	81.00	79.167	-2.26	81.412	.509	78.630	-2.93	84.270	4.04	79.223	-2.19	78.060	-3.63
4.500	73.00	72.154	-1.16			71.660	-1.84						
5.000	67.00	66.376	-.931			65.910	-1.63	70.380	5.04	66.462	-.803	65.590	-2.10
5.500	62.00	61.527	-.763	58.079	.136	61.100	-1.45	57.490	-.879	56.690	-2.26	56.000	-3.45
6.000	58.00	57.394	-1.04			60.690	4.64						

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -.854 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.31 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 1.0 TO 10. PERCENT

THIS COMPARISON IS FOR BERYLLIUM
THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E (MEV)	EXPERIMENTAL DATA	WILLIAMSON*		ARON**		ARON, ET AL*	
		PRCT	DIFF	PRCT	DIFF	PRCT	DIFF
.1000	700.0						
.1500	640.0						
.2000	565.0						
.2500	505.0						
.3000	460.0						
.3500	425.0						
.4000	390.0						
.4500	367.0						
.5000	345.0	348.00	.875				
.5500	327.0						
.6000	305.0	305.81	.266				
.7000	276.0	273.83	-.786				
.8000	255.0	246.78	-2.44				
.9000	236.0	228.58	-3.14				
1.000	220.0	211.92	-3.67	231.05	5.02	246.97	12.3
1.100	209.0	197.91	-5.31				
1.200	198.0	185.93	-6.10				
1.300	187.0	175.54	-6.13				
1.400	179.0	166.43	-7.02				
1.500	170.0	158.36	-6.85				
1.600	161.0	151.16	-6.11				
1.800	148.0	138.80	-6.22				
2.000	137.0	137.89	.650	145.87	6.47		
2.500	116.0	109.12	-5.93			106.05	5.00
3.000	101.0	95.271	-5.67				
3.500	90.00	84.831	-5.74	80.267	-.905	84.267	4.03
4.000	81.00	76.640	-5.38				
4.500	73.00	70.021	-4.08			70.377	5.04
5.000	67.00	64.548	-3.66				
5.500	62.00	59.539	-3.32				
6.000	58.00	58.011	.019	60.687	4.63		

THIS COMPARISON IS FOR CARBON

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHEL'S SUMMARY IN REFERENCE 4

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*		BARKAS ET AL		*RICH, MADEY*		HILL, ET AL*		*WILLIAMSON*		***ARGON***			
		PRCT	DIFF	PRCT	DIFF	PRCT	DIFF	PRCT	DIFF	PRCT	DIFF	PRCT	DIFF		
.1000	823.0	822.92	-.010												
.1500	720.0	720.41	.057												
.2000	636.0	635.71	-.046												
.2500	567.0	566.14	-.152												
.3000	508.0	509.25	.246												
.3500	443.0	462.81	-.041												
.4000	426.0	424.85	-.270												
.4500	392.0	393.63	.416					357.62	-2.82	379.14	3.03				
.5000	368.0	367.65	-.095												
.5500	346.0	345.65	-.101												
.6000	327.0	326.61	-.119					317.99	-2.76	337.11	3.09				
.7000	294.0	294.48	.163					287.96	-2.05	303.90	3.37				
.8000	268.0	267.87	-.049					263.91	-1.53	276.98	3.35				
.9000	246.0	249.38	1.37				241.80	5.13	243.93	-.841	254.71	3.54			
1.000	230.0	230.88	.383					227.34	-1.16	235.98	2.60			236.29	2.73
1.100	216.0	216.26	.120							220.03	1.87				
1.200	204.0	203.65	-.172							206.28	1.12				
1.300	192.0	192.64	.333							194.31	1.20				
1.400	183.0	182.92	-.044							183.80	.437				
1.500	175.0	174.26	-.423							174.49	-.291				
1.600	167.0	166.48	-.311							166.18	-.491				
1.800	154.0	153.08	-.597							151.99	-1.31				
2.000	143.0	141.89	-.776							140.31	-1.88				
2.500	121.0	120.53	-.388							118.39	-2.16				
3.000	106.0	105.22	-.736							103.02	-2.81				
3.500	94.00	93.658	-.364							91.564	-2.59				
4.000	85.00	84.577	-.498							82.648	-2.77				
4.500	77.00	77.109	.142							75.482	-1.97				
5.000	71.00	71.081	.114							69.581	-2.00				
5.500	66.00	66.001	.002							64.624	-2.08				
6.000	62.00	61.656	-.555							60.395	-2.59				
				146.06	2.14	149.70	4.69	140.15	-1.99			146.94	2.76		
						109.80	3.58	104.10	-1.79						
				86.414	1.66	87.580	3.04	83.704	-1.52						
						73.400	3.38	70.459	-.762						
				61.760	-.387	63.450	2.34	61.110	-1.44						

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -.077 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .411 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 1.0 TO 10. PERCENT

THIS COMPARISON IS FOR CARBON
 THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E(MEV)	EXPERIMENTAL DATA	*ARON, ET AL*	STERNHEIMER*
		PRCT DIFF	PRCT DIFF
.1000	823.0		
.1500	720.0		
.2000	636.0		
.2500	567.0		
.3000	508.0		
.3500	463.0		
.4000	426.0		
.4500	392.0		
.5000	368.0		
.5500	346.0		
.6000	327.0		
.7000	294.0		
.8000	268.0		
.9000	246.0		
1.000	230.0	241.76	5.11
1.100	216.0		
1.200	204.0		
1.300	192.0		
1.400	183.0		
1.500	175.0		
1.600	167.0		
1.800	154.0		
2.000	143.0	149.68	4.67
2.500	121.0	109.76	3.55
3.000	106.0		
3.500	94.00	87.583	3.04
4.000	83.00	73.396	3.37
4.500	77.00		
5.000	71.00	63.452	2.34
5.500	66.00		
6.000	62.00		
			140.60 -1.68
			104.40 -1.51
			83.970 -1.21
			70.740 -.366
			61.290 -1.15

THIS COMPARISON IS FOR NITROGEN
 THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*	HILL, ET AL*		*WILLIAMSON*	
			PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF
.1000	775.0	774.81	.025			
.1500	692.0	693.26	.182			
.2000	610.0	606.52	.570			
.2500	530.0	534.63	.674			
.3000	482.0	478.65	.695			
.3500	438.0	436.92	.247			
.4000	400.0	401.55	.387			
.4500	371.0	370.91	.024			
.5000	345.0	344.76	.070	340.04	-1.44	357.62
.5500	324.0	323.68	.099			
.6000	307.0	307.28	.091	303.44	-1.16	319.92
.7000	278.0	277.95	.018	275.13	-1.03	289.78
.8000	254.0	254.00	0.	252.04	-1.772	265.27
.9000	235.0	238.30	1.40	233.13	-1.796	244.84
1.0000	220.0	222.58	1.17	227.53	3.42	227.53
1.1000	206.0	208.44	1.18	212.67	3.24	212.67
1.2000	194.0	196.24	1.15	192.76	2.97	192.76
1.3000	185.0	185.58	.314	188.44	1.86	188.44
1.4000	176.0	176.18	.102	178.43	1.38	178.43
1.5000	168.0	167.82	-.107	169.53	.911	169.53
1.6000	160.0	160.33	.206	161.55	.969	161.55
1.8000	146.0	147.44	.378	147.84	-.105	147.84
2.0000	137.0	136.71	-.212	134.74	-1.65	136.49
2.5000	117.0	116.26	-.632	115.11	-1.62	115.11
3.0000	102.0	101.62	-.373	100.41	-1.56	100.09
3.5000	91.00	90.559	-.485	88.899	-2.31	88.899
4.0000	82.00	81.663	-.167	80.970	-1.26	80.206
4.5000	75.00	74.828	-.229	73.232	-2.36	73.232
5.0000	69.00	69.006	.009	67.498	-2.18	67.498
5.5000	64.00	64.101	.158	62.688	-2.05	62.688
6.0000	60.00	59.828	-.287	59.329	-1.12	58.588

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
 OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .085 PERCENT
 THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
 OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .546 PERCENT
 THE EXPERIMENTAL ERROR IS APPROXIMATELY 1.0 TO 10. PERCENT

THIS COMPARISON IS FOR OXYGEN

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E (MEV)	EXPERIMENTAL DATA	THIS REPORT* PRCT DIFF	HILL, ET AL*		WILLIAMSON*	
			PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF
.1000	610.0	.125				
.1500	600.0	.113				
.2000	543.55	-.083				
.2500	494.09	-.184				
.3000	450.79	.176				
.3500	413.32	.077				
.4000	381.69	-.081				
.4500	355.72	-.254				
.5000	334.64	-.405				
.5500	317.17	.054				
.6000	301.66	.219				
.7000	271.73	-.099				
.8000	252.03	.012				
.9000	237.50	1.93				
1.000	222.95	1.80	322.73	-3.95	338.62	.782
1.100	204.0	2.26				
1.200	196.26	2.22				
1.300	185.48	1.91	289.34	-3.87	304.13	1.04
1.400	175.97	1.72	262.94	-3.33	276.56	1.68
1.500	167.51	1.52	241.67	-4.10	253.98	.786
1.600	159.94	1.87	224.64	-3.85	235.10	.901
1.800	146.92	2.03	209.05	-4.54	219.05	.023
2.000	136.11	1.57			205.22	.598
2.500	115.61	1.41			193.16	.604
3.000	101.00	1.00			182.54	.297
3.500	89.00	1.11			173.11	.064
4.000	81.350	1.69			164.68	-.194
4.500	74.365	1.87			157.13	.064
5.000	68.588	.865			144.01	.007
5.500	63.721	1.14			133.09	-.679
6.000	59.559	.947			112.38	-1.42
			130.06	-2.94	97.724	-2.28
			97.160	-2.84	86.777	-2.17
			78.574	-1.78	78.266	-2.14
			66.408	-2.34	71.441	-2.19
			57.758	-2.11	65.832	-3.19
					61.132	-2.97
					57.129	-3.17

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .847 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.35 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 1.0 TO 10. PERCENT

THIS COMPARISON IS FOR NEON

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*		BARKAS, ET AL		HILL, ET AL*		WILLIAMSON*	
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF
.1000									
.1500	435.83	.191							
.2000	438.74	.169							
.2500	417.72	.173							
.3000	393.99	.252							
.3500	364.68	.187							
.4000	341.18	.053							
.4500	319.66	.207							
.5000	300.71	.237							
.5500	284.93	-.340				285.92	.323	303.63	6.54
.6000	269.32	.119							
.6500	256.16	.062				258.96	1.16	274.79	7.34
.7000	232.91	-.039				237.48	1.92	251.31	7.86
.7500	214.01	.005				219.48	2.56	231.86	8.35
.8000	202.68	2.36				204.30	3.18	215.48	8.83
.8500	191.34	3.43				191.45	3.49	201.48	8.91
.9000	179.64	3.24						189.37	8.83
.9500	169.54	3.38						178.78	9.01
1.000	160.58	2.94				169.42	8.60	169.42	8.60
1.100	152.62	2.43						161.08	8.11
1.200	145.56	1.08						153.61	6.67
1.300	139.23	1.63						142.85	7.19
1.400	128.33	1.05						135.13	6.40
1.500	119.72	.185						125.28	5.28
1.600	101.77	-.225				124.28	4.44	106.35	4.26
1.700	89.612	-.431						92.736	3.04
1.800	80.052	.065				90.928	1.03	82.459	3.07
1.900	72.541	-.629						74.413	1.94
2.000	66.462	-.803				75.063	2.83	67.934	1.39
2.500	61.424	-.929						62.598	.965
3.000	57.173	-1.43				62.455	.734	58.122	.210
3.500	53.530	-.870				54.041	.076	54.308	.570
4.000									
4.500									
5.000									
5.500									
6.000									

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .572 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.44 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 1.0 TO 10. PERCENT

THIS COMPARISON IS FOR ALUMINUM

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSLS SUMMARY IN REFERENCE 4

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*	BARKAS, ET AL PRCT DIFF	**BICHSEL** PRCT DIFF	HILL, ET AL* PRCT DIFF	WILLIAMSON* PRCT DIFF	STERNWEIMER* PRCT DIFF
.1000							
.1500	420.0	418.06					
.2000	380.0	371.51					
.2500	343.0	344.46					
.3000	327.0	323.56					
.3500	310.0	305.58					
.4000	293.0	289.78					
.4500	279.0	276.04					
.5000	265.0	263.68			255.92	250.87	
.5500	252.0	251.99					
.6000	241.0	240.68			233.22	236.89	
.6500	230.0	229.99			214.41	218.40	
.7000	212.0	212.01			198.62	202.74	
.7500	197.0	196.99			185.22	189.34	
.8000	185.0	185.51			173.72	177.76	
.8500	173.0	174.02				167.65	
.9000	163.0	163.92				158.75	
.9500	155.0	155.65				150.84	
1.000	147.0	147.81				143.77	
1.100	149.0	145.88				137.40	
1.200	134.3	134.63				131.64	
1.300	129.0	128.96				121.59	
1.400	119.0	119.11			110.30	113.12	110.80
1.500	110.7	110.82	112.40	1.54		96.732	.090
1.600	94.70	94.806				84.828	
1.700	83.20	83.278			83.115	75.744	83.160
1.800	74.50	74.522				68.560	
1.900	67.60	67.606	68.576	1.44	67.550	62.724	67.440
2.000	62.00	61.992				57.883	
2.100	57.30	57.335			57.320	53.798	57.190
2.200	53.40	53.402				50.303	
2.300	50.00	50.135	49.597	-.806	50.039		49.840

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
 OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -.117 PERCENT
 THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
 OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .642 PERCENT
 THE EXPERIMENTAL ERROR IS APPROXIMATELY 1.0 TO 10. PERCENT

THIS COMPARISON IS FOR ALUMINUM
 THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF RICHSELS SUMMARY IN REFERENCE 4

E(MEV)	EXPERIMENTAL DATA	*RICH,HADEY*		***ARON***	
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF
1000	420.0				
1500	380.0				
2000	343.0				
2500	327.0				
3000	310.0				
3500	293.0				
4000	279.0				
4500	265.0				
5000	252.0				
5500	241.0				
6000	230.0				
7000	212.0				
8000	197.0				
9000	185.0				
10000	173.0				
1100	163.0				
1200	155.0				
1300	147.0				
1400	140.0				
1500	134.3				
1600	129.0				
1800	119.0				
2000	110.7	115.00	3.88	115.00	3.88
2500	94.70	98.500	4.01		
3000	83.20	86.200	3.61		
3500	74.50			69.600	2.96
4000	67.60				
4500	62.00				
5000	57.30	58.800	2.62		
5500	53.40				
6000	50.00	51.200	2.40	51.200	2.40

THIS COMPARISON IS FOR ARGON

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*		BARKAS, ET AL		HILL, ET AL*	
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF		
.1000	484.0	487.80	.785			214.41	-2.54
.1500	427.0	427.01	.002			192.41	-3.80
.2000	377.0	373.13	-1.03			175.43	-4.66
.2500	328.0	328.22	.067			162.40	-5.03
.3000	295.0	294.13	-.295			151.93	-5.04
.3500	269.0	269.35	.130			143.11	-4.59
.4000	251.0	250.37	-.251				
.4500	234.0	234.16	.068				
.5000	220.0	219.80	-.091				
.5500	208.0	208.20	.096				
.6000	200.0	199.94	-.030				
.7000	184.0	184.01	.005				
.8000	171.0	170.99	-.006				
.9000	160.0	158.87	-.706				
1.000	150.0	146.74	-2.17				
1.100	142.0	138.58	-2.41				
1.200	134.0	131.45	-1.90				
1.300	127.0	125.16	-1.45				
1.400	121.0	119.53	-1.21				
1.500	116.0	114.47	-1.32				
1.600	112.0	109.87	-1.90				
1.800	103.0	101.84	-1.13				
2.000	95.00	92.635	-11.8	96.061	13.0	94.035	10.6
2.500	82.00	81.796	-.249			71.679	-.446
3.000	72.00	72.167	.232			58.609	-.663
3.500	65.00	64.756	-.375	59.363	.615		
4.000	59.00	58.991	-.015			49.921	-.158
4.500	54.00	54.242	.448			43.694	-.695
5.000	50.00	50.278	.556				
5.500	47.00	45.918	-.174				
6.000	44.00	44.026	.059	43.210	-1.80		

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -.079 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 2.32 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 1.0 TO 10. PERCENT

THIS COMPARISON IS FOR NICKEL

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E(NEV)	EXPERIMENTAL DATA	THIS REPORT*		HILL, ET AL*		WILLIAMSON*	
		PRCT	DIFF	PRCT	DIFF	PRCT	DIFF
.2000	247.0	251.26	1.72	189.09	3.90	150.51	-17.3
.2500	247.0	245.30	-.688	174.37	5.68	146.37	-11.3
.3000	235.0	234.47	-.226	161.74	7.11	140.63	-6.87
.3500	220.0	220.65	.295	150.89	7.01	134.56	-4.57
.4000	206.0	206.16	.078	141.53	6.41	128.64	-3.28
.4500	193.0	192.85	-.078	133.38	4.20	123.05	-3.87
.5000	182.0	181.60	-.220			117.84	-3.41
.5500	173.0	172.49	-.295			113.03	-2.56
.6000	165.0	164.93	-.042			108.55	-1.28
.7000	151.0	151.54	.358			104.49	-1.42
.8000	141.0	141.13	.092			100.71	-.287
.9000	133.0	134.97	1.48			97.207	.213
1.000	128.0	128.79	.617			90.938	-.068
1.100	122.0	121.86	-.115			85.497	.585
1.200	116.0	115.71	-.250			74.593	.808
1.300	110.0	110.22	.264			66.395	.605
1.400	106.0	105.45	-.519			59.992	-.013
1.500	101.0	101.22	.218			54.833	1.54
1.600	97.00	97.375	.387			50.582	1.16
1.800	91.00	90.648	-.387			47.011	.023
2.000	85.00	84.935	-.076	86.471	1.73	43.964	-.082
2.500	74.00	73.893	-.145			41.331	.807
3.000	66.00	65.764	-.358				
3.500	60.00	59.475	-.875				
4.000	54.00	54.427	.791				
4.500	50.00	50.264	.528				
5.000	47.00	46.761	-.509				
5.500	44.00	43.765	-.534				
6.000	41.00	41.181	.441				

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .068 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .580 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 1.0 TO 10. PERCENT

THIS COMPARISON IS FOR COPPER

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*		BARKAS, ET AL		**BICHSEL***		HILL, ET AL*		WILLIAMSON*		STERNHEIMER*	
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF
1.000	228.0	225.66	-1.03										
1.500	228.0	227.21	-.346										
2.000	221.0	221.45	.204										
2.500	211.0	211.34	.161										
3.000	201.0	200.95	-.025										
3.500	192.0	191.12	-.458										
4.000	183.0	182.31	-.377										
4.500	175.0	174.49	-.291										
5.000	168.0	167.45	-.327										
5.500	161.0	160.94	-.037										
6.000	155.0	154.86	-.090										
7.000	144.0	144.04	.028										
8.000	135.0	135.27	.200										
9.000	128.0	128.44	.344										
1.000	121.0	121.60	.496										
1.100	114.0	115.15	1.01										
1.200	109.0	109.47	.431										
1.300	104.0	104.40	.385										
1.400	99.00	99.834	.842										
1.500	95.00	95.778	.819										
1.600	92.00	92.062	.067										
1.800	85.00	85.765	.900										
2.000	80.00	80.408	.510										
2.500	70.00	69.921	-.113										
3.000	62.00	62.325	.524										
3.500	56.00	56.384	.686										
4.000	51.00	51.618	1.21										
4.500	47.00	47.688	1.46										
5.000	44.00	44.381	.866										
5.500	41.00	41.553	1.35										
6.000	39.00	39.165	.269										
				83.224	4.03	81.080	1.35	82.165	2.71	80.632	.790	78.930	-1.34
						70.390	.557			70.437	.624		
						62.550	.887	63.019	1.64	62.748	1.21	61.830	-.274
						56.510	.911			56.728	1.33		
						51.700	1.37	52.123	2.20	51.875	1.72	51.270	.529
						47.740	1.57			47.372	1.86		
						44.420	.955	44.828	1.88	44.507	1.15	44.080	.182
						41.590	1.44			41.635	1.55		
						39.130	.333	39.505	1.29	39.151	.117	38.730	-.692

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .312 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .648 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 1.0 TO 10. PERCENT

THIS COMPARISON IS FOR COPPER

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E(MEV)	EXPERIMENTAL DATA	*RICH,MADEY*		*****ARON****		*ARON,ET AL*	
		PRCT	DIFF	PRCT	DIFF	PRCT	DIFF
.1000	228.0						
.1500	228.0						
.2000	221.0						
.2500	211.0						
.3000	201.0						
.3500	192.0						
.4000	183.0						
.4500	175.0						
.5000	168.0						
.5500	161.0						
.6000	155.0						
.7000	144.0						
.8000	135.0						
.9000	128.0						
1.000	121.0						
1.100	114.0						
1.200	109.0						
1.300	104.0						
1.400	99.00						
1.500	95.00						
1.600	92.00						
1.800	85.00						
2.000	80.00						
2.500	70.00						
3.000	62.00						
3.500	56.00						
4.000	51.00						
4.500	47.00						
5.000	44.00	46.080	4.73	47.050	6.93	46.080	4.73
5.500	41.00	40.460	3.74	41.270	5.82	40.460	3.74
6.000	39.00						

THIS COMPARISON IS FOR KRYPTON
 THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E(MEV) EXPERIMENTAL DATA	THIS REPORT*		BARKAS, ET AL		HILL, ET AL*		
	PRCT	DIFF	PRCT	DIFF	PRCT	DIFF	
.1000	285.0	284.78	-.077				
.1500	252.0	247.87	-1.64				
.2000	221.0	220.01	-.448				
.2500	198.0	198.68	.343				
.3000	182.0	182.07	.038				
.3500	169.0	168.96	-.024				
.4000	159.0	158.48	-.327				
.4500	150.0	150.00	0.		140.32	-1.87	
.5000	143.0	143.02	.014				
.5500	137.0	137.14	.102				
.6000	132.0	131.99	-.008				
.7000	123.0	122.95	-.041				
.8000	116.0	116.01	.009				
.9000	109.0	110.00	.917				
1.000	104.0	103.99	-.010				
1.100	99.00	98.856	-.145				
1.200	94.00	94.346	.368				
1.300	90.00	90.328	.364				
1.400	87.00	86.696	-.349				
1.500	84.00	83.375	-.744				
1.600	81.00	80.356	-.795				
1.800	76.00	75.102	-1.18				
2.000	72.00	70.699	-1.81	72.252	.350	71.563	-.607
2.500	63.00	61.886	-1.77				
3.000	56.00	55.283	-1.28				
3.500	50.00	50.126	.252				
4.000	46.00	45.586	-.030	46.234	.509	45.807	-.420
4.500	43.00	42.578	-.981				
5.000	40.00	39.728	-.680				
5.500	37.00	37.282	.762				
6.000	35.00	35.169	.483	34.330	-1.91	34.960	-.714

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
 OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -.280 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
 OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .747 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 1.0 TO 10. PERCENT

THIS COMPARISON IS FOR SILVER

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICKSELS SUMMARY IN REFERENCE 4

E(PEV) EXPERIMENTAL DATA	THIS REPORT* PRCT DIFF	BARKAS,ET AL PRCT DIFF	BICKSEL*** PRCT DIFF	WILLIAMSON* PRCT DIFF	ARON*** PRCT DIFF	ARON,ET AL* PRCT DIFF
.4000	150.62	- .252		79.200	-40.9	
.4500	142.0	.063				
.5000	134.0	.425				
.5500	128.0	- .148				
.6000	121.63	- .303				
.7000	110.90	-1.86				
.8000	103.26	-1.66				
.9000	97.942	-1.07				
1.000	92.620	-1.47				
1.100	88.181	- .920				
1.200	84.231	- .905				
1.300	80.684	-1.59				
1.400	77.506	-1.89				
1.500	74.628	- .496				
1.600	72.232	.322				
1.800	67.619	- .560				
2.000	63.693	- .480	63.940	61.746	-3.52	
2.500	55.971	- .052	56.300	55.049	-1.70	
3.000	50.214	-1.54	50.550	45.732	-2.49	
3.500	45.699	- .654	46.010	45.431	-1.24	
4.000	42.055	.131	42.280	41.883	- .279	
4.500	39.038	.097	39.200	38.905	- .244	
5.000	36.488	-1.38	36.610	36.367	-1.71	
5.500	34.291	.856	34.400	34.177	.521	
6.000	32.387	1.21	32.470	32.266	.831	
			65.775	2.77		
			42.787	1.87		44.229 5.31
			32.097	.503		33.718 5.37
					46.436	10.6
					35.194	9.98

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -.565 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.01 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 1.0 TO 10. PERCENT

THIS COMPARISON IS FOR SILVER

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E(MEV)	EXPERIMENTAL DATA	HILL, ET AL*	PRCT DIFF
.4000	151.0		
.4500	142.0		
.5000	134.0	128.05	-4.44
.5500	128.0		
.6000	122.0	115.92	-4.98
.7000	113.0	106.53	-5.73
.8000	105.0	99.929	-4.83
.9000	99.00	94.536	-4.51
1.000	94.00	89.902	-4.36
1.100	89.00		
1.200	85.00		
1.300	82.00		
1.400	79.00		
1.500	75.00		
1.600	72.00		
1.800	68.00		
2.000	64.00	63.746	-.397
2.500	56.00		
3.000	51.00	50.484	-1.01
3.500	46.00		
4.000	42.00	42.302	.719
4.500	39.00		
5.000	37.00	36.639	-.976
5.500	34.00		
6.000	32.00	32.467	1.46

THIS COMPARISON IS FOR TIN

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*	PRCT DIFF	HILL, ET AL*	PRCT DIFF
.4000	142.0	145.09	2.18		
.4500	134.0	135.61	1.20		
.5000	127.0	127.69	.543	129.40	1.89
.5500	121.0	121.10	.083		
.6000	115.0	115.61	.530	116.33	1.16
.7000	107.0	106.97	-.028	106.28	-.673
.8000	100.0	99.919	-.081	98.263	-1.74
.9000	94.00	94.257	.273	92.129	-1.99
1.000	89.00	88.591	-.460	87.392	-1.81
1.100	85.00	84.296	-.828		
1.200	81.00	80.465	-.660		
1.300	78.00	77.018	-1.26		
1.400	75.00	73.924	-1.43		
1.500	71.00	71.123	.173		
1.600	68.00	68.640	.941		
1.800	65.00	64.259	-1.14		
2.000	61.00	60.510	-.803	60.808	-.315
2.500	53.00	53.156	.294		
3.000	48.00	47.710	-.604	48.131	.273
3.500	44.00	43.457	-1.23		
4.000	40.00	40.016	.040	40.236	.590
4.500	37.00	37.160	.432		
5.000	35.00	34.740	-.743	34.845	-.443
5.500	33.00	32.739	-.791		
6.000	31.00	30.926	-.239	30.903	-.313

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -.145 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .850 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 1.0 TO 10. PERCENT

THIS COMPARISON IS FOR XENON

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E (MEV)	EXPERIMENTAL DATA	THIS REPORT		BARKAS, ET AL		HILL, ET AL	
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF		
.1000	230.0	229.89	-.048			117.89	-7.17
.1500	207.0	207.56	.271			106.66	-7.25
.2000	192.0	190.99	-.526			97.862	-7.68
.2500	176.0	176.50	.284			91.148	-6.99
.3000	163.0	163.39	.239			85.457	-7.11
.3500	152.0	151.92	-.053			80.688	-7.26
.4000	143.0	142.31	-.483				
.4500	134.0	134.29	.216				
.5000	127.0	127.31	.244				
.5500	121.0	120.88	-.099				
.6000	115.0	114.89	-.096				
.7000	106.0	106.04	.038				
.8000	98.00	97.994	-.006				
.9000	92.00	89.374	-2.85				
1.000	87.00	80.751	-7.18				
1.100	82.00	77.261	-5.78				
1.200	78.00	74.067	-5.04				
1.300	75.00	71.144	-5.14				
1.400	72.00	68.466	-4.91				
1.500	69.00	66.009	-4.33				
1.600	66.00	63.750	-3.41				
1.800	62.00	59.746	-3.64				
2.000	59.00	56.301	-4.57	584.79	891.	56.300	-4.58
2.500	52.00	49.483	-4.84			45.109	-4.02
3.000	47.00	44.485	-5.35				
3.500	43.00	40.565	-5.66				
4.000	39.00	37.421	-4.05	383.95	884.	37.931	-2.74
4.500	36.00	34.809	-3.31				
5.000	34.00	32.594	-4.14			33.936	-.188
5.500	32.00	30.687	-4.10				
6.000	30.00	29.024	-3.25	289.73	866.	29.250	-2.50

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -2.63 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 3.55 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 1.0 TO 10. PERCENT

THIS COMPARISON IS FOR GOLD

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*		BARKAS, ET AL		HILL, ET AL*		WILLIAMSON*		
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	
.1000	105.0	104.91	-.086							
.1500	116.0	116.33	.284							
.2000	119.0	118.68	-.269							
.2500	116.0	115.79	-.181							
.3000	110.0	110.35	.318							
.3500	104.0	104.06	.077							
.4000	99.00	98.012	.012							
.4500	93.00	92.637	-.390			90.926	3.32	38.605	-56.1	
.5000	88.00	88.077	.088							
.5500	84.00	84.229	.273							
.6000	81.00	80.891	-.135			85.129	5.10	40.461	-50.0	
.7000	75.00	74.994	-.008			79.976	6.63	41.883	-44.2	
.8000	70.00	70.003	.004			75.985	8.55	42.971	-38.6	
.9000	66.00	66.803	1.22			71.871	8.90	43.777	-33.7	
1.000	63.00	63.601	.954			68.348	8.49	44.350	-29.6	
1.100	59.60	61.270	2.80					44.724	-25.0	
1.200	57.00	59.084	3.66					44.925	-21.2	
1.300	54.30	57.073	5.11					44.975	-17.2	
1.400	52.50	55.155	5.06					44.829	-14.6	
1.500	50.50	53.544	6.03					44.505	-11.9	
1.600	49.00	52.023	6.17					44.062	-10.1	
1.800	46.80	49.237	5.21					42.961	-8.20	
2.000	44.00	46.761	6.27			47.648	8.29	41.723	-5.18	
2.500	39.50	41.651	4.65		47.870	8.80		38.566	-3.10	
3.000	36.40	37.679	3.51			38.125	4.74	35.677	-1.99	
3.500	33.90	34.495	1.76					33.152	-2.21	
4.000	31.60	31.882	.892		32.311	2.25	32.319	2.28	30.961	-2.02
4.500	29.60	29.707	.361					29.056	-1.84	
5.000	27.70	27.849	.538			28.279	2.09	27.390	-1.12	
5.500	26.20	26.234	.130					25.922	-1.06	
6.000	24.80	24.862	.250		24.831	.125	25.300	2.02	24.619	-.730

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.76 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 2.87 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 1.0 TO 10. PERCENT
WILLIAMSON'S LARGE ERROR IS BECAUSE HE USED ONLY A K-SHELL CORRECTION

THIS COMPARISON IS FOR LEAD

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*		BARKAS, ET AL		**BICHSEL***		HILL, ET AL*		STERNHEIMER*		*RICH, MADEY*		
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	
.1000	122.0	121.90	-.082											
.1500	127.0	127.51	.402											
.2000	127.0	126.11	-.701											
.2500	125.0	120.48	.400											
.3000	113.0	113.18	.159											
.3500	106.0	106.51	.009											
.4000	100.0	99.802	-.198											
.4500	95.00	94.678	-.339					86.467	-3.93					
.5000	90.00	90.308	.342											
.5500	86.00	86.326	.379											
.6000	83.00	82.632	-.443					80.110	-3.48					
.7000	77.00	77.074	.096					75.076	-2.50					
.8000	71.00	70.991	-.013					71.496	.699					
.9000	67.00	67.040	.060					67.596	.890					
1.000	63.00	63.087	.138									61.910	-1.89	
1.100	60.00	60.540	.900											
1.200	57.50	58.205	1.23											
1.300	55.00	50.092	1.99											
1.400	53.00	54.151	2.17											
1.500	51.50	52.370	1.69											
1.600	50.00	50.732	1.46											
1.800	47.00	47.812	1.73											
2.000	44.50	45.273	1.74											
2.500	40.00	40.311	.777											
3.000	36.50	36.515	.041											
3.500	33.80	33.465	-.991											
4.000	31.80	30.956	-2.65											
4.500	29.80	28.852	-3.18											
5.000	27.90	27.062	-3.00											
5.500	26.50	25.518	-3.71											
6.000	25.00	24.162	-3.35											
				46.397	4.26	45.140	1.44			41.140	-7.55		46.980	5.57
						40.140	.350							
						36.360	-.384		36.837	.923			38.530	5.56
						33.280	-1.54							
						30.780	-3.21		31.158	-2.02			32.760	3.02
						28.670	-3.79							
						26.920	-3.51		27.501	-1.43				
						25.420	-4.08							
						24.120	-3.52		24.609	-1.56			25.500	2.00

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -.095 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.57 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 1.0 TO 10. PERCENT

THIS COMPARISON IS FOR LEAD

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E (MEV)	EXPERIMENTAL DATA	WILLIAMSON*		ARON***		ARON, ET AL*	
		PRCT	DIFF	PRCT	DIFF	PRCT	DIFF
.1000	122.0						
.1500	127.0						
.2000	127.0						
.2500	120.0						
.3000	113.0						
.3500	106.0						
.4000	100.0						
.4500	95.00						
.5000	90.00						
.5500	86.00						
.6000	83.00						
.7000	77.00						
.8000	71.00						
.9000	67.00						
1.000	63.00						
1.100	60.00			71.435	13.4	61.810	-1.89
1.200	57.50						
1.300	55.00						
1.400	53.00						
1.500	51.50						
1.600	50.00						
1.800	47.00						
2.000	44.50						
2.500	40.00						
3.000	36.50						
3.500	33.80						
4.000	31.80						
5.000	27.90						
5.500	26.50						
6.000	25.00						
		36.363	-59.6				
		38.157	-54.0				
		39.549	-48.6				
		40.622	-42.8				
		41.436	-38.2				
		42.031	-33.3				
		42.441	-29.3				
		42.269	-26.5				
		42.797	-22.2				
		42.760	-19.3				
		42.542	-17.4				
		42.192	-15.6				
		41.253	-12.2				
		40.147	-9.78				
		37.242	-6.90				
		34.531	-5.39				
		32.137	-4.92				
		30.049	-5.51				
		28.226	-5.28				
		26.628	-4.56				
		25.216	-4.85				
		23.961	-4.16				
				51.304	15.3	46.985	5.58
				41.418	13.5	38.534	5.57
				34.923	9.82	32.756	3.01
				26.940	7.76	25.491	1.96

THIS COMPARISON IS FOR AIR
THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*		BARKAS, ET AL		**BICHSEL**		HILL, ET AL*		STERNHEIMER*		*RICH, MADEY*	
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	
.1000	728.0	729.86	.255										
.1500	650.0	665.21	2.34										
.2000	584.0	586.10	.360										
.2500	523.0	520.04	-.566										
.3000	478.0	467.53	-2.19										
.3500	433.0	427.21	-1.34										
.4000	408.0	393.12	-3.65										
.4500	375.0	363.92	-2.95										
.5000	354.0	339.23	-4.17										
.5500	333.0	319.22	-4.14										
.6000	312.0	303.23	-2.81										
.7000	284.0	274.11	-3.48										
.8000	261.0	251.42	-3.67										
.9000	242.0	236.08	-2.45										
1.000	223.0	220.72	-1.02										
1.100	210.0	206.69	-1.58										
1.200	198.0	194.58	-1.73										
1.300	186.0	184.00	-1.08										
1.400	177.0	174.68	-1.31										
1.500	168.0	166.38	-.964										
1.600	160.0	158.95	-.656										
1.800	147.0	146.15	-.578										
2.000	136.0	135.50	-.368										
2.500	116.0	115.22	-.672										
3.000	101.0	100.72	-.277										
3.500	90.00	89.766	-.260										
4.000	81.00	81.158	.195										
4.500	74.00	74.193	.261										
5.000	69.00	68.429	-.828										
5.500	64.00	63.572	-.669										
6.000	59.00	59.361	.612										
				141.70	4.19	136.40	.294	133.38	-1.93	134.00	-1.47		
						115.90	-.086	99.463	-1.52	99.860	-1.13	102.00	.990
						101.20	.198						
						90.110	.122						
						81.420	.519	80.260	-.914	80.530	-.580	81.730	.901
						74.400	.541						
						68.590	-.594	67.740	-1.83	68.000	-1.45	68.680	-.464
						63.690	-.484						
						59.490	.831	58.854	-.247	58.990	45.7	59.380	.644

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -1.27 PERCENT
THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.98 PERCENT
THE EXPERIMENTAL ERROR IS APPROXIMATELY 1.0 TO 10. PERCENT

THIS COMPARISON IS FOR WATER

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SUMMARY IN REFERENCE 4

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*		**BICHSEL***		HILL, ET AL*		*RICH, MADEY*		BARKAS, ET AL		
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	
.1000	912.0	931.91	2.18									
.1500	826.0	847.65	2.62									
.2000	735.0	743.55	1.16									
.2500	662.0	661.57	-.065									
.3000	600.0	595.40	-.767									
.3500	543.0	541.15	-.341									
.4000	500.0	496.45	-.710									
.4500	460.0	459.61	-.085				401.53	-6.62				
.5000	430.0	429.20	-.186									
.5500	400.0	403.78	.945									
.6000	376.0	381.79	1.54									
.7000	341.0	343.23	.654									
.8000	310.0	314.91	1.58									
.9000	286.0	291.44	1.90									
1.000	264.0	267.95	1.50						279.40	5.83		
1.100	259.0	250.25	-3.38									
1.200	233.0	235.04	.876									
1.300	220.0	221.78	.809									
1.400	208.0	210.12	1.02									
1.500	197.0	199.76	1.40									
1.600	198.0	190.50	-1.33									
1.800	172.0	174.62	1.52									
2.000	159.0	161.46	1.55		159.80	.503			167.60	5.41	170.11	6.99
2.500	135.0	136.58	1.17		134.60	-.296						
3.000	117.0	118.96	1.68		117.20	.171			122.76	4.87		
3.500	104.0	105.72	1.65		104.20	.192						
4.000	94.00	95.376	1.46		93.950	-.053			97.930	4.18	100.03	6.41
4.500	86.00	87.038	1.21		85.730	-.314						
5.000	79.00	80.160	1.47		78.960	-.051			82.000	3.85		
5.500	73.00	74.379	1.89		73.270	.370						
6.000	68.00	69.446	2.13		68.410	.603			70.900	4.26	71.390	4.99

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
 OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .959 PERCENT
 THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
 OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.50 PERCENT
 THE EXPERIMENTAL ERROR IS APPROXIMATELY 1.0 TO 10. PERCENT

THIS COMPARISON IS FOR ALUMINUM

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF NIELSEN (REFERENCES 130, 131)

E(KEV)	EXPERIMENTAL DATA	THIS REPORT*		BARKAS, ET AL		BICHSEL***		HILL, ET AL*		WILLIAMSON*		ARON***	
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	
1.000	172.4	174.02	.940					173.72	.766	177.76	3.11		
1.500	133.3	134.63	.998							137.40	3.08		
2.000	109.9	110.82	.837							113.12	2.93		
2.500	94.20	94.806	.643	112.40	2.127	110.66	.692	110.30	.364	96.732	2.69	115.00	4.64
3.000	82.80	83.278	.577			94.740	.573			84.828	2.45		
3.500	74.20	74.522	.434			83.230	.519	83.115	.380	75.000	1.06	74.400	.270
4.000	67.40	67.606	.306	66.576	1.74	74.490	.391	67.550	.223	68.560	1.72	69.600	3.26
4.500	62.00	61.992	-.013			67.583	.272			62.724	1.17		
5.000	57.40	57.335	-.113			61.979	-.034	57.320	-.139	57.883	.841		

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .512 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .634 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR ALUMINUM

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF NIELSEN (Ref. 130)

E(MEV)	EXPERIMENTAL DATA	STERNWEIMER*	PRCT DIFF
1.000	172.4		
1.500	133.3		
2.000	109.9	110.80	.819
2.500	94.20		
3.000	82.80	83.160	.435
3.500	74.20		
4.000	67.40	67.440	.059
4.500	62.00		
5.000	57.40	57.190	-.366

THIS COMPARISON IS FOR NICKEL

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF NIELSEN (Ref. 130)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*	PRCT DIFF	HILL, ET AL*	PRCT DIFF	*WILLIAMSON*	PRCT DIFF
1.000	126.8	128.79	1.57	133.38	5.19	123.05	-2.96
1.500	100.8	101.22	.417			100.71	-.089
2.000	84.60	84.973	.441	86.471	2.27	85.497	1.06
2.500	73.50	73.893	.535			74.598	1.49
3.000	65.40	65.764	.557	66.464	1.63	66.399	1.53
3.500	59.30	59.475	.295			59.992	1.17
4.000	54.40	54.427	.050	54.990	1.08	54.833	.796
4.500	50.50	50.264	-.467			50.582	.162
5.000	47.40	46.761	-1.35	47.274	-.266	47.011	-.821

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .228 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .785 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR SILVER

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF NIELSEN (Ref. 130)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*		HILL, ET AL*		BARKAS, ET AL		**BICHSEL**		*WILLIAMSON*		*ARON, ET AL*	
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF		
1.000	93.7	92.620	-1.15	89.902	-4.05	63.746	-3.97	63.940	-0.094	79.759	-14.9		
1.500	74.80	74.628	-.230	63.746	2.77	65.775	2.77	56.300	-1.177	70.212	-6.13		
2.000	64.00	63.693	-.480					50.550	-1.296	61.746	-3.52		
2.500	56.40	55.971	-.761					46.010	-1.841	55.049	-2.40		
3.000	50.70	50.214	-.959					42.280	-1.45	49.732	-1.91		
3.500	46.40	45.699	-1.51					39.200	-2.00	45.431	-2.09		
4.000	42.90	42.055	-1.97	42.302	-1.39	42.787	-0.263	36.610	-2.37	41.883	-2.37	44.229	3.10
4.500	40.00	39.038	-2.40	36.639	-2.30					38.905	-2.74		
5.000	37.50	36.488	-2.70							36.367	-3.02		

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -1.35 PERCENT
 THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.58 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR COPPER

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF NIELSEN (Ref. 130)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*		BARKAS, ET AL		**BICHSEL**		HILL, ET AL*		*WILLIAMSON*		*STERNEHEIMER*	
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	
1.500	95.00	95.778	.819	83.224	4.03	81.080	1.35	70.791	-11.5	94.800	-.213		
2.000	80.00	80.408	.510			70.390	1.28	64.235	-7.58	80.632	.790		
2.500	69.50	69.921	.606			62.550	.563	58.729	-5.58	70.437	1.35	78.930	-1.34
3.000	62.20	62.325	.201			56.510	.018	54.143	-4.17	62.748	.681	61.830	-.595
3.500	56.50	56.384	-.205			51.700	0.	50.278	-2.75	56.728	.404	51.270	-.632
4.000	51.70	51.618	-.159	52.615	1.77	47.740	.505	47.000	-1.05	51.875	.338		
4.500	47.50	47.688	.396							47.872	.783		

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .310 PERCENT
 THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .472 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR GOLD

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF NIELSEN (Ref. 130)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*		BARKAS, ET AL		HILL, ET AL*		WILLIAMSON*	
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF
1.500	50.70	53.544	5.61	47.870	8.80	47.648	8.29	44.505	-12.2
2.000	44.00	46.761	6.27					41.723	-5.18
2.500	40.00	41.651	4.13					38.566	-3.58
3.000	36.50	37.679	3.23			38.125	4.45	35.677	-2.25
3.500	34.00	34.495	1.46					33.152	-2.49
4.000	32.00	31.882	-1.369	32.311	.972	32.319	.997	30.961	-3.25
4.500	29.50	29.707	.702					29.056	-1.51

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 3.00 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 3.80 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 PERCENT

THIS COMPARISON IS FOR SILVER

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF NIELSEN (Ref. 130)

E(MEV)	EXPERIMENTAL DATA	*****ARON****	
		PRCT DIFF	PRCT DIFF
1.000	93.70		
1.500	74.80		
2.000	64.00		
2.500	56.40		
3.000	50.70		
3.500	46.40		
4.000	42.90		
4.500	40.00	46.436	8.24
5.000	37.50		

THIS COMPARISON IS FOR BERYLLIUM

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF KAHN AND WARSHAW (REFS 20,54)

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*		*WILLIAMSON*		HILL, ET AL*	
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF		
.1000	615.0	699.89	13.8	348.00	7.08	342.59	5.41
.1500	521.0	630.27	21.0	305.81	2.79	305.80	2.79
.2000	467.5	535.25	20.9	273.83	.488	277.18	1.72
.2500	433.0	508.27	17.4	248.78	-.845	254.46	1.42
.3000	405.0	461.13	13.9	228.58	-1.35	235.45	1.62
.3500	380.8	422.99	11.1	211.92	-1.43	219.29	2.00
.4000	360.0	392.19	6.94	197.91	-.045		
.4500	342.0	366.75	7.24	185.93	.775		
.5000	325.0	344.82	6.10	175.54	1.29		
.5500	310.8	325.09	4.60				
.6000	297.5	306.87	3.15				
.6500	284.2	291.21	2.47				
.7000	272.5	275.56	1.12				
.7500	266.3	265.30	.376				
.8000	250.9	255.05	1.65				
.8500	241.0	246.36	2.22				
.9000	231.7	237.68	2.58				
.9500	223.0	228.99	2.69				
1.000	215.0	220.28	2.46				
1.050	206.3	213.17	3.33				
1.100	198.0	206.53	4.31				
1.150	190.8	200.34	5.00				
1.200	184.5	194.53	5.44				
1.250	178.8	189.08	5.75				
1.300	173.3	183.95	6.15				
1.350	168.5	179.12	6.30				

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 6.89 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 9.02 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 15. PERCENT

THIS COMPARISON IS FOR ALUMINUM

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF KAHN AND WARSHAW (REFS 20,54)

E(HEV)	EXPERIMENTAL DATA	THIS REPORT*		WILLIAMSON*		HILL, ET AL*	
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF		
.1000	416.0	418.06	.495	258.87	3.55	255.92	2.37
.1500	366.0	371.51	1.51				
.2000	333.5	344.46	3.29	236.89	1.67	233.22	.094
.2500	314.5	323.66	2.91	218.40	.645	214.41	-1.19
.3000	297.0	305.58	2.89				
.3500	283.0	289.78	2.40				
.4000	271.0	276.04	1.86				
.4500	260.0	263.68	1.42	258.87	3.55	255.92	2.37
.5000	250.0	251.99	.796				
.5500	241.0	240.68	-.133				
.6000	233.0	229.99	-1.29	236.89	1.67	233.22	.094
.6500	223.5	220.98	-1.13				
.7000	217.0	212.01	-2.30	218.40	.645	214.41	-1.19
.7500	210.0	204.50	-2.62				
.8000	202.5	196.99	-2.72	202.74	.119	198.62	-1.92
.8500	196.0	191.25	-2.42				
.9000	189.5	185.51	-2.11	189.34	-.084	185.22	-2.26
.9500	183.0	179.77	-1.77				
1.000	177.0	174.02	-1.68	177.76	.429	173.72	-1.85
1.050	171.0	168.77	-1.30				
1.100	166.5	163.93	-1.54	167.65	.691		
1.150	162.0	159.51	-1.54				
1.200	157.5	155.48	-1.28	158.75	.794		
1.250	154.0	151.68	-1.51				
1.300	150.5	147.81	-1.79	150.84	.226		
1.350	146.5	143.31	-2.18				

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -.452 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.95 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 TO 4.5 PERCENT

THIS COMPARISON IS FOR COPPER

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF KAHN AND WARSHAW (REFS 20,54)

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*		WILLIAMSON*		HILL, ET AL*	
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF		

.1000	223.5	225.64	.966	139.37	-16.0	177.41	6.87
.1500	228.0	227.21	-.346	136.17	-11.6	167.11	6.56
.2000	222.0	221.45	-.248	131.24	-8.86	152.51	5.91
.2500	212.0	211.34	-.311	125.84	-7.47	142.46	4.75
.3000	200.0	200.95	.475	120.49	-6.38	133.77	3.94
.3500	189.5	191.92	1.28	115.40	-5.41	126.16	3.41
.4000	180.5	182.31	1.00	110.63	-5.44		
.4500	172.5	174.49	1.15	106.20	-5.60		
.5000	166.0	167.45	.873	102.10	-6.33		
.5500	160.0	160.94	.587				
.6000	154.0	154.86	.558				
.6500	148.5	149.45	.640				
.7000	144.0	144.04	.028				
.7500	140.0	139.65	-.250				
.8000	136.0	135.27	-.537				
.8500	132.0	131.85	-.114				
.9000	129.7	128.44	-.202				
.9500	126.0	125.02	-.778				
1.000	122.0	121.60	-.328				
1.050	119.5	118.26	-1.04				
1.100	117.0	115.15	-2.58				
1.150	114.7	112.22	-2.16				
1.200	112.5	109.47	-2.69				
1.250	110.0	106.87	-2.85				
1.300	109.0	104.46	-4.17				
1.350	107.0	102.06	-4.62				

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -.564 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.65 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 TO 4.5 PERCENT

THIS COMPARISON IS FOR GOLD

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF KAHN AND WARSHAW (REFS 20,54)

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*		*WILLIAMSON*		HILL, ET AL*	
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF		
.1000	87.00	104.91	20.6				
.1500	90.00	116.33	29.3				
.2000	88.50	118.62	34.1				
.2500	84.50	115.79	37.0				
.3000	80.50	110.35	37.1				
.3500	77.20	104.08	34.8				
.4000	74.50	98.012	31.6				
.4500	72.00	92.637	28.7				
.5000	69.50	88.077	26.7				
.5500	67.50	84.229	24.8				
.6000	66.00	80.891	22.6				
.6500	64.50	77.942	20.8				
.7000	63.50	74.994	18.1				
.7500	62.00	72.498	16.9				
.8000	60.20	70.003	16.3				
.8500	59.00	68.403	15.9				
.9000	58.50	66.803	14.2				
.9500	58.00	65.202	12.4				
1.0000	57.00	63.601	11.6				
1.0500	56.50	62.415	10.5				
1.1000	55.20	61.270	11.0				
1.1500	54.70	60.160	9.98				
1.2000	54.00	59.084	9.41				
1.2500	53.50	58.047	8.50				
				39.605	-44.5	90.926	30.8
				40.461	-38.7	85.129	29.0
				41.886	-34.0	79.976	25.9
				42.971	-28.6	75.985	26.2
				43.777	-25.2	71.871	22.9
				44.350	-22.2	68.340	19.9
				44.724	-19.0		
				44.925	-16.8		

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 21.0 PERCENT

THE PERCENT RELATIVE STANCARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 22.9 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY 3.0 TO 4.5 PERCENT
THIS EXPERIMENTAL DATA STRONGLY DISAGREES WITH THAT OF REFS 4,41, AND 42

THIS COMPARISON IS FOR NICKEL

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SELECTION IN REF. 21

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*		HILL, ET AL*		*WILLIAMSON*	
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF		
.5000	180.0	181.60	.889	189.09	5.05	150.51	-16.4
.6000	166.0	164.93	-.645	174.37	5.04	146.37	-11.8
.8000	141.0	141.13	.092	150.89	7.01	134.56	-4.57
1.000	124.0	126.79	3.86	133.38	7.56	123.05	-.766
1.200	113.0	115.71	2.40			113.03	.027
1.400	103.0	105.45	2.38			104.49	1.45
1.600	96.50	97.375	.907			97.207	.733
1.800	90.00	90.648	.720	86.471	-.608	90.938	1.04
2.000	87.00	84.935	-2.37			85.497	-1.73
2.500	78.00	73.893	-5.27			74.598	-4.36
12.00	25.23	24.979	-.995	25.190	-.159	24.854	-1.49
20.00	17.05	17.066	.094	17.154	.610	16.847	-1.19
29.00	12.84	12.883	.335			12.649	-1.49

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS .184 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 2.21 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY .20 TO 3.0 PERCENT

THIS COMPARISON IS FOR COPPER

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*		BARKAS, ET AL		**BICHSEL**		HILL, ET AL*		*WILLIAMSON*		STERNWEIMER*	
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	
.5000	166.0	167.45	.873					177.41	6.87	139.37	-16.0		
.6000	157.0	154.86	-1.36					164.11	4.53	136.17	-13.3		
.8000	135.0	135.27	.200					142.46	5.53	125.84	-6.79		
1.000	121.0	121.60	.496					126.16	4.26	115.40	-4.63		
1.200	111.0	109.47	-1.38							106.20	-4.32		
1.400	104.0	99.834	-4.01							98.311	-5.47		
1.600	94.50	92.062	-2.58							91.546	-3.13		
1.800	88.50	85.765	-3.09							85.710	-3.15		
2.000	83.50	80.408	-3.70	83.224	-.331	81.080	-2.90	82.165	-1.60	80.632	-3.43	78.930	-5.47
2.500	74.00	69.921	-5.51			70.390	-4.88			70.437	-4.81		
12.00	23.87	23.738	-.553			23.756	-.478	23.928	.243	23.582	-1.21	23.380	-2.05
20.00	16.22	16.236	.099			16.235	.092	16.306	.530	16.004	-1.33	15.910	-1.91
29.00	12.15	12.263	.930			12.251	.831			12.023	-1.05		
267.0	2.610	2.5731	-1.41										
300.0	2.422	2.4138	-.339			2.4130	-.372	2.4184	-.149			2.3660	-2.31
615.0	1.772	1.7616	-.587										
651.0	1.740	1.7292	-.621										

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -1.33 PERCENT
 THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 2.24 PERCENT
 THE EXPERIMENTAL ERROR IS APPROXIMATELY .50 TO 5.0 PERCENT

THIS COMPARISON IS FOR COPPER

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SELECTION IN REF. 21

E (MEV)	EXPERIMENTAL DATA	*RICH, MADEY*		***ARON***		*ARON, ET AL*	
		PRCT	DIFF	PRCT	DIFF	PRCT	DIFF
.5000	166.0						
.6000	157.0						
.8000	235.0						
1.000	121.0						
1.200	111.0						
1.400	104.0						
1.600	94.50						
1.800	88.50						
2.000	83.50						
2.500	74.00						
12.00	23.87	24.240	1.55	24.650	3.27	24.240	1.55
20.00	16.22	16.420	1.23	16.670	2.77	16.420	1.23
29.00	12.15						
267.0	2.610						
300.0	2.422	2.4020	.826	2.4260	.165	2.4020	-.826
615.0	1.772						
651.0	1.740						

THIS COMPARISON IS FOR SILVER

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SELECTION IN REF. 21

E (MEV)	EXPERIMENTAL DATA	THIS REPORT*	BARKAS, ET AL		BICHSEL**		WILLIAMSON*		*****ARON***		*ARON, ET AL*		
			PRCT	DIFF	PRCT	DIFF	PRCT	DIFF	PRCT	DIFF	PRCT	DIFF	
.5000	135.0	134.57					79.200	-41.3					
.6000	121.0	121.63					81.141	-32.9					
.8000	104.0	103.26					82.138	-21.0					
1.0000	93.00	92.620					79.759	-14.2					
1.2000	84.50	84.231					76.039	-10.0					
1.4000	80.00	77.506					72.118	-9.85					
1.6000	72.50	72.232					68.370	-5.70					
1.8000	68.00	67.619			65.940	-0.560	64.906	-4.55					
2.0000	64.30	63.693			56.300	-3.76	61.740	-3.97					
2.5000	58.50	55.971			50.550	-2.79	55.249	-5.90					
3.0000	52.00	50.214			46.010	-4.15	49.732	-4.36					
3.5000	48.00	45.699			20.268	-1.04	45.431	-5.35					
4.0000	40.48	20.278			14.039	-0.644	19.937	-2.65					
12.00	14.13	14.095			10.677	1.01	13.731	-2.82					
20.00	10.57	10.221			2.1722	-1.17	10.415	-1.47					
300.0	2.198	2.1820											
										21.320	4.10	20.575	.464
										14.569	3.11	14.116	-.099
										2.1864	-.528	2.1424	-.255

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -1.50 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 2.21 PERCENT

THE EXPERIMENTAL ERROR IS APPROXIMATELY .30 TO 4.0 PERCENT

THIS COMPARISON IS FOR SILVER
 THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SELECTION IN REF. 21

E(MEV)	EXPERIMENTAL DATA	HILL, ET AL*	PRCT DIFF
.5000	135.0	128.05	-5.15
.6000	121.0	115.92	-4.20
.8000	104.0	99.929	-3.91
1.000	93.00	89.902	-3.33
1.200	84.50		
1.400	80.00		
1.600	72.50		
1.800	68.00		
2.000	64.30	63.746	-.862
2.500	58.50		
3.000	52.00	50.484	-2.92
3.500	48.00		
12.00	20.48	20.253	-1.11
20.00	14.13	14.032	-.694
29.00	10.57		
300.0	2.198	2.1698	-1.28

THIS COMPARISON IS FOR GOLD
THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SELECTION IN REF. 21

E(KEV)	EXPERIMENTAL DATA	THIS REPORT*		BARKAS, ET AL		HILL, ET AL*		WILLIAMSON*	
		PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF	PRCT DIFF
.5000	88.00	68.977	.028			90.926	3.32	38.605	-56.1
.6000	81.00	60.891	-.135			85.129	5.10	40.461	-50.0
.7000	75.00	74.994	-.008			79.976	6.63	41.886	-44.2
.8000	71.00	70.003	-1.40			75.985	7.02	42.971	-39.5
1.000	65.00	63.601	-2.15			68.348	5.15	44.350	-31.8
1.200	60.00	59.084	-1.53					44.925	-25.1
1.400	56.00	55.155	-1.51					44.829	-19.9
1.600	52.00	52.023	.044					44.062	-15.3
1.800	49.00	49.237	.484					42.961	-12.3
2.000	46.80	46.761	-.083	47.870	2.29	47.648	1.81	41.723	-10.8
2.500	41.50	41.651	.364					38.966	-7.07
3.000	38.00	37.679	-.045			38.125	.329	35.677	-6.11
3.500	34.00	34.495	1.46					33.152	-2.49
4.000	31.40	31.882	1.54	32.311	2.90	32.319	2.93	30.961	-1.40
4.500	29.40	29.707	1.04					29.056	-1.17
5.000	27.80	27.849	.176			28.279	1.72	27.390	-1.47
12.00	16.23	15.922	-1.90			16.090	-.863	15.784	-2.75
20.00	11.38	11.240	-1.23			11.328	-.457	11.077	-2.66
29.00	8.610	8.6618	.602						

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -.263 PERCENT
THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA
OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.11 PERCENT
WILLIAMSON'S LARGE ERROR IS BECAUSE HE USED ONLY A K-SHELL CORRECTION

THIS COMPARISON IS FOR LEAD

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SELECTION IN REF. 21

E(MEV)	EXPERIMENTAL DATA	THIS REPORT*	BARKAS, ET AL PRCT DIFF	**BICHSEL** PRCT DIFF	HILL, ET AL* PRCT DIFF	STERNHEIMER* PRCT DIFF	*RICH, MADEY* PRCT DIFF
5000	90.00	90.308			86.467		
6000	83.00	82.632			-3.93		
7000	75.00	77.074			-3.48		
8000	70.00	70.991			.301		
10000	64.00	63.087			2.14		
12000	59.00	58.205					61.810 -3.42
14000	54.60	54.151					
16000	51.00	50.732					
18000	48.50	47.812					
20000	46.50	45.273			45.903	41.140	-11.5
25000	41.60	40.311		45.140	-1.28		-16.900 1.05
30000	38.00	36.971		40.140	.764	10.730	-2.37
35000	34.86	33.4753		10.960			11.210 2.00
40000	32.356	30.3530		2.3591			
45000	30.00	28.9461		1.8253			
50000	28.19	26.8223		1.8146			
55000	26.343	24.3474			1.8167	1.7470	-3.96
60000	24.328	22.3246		1.3277			1.7370 -1.76
65000	22.256	20.256					

THE MEAN PERCENTAGE DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS -.292 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE TABULATED DATA OF THIS REPORT FROM THE ABOVE EXPERIMENTAL DATA IS 1.48 PERCENT

THE EXPERIMENTAL POINTS AT 175 AND 190 MEV ARE SCALED ALPHA AND DEUTERON DATA

THIS COMPARISON IS FOR LEAD

THIS IS THE EXPERIMENTAL ENERGY LOSS DATA OF BICHSELS SELECTION IN REF. 21

E(MEV)	EXPERIMENTAL DATA	*WILLIAMSON* PRCT DIFF	***ARON*** PRCT DIFF	*ARON,ET AL* PRCT DIFF
.5000	90.00	36.363 -59.6		
.6000	83.00	38.157 -54.9		
.7000	75.00	39.549 -47.3		
.8000	70.00	40.622 -42.0		
1.000	64.00	42.031 -34.3	71.435 11.6	61.810 -3.42
1.200	59.00	42.269 -28.4		
1.400	54.60	42.760 -21.7		
1.600	51.00	42.192 -17.3		
1.800	48.50	41.253 -14.9		
2.000	46.50	40.147 -13.7	51.304 10.3	46.985 1.04
2.500	41.60	37.242 -10.5	11.659 6.09	11.215 2.05
20.00	10.99	10.633 -1.43	2.3729 .717	2.3134 -1.81
175.0	2.486		1.8304 .627	1.7872 -1.75
190.0	2.356		1.3274 -.045	1.2993 -2.16
265.0	1.900			
300.0	1.819			
615.0	1.343			
650.0	1.328			

THIS ENERGY LOSS COMPARISON IS FOR ILFORD EMULSION (G-5)

PHOTON ENERGY (MEV)	EXPERIMENTAL ENERGY LOSS MEV/CM	THIS REPORT** MEV/CM	PRCT DIFF
.1000	1500.0 (REF. 133)	1460.8	=2.61
.2000	1130.0 (REF. 133)	1154.5	2.17
.3000	950.00 (REF. 133)	948.84	=.122
.4000	820.00 (REF. 133)	813.40	=.805
.6000	650.00 (REF. 133)	650.55	.085
1.000	490.00 (REF. 133)	483.65	=1.30
1.500	380.00 (REF. 133)	379.38	=.163
2.000	316.00 (REF. 133)	317.72	.544
3.000	244.00 (REF. 133)	244.46	.189
4.000	201.00 (REF. 133)	201.54	.269
5.000	172.00 (REF. 133)	172.94	.547
6.000	151.00 (REF. 133)	152.25	.828
7.000	136.00 (REF. 133)	136.54	.397
8.000	123.00 (REF. 133)	124.12	.911
9.000	113.00 (REF. 133)	114.00	.885
10.00	104.00 (REF. 133)	105.58	1.52
11.00	97.100 (REF. 133)	98.431	1.42
13.00	90.900 (REF. 133)	92.375	1.62
13.00	85.500 (REF. 133)	87.071	1.84
14.00	80.700 (REF. 133)	82.406	2.11

THE MEAN DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL ENERGY LOSS DATA IS .517 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL ENERGY LOSS DATA IS 1.26 PERCENT

Most common nuclear emulsions have atomic compositions which are similar. As a result, the various emulsions differ only slightly in their pathlength and stopping power characteristics. Experimental measurements have shown that the stopping power of Ilford E1 emulsion is only 0.3 percent lower than that of Ilford C-2. The stopping power of Ilford G-5 is 1.0 percent greater than the C-2 emulsion, and Kodak NTA has a stopping power 1.8 percent greater than that of the C-2 emulsion (Ref. 135).

THIS PATH LENGTH COMPARISON IS FOR ILFORD EMULSION (G-5)

PROTON ENERGY (MEV)	EXPERIMENTAL PATH LENGTH MICRONS	THIS REPORT** MICRONS	PRCT DIFF
.1000	.92000 (REF. 133)	1.0200	3.03
.2000	1.7800 (REF. 133)	1.7900	.562
.3000	2.7600 (REF. 133)	2.7500	-.362
.4000	3.9100 (REF. 133)	3.8900	-.512
.6000	6.6900 (REF. 133)	6.6600	-.448
1.000	13.920 (REF. 133)	13.890	-.216
1.200	19.300 (REF. 134)	18.260	-5.34
1.295	20.690 (REF. 127)	20.500	-.918
1.500	25.630 (REF. 133)	25.670	.156
2.000	40.010 (REF. 133)	40.140	.325
2.421	53.890 (REF. 127)	54.260	.687
2.450	55.670 (REF. 127)	55.300	-.665
2.590	59.600 (REF. 134)	60.400	1.34
3.000	76.430 (REF. 133)	76.410	-.026
3.200	82.700 (REF. 134)	84.770	2.50
3.250	83.900 (REF. 134)	86.920	3.60
4.000	121.00 (REF. 133)	121.72	.595
4.510	147.00 (REF. 134)	148.12	.762
4.750	159.50 (REF. 134)	161.28	1.12
4.960	170.00 (REF. 134)	173.16	1.87
4.990	171.00 (REF. 134)	174.90	2.28
5.000	175.90 (REF. 133)	175.48	-.239
5.000	175.10 (REF. 127)	175.48	.217
5.477	204.60 (REF. 127)	203.97	-.308
6.000	237.90 (REF. 133)	237.26	-.269
6.240	250.00 (REF. 134)	253.25	1.07
7.000	307.00 (REF. 127)	306.75	-.341
7.000	321.00 (REF. 134)	313.38	-2.37
8.000	385.30 (REF. 133)	383.67	-.423
9.000	470.30 (REF. 133)	467.83	-.525
9.050	474.00 (REF. 134)	472.22	-.376
9.090	482.00 (REF. 134)	475.75	-1.30
10.00	562.50 (REF. 133)	559.06	-.612
10.00	562.70 (REF. 127)	559.06	-.647
11.00	662.00 (REF. 133)	657.19	-.727
12.00	768.50 (REF. 133)	762.10	-.833
13.00	882.00 (REF. 133)	873.65	-.947
13.06	896.10 (REF. 134)	880.55	-1.74
13.96	988.20 (REF. 127)	986.91	-.131
14.00	1002.4 (REF. 133)	991.76	-1.06
21.21	2056.0 (REF. 127)	2029.0	-1.31
33.64	4580.0 (REF. 80)	4530.8	-1.07
36.55	5345.0 (REF. 127)	5238.6	-1.99
200.0	10309. (REF. 127)	10036.	-2.65
340.0	24739. (REF. 127)	24120.	-2.50
540.0	51402. (REF. 127)	49833.	-3.05
700.0	74967. (REF. 127)	73388.	-2.11

THE MEAN DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL PATH LENGTH DATA IS -.385 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL PATH LENGTH DATA IS 1.62 PERCENT

THE UNITS OF REFERENCE 127 HAVE BEEN CHANGED TO MICRONS FOR PRESENTATION HERE

THIS RANGE COMPARISON IS FOR HYDROGEN

PROTON ENERGY (MEV)	EXPERIMENTAL RANGE		*THIS REPORT*		**WILLIAMSON**	
	MG/CH2	MG/CH2	MG/CH2	PRCT DIFF	MG/CH2	PRCT DIFF
1.000	.83700 (REF. 129)	.83832	.158			
2.000	2.8630 (REF. 129)	2.8524	-.370			
3.000	5.9470 (REF. 129)	5.9087	-.644			
4.000	10.010 (REF. 129)	9.9450	-.649		9.7834	-2.26
5.000	15.020 (REF. 129)	14.920	-.666		14.660	-2.40
6.000	20.940 (REF. 129)	20.810	-.621		20.425	-2.46
7.000	27.750 (REF. 129)	27.580	-.613		27.056	-2.50
8.000	35.440 (REF. 129)	35.220	-.621		34.536	-2.55

THE MEAN DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL RANGE DATA IS -.503 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL RANGE DATA IS .569 PERCENT

THIS RANGE COMPARISON IS FOR BERYLLIUM

PROTON ENERGY (MEV)	EXPERIMENTAL RANGE		*THIS REPORT*		**WILLIAMSON**	
	GM/CH2	GM/CH2	GM/CH2	PRCT DIFF	GM/CH2	PRCT DIFF
1.000	.00291 (REF. 129)	.00289	-.687			
2.000	.00893 (REF. 129)	.00889	-.680			
3.000	.01753 (REF. 129)	.01755	.685			
4.000	.02882 (REF. 129)	.02902	.694			
5.000	.04259 (REF. 129)	.04285	.610		.03001	4.13
6.000	.05791 (REF. 129)	.05909	2.04		.04432	4.07
7.000	.07614 (REF. 129)	.07764	1.97		.06304	3.40
8.000	.09662 (REF. 129)	.09846	1.90		.08008	3.17
9.578	.13774 (REF. 36)	.13582	-1.39		.10140	4.93
17.34	.39959 (REF. 36)	.39539	-1.05			
339.7	76.680 (REF. 36)	76.980	.391			

THE MEAN DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL RANGE DATA IS .531 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL RANGE DATA IS 1.23 PERCENT

THIS RANGE COMPARISON IS FOR IRON

PROTON ENERGY (MEV)	EXPERIMENTAL RANGE		THIS REPORT**		**WILLIAMS**	
	MG/CH2	MG/CH2	MG/CH2	PRCT DIFF	MG/CH2	PRCT DIFF
1.000	5.7100 (REF. 129)	5.1592	-9.65			
2.000	14.510 (REF. 129)	14.0615	-3.09			
3.000	28.190 (REF. 129)	27.703	-1.73			
4.000	44.540 (REF. 129)	44.050	-1.10			
5.000	63.390 (REF. 129)	63.470	.126		47.613	5.90
6.000	86.230 (REF. 129)	85.830	-.434		67.431	6.37
7.000	111.00 (REF. 129)	111.02	.018		90.259	4.67
8.000	140.00 (REF. 129)	136.96	-1.93		116.00	4.50
					144.57	2.53

THE MEAN DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL RANGE DATA IS -1.67 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL RANGE DATA IS 3.53 PERCENT

THIS RANGE COMPARISON IS FOR COPPER

PROTON ENERGY (MEV)	EXPERIMENTAL RANGE		THIS REPORT**		WILLIAMSON**	
	GM/CM2	REF.	GM/CM2	PRCT DIFF	GM/CM2	PRCT DIFF
1.000	.00601	(REF. 129)	.00603	.333		
2.000	.01346	(REF. 129)	.01632	5.57		
3.000	.02990	(REF. 129)	.03047	1.91		
4.000	.04743	(REF. 129)	.04804	1.29	.05116	7.86
5.000	.05923	(REF. 129)	.05884	0.563	.07205	4.07
6.000	.09402	(REF. 129)	.09371	-1.39	.09607	2.18
7.000	.12080	(REF. 129)	.11955	-1.03	.12312	1.92
8.000	.15066	(REF. 129)	.14927	-.883	.15311	1.67
9.938	.21580	(REF. 36)	.21477	-.477		
17.89	.58867	(REF. 36)	.58514	-.600		
44.00	2.8200	(REF. 37)	2.7973	-.805	2.8663	1.54
55.70	4.2500	(REF. 37)	4.2278	-.522		
65.20	5.6700	(REF. 37)	5.5705	-1.75		
73.00	6.9300	(REF. 37)	6.9884	.843	6.9816	.745
76.10	7.5100	(REF. 37)	7.3004	-2.79		
79.10	7.9700	(REF. 37)	7.8107	-2.00		
84.00	8.8400	(REF. 37)	8.6750	-1.87	8.9285	1.00
86.90	9.3800	(REF. 37)	9.2044	-1.87		
89.80	9.9500	(REF. 37)	9.7466	-2.04		
96.20	11.210	(REF. 37)	10.988	-1.98		
99.80	11.960	(REF. 37)	11.714	-1.23		
102.1	12.400	(REF. 37)	12.187	-2.35		
109.3	13.680	(REF. 37)	13.501	-1.31		
111.3	14.860	(REF. 37)	14.156	-4.74		
113.7	14.860	(REF. 37)	14.689	-1.15		
337.9	91.430	(REF. 35)	91.859	.469		
338.5	91.360	(REF. 35)	92.122	.834		
339.7	92.270	(REF. 35)	92.649	.411		
658.0	256.40	(REF. 24)	257.55	.449		
752.2	314.90	(REF. 27)	313.04	-.591		

THE MEAN DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL

THE ABOVE EXPERIMENTAL RANGE DATA IS -.662 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL

THE ABOVE EXPERIMENTAL RANGE DATA IS 1.89 PERCENT

THIS RANGE COMPARISON IS FOR SILVER

PROTON ENERGY (MEV)	EXPERIMENTAL RANGE GH/CM2	THIS REPORT** PRCT DIFF
10.02	.26166 (REF. 36)	.26220 .206
17.92	.69198 (REF. 36)	.68996 -.292

THE MEAN DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL RANGE DATA IS -.043 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL RANGE DATA IS .253 PERCENT

THIS RANGE COMPARISON IS FOR TIN

PROTON ENERGY (MEV)	EXPERIMENTAL RANGE MG/CM2	THIS REPORT** PRCT DIFF
1.000	8.6980 (REF. 129)	7.8687 -9.53
2.000	20.420 (REF. 129)	21.621 5.88
3.000	38.050 (REF. 129)	40.107 5.41
4.000	60.630 (REF. 129)	62.757 3.51
5.000	87.190 (REF. 129)	89.270 2.39
6.000	117.60 (REF. 129)	119.41 1.54
7.000	152.10 (REF. 129)	153.04 .618
8.000	189.50 (REF. 129)	190.07 .301

THE MEAN DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL RANGE DATA IS 1.26 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL RANGE DATA IS 4.68 PERCENT

THIS RANGE COMPARISON IS FOR GOLD

PROTON ENERGY (MEV)	EXPERIMENTAL RANGE		THIS REPORT**	
	GM/CH2	PRCT DIFF	GM/CH2	PRCT DIFF
9.608	.32386 (REF. 36)		.32302	-.259
17.55	.84959 (REF. 36)		.84827	-.155

THE MEAN DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL RANGE DATA IS -.207 PERCENT
 THE PERCENT RELATIVE STANDARD DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL RANGE DATA IS .214 PERCENT

THIS GOOD AGREEMENT INDICATES CORRECTNESS OF THE NIGAM OVER MOLIERE THEORY

THIS RANGE COMPARISON IS FOR LEAD

PROTON ENERGY (MEV)	EXPERIMENTAL RANGE		THIS REPORT**		MILLIAMSDEN**	
	GM/CH2	PRCT DIFF	GM/CH2	PRCT DIFF	GM/CH2	PRCT DIFF
1.000	.01128 (REF. 129)		.01132	.355		
2.000	.02948 (REF. 129)		.02978	1.02		
3.000	.05405 (REF. 129)		.05387	-.333		
4.000	.08354 (REF. 129)		.08295	-.706	.11716	40.2
5.000	.11740 (REF. 129)		.11673	-.571	.15260	20.8
6.000	.15430 (REF. 129)		.15498	.441	.19226	24.6
7.000	.19820 (REF. 129)		.19752	1.19	.23606	20.9
8.000	.23999 (REF. 129)		.24410	1.71	.28388	19.3

THE MEAN DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL RANGE DATA IS .388 PERCENT
 THE PERCENT RELATIVE STANDARD DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL RANGE DATA IS .911 PERCENT

THIS GOOD AGREEMENT INDICATES CORRECTNESS OF THE NIGAM OVER MOLIERE THEORY

THIS RANGE COMPARISON IS FOR AIR

PROTON ENERGY (MEV)	EXPERIMENTAL RANGE GM/CM2	*THIS REPORT* GM/CM2	PRCT DIFF
.2320	.00029 (REF. 123)	.00035	20.7
.3290	.00045 (REF. 123)	.00054	20.0
.5000	.00077 (REF. 123)	.00099	28.6
.6570	.00141 (REF. 123)	.00149	5.67
.7960	.00192 (REF. 123)	.00202	5.21
.9830	.00272 (REF. 123)	.00279	2.57
1.184	.00378 (REF. 123)	.00376	.529
1.339	.00448 (REF. 123)	.00458	2.23
1.514	.00550 (REF. 123)	.00559	1.64
1.739	.00689 (REF. 123)	.00702	1.89
1.950	.00838 (REF. 123)	.00848	1.19

THE MEAN DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL RANGE DATA IS 8.10 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL RANGE DATA IS 12.5 PERCENT

THE LOW ENERGY ERROR MAY BE THE RESULT OF THE NORMALIZATION AT .1 MEV

THIS RANGE COMPARISON IS FOR ALUMINUM

PROTON ENERGY (MEV)	EXPERIMENTAL RANGE GM/CM2	*THIS REPORT*		**WILLIAMSON**	
		GM/CM2	PRCT DIFF	GM/CM2	PRCT DIFF
.1170	.00026 (REF, 123)	.00026	0.		
.1660	.00039 (REF, 123)	.00042	7.69		
.2570	.00062 (REF, 123)	.00072	5.88		
.3420	.00093 (REF, 123)	.00096	3.23		
.4330	.00126 (REF, 123)	.00129	2.38		
.4960	.00145 (REF, 123)	.00149	2.76		
.5200	.00160 (REF, 123)	.00163	1.88		
.6300	.00207 (REF, 123)	.00209	.966		
.7450	.00260 (REF, 123)	.00263	1.15		
1.000	.00385 (REF, 129)	.00397	3.12		
1.055	.00420 (REF, 123)	.00429	2.14		
1.130	.00466 (REF, 122)	.00475	1.93		
1.352	.00619 (REF, 122)	.00619	0.		
1.393	.00642 (REF, 123)	.00648	.935		
1.389	.00810 (REF, 122)	.00793	-2.10		
1.623	.00827 (REF, 122)	.00819	-.967		
1.342	.01015 (REF, 123)	.00997	-1.77		
1.311	.01062 (REF, 122)	.01057	-1.03		
2.000	.01114 (REF, 129)	.01136	1.97		
2.114	.01264 (REF, 122)	.01240	-1.90		
2.577	.01331 (REF, 122)	.01814	.928		
3.000	.02171 (REF, 129)	.02185	.645		
3.062	.02285 (REF, 122)	.02260	-1.09		
4.000	.03471 (REF, 129)	.03521	1.44	.03504	.951
4.023	.03574 (REF, 122)	.03555	-.532		
5.000	.05083 (REF, 129)	.05128	.885	.05000	.334
5.038	.05231 (REF, 122)	.05194	-.707		
5.504	.06051 (REF, 122)	.06037	-.231		
6.000	.06971 (REF, 129)	.06993	.316	.06960	-.158
6.150	.07301 (REF, 36)	.07295	-.082		
7.000	.09114 (REF, 129)	.09105	-.099	.09077	-.406
8.000	.11460 (REF, 129)	.11458	-.017	.11443	-.148
11.82	.22633 (REF, 36)	.22582	-.225		
14.97	.34263 (REF, 36)	.34189	-.242		
17.84	.46692 (REF, 36)	.46534	-.328		
18.00	.44700 (REF, 32)	.47298	5.81	.47718	6.75
34.96	1.5480 (REF, 37)	1.5370	-.711		
37.16	1.7630 (REF, 37)	1.7135	-2.81		
39.66	2.9340 (REF, 37)	1.9244	-.496		
42.57	2.2070 (REF, 37)	2.1832	-1.08		
44.86	2.3930 (REF, 37)	2.3968	.159		
52.08	3.1810 (REF, 37)	3.1269	-1.70		
56.96	3.6940 (REF, 37)	3.6675	-.717		
62.10	4.2690 (REF, 37)	4.2769	.185		
66.10	4.7740 (REF, 37)	4.7788	.101		
73.05	5.6990 (REF, 37)	5.7072	.144		
75.84	6.0630 (REF, 37)	6.0538	-.508		
87.40	7.8200 (REF, 141)	7.8410	.269		
117.9	13.230 (REF, 141)	13.279	.370		
145.5	19.310 (REF, 141)	19.389	.409		
338.5	78.470 (REF, 35)	79.569	1.40		
539.7	79.260 (REF, 35)	80.028	.969		

THE MEAN DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL RANGE DATA IS .575 PERCENT
 THE PERCENT RELATIVE STANDARD DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL RANGE DATA IS 2.34 PERCENT

THE EXPERIMENTAL DATA POINT AT 18 MEV FROM REFERENCE 32 IS PROBABLY IN ERROR

THIS STRAGGLING COMPARISON IS FOR BERYLLIUM

PROTON ENERGY (MEV)	EXPERIMENTAL STRAGGLING PERCENT	*THIS REPORT*		*STERNWEIMER*	
		PERCENT	PRCT DIFF	PERCENT	PRCT DIFF
10.00	1.7100 (REF. 36)	1.3540	-20.8	1.3820	-19.2
18.00	1.5500 (REF. 36)	1.2800	-17.4		
339.7	1.1800 (REF. 35)	.97790	-17.1		

THE MEAN DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL STRAGGLING DATA IS -18.5 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL STRAGGLING DATA IS 18.5 PERCENT

THE STRAGGLING SHOULD ACTUALLY BE CORRECTED FOR MULTIPLE SCATTERING EFFECTS

THIS STRAGGLING COMPARISON IS FOR ALUMINUM

PROTON ENERGY (MEV)	EXPERIMENTAL STRAGGLING PERCENT	*THIS REPORT*		*STERNWEIMER*	
		PERCENT	PRCT DIFF	PERCENT	PRCT DIFF
6.000	1.6300 (REF. 36)	1.6520	1.35	1.7200	3.52
12.00	1.4900 (REF. 36)	1.4980	.537	1.5070	1.14
15.00	1.4200 (REF. 36)	1.4560	2.54		
18.00	1.4200 (REF. 36)	1.4230	.211		
75.80	1.4400 (REF. 37)	1.2200	-15.3		
338.5	1.1700 (REF. 35)	1.0380	-11.3		
339.7	1.3100 (REF. 35)	1.0380	-20.6		

THE MEAN DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL STRAGGLING DATA IS -6.10 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL STRAGGLING DATA IS 10.7 PERCENT

THE STRAGGLING SHOULD ACTUALLY BE CORRECTED FOR MULTIPLE SCATTERING EFFECTS

THIS STRAGGLING COMPARISON IS FOR COPPER

PROTON ENERGY (MEV)	EXPERIMENTAL STRAGGLING PERCENT	*THIS REPORT*		*STERNWEIMER*	
		PERCENT	PRCT DIFF	PERCENT	PRCT DIFF
10.00	1.7100 (REF. 36)	1.7290	1.11	1.7490	2.28
18.00	1.5500 (REF. 36)	1.5840	2.19		
72.60	1.9200 (REF. 37)	1.3180	-31.4		
110.0	1.8100 (REF. 37)	1.2540	-30.7	1.2850	-29.0
337.9	1.2100 (REF. 35)	1.0930	-10.3		
338.5	1.3620 (REF. 35)	1.0920	-19.8		
339.7	1.2430 (REF. 35)	1.0040	-19.2		

THE MEAN DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL STRAGGLING DATA IS -15.5 PERCENT

THE PERCENT RELATIVE STANDARD DEVIATION OF THE CALCULATIONS OF THIS REPORT FROM ALL THE ABOVE EXPERIMENTAL STRAGGLING DATA IS 20.0 PERCENT

THE STERNWEIMER POINT AT 110 MEV WAS OBTAINED BY INTERPOLATION

TABULATIONS (ELEMENTS)

ALPHABETIC LIST OF MATERIALS

ALUMINUM	MOLYBDENUM
ANTIMONY	NEON
ARGON	NICKEL
BERYLLIUM	NITROGEN (DIATOMIC)
BISMUTH	OSMIUM
BORON	OXYGEN (DIATOMIC)
CADMIUM	PLATINUM
CALCIUM	RADIUM
CARBON	SELENIUM
CESIUM	SILICON
CHLORINE	SILVER
CHROMIUM	STRONTIUM
COBALT	TANTALUM
COPPER	THORIUM
FLUORINE	TIN
GERMANIUM	TITANIUM
GOLD	TUNGSTEN
HELIUM	URANIUM
HYDROGEN(DIATOMIC)	VANADIUM
IRON	XENON
KRYPTON	ZINC
LEAD	
LITHIUM	
MAGNESIUM	
MANGANESE	

ALUMINUM

ELEMENT AL
 ATOMIC NUMBER 13
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 26.981
 ADJUSTED IONIZATION POTENTIAL 163.0

DENSITY * 2.6990 GM/CM3

PRCTCN ENERGY MEV	ENERGY LOSS MEV/GM	PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH SYRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION	
		MG/CM2	MM	MG/CM2	MM	MG/CM2	MM			
.10	418.06	.25660	.00095	.26000	.00095	.00996	.00004	3.833	1.310	0.
.15	371.51	.38302	.00142	.38680	.00143	.01412	.00005	3.651	.9762	0.
.20	344.46	.52201	.00193	.52655	.00195	.01810	.00007	3.436	.8637	0.
.30	305.58	.82870	.00307	.83521	.00309	.02559	.00009	3.033	.7792	0.
.40	276.04	1.1713	.00434	1.1800	.00437	.03294	.00012	2.792	.7359	0.
.50	251.99	1.5483	.00574	1.5593	.00578	.04044	.00015	2.594	.7034	0.
.60	229.99	1.9614	.00727	1.9748	.00732	.04835	.00018	2.448	.6757	0.
.70	212.01	2.4117	.00894	2.4276	.00899	.05679	.00021	2.339	.6517	0.
.80	196.99	2.8985	.01074	2.9160	.01081	.06586	.00024	2.258	.6305	0.
.90	185.51	3.4186	.01267	3.4396	.01274	.07564	.00028	2.199	.6119	0.
1.00	174.02	3.9725	.01472	3.9963	.01481	.08603	.00032	2.153	.5952	0.
1.20	155.48	5.1858	.01921	5.2153	.01932	.10889	.00040	2.088	.5667	0.
1.40	140.88	6.5327	.02420	6.5684	.02434	.13402	.00050	2.040	.5435	0.
1.60	128.96	8.0116	.02968	8.0537	.02984	.16115	.00060	2.001	.5239	0.
1.80	119.11	9.6231	.03565	9.6721	.03584	.19026	.00070	1.967	.5071	.00001
2.00	110.82	11.355	.04207	11.411	.04228	.22123	.00082	1.939	.4930	.00001
2.20	103.74	13.214	.04896	13.277	.04919	.25395	.00094	1.913	.4811	.00001
2.40	97.580	15.196	.05630	15.267	.05657	.28842	.00107	1.889	.4702	.00002
2.60	92.210	17.298	.06409	17.378	.06439	.32455	.00120	1.868	.4605	.00003
2.80	87.483	19.516	.07231	19.605	.07264	.36229	.00134	1.848	.4521	.00004
3.00	83.278	21.851	.08096	21.948	.08132	.40158	.00149	1.830	.4446	.00005
3.20	79.508	24.300	.09003	24.407	.09043	.44238	.00164	1.813	.4377	.00006
3.40	76.104	26.864	.09953	26.981	.09997	.48466	.00180	1.796	.4315	.00007
3.60	73.012	29.542	.10946	29.668	.10992	.52841	.00196	1.781	.4258	.00008
3.80	70.191	32.322	.11975	32.458	.12026	.57359	.00213	1.767	.4207	.00010
4.00	67.606	35.213	.13047	35.360	.13101	.62018	.00230	1.754	.4156	.00012
4.20	65.227	38.216	.14159	38.374	.14218	.66817	.00248	1.741	.4114	.00014
4.40	63.029	41.325	.15311	41.494	.15374	.71753	.00266	1.729	.4072	.00015
4.60	60.993	44.538	.16502	44.718	.16568	.76824	.00285	1.718	.4034	.00018
4.80	59.099	47.861	.17733	48.053	.17804	.82029	.00304	1.707	.3998	.00020

ALUMINUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CM2	MEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	CM	PERCENT	PERCENT	
5.00	57.335	154.75	.05128	.01900	.05149	.01908	.00087	.00032	1.697	.3964	.00022
5.50	53.402	144.13	.06029	.02234	.06053	.02243	.00101	.00038	1.673	.3889	.00029
6.00	50.135	135.32	.06993	.02591	.07020	.02601	.00116	.00043	1.652	.3825	.00037
6.50	47.197	127.39	.08019	.02971	.08049	.02982	.00131	.00049	1.632	.3767	.00046
7.00	44.621	120.43	.09105	.03373	.09139	.03386	.00148	.00055	1.614	.3716	.00057
7.50	42.342	114.28	.10251	.03798	.10289	.03812	.00164	.00061	1.598	.3671	.00069
8.00	40.309	108.79	.11456	.04245	.11500	.04261	.00182	.00067	1.583	.3630	.00154
8.50	38.483	103.87	.12725	.04715	.12771	.04732	.00200	.00074	1.570	.3592	.00275
9.00	36.833	99.413	.14049	.05205	.14099	.05220	.00220	.00081	1.557	.3558	.00402
9.50	35.334	95.366	.15430	.05717	.15485	.05737	.00239	.00089	1.546	.3528	.00578
10.00	33.965	91.671	.16868	.06250	.16928	.06272	.00260	.00096	1.535	.3498	.00755
11.00	31.553	85.163	.19916	.07379	.19985	.07405	.00303	.00112	1.515	.3447	.01108
12.00	29.494	79.605	.23186	.08591	.23265	.08620	.00348	.00129	1.498	.3403	.01462
13.00	27.714	74.800	.26675	.09883	.26765	.09917	.00397	.00147	1.482	.3363	.01819
14.00	26.157	70.599	.30379	.11256	.30481	.11293	.00448	.00166	1.468	.3328	.02176
15.00	24.784	66.892	.34297	.12707	.34410	.12749	.00501	.00186	1.456	.3298	.02535
16.00	23.563	63.595	.38425	.14237	.38551	.14283	.00557	.00206	1.444	.3269	.02896
17.00	22.468	60.642	.42759	.15843	.42898	.15894	.00615	.00228	1.433	.3244	.03259
18.00	21.482	57.980	.47298	.17524	.47451	.17581	.00675	.00250	1.423	.3221	.03623
19.00	20.588	55.566	.52040	.19281	.52207	.19343	.00738	.00274	1.414	.3199	.03989
20.00	19.765	53.346	.56984	.21113	.57165	.21180	.00803	.00298	1.406	.3180	.04356
22.00	18.338	49.494	.67467	.24997	.67880	.25076	.00941	.00349	1.390	.3144	.05096
24.00	17.123	46.216	.78727	.29169	.78973	.29260	.01087	.00403	1.376	.3114	.05842
26.00	16.077	43.391	.90754	.33625	.91035	.33729	.01242	.00460	1.364	.3087	.06311
28.00	15.155	40.930	1.0353	.38360	1.0385	.38478	.01405	.00521	1.353	.3063	.06496
30.00	14.363	38.765	1.1705	.43367	1.1741	.43500	.01576	.00584	1.343	.3041	.06688
32.00	13.651	36.844	1.3130	.48646	1.3169	.48794	.01756	.00651	1.333	.3022	.06886
34.00	13.015	35.127	1.4626	.54192	1.4671	.54355	.01943	.00720	1.325	.3005	.07092
36.00	12.443	33.584	1.6194	.60001	1.6243	.60181	.02138	.00792	1.316	.2989	.07303
38.00	11.926	32.188	1.7832	.66067	1.7885	.66264	.02341	.00867	1.309	.2974	.07520
40.00	11.456	30.919	1.9539	.72392	1.9597	.72607	.02551	.00945	1.302	.2960	.07742
45.00	10.448	28.199	2.4102	.89298	2.4173	.89561	.03109	.01152	1.286	.2931	.08318
50.00	9.6250	25.978	2.9279	1.0774	2.9164	1.0805	.03710	.01375	1.272	.2906	.08917
55.00	8.9399	24.129	3.4459	1.2767	3.4358	1.2804	.04354	.01613	1.260	.2884	.09541
60.00	8.3601	22.564	4.0231	1.4906	4.0146	1.4949	.05039	.01867	1.249	.2866	.10194
65.00	7.8627	21.221	4.6385	1.7186	4.6317	1.7235	.05763	.02135	1.239	.2850	.10873
70.00	7.4311	20.057	5.2911	1.9604	5.3062	1.9660	.06525	.02416	1.230	.2835	.11575
75.00	7.0529	19.036	5.9802	2.2157	5.9971	2.2220	.07324	.02713	1.221	.2822	.12296
80.00	6.7186	18.133	6.7049	2.4842	6.7338	2.4912	.08158	.03023	1.213	.2811	.13034
90.00	6.1340	16.610	8.2578	3.0590	8.2809	3.0681	.09929	.03679	1.199	.2791	.14549

ALUMINUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CM	GM/CH2	CM	GM/CH2	CM	GM/CH2	CM		
100.00	5.6952	15.371	9.9441	3.6044	9.9718	3.6946	.11829	.04383	1.186	.16101
110.00	5.3147	14.344	11.758	4.3566	11.791	4.7786	.13852	.05132	1.175	.17589
120.00	4.9940	13.479	13.696	5.0743	13.733	5.0883	.15991	.05925	1.164	.19316
130.00	4.7198	12.739	15.751	5.8359	15.794	5.8519	.18239	.06758	1.155	.20971
140.00	4.4827	12.099	17.920	6.6396	17.969	6.6578	.20590	.07629	1.146	.22643
150.00	4.2757	11.540	20.199	7.4848	20.254	7.5044	.23041	.08537	1.138	.24322
160.00	4.0932	11.048	22.584	8.3677	22.646	8.3904	.25585	.09477	1.130	.26014
170.00	3.9313	10.611	25.071	9.2891	25.139	9.3143	.28218	.10455	1.122	.27722
180.00	3.7865	10.220	27.657	10.247	27.732	10.275	.30937	.11462	1.116	.29440
190.00	3.6564	9.8687	30.338	11.241	30.420	11.271	.33736	.12499	1.109	.31162
200.00	3.5388	9.5513	33.112	12.268	33.201	12.301	.36613	.13565	1.103	.32824
210.00	3.4321	9.2631	35.974	13.329	36.071	13.364	.39563	.14658	1.097	.34606
220.00	3.3347	9.0003	38.923	14.421	39.027	14.460	.42584	.15778	1.091	.36329
230.00	3.2455	8.7596	41.955	15.543	42.067	15.586	.45672	.16922	1.086	.38051
240.00	3.1636	8.5385	45.068	16.698	45.189	16.743	.48826	.18090	1.080	.39766
250.00	3.0880	8.3346	48.260	17.881	48.389	17.928	.52040	.19281	1.075	.41472
260.00	3.0181	8.1460	51.527	19.091	51.605	19.142	.55314	.20494	1.071	.43165
270.00	2.9533	7.9711	54.868	20.329	55.014	20.383	.58645	.21729	1.066	.44844
280.00	2.8931	7.8084	58.281	21.593	58.436	21.651	.62031	.22983	1.062	.46504
290.00	2.8369	7.6569	61.763	22.884	61.927	22.944	.65469	.24257	1.057	.48145
300.00	2.7845	7.5153	65.312	24.199	65.485	24.263	.68957	.25549	1.053	.49763
310.00	2.7354	7.3827	68.926	25.538	69.109	25.605	.72494	.26860	1.049	.51359
320.00	2.6893	7.2584	72.604	26.900	72.796	26.971	.76077	.28187	1.045	.52933
330.00	2.6460	7.1417	76.343	28.286	76.545	28.361	.79705	.29531	1.041	.54482
340.00	2.6053	7.0317	80.142	29.693	80.354	29.772	.83376	.30891	1.038	.56006
350.00	2.5669	6.9281	84.000	31.122	84.221	31.205	.87088	.32287	1.034	.57504
360.00	2.5307	6.8303	87.913	32.572	88.145	32.658	.90841	.33657	1.031	.58973
370.00	2.4964	6.7378	91.882	34.043	92.123	34.132	.94632	.35062	1.027	.60415
380.00	2.4640	6.6503	95.904	35.533	96.156	35.626	.98460	.36480	1.024	.61827
390.00	2.4332	6.5673	99.977	37.042	100.24	37.140	1.0232	.37914	1.021	.63210
400.00	2.4041	6.4885	104.10	38.570	104.37	38.672	1.0622	.39356	1.018	.64562
410.00	2.3763	6.4137	108.27	40.117	108.56	40.222	1.1015	.40813	1.015	.65881
420.00	2.3500	6.3425	112.50	41.681	112.79	41.790	1.1412	.42282	1.012	.67164
430.00	2.3249	6.2748	116.76	43.262	117.07	43.375	1.1811	.43762	1.009	.68413
440.00	2.3009	6.2102	121.08	44.860	121.39	44.977	1.2214	.45253	1.006	.69627
450.00	2.2781	6.1486	125.43	46.474	125.76	46.595	1.2617	.46755	1.003	.70905
460.00	2.2563	6.0898	129.83	48.104	130.17	48.230	1.3028	.48268	1.001	.71949
470.00	2.2355	6.0335	134.27	49.750	134.62	49.879	1.3439	.49791	.9982	.73058
480.00	2.2156	5.9798	138.76	51.410	139.12	51.544	1.3852	.51323	.9957	.74132
490.00	2.1965	5.9283	143.28	53.086	143.65	53.224	1.4268	.52865	.9933	.75172

ALUMINUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/GM/CM2	MEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	CM	PERCENT	PERCENT	
500.00	2.1782	5.8790	147.84	54.775	148.23	54.918	1.4687	.54416	.9909	.2594	.76179
510.00	2.1607	5.8318	152.44	56.479	152.83	56.626	1.5108	.55976	.9885	.2592	.77153
520.00	2.1439	5.7855	157.07	58.196	157.48	58.347	1.5531	.57545	.9862	.2590	.78084
530.00	2.1278	5.7430	161.74	59.927	162.16	60.082	1.5957	.59122	.9840	.2588	.79003
540.00	2.1123	5.7012	166.45	61.670	166.88	61.830	1.6385	.60707	.9818	.2585	.79880
550.00	2.0975	5.6611	171.19	63.426	171.63	63.590	1.6815	.62299	.9797	.2583	.80727
560.00	2.0832	5.6225	175.96	65.194	176.41	65.362	1.7247	.63900	.9776	.2581	.81543
570.00	2.0694	5.5853	180.76	66.974	181.23	67.147	1.7681	.65508	.9756	.2579	.82330
580.00	2.0562	5.5496	185.60	68.766	186.08	68.943	1.8116	.67123	.9736	.2577	.83089
590.00	2.0435	5.5152	190.46	70.569	190.96	70.751	1.8554	.68745	.9716	.2574	.83819
600.00	2.0311	5.4820	195.36	72.383	195.87	72.569	1.8994	.70374	.9697	.2572	.84521
620.00	2.0178	5.4191	205.24	76.043	205.77	76.239	1.9878	.73651	.9661	.2568	.85867
640.00	1.9952	5.3607	215.23	79.745	215.79	79.950	2.0770	.76953	.9625	.2564	.87072
660.00	1.9659	5.3061	225.33	83.486	225.91	83.700	2.1667	.80279	.9591	.2559	.88203
680.00	1.9371	5.2551	235.53	87.264	236.13	87.488	2.2571	.83628	.9559	.2555	.89244
700.00	1.9094	5.2075	245.82	91.078	246.45	91.311	2.3481	.86997	.9528	.2551	.90201
720.00	1.9129	5.1628	256.21	94.926	256.86	95.169	2.4396	.90387	.9498	.2545	.91080
740.00	1.8973	5.1209	266.68	98.807	267.36	99.059	2.5316	.93797	.9469	.2542	.91887
760.00	1.8828	5.0816	277.24	102.72	277.94	102.98	2.6241	.97225	.9441	.2538	.92626
780.00	1.8691	5.0446	287.87	106.66	288.60	106.93	2.7171	1.0067	.9415	.2533	.93303
800.00	1.8562	5.0098	298.59	110.63	299.34	110.91	2.8105	1.0413	.9389	.2529	.93921
820.00	1.8440	4.9770	309.37	114.62	310.15	114.91	2.9044	1.0761	.9364	.2525	.94486
840.00	1.8325	4.9460	320.23	118.65	321.04	118.95	2.9987	1.1111	.9341	.2521	.95002
860.00	1.8217	4.9169	331.15	122.69	331.98	123.00	3.0934	1.1461	.9318	.2516	.95471
880.00	1.8115	4.8893	342.13	126.76	343.00	127.08	3.1885	1.1814	.9296	.2512	.95899
900.00	1.8019	4.8632	353.18	130.86	354.07	131.19	3.2840	1.2167	.9275	.2508	.96289
920.00	1.7927	4.8385	364.29	134.97	365.21	135.31	3.3798	1.2522	.9254	.2503	.96643
940.00	1.7841	4.8152	375.46	139.11	376.40	139.46	3.4759	1.2879	.9235	.2498	.96965
960.00	1.7759	4.7931	386.70	143.27	387.66	143.63	3.5724	1.3236	.9215	.2493	.97257
1000.00	1.7607	4.7522	409.42	151.69	410.44	152.07	3.7663	1.3954	.9176	.2479	.97763

THE ELECTRON DENSITY OF ALUMINUM IS 2.903E 23 ELECTRONS PER GRAH
 THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.182 BEV, AND THE MINIMUM ENERGY LOSS IS 1.6251 MEV/GM/CM2

ANTIMONY

ADJUSTED IONIZATION POTENTIAL 505.9
 ATOMIC NUMBER 51
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 121.75
 ELEMENT Sb

DENSITY = 6.6800 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS MEV/CH2	MEV/CH	PROTON RANGE MM	MG/CH2	MM	PROTON PATH LENGTH MM	MG/CH2	ATOMIC WEIGHT	ATOMS/MOLECULE	ADJUSTED IONIZATION POTENTIAL	MG/CH2	PATH LENGTH STRAGGLING MM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	238.71	1580.3	.84201	.00127	.87500	.00132	.04191	121.75	1	505.9	.00006	4.789	3.771	0.	
.15	214.65	1421.0	1.0612	.00160	1.0958	.00166	.04622	121.75	1	505.9	.00007	4.218	3.155	0.	
.20	195.18	1292.1	1.3018	.00197	1.3400	.00202	.05139	121.75	1	505.9	.00008	3.835	2.850	0.	
.30	166.43	1101.8	1.8478	.00279	1.8964	.00286	.07396	121.75	1	505.9	.00010	3.373	2.562	0.	
.40	146.54	970.09	2.4765	.00374	2.5380	.00383	.07960	121.75	1	505.9	.00012	3.136	2.425	0.	
.50	131.42	870.00	3.1830	.00481	3.2593	.00492	.09911	121.75	1	505.9	.00015	3.041	2.341	0.	
.60	118.77	786.26	3.9676	.00599	4.0601	.00613	.12155	121.75	1	505.9	.00018	2.994	2.278	0.	
.70	108.16	716.02	4.8331	.00730	4.9433	.00747	.14662	121.75	1	505.9	.00022	2.966	2.229	0.	
.80	100.95	668.29	5.7742	.00872	5.9033	.00892	.17357	121.75	1	505.9	.00026	2.940	2.188	0.	
.90	93.234	617.21	6.7839	.01025	6.9231	.01047	.20195	121.75	1	505.9	.00031	2.913	2.152	0.	
1.00	85.514	566.11	7.8825	.01191	8.0533	.01217	.23317	121.75	1	505.9	.00035	2.895	2.121	0.	
1.20	77.918	515.82	10.268	.01554	10.505	.01587	.29949	121.75	1	505.9	.00045	2.851	2.070	0.	
1.40	71.748	474.97	12.915	.01951	13.183	.01991	.36720	121.75	1	505.9	.00055	2.785	2.028	0.	
1.60	66.600	440.89	15.759	.02380	16.079	.02429	.43698	121.75	1	505.9	.00066	2.718	1.991	0.	
1.80	62.408	413.14	18.808	.02841	19.193	.02898	.50895	121.75	1	505.9	.00077	2.653	1.958	0.	
2.00	58.830	389.46	22.052	.03331	22.486	.03397	.58298	121.75	1	505.9	.00088	2.593	1.929	0.	
2.20	55.719	368.86	25.486	.03890	25.980	.03924	.65988	121.75	1	505.9	.00100	2.540	1.901	0.	
2.40	52.990	350.80	29.106	.04397	29.653	.04481	.74064	121.75	1	505.9	.00112	2.497	1.875	0.	
2.60	50.574	334.80	32.907	.04971	33.528	.05065	.82480	121.75	1	505.9	.00125	2.460	1.852	0.	
2.80	48.428	320.59	36.882	.05571	37.570	.05675	.91196	121.75	1	505.9	.00138	2.427	1.829	0.	
3.00	46.494	307.79	41.031	.06198	41.786	.06312	1.0019	121.75	1	505.9	.00151	2.398	1.808	0.	
3.20	44.740	296.18	45.346	.06850	46.172	.06975	1.0943	121.75	1	505.9	.00165	2.370	1.789	0.	
3.40	43.140	285.59	49.828	.07527	50.726	.07663	1.1892	121.75	1	505.9	.00180	2.344	1.770	0.	
3.60	41.672	275.87	54.475	.08229	55.447	.08376	1.2865	121.75	1	505.9	.00194	2.320	1.753	0.	
3.80	40.320	266.92	59.277	.08954	60.324	.09112	1.3859	121.75	1	505.9	.00209	2.297	1.736	0.	
4.00	39.068	258.63	64.239	.09704	65.363	.09874	1.4876	121.75	1	505.9	.00225	2.276	1.720	0.	
4.20	37.905	250.93	69.361	.10478	70.564	.10659	1.5914	121.75	1	505.9	.00240	2.255	1.705	0.	
4.40	36.821	243.76	74.632	.11274	75.915	.11468	1.6973	121.75	1	505.9	.00256	2.236	1.691	0.	
4.60	35.808	237.05	80.060	.12094	81.425	.12300	1.8053	121.75	1	505.9	.00273	2.217	1.677	0.	
4.80	34.859	230.76	85.637	.12936	87.086	.13155	1.9153	121.75	1	505.9	.00289	2.199	1.664	0.	

ANTIMONY

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	GM/CM2	MEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	CM	PERCENT	PERCENT	
5.00	33.966	224.86	.09137	.01380	.09290	.01403	.00203	.00031	2.182	1.651	0.
5.50	31.951	211.52	.10633	.01606	.10808	.01633	.00232	.00035	2.143	1.622	0.
6.00	30.202	199.94	.12221	.01846	.12419	.01876	.00262	.00040	2.107	1.596	0.
6.50	28.664	189.76	.13997	.02099	.14119	.02133	.00293	.00044	2.074	1.572	.00001
7.00	27.355	181.09	.15660	.02366	.15907	.02403	.00325	.00049	2.044	1.550	.00001
7.50	26.122	172.93	.17504	.02644	.17776	.02685	.00358	.00054	2.016	1.530	.00002
8.00	25.011	165.57	.19438	.02936	.19736	.02981	.00393	.00059	1.990	1.512	.00003
8.50	23.994	158.84	.21451	.03240	.21776	.03289	.00428	.00065	1.966	1.495	.00004
9.00	23.094	152.89	.23545	.03557	.23899	.03610	.00465	.00070	1.945	1.479	.00006
9.50	22.270	147.43	.25721	.03885	.26103	.03943	.00502	.00076	1.924	1.464	.00008
10.00	21.510	142.40	.27980	.04227	.28392	.04289	.00541	.00082	1.905	1.450	.00010
11.00	20.156	133.43	.32722	.04943	.33195	.05014	.00621	.00094	1.870	1.425	.00017
12.00	18.983	125.67	.37722	.05706	.38309	.05787	.00704	.00106	1.838	1.403	.00027
13.00	17.955	118.86	.43123	.06514	.43728	.06605	.00792	.00120	1.810	1.383	.00039
14.00	17.055	112.91	.48772	.07367	.49446	.07469	.00883	.00133	1.785	1.365	.00053
15.00	16.253	107.59	.54709	.08264	.55457	.08377	.00977	.00148	1.762	1.348	.00070
16.00	15.531	102.81	.60929	.09204	.61753	.09328	.01076	.00163	1.742	1.333	.00089
17.00	14.880	98.505	.67429	.10186	.68331	.10322	.01178	.00178	1.724	1.320	.00111
18.00	14.288	94.585	.74209	.11210	.75192	.11358	.01284	.00194	1.708	1.307	.00135
19.00	13.747	91.004	.81264	.12276	.82331	.12437	.01394	.00211	1.693	1.295	.00161
20.00	13.250	87.718	.88585	.13381	.89737	.13555	.01507	.00228	1.679	1.284	.00190
22.00	12.379	81.892	1.0404	.15716	1.0537	.15917	.01743	.00263	1.654	1.265	.00505
24.00	11.614	76.883	1.2055	.18210	1.2207	.18440	.01993	.00301	1.633	1.247	.00904
26.00	10.956	72.529	1.3609	.20859	1.3981	.21119	.02256	.00341	1.614	1.232	.01178
28.00	10.379	68.707	1.5665	.23663	1.5858	.23955	.02531	.00382	1.596	1.219	.01321
30.00	9.8667	65.316	1.7620	.26616	1.7835	.26941	.02819	.00426	1.580	1.206	.01470
32.00	9.4109	62.300	1.9673	.29718	1.9911	.30077	.03118	.00471	1.566	1.195	.01629
34.00	9.0005	59.583	2.1824	.32966	2.2085	.33362	.03429	.00518	1.552	1.185	.01785
36.00	8.6296	57.128	2.4079	.36389	2.4356	.36792	.03751	.00567	1.540	1.176	.01951
38.00	8.2909	54.885	2.6409	.39893	2.6721	.40364	.04084	.00617	1.528	1.168	.02122
40.00	7.9859	52.867	2.8841	.43566	2.9179	.44078	.04428	.00669	1.518	1.160	.02297
45.00	7.3270	48.505	3.5316	.53348	3.5725	.53965	.05334	.00806	1.493	1.143	.02754
50.00	6.7837	44.908	4.2340	.63958	4.2824	.64688	.06302	.00952	1.472	1.128	.03235
55.00	6.3279	41.890	4.9898	.75375	5.0462	.76226	.07329	.01107	1.452	1.116	.03740
60.00	5.9394	39.319	5.7975	.87576	5.8624	.88555	.08414	.01271	1.435	1.106	.04271
65.00	5.6043	37.100	6.6557	1.0054	6.7295	1.0165	.09554	.01443	1.420	1.097	.04825
70.00	5.3120	35.166	7.5631	1.1425	7.6463	1.1550	.10748	.01624	1.406	1.089	.05401
75.00	5.0548	33.483	8.5186	1.2888	8.6117	1.3009	.11994	.01812	1.393	1.081	.05996
80.00	4.8266	31.952	9.5208	1.4382	9.6243	1.4538	.13289	.02007	1.381	1.075	.06608
85.00	4.6392	29.388	11.662	1.7616	11.787	1.7806	.16023	.02420	1.359	1.064	.07879

ANTIMONY

PROTON ENERGY HEV	ENERGY LOSS HEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH CM	PROTON PATH LENGTH GM/CM2	PROTON RANGE CM	PROTON PATH LENGTH CM	PROTON PATH LENGTH GM/CM2	PATH LENGTH STRAGGLING CM	PATH LENGTH STRAGGLING GM/CM2	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	4.1227	27.292	13.978	2.1115	14.127	2.1340	18938	.02861	1.341	1.055	.09200
110.00	3.8589	25.546	16.462	2.4867	16.636	2.5130	22024	.03327	1.324	1.047	.10570
120.00	3.6356	24.068	19.107	2.8863	19.308	2.9166	25270	.03817	1.309	1.041	.11992
130.00	3.4441	22.800	21.906	3.3091	22.136	3.3437	28568	.04330	1.295	1.035	.13457
140.00	3.2802	21.715	24.853	3.7542	25.112	3.7933	32204	.04865	1.282	1.030	.14956
150.00	3.1344	20.750	27.944	4.2211	28.234	4.2649	35875	.05419	1.271	1.025	.16484
160.00	3.0056	19.897	31.169	4.7084	31.491	4.7570	39676	.05993	1.260	1.022	.18038
170.00	2.8911	19.139	34.531	5.2161	34.886	5.2698	43600	.06586	1.250	1.019	.19619
180.00	2.7886	18.461	38.016	5.7427	38.486	5.8016	47640	.07196	1.240	1.016	.21222
190.00	2.6963	17.850	41.630	6.2864	42.055	6.3528	51792	.07824	1.232	1.013	.22840
200.00	2.6128	17.297	45.362	6.8523	45.825	6.9222	56050	.08467	1.223	1.010	.24470
210.00	2.5368	16.794	49.207	7.4332	49.709	7.5088	60408	.09125	1.215	1.008	.26104
220.00	2.4675	16.335	53.167	8.0312	53.707	8.1129	64862	.09798	1.208	1.006	.27736
230.00	2.4033	15.910	57.234	8.6456	57.815	8.7333	69411	.10485	1.201	1.004	.29362
240.00	2.3448	15.523	61.406	9.2759	62.028	9.3698	74047	.11185	1.194	1.002	.30978
250.00	2.2909	15.166	65.679	9.9213	66.343	10.022	78768	.11898	1.187	1.001	.32583
260.00	2.2410	14.835	70.050	10.582	70.757	10.688	83568	.12624	1.181	.9992	.34182
270.00	2.1946	14.528	74.516	11.256	75.267	11.370	88445	.13360	1.175	.9977	.35782
280.00	2.1515	14.243	79.073	11.945	79.869	12.065	93394	.14108	1.169	.9964	.37380
290.00	2.1114	13.977	83.720	12.647	84.561	12.774	98414	.14866	1.164	.9952	.38974
300.00	2.0738	13.729	88.452	13.341	89.341	13.496	1.0350	.15635	1.158	.9941	.40561
310.00	2.0387	13.496	93.269	14.089	94.204	14.230	1.0865	.16413	1.153	.9930	.42136
320.00	2.0057	13.278	98.162	14.828	99.146	14.977	1.1386	.17200	1.148	.9919	.43695
330.00	1.9747	13.073	103.14	15.581	104.18	15.737	1.1913	.17995	1.144	.9909	.45235
340.00	1.9456	12.880	108.20	16.344	109.28	16.507	1.2446	.18801	1.139	.9899	.46755
350.00	1.9181	12.698	113.32	17.118	114.45	17.289	1.2985	.19614	1.134	.9890	.48254
360.00	1.8921	12.526	118.52	17.904	119.70	18.082	1.3528	.20435	1.130	.9882	.49731
370.00	1.8676	12.363	123.79	18.699	125.02	18.886	1.4076	.21264	1.126	.9874	.51188
380.00	1.8443	12.210	129.13	19.505	130.41	19.700	1.4630	.22099	1.122	.9865	.52622
390.00	1.8223	12.064	134.53	20.321	135.87	20.524	1.5188	.22942	1.118	.9857	.54033
400.00	1.8014	11.926	139.99	21.147	141.39	21.357	1.5750	.23792	1.114	.9850	.55420
410.00	1.7816	11.794	145.52	21.982	146.97	22.201	1.6317	.24648	1.110	.9843	.56782
420.00	1.7627	11.669	151.11	22.826	152.61	23.054	1.6888	.25510	1.107	.9836	.58119
430.00	1.7448	11.550	156.76	23.679	158.31	23.914	1.7462	.26378	1.103	.9829	.59431
440.00	1.7276	11.437	162.46	24.541	164.07	24.785	1.8041	.27252	1.100	.9822	.60717
450.00	1.7113	11.329	168.22	25.411	169.89	25.663	1.8623	.28132	1.096	.9815	.61977
460.00	1.6957	11.226	174.04	26.289	175.76	26.550	1.9209	.29017	1.093	.9810	.63209
470.00	1.6809	11.127	179.90	27.176	181.68	27.445	1.9799	.29907	1.090	.9803	.64415
480.00	1.6666	11.033	185.82	28.069	187.66	28.347	2.0391	.30802	1.087	.9797	.65593
490.00	1.6530	10.943	191.79	28.971	193.68	29.257	2.0987	.31702	1.084	.9791	.66744

ANTIMONY

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION	
	MEV/CM ²	MEV/CM	GH/CM ²	CM	GH/CM ²	CM	GH/CM ²	PERCENT			
500.00	1.6400	10.857	197.80	29.879	199.76	30.175	2.1586	.32607	1.081	.9785	.67867
510.00	1.6275	10.774	203.86	30.795	205.88	31.099	2.2188	.33516	1.078	.9779	.68963
520.00	1.6156	10.695	209.97	31.718	212.04	32.031	2.2793	.34430	1.075	.9773	.70031
530.00	1.6041	10.619	216.12	32.647	218.26	32.969	2.3400	.35347	1.072	.9767	.71071
540.00	1.5931	10.546	222.32	33.583	224.51	33.914	2.4010	.36269	1.069	.9762	.72085
550.00	1.5825	10.476	228.56	34.525	230.81	34.865	2.4623	.37195	1.067	.9756	.73071
560.00	1.5723	10.409	234.84	35.474	237.15	35.823	2.5238	.38124	1.064	.9750	.74030
570.00	1.5626	10.344	241.16	36.428	243.53	36.787	2.5856	.39057	1.062	.9745	.74963
580.00	1.5532	10.282	247.51	37.389	249.95	37.756	2.6476	.39994	1.059	.9739	.75869
590.00	1.5441	10.222	253.91	38.355	256.40	38.732	2.7098	.40934	1.057	.9734	.76749
600.00	1.5354	10.164	260.34	39.326	262.90	39.713	2.7723	.41877	1.054	.9728	.77604
620.00	1.5189	10.055	273.31	41.286	276.00	41.691	2.8978	.43773	1.050	.9717	.79237
640.00	1.5036	9.9541	286.42	43.266	289.23	43.690	3.0241	.45681	1.046	.9707	.80772
660.00	1.4894	9.8598	299.66	45.266	302.59	45.709	3.1512	.47601	1.041	.9696	.82212
680.00	1.4761	9.7718	313.02	47.284	316.08	47.747	3.2789	.49530	1.037	.9685	.83560
700.00	1.4637	9.6898	326.50	49.321	329.69	49.803	3.4073	.51470	1.033	.9674	.84922
720.00	1.4521	9.6131	340.09	51.374	343.41	51.875	3.5364	.53420	1.030	.9663	.86000
740.00	1.4413	9.5413	353.79	53.442	357.24	53.963	3.6660	.55378	1.026	.9653	.87098
760.00	1.4311	9.4741	367.59	55.527	371.17	56.067	3.7962	.57344	1.023	.9643	.88121
780.00	1.4216	9.4111	381.48	57.625	385.19	58.186	3.9269	.59318	1.019	.9632	.89073
800.00	1.4127	9.3519	395.46	59.737	399.30	60.318	4.0581	.61300	1.016	.9621	.89956
820.00	1.4043	9.2963	409.53	61.862	413.50	62.463	4.1897	.63289	1.013	.9610	.90776
840.00	1.3964	9.2441	423.68	64.000	427.79	64.620	4.3218	.65284	1.010	.9599	.91536
860.00	1.3890	9.1949	437.91	66.149	442.15	66.790	4.4544	.67286	1.007	.9588	.92239
880.00	1.3820	9.1487	452.21	68.310	456.59	68.971	4.5873	.69294	1.005	.9578	.92890
900.00	1.3754	9.1051	466.62	70.487	471.13	71.168	4.7206	.71308	1.002	.9568	.93490
920.00	1.3692	9.0640	481.16	72.682	485.80	73.383	4.8542	.73327	.9992	.9551	.94044
940.00	1.3633	9.0253	495.83	74.877	500.46	75.598	4.9882	.75351	.9967	.9538	.94555
960.00	1.3578	8.9888	510.55	77.092	515.26	77.835	5.1226	.77380	.9942	.9537	.95025
1000.00	1.3477	8.9217	539.93	81.560	545.10	82.342	5.3922	.81453	.9892	.9492	.95850

THE ELECTRON DENSITY OF ANTIMONY IS 2.524E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 1.997 BEV, AND THE MINIMUM ENERGY LOSS IS 1.2722 MEV/GH/CM²

ARGON

ELEMENT A
 ATOMIC NUMBER 18
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 39.948
 ADJUSTED IONIZATION POTENTIAL 205.0

DENSITY = 1.7836 MG/CM3

PROTON ENERGY MEV	ENERGY LOSS GH/CH2	ENERGY LOSS KEV/CM	PROTON RANGE MG/CH2	PROTON RANGE METER	PROTON PATH LENGTH MG/CH2	PROTON PATH LENGTH METER	MG/CM2	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	487.80	870.04	.20237	.00113	.20584	.00115	.00836	.00005	5.360	0.
.15	427.01	761.62	.31154	.00175	.31531	.00177	.01100	.00006	3.468	0.
.20	375.13	665.51	.43605	.00244	.44049	.00247	.01438	.00008	3.263	0.
.30	294.13	524.61	.73767	.00414	.74407	.00417	.02288	.00013	3.076	0.
.40	250.37	446.56	1.1053	.00620	1.1142	.00625	.03293	.00018	2.955	0.
.50	219.80	392.04	1.5291	.00857	1.5410	.00864	.04360	.00025	2.842	0.
.60	199.94	356.61	2.0045	.01124	2.0197	.01132	.05535	.00031	2.740	0.
.70	184.01	328.20	2.5222	.01414	2.5409	.01425	.06711	.00038	2.641	0.
.80	170.99	304.98	3.0824	.01728	3.1048	.01741	.07929	.00044	2.554	0.
.90	158.87	283.36	3.6849	.02066	3.7112	.02081	.09201	.00052	2.479	0.
1.00	146.74	261.73	4.3357	.02431	4.3661	.02448	.10566	.00059	2.420	0.
1.20	131.45	234.46	5.7690	.03234	5.8083	.03256	.13503	.00076	2.325	0.
1.40	119.53	213.20	7.3572	.04125	7.4061	.04152	.16613	.00093	2.243	0.
1.60	109.87	195.97	9.0945	.05099	9.1536	.05132	.19919	.00112	2.177	0.
1.80	101.84	181.64	10.977	.06154	11.047	.06193	.23476	.00132	2.125	0.
2.00	95.036	169.51	12.999	.07288	13.080	.07334	.27267	.00153	2.085	0.
2.20	89.187	159.07	15.160	.08500	15.254	.08552	.31276	.00175	2.050	0.
2.40	84.106	150.00	17.459	.09788	17.564	.09848	.35499	.00199	2.021	.00601
2.60	79.633	142.03	19.891	.11152	20.010	.11219	.39901	.00224	1.994	.00001
2.80	75.685	134.99	22.455	.12589	22.587	.12664	.44500	.00249	1.970	.00001
3.00	72.167	128.72	25.147	.14099	25.294	.14181	.49279	.00276	1.948	.00001
3.20	68.976	123.03	27.968	.15681	28.129	.15771	.54234	.00304	1.928	.00002
3.40	66.068	117.84	30.917	.17334	31.093	.17433	.59373	.00333	1.910	.00002
3.60	63.502	113.26	33.991	.19058	34.183	.19165	.64674	.00363	1.892	.00003
3.80	61.148	109.06	37.185	.20848	37.393	.20965	.70131	.00393	1.876	.00004
4.00	58.991	105.22	40.498	.22706	40.722	.22831	.75740	.00425	1.860	.00005
4.20	56.985	101.64	43.932	.24631	44.173	.24766	.81502	.00457	1.845	.00006
4.40	55.123	98.317	47.484	.26623	47.742	.26767	.87418	.00490	1.831	.00007
4.60	53.393	95.231	51.152	.28679	51.428	.28834	.93487	.00524	1.818	.00008
4.80	51.782	92.358	54.940	.30803	55.234	.30968	.99706	.00559	1.805	.00009

ARGON

FAC- TOR ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	GM/CM2	KEY/CH	GM/CM2	METER	GM/CM2	METER	GM/CM2	METER PERCENT		
5.00	50.278	89.676	.05884	3.2989	.05915	.33165	.00106	.00595	1.793	.00011
5.50	46.918	83.683	.06909	3.8738	.06945	.38941	.00123	.00688	1.766	.00015
6.00	44.026	78.525	.08005	4.4882	.08046	.45113	.00140	.00785	1.741	.00020
6.50	41.507	74.031	.09170	5.1413	.09217	.51675	.00158	.00888	1.719	.00026
7.00	39.290	70.077	.10403	5.8326	.10455	.58619	.00178	.00996	1.699	.00032
7.50	37.322	66.567	.11703	6.5616	.11761	.65942	.00198	.01108	1.680	.00040
8.00	35.563	63.430	.13070	7.3279	.13134	.73639	.00219	.01225	1.664	.00045
8.50	33.980	60.507	.14502	8.1310	.14573	.81706	.00240	.01347	1.649	.00049
9.00	32.548	58.053	.16000	8.9706	.16077	.90139	.00263	.01473	1.634	.00132
9.50	31.245	55.729	.17561	9.8459	.17645	.98931	.00286	.01603	1.621	.00166
10.00	30.054	53.605	.19186	1.0757	.19277	1.0808	.00310	.01738	1.608	.00201
11.00	27.954	49.859	.22624	1.2684	.22730	1.2744	.00360	.02021	1.586	.00330
12.00	27.158	46.656	.26309	1.4750	.26430	1.4819	.00414	.02320	1.566	.00624
13.00	24.604	43.883	.30236	1.6952	.30374	1.7030	.00470	.02636	1.548	.00920
14.00	23.243	41.456	.34402	1.9288	.34558	1.9375	.00529	.02968	1.532	.01219
15.00	22.048	39.325	.38803	2.1755	.38977	2.1853	.00591	.03315	1.517	.01519
16.00	20.978	37.416	.43435	2.4353	.43628	2.4461	.00656	.03678	1.504	.01821
17.00	20.018	35.704	.48296	2.7078	.48510	2.7198	.00723	.04056	1.491	.02125
18.00	19.152	34.159	.53365	2.9931	.53619	3.0062	.00793	.04448	1.480	.02431
19.00	18.366	32.757	.58697	3.2909	.58952	3.3052	.00866	.04856	1.469	.02730
20.00	17.649	31.480	.64230	3.6011	.64507	3.6167	.00941	.05278	1.459	.03048
22.00	16.390	29.233	.75951	4.2583	.76276	4.2765	.01099	.06164	1.441	.03673
24.00	15.317	27.320	.88532	4.9637	.88907	4.9847	.01267	.07106	1.425	.04305
26.00	14.392	25.670	1.0196	5.7164	1.0239	5.7404	.01445	.08101	1.411	.04709
28.00	13.585	24.230	1.1621	6.5156	1.1670	6.5427	.01632	.09150	1.398	.04878
30.00	12.874	22.963	1.3128	7.3605	1.3183	7.3910	.01828	.10250	1.387	.05053
32.00	12.244	21.838	1.4716	8.2506	1.4776	8.2844	.02033	.11401	1.376	.05236
34.00	11.679	20.831	1.6382	9.1850	1.6449	9.2224	.02247	.12601	1.366	.05424
36.00	11.172	19.926	1.8127	10.163	1.8201	10.204	.02470	.13849	1.357	.05619
38.00	10.712	19.106	1.9949	11.185	2.0029	11.230	.02701	.15145	1.349	.05820
40.00	10.293	18.358	2.1847	12.249	2.1935	12.298	.02941	.16489	1.341	.06025
45.00	9.3964	16.759	2.6918	15.092	2.7025	15.152	.03575	.20046	1.323	.06560
50.00	8.6636	15.452	3.2454	18.191	3.2573	18.262	.04259	.23878	1.307	.07121
55.00	8.0527	14.353	3.8414	21.537	3.8564	21.621	.04989	.27973	1.294	.07708
59.00	7.5351	13.440	4.4813	25.125	4.4987	25.222	.05765	.32322	1.281	.08321
65.00	7.0906	12.647	5.1632	28.948	5.1831	29.060	.06584	.36916	1.270	.08957
70.00	6.7046	11.958	5.8861	33.001	5.9087	33.128	.07446	.41747	1.260	.09618
75.00	6.3661	11.355	6.6489	37.278	6.6744	37.421	.08348	.46807	1.251	.10296
80.00	6.0667	10.821	7.4508	41.774	7.4792	41.933	.09290	.52088	1.242	.10990
90.00	5.5606	9.9179	9.1684	51.404	9.2031	51.598	.11288	.63287	1.227	.12415

ARGON

PROTON ENERGY MEV	ENERGY LOSS HEV/GM/CM2	PROTON RANGE GM/CM2	PROTON RANGE METER	PATH LENGTH GM/CM2	PATH LENGTH METER	GH/CM2	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	5.1490	11.032	61.855	11.074	62.087	.13429	.75294	.3744	.13875
110.00	4.8073	13.037	73.092	13.085	73.365	.15707	.8062	.3724	.15376
120.00	4.5192	15.176	85.086	15.232	85.402	.18112	1.0155	.3707	.16924
130.00	4.2727	17.445	97.806	17.509	98.169	.20639	1.2572	.3692	.18511
140.00	4.0594	19.858	111.23	19.912	111.64	.23282	1.5053	.3679	.20125
150.00	3.8731	22.352	125.32	22.435	125.78	.26033	1.7596	.3667	.21760
160.00	3.7089	24.982	140.07	25.074	140.58	.28888	1.6197	.3657	.23415
170.00	3.5630	27.724	155.44	27.826	156.01	.31842	1.7853	.3648	.25091
180.00	3.4326	30.574	171.42	30.686	172.05	.34890	1.9562	.3639	.26783
190.00	3.3154	33.529	187.98	33.651	188.67	.38028	2.1321	.3631	.28483
200.00	3.2094	36.584	205.12	36.717	205.86	.41251	2.3128	.3624	.30188
210.00	3.1132	39.737	222.79	39.882	223.60	.44556	2.4981	.3618	.31896
220.00	3.0254	42.985	241.00	43.141	241.87	.47939	2.6878	.3611	.33603
230.00	2.9450	46.324	259.72	46.491	260.66	.51397	2.8816	.3606	.35308
240.00	2.8711	5.1208	278.94	49.931	279.95	.54926	3.0795	.3600	.37005
250.00	2.8029	4.9993	298.63	53.457	299.71	.58523	3.2812	.3595	.38692
260.00	2.7399	4.8869	318.80	57.066	319.95	.62185	3.4865	.3590	.40367
270.00	2.6815	4.7827	339.41	60.755	340.63	.65910	3.6953	.3586	.42033
280.00	2.6272	4.6858	350.46	64.523	361.76	.69695	3.9076	.3581	.43684
290.00	2.5765	4.5955	381.94	68.367	383.31	.73538	4.1230	.3577	.45320
300.00	2.5292	4.5112	403.83	72.285	405.28	.77436	4.3415	.3572	.46938
310.00	2.4850	4.4322	426.11	76.274	427.64	.81487	4.5631	.3569	.48535
320.00	2.4435	4.3582	448.79	80.333	450.40	.85389	4.7874	.3566	.50108
330.00	2.4045	4.2897	471.84	84.458	473.53	.89439	5.0145	.3562	.51660
340.00	2.3678	4.2233	495.26	88.650	497.03	.93537	5.2443	.3559	.53185
350.00	2.3333	4.1616	519.03	92.904	520.88	.97680	5.4766	.3555	.54684
360.00	2.3006	4.1034	543.15	97.221	545.08	1.0187	5.7113	.3552	.56158
370.00	2.2698	4.0484	567.60	101.60	569.62	1.0610	5.9484	.3549	.57609
380.00	2.2406	3.9963	592.37	106.03	594.48	1.1036	6.1877	.3545	.59036
390.00	2.2129	3.9470	617.47	110.52	619.66	1.1467	6.4292	.3542	.60439
400.00	2.1867	3.9002	642.87	115.07	645.15	1.1902	6.6729	.3539	.61815
410.00	2.1617	3.8557	668.57	119.67	670.94	1.2340	6.9185	.3536	.63161
420.00	2.1380	3.8134	694.56	124.32	697.02	1.2781	7.1661	.3533	.64474
430.00	2.1155	3.7732	720.83	129.02	723.38	1.3226	7.4155	.3530	.65755
440.00	2.0940	3.7348	747.38	133.77	750.02	1.3675	7.6668	.3528	.67001
450.00	2.0735	3.6983	774.19	138.57	776.93	1.4126	7.9199	.3525	.68214
460.00	2.0539	3.6634	801.27	143.42	804.10	1.4580	8.1746	.3522	.69394
470.00	2.0352	3.6300	828.60	148.31	831.52	1.5037	8.4307	.3519	.70540
480.00	2.0173	3.5981	856.17	153.25	859.19	1.5497	8.6889	.3516	.71654
490.00	2.0002	3.5676	883.99	158.22	887.10	1.5960	8.9483	.3514	.72734

ARGON

PROTON ENERGY MEV	ENERGY LOSS HEV/GM/CM2	PROTON RANGE GH/CM2	PROTON RANGE METER	PATH LENGTH GH/CM2	PATH LENGTH METER	GH/CM2	PATH LENGTH STRAGGLING METER	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION		
500.00	1.9839	3.5384	162.67	912.04	163.24	915.25	1.6426	9.2093	1.006	.3511	.73782
510.00	1.9682	3.5105	167.71	940.31	168.30	943.62	1.6094	9.4716	1.004	.3508	.74797
520.00	1.9532	3.4836	172.80	968.81	173.41	972.22	1.7364	9.7354	1.001	.3506	.75781
530.00	1.9387	3.4579	177.92	997.53	178.54	1001.0	1.7837	10.000	.9990	.3503	.76733
540.00	1.9249	3.4332	183.08	1026.5	183.72	1030.1	1.8312	10.267	.9967	.3500	.77655
550.00	1.9116	3.4095	188.27	1055.6	188.93	1059.3	1.8789	10.534	.9945	.3497	.78546
560.00	1.8988	3.3867	193.50	1084.9	194.18	1088.7	1.9269	10.803	.9923	.3495	.79407
570.00	1.8865	3.3647	198.77	1114.4	199.47	1118.3	1.9750	11.073	.9902	.3492	.80239
580.00	1.8747	3.3436	204.07	1144.1	204.78	1148.2	2.0234	11.344	.9881	.3489	.81043
590.00	1.8632	3.3233	209.40	1174.0	210.14	1178.2	2.0720	11.617	.9860	.3487	.81819
600.00	1.8523	3.3038	214.77	1204.1	215.52	1208.3	2.1207	11.890	.9840	.3484	.82567
620.00	1.8315	3.2667	225.59	1264.8	226.38	1269.2	2.2188	12.440	.9801	.3479	.83984
640.00	1.8122	3.2323	236.53	1326.1	237.36	1330.8	2.3175	12.993	.9764	.3474	.85300
660.00	1.7943	3.2002	247.59	1388.1	248.45	1393.0	2.4169	13.551	.9728	.3468	.86519
680.00	1.7775	3.1703	258.75	1450.7	259.65	1455.8	2.5169	14.112	.9694	.3463	.87648
700.00	1.7618	3.1423	270.01	1513.9	270.95	1519.1	2.6176	14.676	.9661	.3458	.88692
720.00	1.7471	3.1162	281.38	1577.6	282.35	1583.0	2.7187	15.243	.9629	.3452	.89655
740.00	1.7334	3.0917	292.83	1641.8	293.84	1647.5	2.8204	15.813	.9598	.3447	.90543
760.00	1.7205	3.0687	304.37	1706.5	305.43	1712.4	2.9226	16.386	.9569	.3442	.91361
780.00	1.7084	3.0471	316.00	1771.7	317.09	1777.8	3.0253	16.962	.9541	.3436	.92113
800.00	1.6971	3.0269	327.71	1837.4	328.84	1843.7	3.1285	17.540	.9514	.3431	.92805
820.00	1.6864	3.0078	339.50	1903.4	340.66	1910.0	3.2320	18.121	.9487	.3426	.93439
840.00	1.6763	2.9899	351.35	1969.9	352.56	1976.7	3.3360	18.704	.9462	.3420	.94022
860.00	1.6668	2.9729	363.28	2036.8	364.53	2043.8	3.4403	19.289	.9438	.3415	.94555
880.00	1.6579	2.9570	375.28	2104.0	376.56	2111.2	3.5451	19.876	.9414	.3409	.95044
900.00	1.6494	2.9419	387.34	2171.7	388.66	2179.1	3.6502	20.465	.9392	.3404	.95490
920.00	1.6415	2.9277	399.46	2239.6	400.83	2247.3	3.7556	21.056	.9370	.3398	.95899
940.00	1.6340	2.9143	411.65	2308.0	413.05	2315.8	3.8613	21.649	.9348	.3392	.96272
960.00	1.6268	2.9016	423.91	2376.7	425.35	2384.8	3.9674	22.244	.9327	.3385	.96613
1000.00	1.6137	2.8783	448.69	2515.7	450.21	2524.2	4.1805	23.438	.9266	.3368	.97208

THE ELECTRON DENSITY OF ARGON IS 2.715E 23 ELECTRONS PER GRAM
 THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.143 BEV, AND THE MINIMUM ENERGY LOSS IS 1.5075 MEV/GM/CM2

BERYLLIUM

ELEMENT BE
 ATOMIC NUMBER 4
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 9.0122
 ADJUSTED IONIZATION POTENTIAL 61.00

DENSITY = 1.8200 GM/CM3

PROCTON ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE MM	PROTON PATH LENGTH MM	PROTON PATH LENGTH HG/CM2	PROTON PATH LENGTH MM	PROTON PATH LENGTH HG/CM2	PATH LENGTH STRAGGLING MM	PATH LENGTH STRAGGLING PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	699.89	1273.8	.0087	.1600	.00088	.00481	.00003	3.008	.5261	0.
.15	630.27	1147.1	.00129	.23525	.00129	.00653	.00004	2.774	.3848	0.
.20	565.05	1028.4	.00175	.31899	.00175	.00830	.00005	2.603	.3245	0.
.30	461.13	839.26	.00282	.51409	.00282	.01228	.00007	2.382	.2683	0.
.40	392.19	713.79	.00412	.75142	.00412	.01688	.00009	2.246	.2401	0.
.50	344.82	627.57	.00561	1.0238	.00561	.02197	.00012	2.146	.2225	0.
.60	306.87	558.50	.00730	1.3314	.00732	.02754	.00015	2.059	.2100	0.
.70	275.56	501.52	.00919	1.6717	.00920	.03367	.00018	2.010	.2005	0.
.80	255.05	464.19	.01125	2.0524	.01128	.04022	.00022	1.960	.1929	0.
.90	237.68	432.57	.01348	2.4582	.01351	.04702	.00026	1.913	.1868	0.
1.00	220.28	400.91	.01588	2.8953	.01591	.05422	.00030	1.873	.1815	0.
1.20	194.53	354.04	.02119	3.8632	.02123	.06992	.00038	1.810	.1730	0.
1.40	174.56	317.70	.02715	4.9503	.02720	.08711	.00048	1.760	.1664	.00001
1.60	158.60	288.66	.03376	6.1543	.03381	.10579	.00058	1.719	.1610	.00002
1.80	145.54	264.88	.04099	7.4721	.04106	.12593	.00069	1.685	.1566	.00003
2.00	134.63	245.03	.04884	8.9021	.04891	.14749	.00081	1.657	.1528	.00005
2.20	125.38	228.19	.05729	10.442	.05737	.17044	.00094	1.632	.1496	.00008
2.40	117.42	213.71	.06634	12.091	.06644	.19477	.00107	1.611	.1468	.00011
2.60	110.50	201.11	.07598	13.848	.07609	.22045	.00121	1.592	.1443	.00015
2.80	104.42	190.04	.08620	15.711	.08632	.24744	.00136	1.575	.1421	.00020
3.00	99.024	180.22	.09700	17.679	.09714	.27574	.00152	1.560	.1402	.00025
3.20	94.210	171.46	.10837	19.750	.10852	.30533	.00168	1.546	.1384	.00030
3.40	89.883	163.59	.12030	21.924	.12046	.33617	.00185	1.533	.1368	.00036
3.60	85.971	156.47	.13279	24.201	.13297	.36826	.00202	1.522	.1353	.00042
3.80	82.415	149.99	.14583	26.577	.14603	.40159	.00221	1.511	.1340	.00049
4.00	79.167	144.08	.15943	29.053	.15963	.43613	.00240	1.501	.1327	.00056
4.20	76.188	138.66	.17356	31.629	.17379	.47187	.00259	1.492	.1316	.00063
4.40	73.446	133.67	.18823	34.303	.18848	.50881	.00280	1.485	.1305	.00070
4.60	70.911	129.06	.20345	37.075	.20371	.54692	.00301	1.475	.1295	.00076
4.80	68.561	124.78	.21919	39.944	.21947	.58620	.00322	1.468	.1286	.00082

BERYLLIUM

PRCTCN ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2 CM	PROTON PATH LENGTH GM/CM2 CM	PATH LENGTH STRAGGLING GM/CM2 CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	66.375	0.4285	0.4291	0.0063	1277	0.0687
5.50	61.527	0.5068	0.5074	0.0073	1257	0.1098
6.00	57.394	0.5909	0.5916	0.0085	1240	0.1506
6.50	53.826	0.6808	0.6816	0.0097	1226	0.1911
7.00	50.711	0.7764	0.7774	0.0109	1212	0.2315
7.50	47.968	0.8777	0.8788	0.0123	1201	0.2716
8.00	45.530	0.9846	0.9858	0.0137	1190	0.3117
8.50	43.358	1.0971	1.0984	0.0151	1180	0.3516
9.00	41.387	1.2151	1.2165	0.0166	1171	0.3913
9.50	39.609	1.3384	1.3400	0.0182	1163	0.4310
10.00	37.991	1.4672	1.4689	0.0199	1156	0.4705
11.00	35.153	1.7408	1.7428	0.0234	1142	0.5493
12.00	32.745	2.0354	2.0378	0.0271	1131	0.6278
13.00	30.672	2.3509	2.3535	0.0310	1120	0.7060
14.00	28.868	2.6867	2.6897	0.0352	1111	0.7839
15.00	27.283	3.0428	3.0462	0.0397	1103	0.8615
16.00	25.879	3.4189	3.4227	0.0443	1096	0.9388
17.00	24.625	3.8148	3.8190	0.0491	1089	1.0159
18.00	23.499	4.2302	4.2348	0.0542	1083	1.0928
19.00	22.480	4.6650	4.6700	0.0595	1077	1.1693
20.00	21.555	5.1189	5.1244	0.0650	1072	1.2457
22.00	19.936	6.0836	6.0901	0.0766	1062	1.3975
24.00	18.566	7.1229	7.1304	0.0890	1054	1.5483
26.00	17.390	8.2355	8.2441	0.1022	1047	1.6963
28.00	16.369	9.4204	9.4302	0.1161	1040	1.8604
30.00	15.473	1.0676	1.0687	0.1308	1034	1.9854
32.00	14.681	1.2003	1.2015	0.1463	1029	1.7111
34.00	13.975	1.3398	1.3412	0.1625	1024	1.7375
36.00	13.342	1.4862	1.4877	0.1793	1020	1.7645
38.00	12.770	1.6393	1.6410	0.1969	1015	1.7919
40.00	12.252	1.7991	1.8009	0.2152	1012	1.8199
45.00	11.143	2.2272	2.2294	0.2636	1003	1.8912
50.00	10.242	2.6953	2.6979	0.3164	0996	1.9636
55.00	9.4934	3.2073	3.2055	0.3729	0989	2.0381
60.00	8.8620	3.7423	3.7510	0.4332	0984	2.1157
65.00	8.3216	4.3293	4.3336	0.4971	0979	2.1960
70.00	7.8537	4.9476	4.9524	0.5645	0975	2.2786
75.00	7.4444	5.6012	5.6066	0.6353	0971	2.3630
80.00	7.0833	6.2892	6.2954	0.7094	0967	2.4489
85.00	6.7747	7.0666	7.0740	0.8671	0960	2.6237

BERYLLIUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CM2	MEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	CM		
100.00	5.9814	10.886	9.3737	5.1504	9.3826	5.1553	.10368	.05697	1.105	.28004
110.00	5.5732	10.143	11.106	6.1019	11.116	6.1077	.12180	.06692	1.096	.29808
120.00	5.2297	9.581	12.957	7.1195	12.970	7.1262	.14099	.07746	1.087	.31672
130.00	4.9366	8.946	14.925	8.2075	14.939	8.2082	.16120	.08857	1.079	.33584
140.00	4.6835	8.5239	17.004	9.3427	17.020	9.3515	.18238	.10021	1.072	.35531
150.00	4.4627	8.1220	19.190	10.544	19.208	10.554	.20449	.11236	1.065	.37541
160.00	4.2683	7.7384	21.480	11.802	21.500	11.813	.22747	.12499	1.058	.39480
170.00	4.0960	7.3747	23.870	13.116	23.893	13.128	.25130	.13808	1.052	.41451
180.00	3.9421	7.0346	26.357	14.482	26.382	14.496	.27592	.15160	1.046	.43406
190.00	3.8039	6.7231	28.938	15.900	28.965	15.915	.30131	.16555	1.040	.45339
200.00	3.6791	6.4359	31.609	17.368	31.639	17.384	.32742	.17990	1.035	.47244
210.00	3.5658	6.1697	34.369	18.884	34.400	18.901	.35423	.19463	1.030	.49093
220.00	3.4625	5.9218	37.212	20.446	37.247	20.465	.38171	.20973	1.025	.50863
230.00	3.3680	5.6898	40.139	22.054	40.175	22.074	.40983	.22518	1.020	.52553
240.00	3.2812	5.4718	43.145	23.706	43.184	23.728	.43856	.24097	1.016	.54161
250.00	3.2012	5.2663	46.228	25.400	46.270	25.423	.46787	.25707	1.011	.55687
260.00	3.1273	5.0717	49.386	27.135	49.431	27.160	.49775	.27349	1.007	.57155
270.00	3.0588	4.8870	52.617	28.910	52.665	28.937	.52817	.29020	1.003	.58589
280.00	2.9951	4.7111	55.918	30.724	55.969	30.752	.55911	.30720	9990	.59986
290.00	2.9358	4.5431	59.288	32.576	59.341	32.605	.59054	.32447	.9952	.61345
300.00	2.8804	4.3823	62.724	34.464	62.781	34.495	.62246	.34201	.9915	.62666
310.00	2.8286	4.2280	66.224	36.387	66.284	36.420	.65483	.35960	.9879	.63979
320.00	2.7800	4.0796	69.787	38.345	69.851	38.379	.68765	.37783	.9845	.65311
330.00	2.7343	3.9365	73.412	40.336	73.478	40.372	.72089	.39609	.9811	.66658
340.00	2.6914	3.7983	77.095	42.360	77.164	42.398	.75455	.41459	.9778	.68015
350.00	2.6508	3.6645	80.836	44.415	80.909	44.455	.78860	.43330	.9747	.69376
360.00	2.6126	3.5349	84.633	46.501	84.709	46.543	.82303	.45222	.9716	.70731
370.00	2.5764	3.4091	88.484	48.617	88.563	48.661	.85784	.47134	.9686	.72069
380.00	2.5422	3.2868	92.388	50.763	92.471	50.808	.89300	.49066	.9657	.73387
390.00	2.5097	3.1677	96.344	52.936	96.430	52.984	.92851	.51017	.9629	.74682
400.00	2.4789	3.0516	100.35	55.137	100.44	55.187	.96436	.52987	.9601	.75952
410.00	2.4496	2.9383	104.40	57.365	104.50	57.416	1.0005	.54974	.9575	.77182
420.00	2.4217	2.8276	108.51	59.619	108.60	59.672	1.0370	.56978	.9549	.78360
430.00	2.3952	2.7192	112.66	61.899	112.76	61.954	1.0738	.58999	.9523	.79488
440.00	2.3699	2.6132	116.85	64.203	116.95	64.260	1.1109	.61037	.9498	.80567
450.00	2.3457	2.5093	121.09	66.531	121.19	66.591	1.1482	.63089	.9474	.81597
460.00	2.3227	2.4073	125.48	68.883	125.48	68.945	1.1859	.65157	.9451	.82581
470.00	2.3006	2.3072	129.69	71.258	129.81	71.322	1.2238	.67240	.9428	.83520
480.00	2.2796	2.2088	134.05	73.656	134.17	73.721	1.2619	.69337	.9405	.84414
490.00	2.2594	2.1120	138.46	76.075	138.58	76.142	1.3004	.71448	.9384	.85266

BERYLLIUM

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PROTON RANGE CH	PROTON PATH LENGTH CM	GM/CM2	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	2.2400	142.90	143.02	78.515	78.505	1.3390	.9362	.0883	.86077
510.00	2.2214	147.38	147.51	80.976	81.048	1.3779	.9341	.0882	.86848
520.00	2.2036	151.89	152.03	83.458	83.531	1.4170	.9321	.0881	.87581
530.00	2.1865	156.44	156.58	85.959	86.034	1.4564	.9301	.0880	.88278
540.00	2.1701	161.03	161.17	88.479	88.557	1.4960	.9282	.0879	.88939
550.00	2.1543	165.65	165.80	91.018	91.098	1.5358	.9263	.0878	.89566
560.00	2.1391	170.31	170.46	93.575	93.657	1.5758	.9244	.0877	.90161
570.00	2.1245	174.99	175.15	96.151	96.235	1.6160	.9226	.0876	.90725
580.00	2.1104	179.71	179.87	98.743	98.830	1.6563	.9209	.0875	.91259
590.00	2.0968	184.46	184.62	101.35	101.44	1.6969	.9191	.0874	.91765
600.00	2.0837	189.24	189.41	103.98	104.07	1.7377	.9174	.0873	.92243
620.00	2.0589	198.89	199.06	109.28	109.38	1.8198	.9142	.0871	.93124
640.00	2.0358	208.65	208.83	114.64	114.74	1.9025	.9110	.0869	.93910
660.00	2.0142	218.52	218.71	120.07	120.17	1.9860	.9080	.0867	.94611
680.00	1.9940	228.49	228.69	125.55	125.65	2.0700	.9052	.0866	.95236
700.00	1.9750	238.56	238.77	131.08	131.19	2.1547	.9024	.0864	.95791
720.00	1.9573	248.73	248.94	136.66	136.78	2.2399	.8998	.0862	.96285
740.00	1.9406	258.91	259.21	142.30	142.42	2.3257	.8972	.0860	.96722
760.00	1.9249	269.32	269.55	147.98	148.11	2.4120	.8948	.0858	.97110
780.00	1.9101	279.75	279.98	153.71	153.84	2.4988	.8925	.0856	.97453
800.00	1.8961	290.25	290.49	159.48	159.61	2.5861	.8903	.0854	.97757
820.00	1.8830	300.82	301.08	165.29	165.43	2.6739	.8881	.0853	.98025
840.00	1.8706	311.47	311.74	171.14	171.28	2.7621	.8860	.0851	.98262
860.00	1.8588	322.19	322.47	177.03	177.18	2.8508	.8841	.0849	.98471
880.00	1.8477	332.98	333.26	182.96	183.11	2.9399	.8822	.0847	.98655
900.00	1.8371	343.83	344.12	188.92	189.08	3.0294	.8803	.0845	.98817
920.00	1.8271	354.74	355.04	194.91	195.08	3.1192	.8786	.0844	.98960
940.00	1.8176	365.72	366.03	200.95	201.12	3.2095	.8769	.0842	.99086
960.00	1.8086	376.77	377.08	207.01	207.19	3.3001	.8752	.0839	.99197
1000.00	1.7929	399.10	399.43	219.29	219.47	3.4825	.8719	.0834	.99380

THE ELECTRON DENSITY OF BERYLLIUM IS 2.674E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.332 BEV, AND THE MINIMUM ENERGY LOSS IS 1.6236 MEV/GM/CM2

BISMUTH

ELEMENT NUMBER 83
 ATOMIC NUMBER 83
 ATOMS/MOLECULE 1
 ADJUSTED IONIZATION POTENTIAL 820.1
 ATOMIC WEIGHT 208.98

DENSITY = 9.8000 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	GM/CM2	MEV/CM	MG/CM2	MM	MG/CM2	MM	MG/CM2	MM		
.10	122.22	1197.8	1.3067	.00133	1.3827	.00141	.07093	.00007	5.496	0.
.15	127.84	1252.9	1.7020	.00174	1.7826	.00182	.08362	.00009	4.522	0.
.20	126.44	1239.1	2.0654	.00213	2.1758	.00222	.09400	.00010	4.320	0.
.30	113.48	1112.1	2.8906	.00295	3.0075	.00307	1.1557	.00012	3.885	0.
.40	100.06	980.63	3.7980	.00388	3.9474	.00403	1.4411	.00015	3.785	0.
.50	90.545	887.34	4.8130	.00491	4.9996	.00510	1.7767	.00018	3.732	0.
.60	82.849	811.92	5.9273	.00605	6.1547	.00628	2.1438	.00022	3.483	0.
.70	77.276	757.31	7.1331	.00728	7.4043	.00756	2.5316	.00026	3.419	0.
.80	71.177	697.54	8.4348	.00861	8.7526	.00893	2.9438	.00030	3.363	0.
.90	67.176	658.32	9.8304	.01003	10.198	.01041	3.3793	.00034	3.314	0.
1.00	63.165	619.01	11.314	.01155	11.734	.01197	3.8311	.00039	3.265	0.
1.20	58.228	570.63	14.504	.01480	15.033	.01534	4.7590	.00049	3.166	0.
1.40	54.128	530.46	17.954	.01832	18.599	.01898	5.8994	.00058	3.064	0.
1.60	50.676	496.63	21.656	.02210	22.421	.02288	6.6688	.00068	2.974	0.
1.80	47.729	467.74	25.661	.02612	26.492	.02703	7.7004	.00079	2.907	0.
2.00	45.254	443.49	29.775	.03038	30.797	.03143	8.7824	.00090	2.852	0.
2.20	43.019	421.59	34.171	.03487	35.327	.03605	9.9080	.00101	2.805	0.
2.40	41.040	402.19	38.796	.03959	40.091	.04091	1.1074	.00113	2.762	0.
2.60	39.252	384.67	43.659	.04453	45.077	.04600	1.2280	.00125	2.724	0.
2.80	37.720	369.75	48.690	.04968	50.274	.05130	1.3514	.00138	2.680	0.
3.00	36.338	356.11	53.942	.05504	55.677	.05681	1.4775	.00151	2.654	0.
3.20	35.062	343.61	59.394	.06061	61.282	.06253	1.6063	.00164	2.621	0.
3.40	33.885	332.07	65.046	.06637	67.096	.06846	1.7377	.00177	2.590	0.
3.60	32.798	321.42	70.891	.07234	73.095	.07459	1.8717	.00191	2.561	0.
3.80	31.790	311.54	76.919	.07849	79.286	.08090	2.0083	.00205	2.533	0.
4.00	30.851	302.34	83.134	.08483	85.668	.08742	2.1474	.00219	2.507	0.
4.20	29.976	293.76	89.550	.09138	92.254	.09414	2.2892	.00234	2.481	0.
4.40	29.157	285.73	96.133	.09810	99.010	.10103	2.4334	.00248	2.458	0.
4.60	28.389	278.21	102.91	.10501	105.97	.10813	2.5802	.00263	2.435	0.
4.80	27.666	271.15	109.87	.11212	113.11	.11541	2.7295	.00279	2.413	0.

BISMUTH

PRCTGN ENERGY MEV	ENERGY LOSS MEV/GM2	MEV/CM	PROTON RANGE GM/CM2	CM	PROTON PATH LENGTH GM/CM2	CM	GM/CM2	PATH LENGTH STRAGGLING CM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	26.990	264.50	.11701	.01194	.12042	.01229	.00288	.00029	2.393	2.835	0.
5.50	25.456	249.47	.13562	.01384	.13951	.01424	.00327	.00033	2.345	2.783	0.
6.00	24.116	236.33	.15533	.01585	.15970	.01630	.00368	.00038	2.301	2.736	0.
6.50	22.930	224.71	.17609	.01797	.18097	.01847	.00409	.00042	2.263	2.693	0.
7.00	21.851	214.14	.19791	.02019	.20330	.02075	.00453	.00046	2.227	2.654	0.
7.50	20.925	205.06	.22077	.02253	.22670	.02313	.00498	.00051	2.196	2.618	0.
8.00	20.085	196.84	.24459	.02496	.25108	.02562	.00545	.00056	2.169	2.585	0.
8.50	19.322	189.36	.26943	.02749	.27649	.02821	.00593	.00061	2.144	2.554	0.
9.00	18.624	182.52	.29522	.03012	.30287	.03090	.00643	.00066	2.122	2.526	0.
9.50	17.984	176.24	.32193	.03285	.33019	.03369	.00694	.00071	2.102	2.499	0.
10.00	17.394	170.46	.34958	.03567	.35845	.03658	.00747	.00076	2.084	2.475	.00061
11.00	16.340	160.13	.40767	.04160	.41782	.04263	.00857	.00087	2.050	2.430	.00002
12.00	15.425	151.16	.46936	.04789	.48085	.04907	.00971	.00099	2.020	2.390	.00004
13.00	14.631	143.38	.53456	.05455	.54745	.05586	.01091	.00111	1.992	2.354	.00007
14.00	13.991	137.11	.60302	.06153	.61736	.06320	.01214	.00124	1.966	2.322	.00012
15.00	13.352	130.85	.67469	.06885	.69052	.07046	.01340	.00137	1.941	2.293	.00019
16.00	12.781	125.25	.74965	.07650	.76703	.07827	.01472	.00150	1.919	2.266	.00027
17.00	12.264	120.18	.82803	.08449	.84702	.08643	.01608	.00164	1.898	2.241	.00038
18.00	11.793	115.57	.90960	.09282	.93024	.09492	.01748	.00178	1.879	2.218	.00051
19.00	11.362	111.35	.99422	.10145	1.0166	.10373	.01892	.00193	1.861	2.198	.00067
20.00	10.967	107.48	1.0820	.11040	1.1060	.11286	.02040	.00208	1.845	2.177	.00084
22.00	10.267	100.62	1.2670	.12928	1.2947	.13211	.02349	.00240	1.814	2.142	.00126
24.00	9.6643	94.710	1.4641	.14959	1.4956	.15261	.02672	.00273	1.787	2.111	.00176
26.00	9.1392	89.564	1.6730	.17071	1.7085	.17434	.03011	.00307	1.762	2.083	.00270
28.00	8.6770	85.035	1.8935	.19322	1.9333	.19728	.03363	.00343	1.740	2.058	.00409
30.00	8.2665	81.012	2.1252	.21686	2.1694	.22136	.03730	.00381	1.719	2.036	.00552
32.00	7.8993	77.413	2.3685	.24168	2.4172	.24665	.04110	.00419	1.700	2.015	.00702
34.00	7.5672	74.159	2.6224	.26760	2.6759	.27305	.04503	.00460	1.683	1.997	.00856
36.00	7.2705	71.251	2.8873	.29463	2.9457	.30058	.04910	.00501	1.667	1.980	.01015
38.00	7.0000	68.600	3.1626	.32272	3.2260	.32918	.05328	.00544	1.652	1.964	.01179
40.00	6.7683	66.330	3.4478	.35182	3.5164	.35881	.05757	.00587	1.637	1.950	.01348
45.00	6.2266	61.020	4.2057	.42915	4.2879	.43755	.06877	.00702	1.604	1.918	.01786
50.00	5.7809	56.653	5.0246	.51271	5.1214	.52259	.08076	.00824	1.577	1.891	.02248
55.00	5.4051	52.970	5.9050	.60255	6.0174	.61402	.09348	.00954	1.553	1.868	.02734
60.00	5.0840	49.823	6.8428	.69825	6.9717	.71139	.10690	.01091	1.533	1.848	.03244
65.00	4.8060	47.099	7.8373	.79973	7.9834	.81464	.12098	.01235	1.515	1.830	.03776
70.00	4.5628	44.715	8.8871	.90684	9.0513	.92361	.13570	.01385	1.499	1.815	.04330
75.00	4.3481	42.612	9.9921	1.0196	10.175	1.0383	.15104	.01541	1.484	1.801	.04903
80.00	4.1574	40.742	11.148	1.1376	11.351	1.1583	.16696	.01704	1.471	1.789	.05494
90.00	3.8324	37.558	13.609	1.3886	13.054	1.4136	.20049	.02046	1.447	1.768	.06722

BISMUTH

PROTON ENERGY MEV	ENERGY LOSS MEV/CH2	PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
		GH/CH2	CH	GM/CH2	CM	GM/CH2	CM		
100.00	3.5657	16.271	1.6603	16.561	1.6899	.23614	.02410	1.426	.08004
110.00	3.3429	19.121	1.9511	19.459	1.9856	.27380	.02794	1.407	.09336
120.00	3.1547	22.151	2.2803	22.539	2.2999	.31330	.03197	1.390	.10719
130.00	2.9928	25.349	2.5867	25.790	2.6317	.35454	.03618	1.375	.12143
140.00	2.8521	28.717	2.9303	29.214	2.9810	.39742	.04055	1.360	.13603
150.00	2.7286	32.244	3.2902	32.799	3.3468	.44185	.04509	1.347	.15092
160.00	2.6194	35.923	3.6657	36.539	3.7285	.48776	.04977	1.335	.16609
170.00	2.5220	39.752	4.0563	40.431	4.1256	.53506	.05460	1.323	.18155
180.00	2.4348	43.724	4.4616	44.468	4.5375	.58370	.05956	1.313	.19724
190.00	2.3561	47.831	4.8807	48.642	4.9634	.63359	.06465	1.303	.21311
200.00	2.2848	52.066	5.3129	52.946	5.4027	.68469	.06987	1.293	.22914
210.00	2.2200	56.436	5.7588	57.389	5.8559	.73693	.07520	1.284	.24523
220.00	2.1607	60.928	6.2172	61.953	6.3211	.79026	.08064	1.276	.26131
230.00	2.1085	65.540	6.6877	66.646	6.8000	.84456	.08618	1.267	.27735
240.00	2.0582	70.260	7.1694	71.437	7.2895	.89976	.09181	1.260	.29330
250.00	2.0119	75.101	7.6634	76.356	7.7914	.95592	.09754	1.252	.30916
260.00	1.9689	80.049	8.1683	81.385	8.3046	1.01330	.10337	1.245	.32495
270.00	1.9291	85.084	8.6821	86.501	8.8267	1.07090	.10928	1.238	.34072
280.00	1.8920	90.238	9.2080	91.739	9.3611	1.12970	.11528	1.231	.35644
290.00	1.8574	95.491	9.7439	97.076	9.9057	1.18930	.12136	1.225	.37210
300.00	1.8250	100.84	10.290	102.51	10.460	1.2496	.12751	1.219	.38766
310.00	1.7948	106.28	10.845	108.04	11.024	1.3107	.13375	1.213	.40312
320.00	1.7663	111.81	11.409	113.66	11.598	1.3725	.14005	1.208	.41849
330.00	1.7396	117.40	11.980	119.34	12.176	1.4349	.14642	1.202	.43375
340.00	1.7134	123.10	12.561	125.13	12.769	1.4980	.15286	1.197	.44887
350.00	1.6897	128.89	13.152	131.02	13.369	1.5618	.15937	1.192	.46385
360.00	1.6674	134.76	13.751	136.98	13.977	1.6262	.16594	1.187	.47864
370.00	1.6462	140.70	14.357	143.01	14.593	1.6912	.17257	1.193	.49318
380.00	1.6262	146.71	14.970	149.12	15.216	1.7567	.17925	1.178	.50746
390.00	1.6071	152.79	15.591	155.30	15.847	1.8227	.18599	1.174	.52149
400.00	1.5891	158.95	16.220	161.56	16.486	1.8892	.19278	1.169	.53525
410.00	1.5720	165.25	16.863	167.96	17.139	1.9562	.19961	1.165	.54877
420.00	1.5557	171.55	17.505	174.36	17.791	2.0237	.20650	1.161	.56206
430.00	1.5402	177.90	18.153	180.81	18.450	2.0915	.21342	1.157	.57510
440.00	1.5254	184.32	18.808	187.34	19.116	2.1599	.22039	1.153	.58791
450.00	1.5113	190.80	19.470	193.92	19.788	2.2286	.22741	1.149	.60047
460.00	1.4979	197.35	20.137	200.57	20.468	2.2977	.23446	1.146	.61278
470.00	1.4850	203.95	20.811	207.27	21.150	2.3672	.24155	1.142	.62483
480.00	1.4728	210.60	21.490	214.04	21.841	2.4371	.24868	1.139	.63663
490.00	1.4610	217.31	22.175	220.86	22.536	2.5073	.25585	1.135	.64816

BISMUTH

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CM	HEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	CM	PERCENT	PERCENT	
500.00	1.4498	14.206	224.08	22,865	227.73	23.237	2.5779	.26305	1.132	1.602	.65944
510.00	1.4390	14.102	230.89	23,561	234.65	23.944	2.6488	.27028	1.129	1.601	.67046
520.00	1.4287	14.001	237.76	24,261	241.63	24.656	2.7200	.27755	1.126	1.601	.68122
530.00	1.4188	13.904	244.67	24,967	248.65	25.372	2.7915	.28485	1.123	1.600	.69172
540.00	1.4092	13.811	251.63	25,677	255.72	26.094	2.8633	.29218	1.120	1.599	.70196
550.00	1.4001	13.721	258.64	26,392	262.84	26.821	2.9354	.29953	1.117	1.598	.71194
560.00	1.3913	13.635	265.69	27,112	270.01	27.552	3.0078	.30692	1.114	1.597	.72167
570.00	1.3829	13.552	272.79	27,836	277.22	28.287	3.0804	.31433	1.111	1.596	.73114
580.00	1.3748	13.473	279.94	28,565	284.47	29.028	3.1533	.32177	1.108	1.595	.74036
590.00	1.3670	13.396	287.12	29,298	291.77	29.772	3.2264	.32923	1.106	1.594	.74933
600.00	1.3595	13.323	294.34	30,035	299.11	30.521	3.2998	.33672	1.103	1.594	.75805
620.00	1.3453	13.183	308.95	31,525	313.94	32.035	3.4473	.35176	1.093	1.591	.77477
640.00	1.3320	13.054	323.66	33,026	328.89	33.560	3.5956	.36690	1.093	1.590	.79054
660.00	1.3198	12.934	338.57	34,548	344.03	35.105	3.7447	.38211	1.088	1.588	.80539
680.00	1.3083	12.821	353.56	36,077	359.26	36.659	3.8946	.39741	1.084	1.587	.81936
700.00	1.2976	12.717	368.68	37,620	374.62	38.226	4.0452	.41278	1.080	1.585	.83247
720.00	1.2876	12.619	383.92	39,175	390.10	39.806	4.1965	.42821	1.076	1.584	.84477
740.00	1.2783	12.527	399.28	40,743	405.70	41.398	4.3484	.44371	1.072	1.582	.85629
760.00	1.2695	12.441	414.74	42,321	421.40	43.000	4.5009	.45927	1.068	1.581	.86706
780.00	1.2613	12.361	430.31	43,910	437.22	44.614	4.6540	.47489	1.064	1.579	.87712
800.00	1.2536	12.286	445.98	45,509	453.13	46.238	4.8076	.49057	1.061	1.578	.88450
820.00	1.2464	12.215	461.76	47,118	469.15	47.872	4.9617	.50629	1.058	1.576	.89525
840.00	1.2396	12.148	477.61	48,736	485.25	49.515	5.1162	.52207	1.054	1.574	.90340
860.00	1.2332	12.086	493.55	50,363	501.44	51.167	5.2713	.53789	1.051	1.572	.91097
880.00	1.2272	12.027	509.58	51,990	517.72	52.828	5.4267	.55375	1.048	1.571	.91801
900.00	1.2216	11.971	525.69	53,642	534.07	54.497	5.5826	.56965	1.045	1.569	.92454
920.00	1.2162	11.919	541.88	55,294	550.51	56.174	5.7389	.58560	1.042	1.567	.93060
940.00	1.2112	11.870	558.15	56,954	567.02	57.859	5.8955	.60158	1.040	1.565	.93621
960.00	1.2063	11.823	574.48	58,621	583.60	59.551	6.0525	.61760	1.037	1.563	.94140
1000.00	1.1978	11.738	607.45	61,986	617.06	62.965	6.3074	.64373	1.032	1.555	.95059

THE ELECTRON DENSITY OF BISMUTH IS 2.393E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 1.914 BEV, AND THE MINIMUM ENERGY LOSS IS 1.1340 MEV/GH/CM2

BORON

ELEMENT NUMBER 5
 ATOMIC MOLECULE 1
 ATOMIC WEIGHT 10.811
 ADJUSTED IONIZATION POTENTIAL 67.10

DENSITY = 2.3000 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS MEV/GH/CH2	GH/CH2	MEV/CH	PROTON RANGE MG/CH2	MM	PROTON RANGE MG/CH2	MM	PROTON PATH LENGTH, MG/CM2	MM	ATOMIC WEIGHT	MOLECULE	ADJUSTED IONIZATION POTENTIAL	MG. M2	PATH LENGTH STRAGGLING MM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	761.40	1751.2	.1434	.00063	.00063	.14525	.00045	.00460	.00002	3.164	.6253	0.					
.15	675.34	1553.3	.21396	.00093	.00093	.21494	.00093	.00606	.00003	2.817	.4524	0.					
.20	600.38	1388.9	.29231	.00127	.00127	.29342	.00128	.00769	.00003	2.622	.3771	0.					
.30	485.19	1115.9	.47782	.00208	.00208	.47929	.00208	.01151	.00005	2.401	.3074	0.					
.40	408.52	939.60	.70274	.00306	.00306	.70467	.00306	.01603	.00007	2.275	.2735	0.					
.50	356.23	819.34	.96487	.00420	.00420	.96732	.00420	.02113	.00009	2.185	.2529	0.					
.60	316.74	728.50	1.2623	.00549	.00549	1.2653	.00550	.02673	.00012	2.113	.2388	0.					
.70	285.02	655.55	1.5944	.00693	.00693	1.5980	.00695	.03283	.00014	2.055	.2283	0.					
.80	261.46	601.36	1.9600	.00852	.00852	1.9644	.00854	.03939	.00017	2.005	.2200	0.					
.90	240.89	554.04	2.3575	.01025	.01025	2.3625	.01027	.04637	.00020	1.963	.2134	0.					
1.00	220.29	506.67	2.7908	.01213	.01213	2.7966	.01216	.05397	.00023	1.930	.2077	0.					
1.20	194.58	447.53	3.7569	.01633	.01633	3.7644	.01637	.07064	.00031	1.876	.1989	0.					
1.40	174.83	402.12	4.8412	.02105	.02105	4.8506	.02109	.08864	.00039	1.822	.1922	.00001					
1.60	159.11	365.94	6.0404	.02626	.02626	6.0518	.02631	.10799	.00047	1.784	.1869	.00002					
1.80	146.24	336.34	7.3511	.03196	.03196	7.3646	.03202	.12869	.00056	1.747	.1825	.00003					
2.00	135.48	311.60	8.7708	.03813	.03813	8.7865	.03820	.15071	.00066	1.715	.1786	.00004					
2.20	126.34	290.58	10.298	.04477	.04477	10.316	.04485	.17405	.00076	1.687	.1755	.00006					
2.40	118.46	272.46	11.931	.05187	.05187	11.952	.05196	.19870	.00086	1.662	.1727	.00009					
2.60	111.50	256.68	13.669	.05943	.05943	13.692	.05953	.22462	.00098	1.641	.1701	.00012					
2.80	105.22	242.01	15.513	.06745	.06745	15.539	.06756	.25187	.00110	1.621	.1679	.00015					
3.00	99.924	229.03	17.461	.07592	.07592	17.490	.07604	.28055	.00122	1.604	.1658	.00019					
3.20	95.177	218.91	19.510	.08483	.08483	19.542	.08497	.31042	.00135	1.588	.1639	.00023					
3.40	90.899	209.07	21.657	.09416	.09416	21.692	.09431	.34147	.00148	1.574	.1623	.00028					
3.60	87.021	200.15	23.902	.10392	.10392	23.940	.10409	.37370	.00162	1.561	.1608	.00033					
3.80	83.489	192.03	26.246	.11411	.11411	26.288	.11430	.40710	.00177	1.549	.1593	.00038					
4.00	80.258	184.59	28.688	.12473	.12473	28.734	.12493	.44166	.00192	1.537	.1580	.00044					
4.20	77.289	177.76	31.221	.13574	.13574	31.270	.13596	.47738	.00208	1.527	.1567	.00049					
4.40	74.551	171.47	33.855	.14720	.14720	33.908	.14742	.51424	.00224	1.517	.1556	.00055					
4.60	72.017	165.64	36.577	.15903	.15903	36.634	.15928	.55223	.00240	1.507	.1545	.00062					
4.80	69.665	160.23	39.400	.17130	.17130	39.461	.17157	.59135	.00257	1.499	.1535	.00068					

BORON

PRCTCN ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	PAT. LENGTH STRAGGLING GM/CM2	PAT. LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	67.476	.04231	.04237	.01842	.00063	.00027	1.490	.00114
5.50	62.609	.05000	.05008	.02177	.00074	.00032	1.472	.00455
6.00	58.453	.05826	.05833	.02533	.00085	.00037	1.455	.00795
6.50	54.858	.06708	.06718	.02921	.00097	.00042	1.441	.01132
7.00	51.716	.07646	.07657	.03325	.00109	.00048	1.428	.01488
7.50	48.944	.08539	.08552	.03756	.00123	.00053	1.416	.01803
8.00	46.479	.09587	.09701	.04218	.00136	.00059	1.406	.02137
8.50	44.272	.10788	.10803	.04690	.00151	.00066	1.396	.02470
9.00	42.283	.11942	.11959	.05192	.00166	.00072	1.387	.02802
9.50	40.481	.13150	.13168	.05717	.00182	.00079	1.379	.03134
10.00	38.839	.14409	.14429	.06273	.00198	.00086	1.371	.03466
11.00	35.958	.17084	.17107	.07438	.00232	.00101	1.358	.04127
12.00	33.510	.19963	.19990	.08691	.00269	.00117	1.345	.04787
13.00	31.401	.23044	.23075	.10033	.00308	.00134	1.334	.05145
14.00	29.565	.26323	.26358	.11460	.00349	.00152	1.325	.06103
15.00	27.950	.29799	.29839	.12973	.00393	.00171	1.316	.06759
16.00	26.519	.33469	.33513	.14571	.00438	.00191	1.307	.07415
17.00	25.240	.37331	.37380	.16252	.00486	.00211	1.300	.08070
18.00	24.091	.41383	.41437	.18016	.00536	.00233	1.293	.08724
19.00	23.052	.45622	.45681	.19836	.00588	.00255	1.286	.09377
20.00	22.107	.50047	.50112	.21760	.00642	.00279	1.280	.10029
22.00	20.454	.59449	.59525	.25881	.00755	.00328	1.269	.11331
24.00	19.053	.69576	.69664	.30289	.00877	.00381	1.259	.12628
26.00	17.851	.80414	.80515	.35007	.01007	.00438	1.250	.13395
28.00	16.806	.91954	.92069	.40030	.01144	.00497	1.242	.13619
30.00	15.890	1.0418	1.0431	.45354	.01288	.00560	1.235	.13851
32.00	15.079	1.1709	1.1724	.50971	.01439	.00626	1.228	.14090
34.00	14.356	1.3068	1.3084	.56886	.01598	.00695	1.221	.14337
36.00	13.708	1.4492	1.4510	.63086	.01763	.00767	1.215	.14589
38.00	13.122	1.5982	1.6002	.69572	.01935	.00841	1.209	.14847
40.00	12.591	1.7537	1.7558	.76339	.02114	.00919	1.204	.15109
45.00	11.455	2.1701	2.1727	.94465	.02590	.01126	1.192	.15781
50.00	10.530	2.6253	2.6284	1.1428	.03105	.01350	1.181	.16468
55.00	9.7631	3.1183	3.1220	1.3574	.03658	.01591	1.172	.17176
60.00	9.1153	3.6481	3.6524	1.5880	.04248	.01847	1.163	.17915
65.00	8.5608	4.2138	4.2188	1.8342	.04873	.02119	1.155	.18679
70.00	8.0805	4.8146	4.8202	2.0958	.05532	.02405	1.148	.19464
75.00	7.6603	5.4497	5.4561	2.3722	.06225	.02706	1.141	.20267
80.00	7.2895	6.1183	6.1254	2.6601	.06949	.03021	1.134	.21083
90.00	6.6645	7.5533	7.5620	3.2878	.08490	.03691	1.123	.22745

BORON

PROTON ENERGY NEV	ENERGY LOSS HEV/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PATH LENGTH STRAGGLING GM/CM2	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	6.1577	9.1142	9.1247	.10148	.1146	.24424
110.00	5.7384	10.796	10.808	.11918	.1141	.26135
120.00	5.3854	12.594	12.609	.13792	.1136	.27896
130.00	5.0841	14.504	14.521	.15765	.1132	.29694
140.00	4.8239	16.522	16.541	.17833	.1128	.31519
150.00	4.5969	18.645	18.666	.19991	.1124	.33360
160.00	4.3971	20.867	20.891	.22235	.1121	.35219
170.00	4.2199	23.187	23.213	.24560	.1118	.37063
180.00	4.0617	25.600	25.629	.26962	.1115	.38912
190.00	3.9195	28.105	28.136	.29439	.1112	.40751
200.00	3.7911	30.697	30.731	.31987	.1110	.42573
210.00	3.6746	33.374	33.411	.34603	.1108	.44365
220.00	3.5684	36.133	36.173	.37283	.1106	.46115
230.00	3.4712	39.071	39.114	.40026	.1103	.47821
240.00	3.3819	41.887	41.934	.42827	.1101	.49478
250.00	3.2996	44.678	44.928	.45686	.1100	.51086
260.00	3.2235	47.942	47.994	.48600	.1098	.52654
270.00	3.1530	51.075	51.131	.51566	.1096	.54192
280.00	3.0875	54.277	54.337	.54582	.1094	.55698
290.00	3.0265	57.545	57.608	.57647	.1093	.57171
300.00	2.9695	60.878	60.944	.60759	.1091	.58609
310.00	2.9162	64.273	64.343	.63915	.1090	.60028
320.00	2.8662	67.728	67.802	.67114	.1088	.61445
330.00	2.8192	71.243	71.320	.70354	.1087	.62855
340.00	2.7751	74.814	74.896	.73634	.1085	.64255
350.00	2.7334	78.442	78.527	.76953	.1084	.65644
360.00	2.6941	82.123	82.212	.80308	.1082	.67018
370.00	2.6570	85.857	85.950	.83699	.1081	.68378
380.00	2.6219	89.642	89.739	.87125	.1080	.69720
390.00	2.5886	93.476	93.577	.90583	.1078	.71042
400.00	2.5570	97.359	97.464	.94074	.1077	.72341
410.00	2.5270	101.29	101.40	.97596	.1076	.73605
420.00	2.4984	105.27	105.38	1.0115	.1075	.74825
430.00	2.4713	109.29	109.40	1.0473	.1073	.75999
440.00	2.4454	113.35	113.47	1.0834	.1072	.77129
450.00	2.4207	117.46	117.58	1.1197	.1071	.78216
460.00	2.3972	121.61	121.73	1.1563	.1070	.79260
470.00	2.3746	125.79	125.92	1.1932	.1068	.80262
480.00	2.3531	130.02	130.15	1.2303	.1067	.81224
490.00	2.3325	134.28	134.42	1.2676	.1066	.82146

BORON

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT		PROBABILITY OF INELASTIC NUCLEAR INTERACTION	
	MEV/CM2	MEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	PERCENT	PERCENT	PERCENT	PERCENT	
500.00	2.3128	5.3194	138.58	60.253	138.73	60.317	1.3052	.56748	.9408	.1065	.83029	
510.00	2.2939	5.2759	142.92	62.138	143.07	62.205	1.3430	.58391	.9387	.1064	.83874	
520.00	2.2757	5.2341	147.29	64.040	147.45	64.108	1.3810	.60044	.9366	.1062	.84683	
530.00	2.2582	5.1940	151.70	65.956	151.86	66.026	1.4192	.61706	.9346	.1061	.85456	
540.00	2.2415	5.1554	156.14	67.886	156.30	67.958	1.4577	.63376	.9326	.1060	.86195	
550.00	2.2254	5.1183	160.61	69.831	160.78	69.905	1.4963	.65056	.9306	.1059	.86901	
560.00	2.2098	5.0826	165.12	71.790	165.29	71.866	1.5351	.66744	.9287	.1058	.87575	
570.00	2.1949	5.0483	169.65	73.762	169.83	73.840	1.5741	.68440	.9269	.1057	.88217	
580.00	2.1805	5.0152	174.22	75.747	174.40	75.827	1.6133	.70144	.9250	.1056	.88839	
590.00	2.1667	4.9833	178.82	77.746	179.00	77.828	1.6527	.71856	.9233	.1055	.89414	
600.00	2.1533	4.9526	183.44	79.757	183.63	79.841	1.6922	.73576	.9215	.1053	.89970	
620.00	2.1279	4.8943	192.77	83.215	192.98	83.903	1.7718	.77037	.9152	.1051	.91004	
640.00	2.1043	4.8399	202.22	87.920	202.43	88.012	1.8521	.80526	.9149	.1049	.91939	
660.00	2.0822	4.7891	211.76	92.070	211.98	92.167	1.9330	.84043	.9119	.1047	.92784	
680.00	2.0616	4.7416	221.40	96.263	221.64	96.364	2.0145	.87586	.9089	.1045	.93546	
700.00	2.0422	4.6971	231.14	100.50	231.38	100.60	2.0965	.91153	.9061	.1042	.94233	
720.00	2.0241	4.6553	240.97	104.77	241.22	104.88	2.1791	.94744	.9034	.1040	.94851	
740.00	2.0070	4.6161	250.88	109.08	251.15	109.19	2.2622	.98357	.9008	.1038	.95405	
760.00	1.9909	4.5791	260.88	113.43	261.15	113.54	2.3458	1.0199	.8983	.1036	.95903	
780.00	1.9758	4.5443	270.96	117.81	271.24	117.93	2.4299	1.0565	.8959	.1034	.96350	
800.00	1.9615	4.5115	281.11	122.22	281.40	122.35	2.5145	1.0932	.8936	.1032	.96750	
820.00	1.9480	4.4805	291.33	126.66	291.63	126.80	2.5995	1.1302	.8914	.1029	.97107	
840.00	1.9353	4.4512	301.62	131.14	301.93	131.27	2.6849	1.1673	.8892	.1027	.97427	
860.00	1.9233	4.4235	311.98	135.64	312.30	135.78	2.7708	1.2047	.8872	.1025	.97712	
880.00	1.9118	4.3973	322.40	140.18	322.73	140.32	2.8570	1.2422	.8853	.1023	.97967	
900.00	1.9010	4.3724	332.89	144.73	333.23	144.88	2.9436	1.2798	.8834	.1021	.98194	
920.00	1.8908	4.3488	343.44	149.32	343.79	149.47	3.0307	1.3177	.8816	.1019	.98396	
940.00	1.8810	4.3264	354.04	153.93	354.40	154.09	3.1180	1.3557	.8798	.1017	.98577	
960.00	1.8718	4.3051	364.71	158.57	365.08	158.73	3.2058	1.3938	.8781	.1014	.98737	
1000.00	1.8546	4.2657	386.29	167.95	386.68	168.12	3.3823	1.4706	.8747	.1008	.99007	

THE ELECTRON DENSITY OF BORON IS 2.786E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.317 BEV, AND THE MINIMUM ENERGY LOSS IS 1.6801 MEV/GM/CM2

CADMIUM

ELEMENT CD
 ATOMIC NUMBER 48
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 112.40
 ADJUSTED IONIZATION POTENTIAL 468.0

DENSITY = 8.6500 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION	
	MEV/GM/CM2	MEV/CM	MG/CM2	MM	MG/CM2	MM	MG/CM2	MM PERCENT			
.10	250.93	2170.6	.79764	.00092	.82741	.00096	.03928	.00005	4.747	3.598	0.
.15	225.31	1948.9	1.0064	.00116	1.0376	.00120	.04312	.00005	4.156	3.009	0.
.20	203.98	1764.4	1.2362	.00143	1.2707	.00147	.04772	.00006	3.755	2.717	0.
.30	171.49	1483.4	1.7627	.00204	1.8068	.00209	.05945	.00007	3.290	2.442	0.
.40	148.78	1286.9	2.3781	.00275	2.4343	.00281	.07614	.00009	3.128	2.311	0.
.50	132.28	1144.2	3.0779	.00356	3.1492	.00364	.09649	.00011	3.065	2.233	0.
.60	119.62	1034.7	3.8581	.00446	3.9440	.00456	.11938	.00014	3.027	2.177	0.
.70	109.59	947.95	4.7155	.00543	4.8183	.00557	.14424	.00017	2.994	2.134	0.
.80	102.15	883.57	5.6445	.00653	5.7654	.00667	.17051	.00020	2.957	2.097	0.
.90	96.595	835.55	6.6312	.00767	6.7712	.00783	.19730	.00023	2.914	2.066	0.
1.00	91.040	787.50	7.6784	.00888	7.8381	.00906	.22479	.00026	2.868	2.038	0.
1.20	82.581	714.33	9.9468	.01150	10.149	.01173	.28229	.00033	2.782	1.988	0.
1.40	75.981	657.23	12.430	.01437	12.676	.01465	.34220	.00040	2.700	1.944	0.
1.60	70.554	610.29	15.118	.01748	15.411	.01782	.40450	.00047	2.625	1.905	0.
1.80	66.013	571.01	18.001	.02081	18.344	.02121	.46936	.00054	2.559	1.869	0.
2.00	62.183	537.86	21.073	.02436	21.467	.02482	.53814	.00062	2.507	1.837	0.
2.20	58.869	509.21	24.326	.02812	24.774	.02864	.61060	.00071	2.465	1.807	0.
2.40	55.966	484.11	27.757	.03209	28.260	.03267	.68627	.00079	2.428	1.779	0.
2.60	53.545	463.16	31.360	.03625	31.920	.03690	.76472	.00088	2.396	1.754	0.
2.80	51.227	443.11	35.117	.04060	35.736	.04131	.84530	.00098	2.365	1.731	0.
3.00	49.141	425.07	39.043	.04514	39.722	.04592	.92844	.00107	2.337	1.708	0.
3.20	47.250	408.71	43.136	.04987	43.876	.05072	1.0140	.00117	2.311	1.688	0.
3.40	45.525	393.80	47.389	.05478	48.193	.05571	1.1019	.00127	2.286	1.668	0.
3.60	43.944	380.12	51.794	.05988	52.663	.06088	1.1920	.00138	2.264	1.650	0.
3.80	42.488	367.52	56.354	.06515	57.290	.06623	1.2844	.00148	2.242	1.633	0.
4.00	41.138	355.85	61.072	.07060	62.076	.07176	1.3788	.00159	2.221	1.617	0.
4.20	39.891	345.06	65.943	.07623	67.016	.07748	1.4754	.00171	2.202	1.601	0.
4.40	38.730	335.02	70.956	.08203	72.100	.08335	1.5739	.00182	2.183	1.587	0.
4.60	37.647	325.65	76.129	.08801	77.346	.08942	1.6745	.00194	2.165	1.573	0.
4.80	36.634	316.89	81.436	.09415	82.726	.09564	1.7770	.00205	2.148	1.560	0.

CADMIUM

PRCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION	
	MEV/GM/CM2	MEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	PERCENT			
5.00	35.684	308.66	.08689	.01005	.08826	.01020	.00188	.00022	2.132	1.547	0.
5.50	33.547	290.13	.10116	.01169	.10272	.01187	.00215	.00025	2.094	1.510	0.
6.00	31.574	273.98	.11630	.01345	.11807	.01365	.00243	.00028	2.059	1.492	0.
6.50	30.035	259.80	.13231	.01530	.13428	.01552	.00272	.00031	2.028	1.469	.00001
7.00	28.501	247.23	.14917	.01724	.15136	.01750	.00303	.00035	2.000	1.448	.00001
7.50	27.305	236.19	.16684	.01929	.16926	.01957	.00334	.00039	1.973	1.428	.00002
8.00	26.154	226.23	.18533	.02143	.18798	.02173	.00366	.00042	1.949	1.411	.00004
8.50	25.109	217.19	.20460	.02365	.20750	.02399	.00400	.00046	1.926	1.394	.00005
9.00	24.155	208.94	.22466	.02597	.22780	.02634	.00434	.00050	1.905	1.379	.00007
9.50	23.281	201.38	.24549	.02838	.24889	.02877	.00469	.00054	1.885	1.365	.00010
10.00	22.477	194.43	.26710	.03098	.27076	.03130	.00505	.00058	1.866	1.352	.00013
11.00	21.047	182.65	.31255	.03613	.31676	.03662	.00580	.00067	1.832	1.328	.00021
12.00	19.819	171.43	.36096	.04173	.36574	.04228	.00659	.00076	1.802	1.307	.00031
13.00	18.742	162.12	.41229	.04766	.41767	.04829	.00742	.00086	1.775	1.288	.00044
14.00	17.794	153.92	.46643	.05392	.47244	.05462	.00828	.00096	1.752	1.271	.00059
15.00	16.947	146.60	.52340	.06051	.53006	.06128	.00918	.00106	1.732	1.256	.00077
16.00	16.187	140.02	.58312	.06741	.59040	.06826	.01017	.00117	1.713	1.242	.00097
17.00	15.500	134.08	.64556	.07463	.65359	.07556	.01109	.00128	1.697	1.229	.00120
18.00	14.876	128.68	.71069	.08216	.71945	.08317	.01210	.00140	1.682	1.217	.00149
19.00	14.307	123.75	.77852	.09000	.78803	.09110	.01314	.00152	1.668	1.207	.00207
20.00	13.785	119.24	.84898	.09815	.85926	.09934	.01422	.00164	1.655	1.196	.00267
22.00	12.860	111.24	.99772	.11534	1.0096	.11672	.01648	.00190	1.632	1.178	.00659
24.00	12.068	104.38	1.1567	.13372	1.1703	.13529	.01886	.00218	1.611	1.162	.01063
26.00	11.379	98.424	1.3257	.15325	1.3411	.15503	.02136	.00247	1.593	1.148	.01339
28.00	10.775	93.205	1.5045	.17393	1.5218	.17593	.02399	.00277	1.576	1.136	.01482
30.00	10.240	88.576	1.6930	.19572	1.7123	.19795	.02673	.00309	1.561	1.125	.01632
32.00	9.7628	84.448	1.8910	.21862	1.9124	.22108	.02959	.00342	1.547	1.114	.01787
34.00	9.3333	80.733	2.0985	.24261	2.1220	.24532	.03256	.00376	1.534	1.105	.01947
36.00	8.9495	77.413	2.3153	.26766	2.3409	.27063	.03563	.00412	1.522	1.097	.02113
38.00	8.6007	74.396	2.5409	.29375	2.5689	.29698	.03881	.00449	1.511	1.089	.02283
40.00	8.2819	71.638	2.7756	.32088	2.8060	.32439	.04210	.00487	1.500	1.082	.02459
45.00	7.5943	65.690	3.4005	.39312	3.4372	.39736	.05074	.00587	1.476	1.067	.02916
50.00	7.0280	60.792	4.0788	.47154	4.1222	.47656	.05999	.00694	1.455	1.054	.03397
55.00	6.5531	56.684	4.8089	.55595	4.8596	.56180	.06981	.00807	1.437	1.043	.03902
60.00	6.1488	53.187	5.5895	.64618	5.6478	.65292	.08020	.00927	1.420	1.033	.04433
65.00	5.8002	50.172	6.4192	.74210	6.4856	.74978	.09112	.01053	1.405	1.025	.04987
70.00	5.4964	47.544	7.2966	.84354	7.3716	.85221	.10255	.01186	1.391	1.017	.05562
75.00	5.2291	45.232	8.2206	.95036	8.3046	.96007	.11449	.01324	1.379	1.011	.06156
80.00	4.9920	43.181	9.1903	1.0625	9.2837	1.0733	.12691	.01467	1.367	1.005	.06768
90.00	4.5898	39.702	11.262	1.3020	11.375	1.3151	.15313	.01770	1.346	.9952	.08037

CADMIUM

PRCTON ENERGY HEV	ENERGY LOSS HEV/CM		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	GM/CM2	HEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	CM	PERCENT	PERCENT	
100.00	4.2613	36.860	13.504	1.5612	13.639	1.5767	.18111	.02094	1.328	.9869	.09355
110.00	3.9677	34.494	15.909	1.8392	16.066	1.8574	.21073	.02436	1.312	.9800	.10721
120.00	3.7587	32.513	18.469	2.1352	18.651	2.1562	.24189	.02796	1.297	.9742	.12137
130.00	3.5598	30.752	21.121	2.4486	21.368	2.4726	.27447	.03173	1.283	.9691	.13595
140.00	3.3872	29.299	24.034	2.7785	24.268	2.8056	.30846	.03566	1.271	.9647	.15088
150.00	3.2362	27.993	27.026	3.1244	27.288	3.1547	.34377	.03974	1.260	.9608	.16608
160.00	3.1029	26.840	30.155	3.4861	30.445	3.5.98	.38033	.04397	1.249	.9573	.18154
170.00	2.9844	25.815	33.413	3.8627	33.735	3.9000	.41808	.04833	1.239	.9543	.19727
180.00	2.8783	24.897	36.793	4.2536	37.147	4.2944	.45696	.05283	1.230	.9515	.21322
190.00	2.7827	24.071	40.295	4.6584	40.681	4.7030	.49691	.05745	1.221	.9490	.22932
200.00	2.6963	23.323	43.914	5.0767	44.333	5.1252	.53789	.06218	1.213	.9468	.24555
210.00	2.6171	22.638	47.642	5.5078	48.097	5.5603	.57984	.06704	1.206	.9447	.26182
220.00	2.5453	22.017	51.483	5.9518	51.973	6.0084	.62277	.07200	1.198	.9428	.27806
230.00	2.4795	21.448	55.428	6.4078	55.954	6.4687	.66657	.07706	1.191	.9411	.29424
240.00	2.4190	20.924	59.476	6.8759	60.040	6.9411	.71122	.08222	1.185	.9395	.31032
250.00	2.3632	20.442	63.618	7.3547	64.221	7.4243	.75667	.08748	1.178	.9380	.32627
260.00	2.3115	19.995	67.858	7.8449	68.500	7.9190	.80290	.09282	1.172	.9367	.34218
270.00	2.2636	19.580	72.100	8.3457	72.872	8.4245	.84987	.09825	1.166	.9354	.35810
280.00	2.2190	19.195	76.611	8.8568	77.334	8.9403	.89755	.10376	1.161	.9343	.37401
290.00	2.1775	18.835	81.123	9.3783	81.887	9.4667	.94591	.10935	1.155	.9331	.38989
300.00	2.1387	18.499	85.715	9.9092	86.521	10.002	.99492	.11502	1.150	.9320	.40572
310.00	2.1023	18.185	90.386	10.449	91.236	10.547	1.0446	.12076	1.145	.9310	.42144
320.00	2.0682	17.890	95.139	10.999	96.032	11.102	1.0948	.12656	1.140	.9301	.43701
330.00	2.0361	17.613	99.968	11.557	100.91	11.665	1.1456	.13244	1.135	.9292	.45242
340.00	2.0060	17.352	104.87	12.124	105.85	12.237	1.1969	.13837	1.131	.9283	.46766
350.00	1.9775	17.106	109.85	12.699	110.87	12.818	1.2488	.14437	1.126	.9275	.48270
360.00	1.9507	16.873	114.89	13.282	115.97	13.406	1.3012	.15043	1.122	.9267	.49753
370.00	1.9253	16.654	120.00	13.873	121.13	14.003	1.3541	.15654	1.118	.9259	.51213
380.00	1.9013	16.446	125.18	14.472	126.35	14.607	1.4074	.16271	1.114	.9252	.52651
390.00	1.8785	16.249	130.43	15.078	131.64	15.219	1.4612	.16893	1.110	.9245	.54064
400.00	1.8569	16.062	135.70	15.688	136.96	15.834	1.5155	.17520	1.106	.9238	.55451
410.00	1.8364	15.885	141.06	16.308	142.38	16.460	1.5701	.18152	1.103	.9231	.56814
420.00	1.8169	15.716	146.49	16.935	147.85	17.092	1.6252	.18788	1.099	.9225	.58152
430.00	1.7983	15.558	151.97	17.568	153.38	17.732	1.6806	.19429	1.096	.9218	.59463
440.00	1.7806	15.402	157.50	18.209	158.97	18.378	1.7364	.20074	1.092	.9212	.60749
450.00	1.7637	15.256	163.09	18.855	164.61	19.030	1.7926	.20723	1.089	.9206	.62008
460.00	1.7476	15.117	168.74	19.507	170.30	19.688	1.8491	.21377	1.086	.9200	.63240
470.00	1.7322	14.983	174.43	20.166	176.05	20.353	1.9059	.22034	1.083	.9194	.64445
480.00	1.7175	14.856	180.18	20.830	181.85	21.023	1.9631	.22695	1.080	.9189	.65622
490.00	1.7034	14.734	185.97	21.499	187.69	21.698	2.0206	.23360	1.077	.9183	.66772

CADMIUM

PRCTCN ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/GM/CM2	MEV/CM	GM/CM2	CM	GM/CM2	CM	GH/CH2	CM		
500.00	1.6899	14.618	191.81	22.174	193.58	22.380	2.0784	.24028	1.074	.67894
510.00	1.6770	14.506	197.69	22.855	199.52	23.066	2.1365	.24699	1.071	.68988
520.00	1.6646	14.399	203.62	23.540	205.51	23.758	2.1948	.25374	1.068	.70055
530.00	1.6528	14.297	209.60	24.231	211.53	24.455	2.2534	.26051	1.065	.71094
540.00	1.6414	14.198	215.61	24.926	217.60	25.157	2.3123	.26732	1.063	.72106
550.00	1.6304	14.103	221.67	25.626	223.72	25.863	2.3715	.27416	1.060	.73091
560.00	1.6198	14.012	227.76	26.331	229.87	26.574	2.4308	.28102	1.057	.74049
570.00	1.6098	13.925	233.90	27.040	236.06	27.290	2.4905	.28791	1.055	.74980
580.00	1.6001	13.841	240.07	27.754	242.29	28.010	2.5503	.29483	1.053	.75884
590.00	1.5907	13.760	246.28	28.472	248.55	28.734	2.6104	.30178	1.050	.76763
600.00	1.5817	13.682	252.53	29.194	254.86	29.463	2.6706	.30874	1.048	.77615
620.00	1.5647	13.535	265.13	30.650	267.57	30.932	2.7918	.32275	1.043	.79245
640.00	1.5489	13.398	277.86	32.122	280.41	32.417	2.9138	.33685	1.039	.80776
660.00	1.5341	13.270	290.71	33.609	293.38	33.917	3.0364	.35103	1.039	.82213
680.00	1.5204	13.151	303.69	35.109	306.47	35.430	3.1598	.36529	1.031	.83559
700.00	1.5075	13.040	316.86	36.632	319.77	36.967	3.2838	.37963	1.027	.84817
720.00	1.4955	12.936	330.07	38.158	333.09	38.507	3.4084	.39403	1.023	.85992
740.00	1.4843	12.839	343.37	39.696	346.51	40.059	3.5336	.40851	1.020	.87088
760.00	1.4738	12.748	356.78	41.246	360.04	41.623	3.6593	.42304	1.016	.88108
780.00	1.4640	12.663	370.28	42.807	373.65	43.197	3.7856	.43764	1.013	.89058
800.00	1.4547	12.583	383.86	44.377	387.36	44.781	3.9123	.45229	1.010	.89939
820.00	1.4460	12.508	397.54	45.958	401.15	46.376	4.0395	.46699	1.007	.90757
840.00	1.4376	12.437	411.29	47.548	415.02	47.980	4.1671	.48174	1.004	.91515
860.00	1.4301	12.371	425.12	49.146	428.97	49.592	4.2951	.49654	1.001	.92217
880.00	1.4229	12.308	439.02	50.754	443.00	51.214	4.4235	.51139	.9985	.92866
900.00	1.4161	12.249	452.99	52.369	457.09	52.843	4.5523	.52628	.9959	.93466
920.00	1.4096	12.193	467.03	53.992	471.26	54.481	4.6815	.54121	.9934	.94019
940.00	1.4036	12.141	481.24	55.635	485.59	56.137	4.8110	.55618	.9908	.94530
960.00	1.3979	12.091	495.44	57.276	499.90	57.792	4.9408	.57119	.9883	.94999
1000.00	1.3873	12.001	524.22	60.604	528.93	61.148	5.2013	.60131	.9834	.95824

THE ELECTRON DENSITY OF CADMIUM IS 2.573E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.011 BEV, AND THE MINIMUM ENERGY LOSS IS 1.3040 MEV/GM/CM2

CALCIUM

ELEMENT CA
 ATOMIC NUMBER 20
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 40.080
 ADJUSTED IONIZATION POTENTIAL 211.3

DENSITY = 1.5500 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE MG/CM2	PROTON PATH LENGTH MM	PROTON PATH LENGTH MG/CM2	MG/CM2	PATH LENGTH STRAGGLING MM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	494.16	.37621	.00243	.38321	.00247	.01584	.00010	1.828	0.
.15	436.16	.48350	.00312	.49084	.00317	.01736	.00011	3.537	0.
.20	392.01	.60363	.00389	.61171	.00395	.01937	.00012	1.322	0.
.30	320.34	.88402	.00570	.89418	.00577	.02532	.00016	1.135	0.
.40	265.61	1.2252	.00790	1.2380	.00799	.03367	.00022	1.034	0.
.50	232.60	1.6262	.01049	1.6421	.01059	.04386	.00028	.9693	0.
.60	213.40	2.0721	.01337	2.0914	.01349	.05465	.00035	.9255	0.
.70	189.70	2.5631	.01654	2.5862	.01669	.06622	.00043	.8923	0.
.80	158.71	3.1240	.02015	3.1512	.02033	.08011	.00052	.8655	0.
.90	162.87	3.7217	.02401	3.7534	.02422	.09410	.00061	.8445	0.
1.00	157.03	4.3434	.02802	4.3796	.02826	.10736	.00069	.8271	0.
1.20	140.76	5.6817	.03666	5.7274	.03695	.13455	.00087	.7983	0.
1.40	128.23	7.1622	.04621	7.2180	.04657	.16364	.00106	.7739	0.
1.60	118.12	8.7784	.05664	8.8451	.05706	.19449	.00125	.7532	0.
1.80	109.71	10.526	.06791	10.604	.06841	.22702	.00146	.7352	0.
2.00	102.56	12.400	.08000	12.490	.08058	.26137	.00169	.7194	0.
2.20	96.390	14.400	.09290	14.502	.09356	.29794	.00192	.7053	0.
2.40	90.996	16.524	.10660	16.639	.10735	.33660	.00217	.6927	0.
2.60	86.240	18.769	.12109	18.898	.12192	.37721	.00243	.6812	0.
2.80	82.028	21.134	.13635	21.277	.13727	.41986	.00271	.6708	0.
3.00	78.267	23.616	.15236	23.773	.15338	.46387	.00299	.6613	.00001
3.20	74.886	26.214	.16912	26.386	.17023	.50974	.00329	.6525	.00001
3.40	71.825	28.972	.18662	29.114	.18783	.55722	.00359	.6445	.00001
3.60	69.030	31.752	.20485	31.955	.20616	.60627	.00391	.6371	.00001
3.80	66.462	34.689	.22380	34.909	.22522	.65687	.00424	.6302	.00002
4.00	64.093	37.736	.24346	37.973	.24499	.70900	.00457	.6237	.00003
4.20	61.919	40.896	.26384	41.150	.26548	.76264	.00492	.6178	.00003
4.40	59.848	44.161	.28491	44.433	.28666	.81772	.00528	.6121	.00004
4.60	58.023	47.536	.30668	47.826	.30856	.87434	.00564	.6068	.00005
4.80	56.318	51.020	.32916	51.329	.33115	.93226	.00601	.6018	.00006

CALCIUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	GM/CM2	MEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	CM	PERCENT	PERCENT	
5.00	54.726	84.825	.05460	.03522	.05493	.03544	.00099	.00064	1.805	.5971	.00007
5.50	51.128	79.249	.06401	.04130	.06439	.04154	.00115	.00074	1.778	.5863	.00011
6.00	48.021	74.432	.07406	.04778	.07449	.04806	.00131	.00094	1.754	.5769	.00015
6.50	45.312	70.233	.08473	.05466	.08521	.05498	.00148	.00095	1.733	.5686	.00020
7.00	42.924	66.532	.09601	.06194	.09655	.06229	.00165	.00107	1.713	.5610	.00026
7.50	40.801	63.242	.10791	.06962	.10851	.07000	.00184	.00119	1.694	.5542	.00032
8.00	38.900	60.296	.12039	.07767	.12105	.07810	.00203	.00131	1.678	.5480	.00040
8.50	37.187	57.540	.13348	.08611	.13421	.08658	.00223	.00144	1.662	.5424	.00048
9.00	35.634	55.233	.14715	.09494	.14795	.09545	.00244	.00157	1.648	.5372	.00057
9.50	34.219	53.040	.16141	.10413	.16227	.10469	.00265	.00171	1.634	.5324	.00067
10.00	32.925	51.033	.17623	.11370	.17717	.11430	.00287	.00185	1.622	.5279	.00078
11.00	30.639	47.490	.20759	.13393	.20868	.13463	.00334	.00215	1.599	.5199	.00102
12.00	28.682	44.457	.24119	.15561	.24243	.15641	.00383	.00247	1.579	.5130	.00145
13.00	26.986	41.828	.27699	.17870	.27840	.17961	.00434	.00230	1.561	.5068	.00145
14.00	25.501	39.526	.31495	.20319	.31653	.20422	.00489	.00315	1.544	.5013	.00688
15.00	24.188	37.491	.35504	.22906	.35881	.23020	.00546	.00352	1.530	.4955	.00962
16.00	23.019	35.679	.39724	.25626	.39921	.25755	.00605	.00390	1.516	.4919	.01238
17.00	21.970	34.053	.44153	.28486	.44369	.28625	.00667	.00430	1.503	.4876	.01516
18.00	21.023	32.586	.48786	.31475	.49024	.31628	.00731	.00472	1.492	.4841	.01796
19.00	20.163	31.253	.53623	.34595	.53882	.34762	.00798	.00515	1.481	.4807	.02078
20.00	19.380	30.040	.58660	.37845	.58942	.38027	.00867	.00559	1.471	.4775	.02361
22.00	18.003	27.905	.69329	.44728	.69657	.44940	.01012	.00653	1.453	.4719	.02933
24.00	16.830	25.086	.80776	.52113	.81155	.52358	.01166	.00752	1.436	.4669	.03511
26.00	15.617	24.516	.92988	.59992	.93420	.60271	.01328	.00857	1.422	.4626	.03886
28.00	14.933	23.147	1.0595	.68356	1.0644	.68671	.01499	.00967	1.409	.4588	.04050
30.00	14.155	21.940	1.1965	.77197	1.2020	.77550	.01679	.01083	1.397	.4553	.04221
32.00	13.464	20.869	1.3409	.86507	1.3470	.86900	.01867	.01204	1.386	.4522	.04399
34.00	12.845	19.910	1.4923	.96280	1.4991	.96715	.02062	.01331	1.376	.4494	.04583
36.00	12.289	19.047	1.6509	1.0651	1.6583	1.0699	.02265	.01462	1.366	.4468	.04773
38.00	11.785	18.266	1.8164	1.1719	1.8246	1.1771	.02477	.01598	1.358	.4445	.04969
40.00	11.326	17.556	1.9389	1.2831	1.9977	1.2888	.02696	.01739	1.349	.4423	.05170
45.00	10.342	16.030	2.4495	1.5803	2.4603	1.5873	.03275	.02113	1.331	.4375	.05693
50.00	9.5360	14.781	3.0914	1.9041	3.0843	1.9124	.03899	.02515	1.315	.4335	.06243
55.00	8.8653	13.741	3.4934	2.2538	3.5085	2.2636	.04565	.02945	1.301	.4301	.06819
60.00	8.2969	12.860	4.0744	2.6287	4.0919	2.6399	.05273	.03402	1.289	.4272	.07422
65.00	7.8086	12.103	4.6935	3.0380	4.7135	3.0410	.06020	.03884	1.277	.4246	.08048
70.00	7.3845	11.446	5.3496	3.4513	5.3723	3.4660	.06805	.04391	1.267	.4224	.08695
75.00	7.0122	10.869	6.0419	3.8980	6.0724	3.9144	.07628	.04921	1.257	.4203	.09361
80.00	6.6831	10.359	6.7696	4.3675	6.7981	4.3859	.08486	.05475	1.248	.4185	.10042
90.00	6.1266	9.4962	8.3281	5.3730	8.3628	5.3954	.10306	.06649	1.232	.4154	.11442

CALCIUM

PROTON ENERGY MEV	ENERGY LOSS MEV/ GM/CM2	PROTON RANGE CM	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	GM/CM2	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	5.6738	8.7944	10.061	6.4908	12256	.07907	1.218	.12878
110.00	5.2980	8.2119	11.886	7.6685	14329	.09245	1.206	.14354
120.00	4.9808	7.7203	13.834	8.9253	16519	.10658	1.194	.15881
130.00	4.7096	7.2998	15.835	10.258	18819	.12141	1.184	.17449
140.00	4.4748	6.9360	18.006	11.617	21224	.13693	1.174	.19049
150.00	4.2697	6.6181	20.286	13.141	23727	.15308	1.165	.20672
160.00	4.0889	6.3378	22.762	14.685	26325	.16984	1.157	.22318
170.00	3.9283	6.0889	25.157	16.230	29012	.18717	1.149	.23987
180.00	3.7848	5.8664	27.852	17.897	31785	.20506	1.141	.25672
190.00	3.6556	5.6663	30.419	19.625	34630	.22347	1.134	.27368
200.00	3.5389	5.4853	33.189	21.412	37570	.24239	1.127	.29070
210.00	3.4329	5.3210	36.192	23.350	40575	.26178	1.121	.30775
220.00	3.3362	5.1711	38.992	25.156	43652	.28162	1.115	.32481
230.00	3.2476	5.0338	42.018	27.217	46795	.30191	1.109	.34183
240.00	3.1662	4.9077	45.125	29.113	50004	.32261	1.104	.35877
250.00	3.0912	4.7913	48.310	31.168	53274	.34371	1.098	.37561
260.00	3.0218	4.6837	51.569	33.271	56604	.36519	1.093	.39235
270.00	2.9574	4.5840	54.902	35.421	59990	.38703	1.088	.40917
280.00	2.8976	4.4912	58.305	37.616	63431	.40923	1.084	.42551
290.00	2.8418	4.4048	61.777	39.866	66924	.43177	1.079	.44189
300.00	2.7897	4.3240	65.315	42.139	70467	.45463	1.075	.45809
310.00	2.7409	4.2484	68.918	44.463	74058	.47780	1.070	.47410
320.00	2.6952	4.1776	72.583	46.828	77696	.50126	1.066	.48989
330.00	2.6523	4.1110	76.309	49.232	81377	.52501	1.062	.50543
340.00	2.6118	4.0483	80.094	51.674	85102	.54904	1.058	.52072
350.00	2.5737	3.9893	83.937	54.153	88867	.57333	1.055	.53575
360.00	2.5378	3.9336	87.835	56.669	92672	.59788	1.051	.55054
370.00	2.5038	3.8809	91.787	59.217	96514	.62257	1.047	.56512
380.00	2.4716	3.8310	95.791	61.801	10039	.64770	1.044	.57948
390.00	2.4412	3.7838	99.847	64.417	10431	.67295	1.041	.59360
400.00	2.4122	3.7390	103.95	67.066	10826	.69843	1.037	.60748
410.00	2.3848	3.6964	108.11	69.746	11224	.72411	1.034	.62106
420.00	2.3586	3.6559	112.31	72.456	11625	.75000	1.031	.63433
430.00	2.3338	3.6174	116.55	75.195	12029	.77608	1.028	.64726
440.00	2.3101	3.5807	120.84	77.963	12436	.80235	1.025	.65987
450.00	2.2875	3.5456	125.18	80.759	12847	.82881	1.022	.67215
460.00	2.2659	3.5122	129.55	83.582	13259	.85544	1.019	.68409
470.00	2.2453	3.4803	133.97	86.432	13675	.88224	1.017	.69571
480.00	2.2257	3.4498	138.43	89.307	14093	.90921	1.014	.70700
490.00	2.2068	3.4206	142.92	92.207	14513	.93633	1.012	.71797

CALCIUM

PRCTCN ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/GM/CM2	MEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	CM	PERCENT	PERCENT	
500.00	2.1888	3.3926	147.45	95.132	145.03	95.502	1.4936	.96361	1.009	.3876	.72861
510.00	2.1715	3.3658	152.02	98.080	152.61	98.461	1.5361	.99104	1.007	.3873	.73893
520.00	2.1549	3.3401	157.63	101.05	157.24	101.44	1.5788	1.0186	1.004	.3870	.74894
530.00	2.1390	3.3155	161.27	104.04	161.90	104.45	1.6218	1.0463	1.002	.3868	.75864
540.00	2.1238	3.2918	165.94	107.06	166.59	107.48	1.6649	1.0742	.9994	.3865	.76802
550.00	2.1091	3.2691	170.65	110.10	171.31	110.52	1.7083	1.1021	.9972	.3862	.77711
560.00	2.0950	3.2473	175.39	113.16	176.07	113.59	1.7519	1.1302	.9950	.3859	.78590
570.00	2.0815	3.2263	180.16	116.23	180.86	116.68	1.7956	1.1585	.9928	.3856	.79440
580.00	2.0684	3.2061	184.96	119.33	185.68	119.79	1.8395	1.1868	.9907	.3854	.80261
590.00	2.0559	3.1866	189.79	122.45	190.53	122.92	1.8837	1.2153	.9886	.3851	.81054
600.00	2.0438	3.1679	194.65	125.58	195.41	126.07	1.9270	1.2438	.9866	.3848	.81820
620.00	2.0209	3.1324	204.46	131.91	205.25	132.42	2.0170	1.3013	.9827	.3842	.83273
640.00	1.9997	3.0995	214.37	138.30	215.20	138.64	2.1067	1.3592	.9790	.3837	.84623
660.00	1.9798	3.0687	224.39	144.77	225.25	145.32	2.1970	1.4174	.9754	.3831	.85877
680.00	1.9614	3.0401	234.50	151.29	235.40	151.87	2.2878	1.4760	.9719	.3826	.87139
700.00	1.9441	3.0133	244.70	157.87	245.64	158.43	2.3792	1.5350	.9686	.3820	.88416
720.00	1.9279	2.9883	255.00	164.51	255.97	165.14	2.4711	1.5943	.9654	.3815	.89711
740.00	1.9128	2.9648	265.37	171.21	266.39	171.86	2.5635	1.6538	.9623	.3809	.91030
760.00	1.8986	2.9428	275.83	177.96	276.89	179.64	2.6563	1.7137	.9593	.3803	.92378
780.00	1.8853	2.9222	286.37	184.75	287.46	185.46	2.7495	1.7739	.9565	.3798	.93659
800.00	1.8728	2.9028	296.97	191.59	298.10	192.32	2.8432	1.8343	.9538	.3792	.94978
820.00	1.8610	2.8845	307.65	198.48	308.82	199.24	2.9372	1.8950	.9511	.3786	.96339
840.00	1.8499	2.8673	318.39	205.41	319.60	206.19	3.0316	1.9559	.9486	.3781	.97647
860.00	1.8395	2.8512	329.19	212.38	330.44	213.19	3.1264	2.0170	.9461	.3775	.98924
880.00	1.8296	2.8359	340.06	219.39	341.35	220.22	3.2215	2.0784	.9438	.3769	.99716
900.00	1.8203	2.8215	350.99	226.44	352.31	227.30	3.3169	2.1399	.9415	.3763	.99584
920.00	1.8115	2.8079	361.97	233.53	363.33	234.41	3.4127	2.2017	.9393	.3757	.99614
940.00	1.8033	2.7950	373.01	240.65	374.41	241.56	3.5087	2.2637	.9371	.3751	.99606
960.00	1.7954	2.7829	384.11	247.81	385.55	248.74	3.6050	2.3258	.9350	.3743	.99366
1000.00	1.7810	2.7606	406.56	262.30	408.08	263.28	3.7984	2.4506	.9308	.3724	.96994

THE ELECTRON DENSITY OF CALCIUM IS 3.006E 23 ELECTRONS PER GRAM
 THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.141 BEV, AND THE MINIMUM ENERGY LOSS IS 1.6644 MEV/GM/CM2

CARBON

ATOMIC NUMBER 6
 ELEMENT C
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 12.011
 ADJUSTED IONIZATION POTENTIAL 75.10

DENSITY * 2.2200 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CH2	PROTON RANGE MG/CH2	PROTON PATH LENGTH MM	MG/CH2	PROTON PATH LENGTH MM	MG/CH2	PATH LENGTH STRAGGLING MM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	822.92	.15995	.00072	.16111	.00073	.00530	.00002	3.291	.7200	0.
.15	720.41	.22478	.00101	.22601	.00102	.00635	.00003	2.810	.5429	0.
.20	635.71	.29848	.00134	.29985	.00135	.00771	.00003	2.571	.4568	0.
.30	509.25	.47443	.00214	.47620	.00215	.01117	.00005	2.346	.3711	0.
.40	424.85	.68965	.00311	.69192	.00312	.01551	.00007	2.242	.3277	0.
.50	367.65	.94268	.00425	.94553	.00426	.02057	.00009	2.175	.3014	0.
.60	326.61	1.2310	.00555	1.2345	.00556	.02618	.00012	2.121	.2836	0.
.70	294.48	1.5536	.00699	1.5569	.00701	.03226	.00015	2.072	.2707	0.
.80	267.87	1.9079	.00859	1.9129	.00862	.03885	.00018	2.031	.2607	0.
.90	249.38	2.2937	.01033	2.2995	.01036	.04583	.00021	1.992	.2527	0.
1.00	230.88	2.7097	.01221	2.7163	.01224	.05319	.00024	1.958	.2460	0.
1.20	203.65	3.6319	.01636	3.6405	.01640	.06917	.00031	1.900	.2356	0.
1.40	182.92	4.6679	.02103	4.6785	.02107	.08656	.00039	1.850	.2276	.00001
1.60	166.46	5.8136	.02619	5.8265	.02625	.10531	.00047	1.807	.2213	.00001
1.80	153.08	7.0656	.03183	7.0809	.03190	.12537	.00056	1.771	.2160	.00002
2.00	141.89	8.4211	.03793	8.4389	.03801	.14671	.00066	1.739	.2115	.00003
2.20	132.39	9.8782	.04450	9.8987	.04459	.16932	.00076	1.710	.2076	.00005
2.40	124.21	11.436	.05151	11.459	.05162	.19316	.00087	1.686	.2042	.00007
2.60	117.08	13.093	.05898	13.119	.05909	.21821	.00098	1.663	.2012	.00010
2.80	110.80	14.846	.06687	14.876	.06701	.24447	.00110	1.643	.1985	.00012
3.00	105.22	16.696	.07521	16.728	.07535	.27191	.00122	1.625	.1961	.00015
3.20	100.24	18.640	.08397	18.676	.08413	.30052	.00135	1.609	.1938	.00019
3.40	95.742	20.679	.09315	20.719	.09333	.33029	.00149	1.594	.1918	.00022
3.60	91.672	22.811	.10275	22.855	.10295	.36119	.00163	1.580	.1900	.00027
3.80	87.967	25.035	.11277	25.082	.11298	.39322	.00177	1.568	.1882	.00031
4.00	84.577	27.350	.12320	27.401	.12343	.42637	.00192	1.556	.1866	.00035
4.20	81.302	29.760	.13405	29.815	.13430	.46078	.00208	1.545	.1851	.00040
4.40	78.453	32.265	.14533	32.322	.14560	.49630	.00224	1.535	.1837	.00045
4.60	75.815	34.847	.15697	34.911	.15726	.53288	.00240	1.526	.1824	.00050
4.80	73.364	37.529	.16905	37.597	.16936	.57051	.00257	1.517	.1812	.00056

CARBON

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/GM/CM2	HEV/CM	GM/CM2	CM	GM/CM2	CH	GM/CM2	CM	PERCENT	PERCENT	
5.00	71.081	157.80	.04029	.01815	.04037	.01818	.00061	.00027	1.509	.1801	.00061
5.50	66.001	146.52	.04759	.02144	.04767	.02147	.00071	.00032	1.490	.1775	.00077
6.00	61.656	136.88	.05542	.02496	.05552	.02501	.00082	.00037	1.473	.1752	.00202
6.50	57.894	128.52	.06378	.02873	.06389	.02878	.00105	.00042	1.459	.1731	.00573
7.00	54.603	121.22	.07266	.03273	.07279	.03279	.00118	.00047	1.445	.1714	.00864
7.50	51.697	114.77	.08206	.03697	.08220	.03703	.00131	.00053	1.433	.1697	.01153
8.00	49.111	109.03	.09197	.04143	.09213	.04150	.00145	.00059	1.422	.1682	.01442
8.50	46.794	103.88	.10239	.04612	.10256	.04620	.00159	.00065	1.412	.1669	.01731
9.00	44.705	99.245	.11331	.05104	.11350	.05112	.00174	.00072	1.403	.1657	.02018
9.50	42.811	95.040	.12472	.05618	.12493	.05627	.00190	.00078	1.394	.1645	.02306
10.00	41.085	91.209	.13663	.06155	.13685	.06165	.00222	.00085	1.386	.1635	.02593
11.00	38.054	84.480	.16191	.07293	.16217	.07305	.00257	.00100	1.372	.1616	.03167
12.00	35.476	78.757	.18910	.08518	.18940	.08532	.00295	.00116	1.359	.1599	.03740
13.00	33.255	73.826	.21818	.09828	.21853	.09844	.00334	.00133	1.348	.1585	.04313
14.00	31.320	69.529	.24914	.11223	.24954	.11240	.00375	.00150	1.338	.1572	.04886
15.00	29.617	65.750	.28194	.12700	.28238	.12720	.00419	.00169	1.329	.1560	.05459
16.00	28.107	62.398	.31656	.14260	.31705	.14282	.00464	.00189	1.320	.1549	.06031
17.00	26.758	59.402	.35299	.15900	.35353	.15925	.00511	.00209	1.312	.1539	.06604
18.00	25.544	56.708	.39120	.17621	.39180	.17648	.00561	.00230	1.305	.1530	.07176
19.00	24.447	54.272	.43116	.19422	.43182	.19451	.00612	.00253	1.298	.1522	.07749
20.00	23.449	52.057	.47288	.21301	.47360	.21333	.00670	.00276	1.292	.1515	.08321
22.00	21.702	48.178	.56149	.25292	.56233	.25330	.00720	.00324	1.281	.1501	.09465
24.00	20.221	44.891	.65898	.29590	.65787	.29634	.00769	.00376	1.270	.1489	.10609
26.00	18.949	42.068	.75898	.34168	.76011	.34239	.00819	.00432	1.261	.1479	.11293
28.00	17.844	39.614	.86765	.39083	.86893	.39141	.00870	.00490	1.253	.1469	.11506
30.00	16.874	37.461	.98280	.44270	.98424	.44335	.00925	.00552	1.245	.1461	.11727
32.00	16.016	35.556	1.1043	.49745	1.1059	.49817	.00984	.00617	1.238	.1453	.11955
34.00	15.251	33.857	1.2322	.55503	1.2340	.55583	.01049	.00684	1.231	.1446	.12190
36.00	14.564	32.332	1.3662	.61542	1.3682	.61630	.01119	.00755	1.225	.1440	.12431
38.00	13.944	30.955	1.5064	.67857	1.5086	.67954	.01194	.00829	1.219	.1434	.12678
40.00	13.381	29.706	1.6527	.74445	1.6550	.74551	.01274	.00905	1.214	.1428	.12929
45.00	12.177	27.033	2.0444	.92088	2.0473	.92219	.01360	.01108	1.202	.1416	.13575
50.00	11.197	24.857	2.4724	1.1137	2.4759	1.1153	.01458	.01328	1.191	.1406	.14239
55.00	10.383	23.051	2.9359	1.3225	2.9400	1.3243	.01564	.01564	1.181	.1397	.14925
60.00	9.6960	21.525	3.4340	1.5468	3.4387	1.5490	.01683	.01815	1.172	.1390	.15640
65.00	9.1076	20.219	3.9656	1.7863	3.9711	1.7888	.01815	.02082	1.164	.1383	.16379
70.00	8.5979	19.087	4.5302	2.0406	4.5365	2.0434	.01954	.02363	1.156	.1377	.17138
75.00	8.1519	18.097	5.1269	2.3094	5.1340	2.3126	.02104	.02658	1.149	.1371	.17915
80.00	7.7582	17.223	5.7551	2.5924	5.7629	2.5959	.02266	.02967	1.143	.1366	.18704
90.00	7.0945	15.750	7.1029	3.1995	7.1126	3.2039	.02543	.03623	1.131	.1357	.20310

CARBON

PRCTON ENERGY MEV	ENERGY LOSS MEV/CH2	MEV/CH	PROTON RANGE CH	PROTON PATH LENGTH GM/CH2	CH	GM/CH2	PROTON PATH LENGTH CH	GM/CH2	CH	PATH LENGTH STRAGGLING GM/CH2	CH	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	6.5563	14.555	3.8598	8.5804	3.8650	.09611	.04329	1.120	.1350	.21932				
110.00	6.1107	13.566	4.9712	10.162	4.5773	.11284	.05083	1.110	.1344	.23580				
120.00	5.7356	12.733	5.3316	11.836	5.3387	.13055	.05880	1.101	.1338	.25270				
130.00	5.4155	12.022	6.1392	13.647	6.1474	.14919	.06720	1.093	.1333	.26990				
140.00	5.1389	11.408	6.9924	15.544	7.0017	.16873	.07601	1.086	.1329	.28728				
150.00	4.8976	10.873	7.8895	17.538	7.9000	.18912	.08519	1.078	.1324	.30474				
160.00	4.6852	10.401	8.8290	19.626	8.8407	.21030	.09473	1.072	.1321	.32230				
170.00	4.4967	9.9826	9.8095	21.806	9.8224	.23226	.10462	1.065	.1317	.33996				
180.00	4.3285	9.6092	10.829	24.073	10.844	.25494	.11484	1.059	.1314	.35765				
190.00	4.1773	9.2736	11.888	26.425	11.903	.27833	.12537	1.053	.1311	.37530				
200.00	4.0407	8.9704	12.963	28.860	13.000	.30238	.13621	1.048	.1308	.39287				
210.00	3.9168	8.6953	14.114	31.374	14.132	.32707	.14733	1.042	.1306	.41033				
220.00	3.8038	8.4445	15.280	33.965	15.300	.35236	.15872	1.037	.1303	.42765				
230.00	3.7004	8.2149	16.479	36.631	16.501	.37824	.17038	1.033	.1301	.44479				
240.00	3.6054	8.0041	17.711	39.359	17.734	.40468	.18229	1.028	.1299	.46172				
250.00	3.5179	7.8098	18.974	42.178	18.999	.43166	.19444	1.023	.1297	.47840				
260.00	3.4370	7.6302	20.268	45.054	20.295	.45915	.20682	1.019	.1295	.49463				
270.00	3.3620	7.4636	21.592	47.996	21.620	.48713	.21943	1.015	.1293	.51100				
280.00	3.2923	7.3089	22.944	51.002	22.974	.51559	.23225	1.011	.1291	.52688				
290.00	3.2274	7.1647	24.325	54.070	24.356	.54450	.24527	1.007	.1289	.54246				
300.00	3.1667	7.0301	25.732	57.198	25.765	.57385	.25849	1.003	.1287	.55772				
310.00	3.1100	6.9042	27.166	60.385	27.201	.60361	.27190	.9996	.1286	.57270				
320.00	3.0568	6.7861	28.625	63.629	28.662	.63378	.28549	.9961	.1284	.58747				
330.00	3.0068	6.6752	30.109	66.928	30.148	.66434	.29925	.9926	.1282	.60200				
340.00	2.9598	6.5708	31.617	70.280	31.658	.69527	.31319	.9893	.1281	.61628				
350.00	2.9155	6.4725	33.149	73.684	33.191	.72657	.32728	.9861	.1279	.63029				
360.00	2.8737	6.3797	34.703	77.199	34.747	.75821	.34153	.9829	.1278	.64410				
370.00	2.8342	6.2920	36.279	80.643	36.326	.79018	.35594	.9798	.1276	.65776				
380.00	2.7968	6.2089	37.877	84.195	37.926	.82248	.37049	.9769	.1275	.67125				
390.00	2.7614	6.1303	39.496	87.794	39.547	.85509	.38517	.9740	.1273	.68455				
400.00	2.7278	6.0557	41.136	91.438	41.188	.88799	.40000	.9711	.1272	.69763				
410.00	2.6958	5.9848	42.795	95.125	42.849	.92119	.41495	.9684	.1270	.71041				
420.00	2.6655	5.9174	44.473	98.856	44.530	.95467	.43003	.9657	.1269	.72277				
430.00	2.6366	5.8532	46.170	102.63	46.229	.98842	.44523	.9631	.1267	.73474				
440.00	2.6090	5.7921	47.886	106.44	47.947	1.0224	.46055	.9606	.1266	.74630				
450.00	2.5828	5.7338	49.619	110.29	49.682	1.0567	.47598	.9581	.1265	.75746				
460.00	2.5577	5.6781	51.370	114.18	51.435	1.0912	.49153	.9556	.1263	.76823				
470.00	2.5338	5.6249	53.137	118.11	53.204	1.1259	.50718	.9533	.1262	.77862				
480.00	2.5109	5.5741	54.921	122.08	54.990	1.1609	.52293	.9510	.1261	.78862				
490.00	2.4889	5.5264	56.720	126.08	56.792	1.1961	.53878	.9487	.1259	.79826				

CARBON

PROTON ENERGY HEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	HEV/CM2	HEV/CH	GM/CM2	CH	GM/CM2	CH	GM/CM2	PERCENT		
500.00	2.4680	5.4789	129.95	58.536	130.11	58.609	1.2315	.9465	.1258	.80752
510.00	2.4478	5.4342	134.01	60.366	134.18	60.442	1.2671	.9443	.1257	.81643
520.00	2.4286	5.3914	138.11	62.212	138.28	62.290	1.3029	.9422	.1255	.82499
530.00	2.4101	5.3503	142.24	64.071	142.42	64.152	1.3389	.9402	.1254	.83321
540.00	2.3923	5.3109	146.40	65.945	146.58	66.028	1.3751	.9381	.1253	.84110
550.00	2.3752	5.2730	150.59	67.832	150.78	67.917	1.4115	.9362	.1251	.84866
560.00	2.3588	5.2365	154.81	69.733	155.00	69.820	1.4481	.9342	.1250	.85591
570.00	2.3430	5.2015	159.06	71.647	159.26	71.737	1.4848	.9323	.1249	.86286
580.00	2.3278	5.1678	163.33	73.574	163.54	73.665	1.5217	.9305	.1248	.86951
590.00	2.3132	5.1353	167.64	75.512	167.85	75.607	1.5588	.9287	.1246	.87587
600.00	2.2991	5.1040	171.97	77.463	172.18	77.560	1.5960	.9269	.1245	.88196
620.00	2.2724	5.0448	180.71	81.400	180.93	81.502	1.6709	.9235	.1242	.89335
640.00	2.2476	4.9897	189.55	85.382	189.78	85.488	1.7464	.9202	.1240	.90373
660.00	2.2245	4.9383	198.48	89.407	198.73	89.518	1.8224	.9170	.1237	.91320
680.00	2.2028	4.8903	207.51	93.472	207.76	93.588	1.8990	.9140	.1235	.92180
700.00	2.1826	4.8455	216.62	97.576	216.89	97.696	1.9763	.9111	.1232	.92962
720.00	2.1637	4.8035	225.81	101.72	226.09	101.84	2.0535	.9083	.1230	.93671
740.00	2.1460	4.7641	235.08	105.89	235.37	106.02	2.1315	.9056	.1228	.94313
760.00	2.1293	4.7271	244.43	110.10	244.73	110.24	2.2099	.9030	.1225	.94894
780.00	2.1137	4.6924	253.85	114.34	254.16	114.48	2.2881	.9005	.1223	.95418
800.00	2.0990	4.6597	263.33	118.62	263.65	118.76	2.3679	.8981	.1220	.95892
820.00	2.0851	4.6289	272.88	122.92	273.21	123.07	2.4474	.8958	.1218	.96319
840.00	2.0720	4.5999	282.49	127.25	282.84	127.40	2.5274	.8936	.1215	.96703
860.00	2.0597	4.5726	292.17	131.61	292.52	131.77	2.6076	.8914	.1213	.97050
880.00	2.0481	4.5467	301.89	135.99	302.26	136.15	2.6882	.8894	.1210	.97361
900.00	2.0371	4.5223	311.68	140.40	312.06	140.57	2.7691	.8874	.1208	.97640
920.00	2.0267	4.4992	321.52	144.83	321.91	145.00	2.8503	.8854	.1205	.97891
940.00	2.0168	4.4774	331.41	149.28	331.81	149.46	2.9317	.8836	.1203	.98116
960.00	2.0075	4.4567	341.36	153.76	341.77	153.95	3.0135	.8817	.1200	.98318
1000.00	1.9904	4.4186	361.47	162.82	361.90	163.02	3.1778	.8781	.1193	.98662

THE ELECTRON DENSITY OF CARBON IS 3.010E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.301 BEV, AND THE MINIMUM ENERGY LOSS IS 1.8403 MEV/GM/CM2

CESIUM

ADJUSTED
IONIZATION
POTENTIAL
545.2

ATOMIC
WEIGHT
132.90

ATOMS/
MOLECULE
1

ATOMIC
NUMBER
55

ELEMENT
CS

DENSITY = 1.9000 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE HG/CM2	PROTON RANGE MM	PROTON PATH LENGTH HG/CM2	PROTON PATH LENGTH MM	ATOMS/MOLECULE	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL	PATH LENGTH STRAGGLING HG/CM2	PATH LENGTH STRAGGLING MM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION	
.10	224.24	.90094	.00474	.93846	.00494	1	132.90	545.2	.04544	.00024	4.842	3.998	0.
.15	203.18	1.1333	.00596	1.1726	.00617	1	132.90	545.2	.05017	.00026	4.272	3.350	0.
.20	187.39	1.3855	.00729	1.4288	.00752	1	132.90	545.2	.05581	.00029	3.906	3.030	0.
.30	160.72	1.9507	.01027	2.0054	.01055	1	132.90	545.2	.06923	.00036	3.452	2.728	0.
.40	140.08	2.6044	.01371	2.6734	.01407	1	132.90	545.2	.08555	.00045	3.200	2.583	0.
.50	125.29	3.3437	.01760	3.4292	.01805	1	132.90	545.2	.10485	.00055	3.058	2.493	0.
.60	113.13	4.1659	.02193	4.2696	.02247	1	132.90	545.2	.12810	.00067	3.000	2.429	0.
.70	104.46	5.0660	.02666	5.1894	.02731	1	132.90	545.2	.15413	.00081	2.970	2.379	0.
.80	96.477	6.0408	.03179	6.1854	.03255	1	132.90	545.2	.18229	.00096	2.947	2.337	0.
.90	88.555	7.0994	.03737	7.2666	.03825	1	132.90	545.2	.21318	.00112	2.934	2.301	0.
1.00	80.630	8.2581	.04346	8.4499	.04447	1	132.90	545.2	.24787	.00130	2.933	2.269	0.
1.20	73.621	10.803	.05686	11.048	.05815	1	132.90	545.2	.32193	.00169	2.914	2.219	0.
1.40	68.043	13.575	.07145	13.877	.07304	1	132.90	545.2	.39685	.00209	2.860	2.179	0.
1.60	63.443	16.563	.08717	16.926	.08908	1	132.90	545.2	.47297	.00249	2.794	2.144	0.
1.80	59.503	19.759	.10400	20.186	.10624	1	132.90	545.2	.55095	.00290	2.729	2.112	0.
2.00	56.105	23.154	.12186	23.647	.12446	1	132.90	545.2	.63110	.00332	2.669	2.082	0.
2.20	53.146	26.747	.14078	27.308	.14373	1	132.90	545.2	.71353	.00376	2.613	2.054	0.
2.40	50.540	30.539	.16073	31.171	.16406	1	132.90	545.2	.79827	.00420	2.561	2.028	0.
2.60	48.224	34.520	.18168	35.226	.18540	1	132.90	545.2	.88574	.00466	2.514	2.004	0.
2.80	46.142	38.685	.20360	39.467	.20772	1	132.90	545.2	.97712	.00514	2.476	1.981	0.
3.00	44.321	43.029	.22647	43.889	.23100	1	132.90	545.2	1.0720	.00564	2.443	1.960	0.
3.20	42.666	47.548	.25025	48.489	.25520	1	132.90	545.2	1.1700	.00616	2.413	1.939	0.
3.40	41.154	52.239	.27494	53.262	.28033	1	132.90	545.2	1.2708	.00669	2.386	1.920	0.
3.60	39.769	57.102	.30054	58.209	.30636	1	132.90	545.2	1.3742	.00723	2.361	1.902	0.
3.80	38.489	62.129	.32699	63.322	.33327	1	132.90	545.2	1.4803	.00779	2.338	1.884	0.
4.00	37.314	67.318	.35431	68.600	.36105	1	132.90	545.2	1.5887	.00836	2.316	1.868	0.
4.20	36.216	72.671	.38248	74.042	.38994	1	132.90	545.2	1.6994	.00894	2.295	1.852	0.
4.40	35.200	78.182	.41148	79.645	.41918	1	132.90	545.2	1.8124	.00954	2.274	1.837	0.
4.60	34.250	83.844	.44129	85.401	.44948	1	132.90	545.2	1.9275	.01014	2.257	1.822	0.
4.80	33.359	89.671	.47195	91.323	.48065	1	132.90	545.2	2.0448	.01076	2.239	1.809	0.

CESIUM

PRCTON ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CH	GM/CM2	PATH LENGTH STRAGGLING CH	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	32.522	61.791	.09564	.05034	.09739	.05126	.00216	0.
5.50	30.629	58.196	.11125	.05855	.11325	.05960	.00247	0.
6.00	28.978	55.058	.12778	.06725	.13004	.06844	.00279	0.
6.50	27.522	52.292	.14522	.07643	.14775	.07776	.00312	0.
7.00	26.227	49.831	.16356	.08608	.16637	.08756	.00346	.00001
7.50	25.066	47.626	.18278	.09620	.18587	.09783	.00382	.00001
8.00	24.020	45.636	.20286	.10677	.20625	.10856	.00419	.00002
8.50	23.071	43.836	.22380	.11779	.22750	.11974	.00456	.00003
9.00	22.206	42.191	.24558	.12925	.24960	.13137	.00495	.00004
9.50	21.410	40.680	.26819	.14115	.27253	.14344	.00535	.00006
10.00	20.679	39.291	.29161	.15348	.29629	.15594	.00576	.00008
11.00	19.381	36.824	.34091	.17943	.34628	.18225	.00660	.00014
12.00	18.259	34.693	.39340	.20705	.39950	.21026	.00749	.00022
13.00	17.288	32.848	.44894	.23629	.45581	.23990	.00842	.00032
14.00	16.429	31.215	.50750	.26710	.51516	.27113	.00938	.00045
15.00	15.689	29.809	.56896	.29945	.57744	.30392	.01037	.00060
16.00	14.993	28.406	.63331	.33332	.64264	.33823	.01140	.00077
17.00	14.371	27.305	.70054	.36870	.71078	.37408	.01247	.00098
18.00	13.806	26.231	.77066	.40561	.78175	.41147	.01357	.00120
19.00	13.288	25.247	.84355	.44400	.85566	.45035	.01471	.00145
20.00	12.814	24.347	.91923	.48381	.93227	.49067	.01589	.00172
22.00	11.974	22.750	1.0788	.56780	1.0939	.57572	.01835	.00383
24.00	11.249	21.374	1.2491	.65742	1.2663	.66647	.02095	.00772
26.00	10.619	20.175	1.4299	.75260	1.4494	.76283	.02369	.01040
28.00	10.064	19.121	1.6211	.85322	1.6429	.86488	.02655	.01183
30.00	9.5720	18.187	1.8226	.95924	1.8468	.97199	.02954	.01332
32.00	9.1329	17.352	2.0340	1.0705	2.0608	1.0846	.03255	.01486
34.00	8.7381	16.602	2.2553	1.1870	2.2847	1.2025	.03588	.01646
36.00	8.3811	15.924	2.4863	1.3086	2.5184	1.3255	.03923	.01811
38.00	8.0566	15.308	2.7269	1.4352	2.7619	1.4536	.04269	.01980
40.00	7.7591	14.742	2.9770	1.5668	3.0149	1.5868	.04627	.02155
45.00	7.1172	13.523	3.6429	1.9173	3.6886	1.9414	.05568	.02610
50.00	6.5932	12.527	4.3650	2.2974	4.4191	2.3259	.06574	.03090
55.00	6.1530	11.691	5.1418	2.7062	5.2040	2.7394	.07642	.03594
60.00	5.7774	10.977	5.9715	3.1429	6.0440	3.1811	.08768	.04123
65.00	5.4533	10.361	6.8529	3.6068	6.9353	3.6502	.09951	.04676
70.00	5.1704	9.8237	7.7843	4.0970	7.8772	4.1459	.11189	.05250
75.00	4.9212	9.3504	8.7650	4.6132	8.8689	4.6679	.12480	.05843
80.00	4.7001	8.9302	9.7936	5.1545	9.9089	5.2152	.13822	.06455
90.00	4.3245	8.2166	11.990	6.3105	12.130	6.3841	.16653	.07724

CESIUM

PROTON ENERGY HEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENTY	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	HEV/CM2	MEV/CH	GH/CM2	CH	GM/CM2	CH	GM/CM2	PERCENT		
100.00	4.9174	7.6330	14.365	7.5607	14.531	7.6480	.19670	.10353	1.142	.09045
110.00	3.7614	7.1466	16.912	8.9010	17.106	9.0030	.22862	.12033	1.133	.10416
120.00	3.5445	6.7346	19.623	10.328	19.846	10.445	.26218	.13799	1.126	.11840
130.00	3.3585	6.3812	22.492	11.838	22.746	11.972	.29730	.15647	1.119	.13308
140.00	3.1971	6.0745	25.512	13.427	25.799	13.578	.33389	.17573	1.114	.14812
150.00	3.0557	5.8058	28.678	15.094	29.900	15.263	.37187	.19572	1.109	.16346
160.00	2.9329	5.5724	31.983	16.833	32.340	17.021	.41114	.21639	1.105	.17907
170.00	2.8215	5.3608	35.426	18.645	35.820	18.853	.45162	.23769	1.101	.19493
180.00	2.7217	5.1712	38.994	20.523	39.427	20.751	.49330	.25963	1.098	.21131
190.00	2.6319	5.0005	42.694	22.470	43.166	22.719	.53513	.28217	1.095	.22724
200.00	2.5506	4.8461	46.515	24.402	47.028	24.752	.58004	.30529	1.092	.24359
210.00	2.4767	4.7057	50.448	26.552	51.004	26.844	.62499	.32894	1.089	.25999
220.00	2.4092	4.5774	54.501	28.685	55.100	29.000	.67092	.35312	1.087	.27636
230.00	2.3473	4.4598	58.663	30.875	59.307	31.214	.71779	.37779	1.085	.29268
240.00	2.2904	4.3517	62.933	33.123	63.622	33.485	.76556	.40293	1.083	.30892
250.00	2.2372	4.2506	67.301	35.422	68.036	35.809	.81419	.42852	1.081	.32504
260.00	2.1886	4.1583	71.775	37.776	72.558	38.189	.86367	.45456	1.079	.34110
270.00	2.1435	4.0726	76.344	40.181	77.176	40.619	.91394	.48102	1.078	.35716
280.00	2.1015	3.9928	81.004	42.634	81.885	43.097	.96495	.50787	1.076	.37320
290.00	2.0624	3.9185	85.757	45.135	86.689	45.626	1.0167	.53510	1.075	.38918
300.00	2.0258	3.8490	90.604	47.686	91.587	48.204	1.0691	.56268	1.073	.40508
310.00	1.9916	3.7840	95.531	50.279	96.566	50.824	1.1222	.59062	1.072	.42084
320.00	1.9595	3.7230	100.54	52.916	101.63	53.489	1.1759	.61888	1.071	.43641
330.00	1.9293	3.6657	105.62	55.592	106.77	56.193	1.2302	.64746	1.070	.45178
340.00	1.9009	3.6117	110.79	58.311	111.99	58.941	1.2851	.67635	1.069	.46692
350.00	1.8741	3.5609	116.03	61.071	117.29	61.730	1.3405	.70552	1.068	.48183
360.00	1.8489	3.5128	121.35	63.868	122.66	64.557	1.3965	.73498	1.067	.49652
370.00	1.8250	3.4674	126.74	66.704	128.10	67.422	1.4530	.76471	1.066	.51102
380.00	1.8023	3.4244	132.20	69.580	133.62	70.329	1.5099	.79470	1.065	.52531
390.00	1.7809	3.3837	137.72	72.487	139.21	73.267	1.5674	.82493	1.064	.53938
400.00	1.7606	3.3451	143.31	75.428	144.85	76.239	1.6253	.85541	1.063	.55322
410.00	1.7412	3.3083	148.97	78.403	150.57	79.245	1.6836	.88612	1.063	.56683
420.00	1.7229	3.2734	154.68	81.410	156.34	82.284	1.7424	.91705	1.062	.58020
430.00	1.7054	3.2402	160.45	84.449	162.17	85.354	1.8016	.94819	1.061	.59331
440.00	1.6887	3.2085	166.28	87.518	168.07	88.456	1.8611	.97953	1.060	.60616
450.00	1.6728	3.1783	172.17	90.617	174.02	91.587	1.9211	1.0111	1.060	.61875
460.00	1.6576	3.1495	178.11	93.745	180.02	94.748	1.9813	1.0428	1.059	.63106
470.00	1.6433	3.1220	184.11	96.901	186.08	97.937	2.0420	1.0747	1.058	.64314
480.00	1.6293	3.0956	190.16	100.08	192.19	101.15	2.1030	1.1068	1.058	.65493
490.00	1.6160	3.0705	196.26	103.29	198.36	104.40	2.1643	1.1391	1.057	.66645

CESIUM

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	PATH LENGTH STRAGGLING GM/CM2	PATH LENGTH STRAGGLING PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	1.6033	3.0464	202.41	106.53	2.2259	1.1715	1.088	.67769
510.00	1.5912	3.0233	208.60	109.79	2.2878	1.2041	1.085	.68866
520.00	1.5795	3.0011	214.84	113.08	2.3501	1.2369	1.082	.69936
530.00	1.5684	2.9799	221.13	116.39	2.4126	1.2698	1.079	.70978
540.00	1.5576	2.9595	227.46	119.72	2.4753	1.3028	1.077	.71993
550.00	1.5473	2.9399	233.84	123.07	2.5384	1.3360	1.074	.72982
560.00	1.5374	2.9211	240.26	126.45	2.6016	1.3693	1.071	.73943
570.00	1.5279	2.9031	246.71	129.85	2.6652	1.4027	1.069	.74878
580.00	1.5188	2.8857	253.21	133.27	2.7290	1.4363	1.066	.75787
590.00	1.5100	2.8699	259.75	136.71	2.7930	1.4700	1.064	.76670
600.00	1.5015	2.8528	266.32	140.17	2.8572	1.5038	1.062	.77527
620.00	1.4855	2.8224	279.57	147.14	2.9863	1.5717	1.057	.79165
640.00	1.4706	2.7941	292.97	154.19	3.1161	1.6401	1.053	.80705
660.00	1.4567	2.7677	306.49	161.31	3.2468	1.7088	1.048	.82151
680.00	1.4438	2.7431	320.15	168.50	3.3782	1.7780	1.044	.83505
700.00	1.4317	2.7202	333.92	175.75	3.5102	1.8475	1.040	.84772
720.00	1.4204	2.6988	347.80	183.05	3.6428	1.9173	1.036	.85956
740.00	1.4099	2.6788	361.79	190.42	3.7761	1.9874	1.033	.87060
760.00	1.4000	2.6600	375.88	197.83	3.9099	2.0578	1.042	.88088
780.00	1.3907	2.6424	390.07	205.30	4.0442	2.1285	1.040	.89044
800.00	1.3820	2.6259	404.35	212.82	4.1791	2.1995	1.033	.89932
820.00	1.3739	2.6103	418.72	220.38	4.3144	2.2707	1.030	.90756
840.00	1.3662	2.5958	433.17	227.98	4.4501	2.3422	1.017	.91520
860.00	1.3590	2.5821	447.74	235.65	4.5863	2.4138	1.014	.92227
880.00	1.3522	2.5691	462.44	243.39	4.7229	2.4857	1.011	.92881
906.00	1.3458	2.5570	477.20	251.16	4.8598	2.5578	1.008	.93484
920.00	1.3398	2.5455	491.97	258.93	4.9972	2.6301	1.005	.94041
940.00	1.3341	2.5347	506.73	266.70	5.1348	2.7025	1.003	.94555
960.00	1.3287	2.5245	521.65	274.55	5.2728	2.7752	1.000	.95027
1000.00	1.3189	2.5059	551.85	290.45	5.5498	2.9209	.9954	.95856

THE ELECTRON DENSITY OF CESIUM IS 2.493E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 1.985 BEV, AND THE MINIMUM ENERGY LOSS IS 1.2450 MEV/GM/CM2

CHLORINE

ELEMENT CL
 ATOMIC NUMBER 17
 ATOMS/MOLECULE 2
 ATOMIC WEIGHT 35.453
 ADJUSTED IONIZATION POTENTIAL 170.0

DENSITY = 3.1633 MG/CM3

FRCTION ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE MG/CM2	PROTON PATH LENGTH MG/CM2	PROTON RANGE METER	PROTON PATH LENGTH METER	MG/CM2	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	473.85	1498.9	.33021	.00104	.00106	.01349	.00004	4.020	0.
.15	415.91	1315.7	.44817	.00140	.00142	.01572	.00005	3.508	0.
.20	367.40	1162.2	.56954	.00180	.00182	.01865	.00006	3.237	0.
.30	296.42	937.67	.87199	.00276	.00278	.02622	.00008	2.978	0.
.40	255.50	808.24	1.2342	.00390	.00394	.03534	.00011	2.838	0.
.50	226.24	715.67	1.6476	.00521	.00525	.04532	.00014	2.728	0.
.60	205.95	651.49	2.1088	.00667	.00672	.05603	.00018	2.635	0.
.70	189.61	599.80	2.6113	.00825	.00832	.06711	.00021	2.550	0.
.80	176.19	557.35	3.1549	.00997	.01005	.07868	.00025	2.475	0.
.90	172.37	545.25	3.7245	.01177	.01186	.08999	.00028	2.398	0.
1.00	168.53	533.12	4.3080	.01362	.01372	.10052	.00032	2.316	0.
1.20	150.54	476.21	5.5583	.01757	.01770	.12231	.00039	2.185	0.
1.40	136.50	431.78	6.9477	.02196	.02211	.14658	.00046	2.096	0.
1.60	125.15	395.68	8.4713	.02678	.02696	.17364	.00055	2.036	0.
1.80	115.74	366.11	10.125	.03201	.03221	.20320	.00064	1.994	0.
2.00	107.77	340.91	11.909	.03765	.03788	.23501	.00074	1.961	0.
2.20	100.94	319.30	13.817	.04368	.04395	.26891	.00085	1.934	.00001
2.40	95.046	300.66	15.850	.05011	.05040	.30475	.00096	1.911	.00001
2.60	89.924	284.46	18.004	.05691	.05725	.34239	.00108	1.891	.00001
2.80	85.288	269.79	20.277	.06410	.06447	.38177	.00121	1.872	.00001
3.00	81.252	257.03	22.670	.07166	.07207	.42292	.00134	1.855	.00002
3.20	77.647	245.62	25.176	.07959	.08003	.46558	.00147	1.839	.00002
3.40	74.382	235.29	27.796	.08787	.08835	.50976	.00161	1.824	.00003
3.60	71.420	225.92	30.529	.09651	.09703	.55541	.00176	1.810	.00004
3.80	68.693	217.30	33.372	.10550	.10606	.60254	.00190	1.796	.00005
4.00	66.187	209.37	36.325	.11483	.11543	.65113	.00206	1.783	.00005
4.20	63.880	202.07	39.387	.12451	.12516	.70116	.00222	1.771	.00007
4.40	61.748	195.33	42.559	.13454	.13523	.75261	.00238	1.759	.00008
4.60	59.773	189.08	45.838	.14491	.14564	.80545	.00255	1.748	.00009
4.80	57.935	183.27	49.223	.15560	.15639	.85966	.00272	1.738	.00010

CHLORINE

FRCTCN ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/GM/CH2	KEV/CM	GM/CH2	METER	GM/CH2	METER	GM/CH2	METER PERCENT		
5.00	56.220	177.04	.05271	1.6663	.05297	1.6740	.00092	.00289	1.728	.00012
5.50	52.393	165.74	.06189	1.9565	.06216	1.9661	.00106	.00335	1.704	.00016
6.00	49.105	155.34	.07171	2.2670	.07206	2.2779	.00121	.00383	1.683	.00022
6.50	46.246	146.29	.08217	2.5975	.08255	2.6097	.00137	.00434	1.664	.00028
7.00	43.736	138.35	.09324	2.9476	.09368	2.9614	.00154	.00488	1.646	.00035
7.50	41.512	131.32	.10493	3.3172	.10542	3.3324	.00172	.00543	1.630	.00043
8.00	39.528	125.04	.11723	3.7059	.11775	3.7228	.00200	.00601	1.616	.00076
8.50	37.745	119.40	.13013	4.1136	.13071	4.1321	.00209	.00662	1.602	.00122
9.00	36.133	114.30	.14361	4.5400	.14425	4.5602	.00229	.00725	1.589	.00168
9.50	34.669	109.67	.15769	4.9849	.15839	5.0069	.00250	.00790	1.577	.00215
10.00	33.331	105.44	.17234	5.4481	.17310	5.4720	.00271	.00857	1.566	.00263
11.00	30.976	97.986	.20337	6.4288	.20424	6.4566	.00316	.00998	1.546	.00437
12.00	28.964	91.622	.23664	7.4808	.23765	7.5127	.00363	.01147	1.527	.00729
13.00	27.239	86.165	.27213	8.6036	.27327	8.6388	.00413	.01305	1.511	.01022
14.00	25.716	81.349	.30978	9.7930	.31108	9.8338	.00465	.01471	1.496	.01318
15.00	24.373	77.099	.34959	1.1051	.35103	1.1097	.00520	.01645	1.482	.01615
16.00	23.177	73.317	.39151	1.2377	.39312	1.2427	.00578	.01827	1.470	.01914
17.00	22.106	69.929	.43554	1.3768	.43731	1.3824	.00638	.02016	1.458	.02215
18.00	21.141	66.874	.48165	1.5226	.48359	1.5287	.00700	.02213	1.448	.02518
19.00	20.265	64.105	.52979	1.6748	.53191	1.6815	.00765	.02418	1.438	.02823
20.00	19.467	61.581	.57996	1.8334	.58227	1.8407	.00832	.02630	1.429	.03130
22.00	18.066	57.148	.68630	2.1695	.68900	2.1781	.00973	.03076	1.412	.03749
24.00	16.873	53.376	.80051	2.5306	.80363	2.5405	.01123	.03550	1.397	.04374
26.00	15.846	50.125	.92245	2.9161	.92602	2.9273	.01282	.04051	1.384	.04775
28.00	14.950	47.292	1.0520	3.3256	1.0560	3.3383	.01449	.04580	1.372	.04942
30.00	14.162	44.798	1.1890	3.7588	1.1936	3.7731	.01624	.05135	1.361	.05115
32.00	13.462	42.586	1.3334	4.2152	1.3384	4.2311	.01808	.05716	1.351	.05296
34.00	12.838	40.609	1.4850	4.6945	1.4906	4.7122	.02000	.06322	1.342	.05483
36.00	12.273	38.824	1.6439	5.1966	1.6500	5.2161	.02200	.06954	1.333	.05676
38.00	11.765	37.218	1.8058	5.7211	1.8165	5.7424	.02407	.07609	1.325	.05874
40.00	11.304	35.757	1.9826	6.2574	1.9900	6.2907	.02622	.08289	1.318	.06078
45.00	10.313	32.622	2.4447	7.7282	2.4537	7.7566	.03192	.10089	1.301	.06607
50.00	9.5032	30.062	2.9485	9.3210	2.9593	9.3549	.03806	.12030	1.286	.07162
55.00	8.8288	27.929	3.4930	11.042	3.5056	11.082	.04462	.14107	1.273	.07742
60.00	8.2579	26.122	4.0769	12.888	4.0916	12.934	.05160	.16313	1.261	.08349
65.00	7.7680	24.573	4.6995	14.856	4.7162	14.909	.05898	.18646	1.251	.08981
70.00	7.3427	23.227	5.3594	16.943	5.3786	17.003	.06674	.21099	1.241	.09633
75.00	6.9699	22.048	6.0552	19.146	6.0778	19.213	.07488	.23670	1.232	.10305
80.00	6.6403	21.005	6.7891	21.462	6.8131	21.536	.08337	.26355	1.224	.10992
90.00	6.0835	19.244	8.3592	26.425	8.3885	26.518	.10139	.32051	1.209	.12405

CHLORINE

PRCTON ENERGY HEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	HEV/CH	KEV/CH	GM/CH2	METER	GM/CH2	METER	GM/CH2	METER PERCENT		
100.00	5.6308	17.812	10.064	31.814	10.099	31.925	.12072	.38162	1.195	.13854
110.00	5.2554	16.625	11.897	37.610	11.939	37.740	.14129	.44664	1.183	.15343
120.00	4.9386	15.623	13.855	43.799	13.903	43.950	.16303	.51536	1.173	.16876
130.00	4.6681	14.767	15.932	50.364	15.987	50.537	.18587	.58758	1.163	.18450
140.00	4.4340	14.026	18.124	57.293	18.186	57.489	.20976	.66311	1.153	.20050
150.00	4.2296	13.379	20.426	64.571	20.496	64.792	.23465	.74180	1.145	.21668
160.00	4.0494	12.809	22.835	72.187	22.913	72.433	.26049	.82348	1.137	.23305
170.00	3.8894	12.303	25.347	80.129	25.434	80.402	.28723	.90801	1.129	.24964
180.00	3.7464	11.851	27.959	88.386	28.054	88.685	.31483	.99526	1.122	.26638
190.00	3.6179	11.445	30.667	96.946	30.771	97.274	.34325	1.0851	1.116	.28322
200.00	3.5017	11.077	33.466	105.80	33.581	106.16	.37245	1.1774	1.109	.30009
210.00	3.3962	10.743	36.359	114.94	36.481	115.33	.40240	1.2721	1.103	.31700
220.00	3.3000	10.439	39.337	124.35	39.469	124.77	.43305	1.3690	1.097	.33393
230.00	3.2118	10.160	42.399	134.03	42.541	134.48	.46439	1.4681	1.092	.35083
240.00	3.1309	9.9040	45.542	143.97	45.695	144.45	.49639	1.5692	1.086	.36768
250.00	3.0562	9.6679	48.765	154.16	48.928	154.67	.52963	1.6723	1.081	.38443
260.00	2.9872	9.4495	52.064	164.59	52.238	165.14	.56222	1.7773	1.076	.40109
270.00	2.9232	9.2470	55.437	175.25	55.623	175.84	.59601	1.8841	1.072	.41764
280.00	2.8637	9.0588	58.883	186.14	59.080	186.76	.63034	1.9927	1.067	.43407
290.00	2.8082	8.8834	62.398	197.25	62.606	197.91	.66521	2.1029	1.063	.45033
300.00	2.7564	8.7195	65.981	208.58	66.201	209.28	.70058	2.2147	1.058	.46642
310.00	2.7080	8.5662	69.629	220.11	69.861	220.85	.73644	2.3281	1.054	.48232
320.00	2.6625	8.4225	73.342	231.85	73.586	232.62	.77276	2.4429	1.050	.49800
330.00	2.6198	8.2874	77.116	243.78	77.372	244.59	.80554	2.5591	1.046	.51345
340.00	2.5797	8.1604	80.950	255.90	81.219	256.75	.84674	2.6767	1.043	.52867
350.00	2.5418	8.0406	84.843	268.21	85.125	269.10	.88436	2.7957	1.039	.54362
360.00	2.5061	7.9276	88.792	280.69	89.087	281.62	.92238	2.9159	1.035	.55833
370.00	2.4723	7.8208	92.797	293.35	93.105	294.32	.96078	3.0373	1.032	.57282
380.00	2.4404	7.7196	96.855	306.18	97.176	307.20	.99956	3.1598	1.029	.58707
390.00	2.4101	7.6238	100.97	319.18	101.30	320.23	1.0367	3.2835	1.025	.60108
400.00	2.3813	7.5329	105.13	332.33	105.47	333.43	1.0782	3.4083	1.022	.61482
410.00	2.3540	7.4466	109.34	345.64	109.70	346.78	1.1180	3.5342	1.019	.62827
420.00	2.3281	7.3645	113.59	359.10	113.97	360.28	1.1581	3.6610	1.016	.64139
430.00	2.3034	7.2863	117.90	372.71	118.29	373.94	1.1985	3.7888	1.013	.65419
440.00	2.2798	7.2118	122.25	386.46	122.65	387.75	1.2393	3.9176	1.010	.66666
450.00	2.2574	7.1408	126.64	400.35	127.06	401.67	1.2803	4.0473	1.008	.67880
460.00	2.2360	7.0730	131.08	414.38	131.51	415.74	1.3216	4.1778	1.005	.69060
470.00	2.2155	7.0083	135.56	428.53	136.00	429.94	1.3631	4.3092	1.002	.70208
480.00	2.1959	6.9464	140.08	442.82	140.54	444.27	1.4050	4.4414	.9997	.71323
490.00	2.1772	6.8872	144.64	457.23	145.11	458.73	1.4470	4.5744	.9972	.72406

CHLORINE

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	HEV/GM/CM2	KEV/CH	GM/CM2	METER	GM/CM2	METER	GM/CM2	METER PERCENT		
500.00	2.1593	6.8304	149.24	471.77	149.72	473.31	1.4894	4.7082	.3269	.73456
510.00	2.1421	6.7761	153.67	486.42	154.37	488.01	1.5319	4.8427	.3267	.74475
520.00	2.1256	6.7240	158.54	501.19	159.06	502.83	1.5747	4.9780	.3264	.75462
530.00	2.1098	6.6740	163.25	516.07	163.78	517.76	1.6177	5.1139	.3262	.76418
540.00	2.0946	6.6260	167.95	531.06	168.54	532.79	1.6609	5.2505	.3259	.77343
550.00	2.0801	6.5799	172.77	546.15	173.33	547.94	1.7043	5.3878	.3257	.78238
560.00	2.0661	6.5356	177.58	561.36	178.15	563.19	1.7480	5.5257	.3255	.79104
570.00	2.0526	6.4930	182.42	576.66	183.01	573.54	1.7918	5.6642	.3252	.79940
580.00	2.0396	6.4520	187.29	592.06	187.90	593.99	1.8358	5.8033	.3250	.80749
590.00	2.0271	6.4125	192.19	607.56	192.82	609.54	1.8800	5.9433	.3247	.81529
600.00	2.0151	6.3745	197.12	623.15	197.76	625.18	1.9243	6.0832	.3245	.82282
620.00	1.9924	6.3026	207.07	654.61	207.75	656.73	2.0135	6.3653	.3240	.83710
640.00	1.9712	6.2356	217.13	686.41	217.84	688.64	2.1034	6.6494	.3235	.85036
660.00	1.9515	6.1733	227.30	718.55	228.04	720.88	2.1939	6.9354	.3231	.86266
680.00	1.9331	6.1151	237.57	751.00	238.33	753.43	2.2850	7.2233	.3226	.87406
700.00	1.9159	6.0607	247.93	783.75	248.73	786.28	2.3766	7.5129	.3221	.88461
720.00	1.8999	6.0099	258.38	816.79	259.21	819.42	2.4687	7.8041	.3216	.89435
740.00	1.8848	5.9622	268.91	850.10	269.78	852.84	2.5613	8.0969	.3211	.90434
760.00	1.8707	5.9175	279.53	883.67	280.43	886.51	2.6544	8.3912	.3206	.91463
780.00	1.8574	5.8755	290.23	917.48	291.16	920.43	2.7479	8.6868	.3201	.91926
800.00	1.8449	5.8361	301.00	951.54	301.97	954.59	2.8419	8.9838	.3196	.92627
820.00	1.8332	5.7989	311.85	985.82	312.84	988.97	2.9362	9.2821	.3191	.93272
840.00	1.8221	5.7640	322.76	1020.3	323.79	1023.6	3.0310	9.5816	.3186	.93864
860.00	1.8117	5.7310	333.73	1055.0	334.80	1058.4	3.1261	9.8822	.3181	.94407
880.00	1.8019	5.7000	344.77	1089.9	345.87	1093.4	3.2215	10.184	.3176	.94904
900.00	1.7926	5.6706	355.87	1125.0	357.01	1128.6	3.3173	10.487	.3171	.95360
920.00	1.7836	5.6429	367.03	1160.3	368.20	1164.0	3.4134	10.790	.3166	.95777
940.00	1.7750	5.6167	378.25	1195.7	379.45	1199.5	3.5098	11.095	.3160	.96158
960.00	1.7670	5.5920	389.53	1231.4	390.76	1235.3	3.6065	11.401	.3154	.96506
1000.00	1.7533	5.5464	412.34	1303.5	413.64	1307.6	3.8007	12.015	.3138	.97114

THE ELECTRON DENSITY OF CHLORINE IS 2.839E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.172 BEV, AND THE MINIMUM ENERGY LOSS IS 1.6347 MEV/GM/CM2

CHROMIUM

ELEMENT CR
 ATOMIC NUMBER 24
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 51.996
 ADJUSTED IONIZATION POTENTIAL 244.4

DENSITY = 7.1900 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE MG/CM2	PROTON PATH LENGTH MM	PROTON PATH LENGTH HG/CM2	PROTON PATH LENGTH MM	PROTON PATH LENGTH HG/CM2	PATH LENGTH STRAGGLING MM	PATH LENGTH STRAGGLING PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	400.73	2881.2	.0061	.44667	.00662	.01904	.00003	4.262	2.104	0.
.15	367.72	2643.9	.0079	.57688	.0080	.02138	.00003	3.705	1.716	0.
.20	337.99	2430.1	.0098	.71867	.0100	.02396	.00003	3.334	1.523	0.
.30	287.65	2068.	.0143	1.0398	.0145	.03000	.00004	2.886	1.322	0.
.40	248.17	1784.3	.0194	1.4146	.0197	.03812	.00005	2.695	1.210	0.
.50	218.01	1567.5	.0254	1.8452	.0257	.04823	.00007	2.614	1.135	0.
.60	195.63	1406.6	.0321	2.3302	.0324	.05987	.00008	2.569	1.080	0.
.70	179.50	1290.6	.0394	2.8647	.0398	.07252	.00010	2.532	1.038	0.
.80	168.08	1208.5	.0474	3.4414	.0479	.08568	.00012	2.490	1.004	0.
.90	153.53	1103.9	.0560	4.0634	.0565	.09968	.00014	2.453	.9762	0.
1.00	138.98	999.24	.0654	4.7480	.0660	.11553	.00016	2.433	.9517	0.
1.20	124.34	894.00	.0834	6.2714	.0872	.15038	.00021	2.398	.9131	0.
1.40	112.95	812.14	.1097	7.9614	.1107	.18702	.00026	2.349	.8842	0.
1.60	103.88	746.88	.1353	9.8105	.1364	.22546	.00031	2.298	.8611	0.
1.80	96.460	693.55	.1629	11.712	.1643	.26563	.00037	2.249	.8418	0.
2.00	90.217	648.66	.1925	13.841	.1941	.30748	.00043	2.203	.8253	0.
2.20	84.869	610.21	.2241	16.242	.2259	.35099	.00049	2.161	.8108	0.
2.40	80.220	576.78	.2576	18.668	.2596	.39610	.00055	2.122	.7978	0.
2.60	76.128	547.36	.2929	21.228	.2953	.44295	.00062	2.087	.7863	0.
2.80	72.489	521.20	.3301	23.922	.3327	.49139	.00068	2.054	.7758	0.
3.00	69.226	497.74	.3691	26.746	.3720	.54184	.00075	2.026	.7661	0.
3.20	66.279	476.55	.4099	29.699	.4131	.59438	.00083	2.001	.7573	0.
3.40	63.603	457.30	.4525	32.780	.4559	.64892	.00090	1.980	.7491	.00001
3.60	61.154	439.70	.4968	35.989	.5005	.70539	.00098	1.960	.7415	.00001
3.80	58.916	423.61	.5429	39.321	.5469	.76373	.00106	1.942	.7343	.00001
4.00	56.857	408.80	.5906	42.776	.5949	.82387	.00115	1.926	.7277	.00001
4.20	54.956	395.13	.6401	46.356	.6447	.88576	.00123	1.911	.7214	.00002
4.40	53.196	382.48	.6912	50.055	.6962	.94935	.00132	1.897	.7155	.00002
4.60	51.562	370.73	.7440	53.874	.7493	1.0146	.00141	1.883	.7100	.00003
4.80	50.039	359.78	.7984	57.813	.8041	1.0815	.00150	1.871	.7047	.00004

CHROMIUM

PRACTCN ENERGY MEV	ENERGY LOSS		PROTON RANGE		TOTAL PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/ GM*CM2	MEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	PERCENT		
5.00	49.617	349.455	.06143	.00854	.06187	.00860	.00115	.00016	1.859	.00064
5.50	45.429	326.63	.07201	.01002	.07251	.01009	.00133	.00018	1.831	.00007
6.00	42.668	306.78	.08331	.01169	.08388	.01167	.00152	.00021	1.807	.00010
6.50	40.258	289.45	.09531	.01326	.09595	.01334	.00171	.00024	1.784	.00013
7.00	38.132	274.17	.10800	.01502	.10872	.01512	.00192	.00027	1.764	.00018
7.50	36.283	260.87	.12136	.01688	.12216	.01699	.00213	.00030	1.746	.00023
8.00	34.620	248.92	.13540	.01883	.13628	.01895	.00236	.00033	1.728	.00029
8.50	33.120	238.13	.15008	.02087	.15104	.02101	.00259	.00036	1.712	.00035
9.00	31.759	228.34	.16541	.02300	.16646	.02315	.00282	.00039	1.697	.00043
9.50	30.518	219.42	.18138	.02523	.18253	.02539	.00307	.00043	1.683	.00051
10.00	29.381	211.25	.19797	.02753	.19922	.02771	.00333	.00046	1.670	.00060
11.00	27.369	196.78	.23307	.03242	.23452	.03262	.00386	.00054	1.645	.00080
12.00	25.643	184.37	.27064	.03764	.27229	.03787	.00442	.00061	1.623	.00111
13.00	24.143	173.59	.31063	.04320	.31250	.04346	.00501	.00070	1.604	.00161
14.00	22.827	164.13	.35300	.04910	.35511	.04939	.00563	.00078	1.587	.00209
15.00	21.663	155.76	.39775	.05532	.40011	.05565	.00628	.00087	1.570	.00261
16.00	20.625	148.30	.44481	.06185	.44742	.06223	.00696	.00097	1.556	.00315
17.00	19.693	141.60	.49418	.06873	.49706	.06913	.00767	.00107	1.542	.00370
18.00	18.852	135.54	.54593	.07591	.54898	.07635	.00840	.00117	1.530	.00428
19.00	18.088	130.05	.59971	.08341	.60315	.08389	.00916	.00127	1.518	.00488
20.00	17.390	125.04	.65580	.09121	.65954	.09173	.00994	.00138	1.507	.00549
22.00	16.164	116.22	.77455	.10773	.77892	.10833	.01159	.00161	1.488	.00615
24.00	15.118	108.70	.90192	.12544	.90695	.12614	.01334	.00185	1.470	.00684
26.00	14.214	102.20	1.0377	.14433	1.0435	.14513	.01518	.00211	1.455	.00753
28.00	13.426	96.533	1.1818	.16437	1.1883	.16527	.01712	.00238	1.441	.00823
30.00	12.730	91.531	1.3341	.18555	1.3414	.18656	.01915	.00266	1.428	.00896
32.00	12.113	87.094	1.4944	.20785	1.5025	.20897	.02128	.00296	1.416	.00960
34.00	11.561	83.123	1.6626	.23124	1.6715	.23248	.02349	.00327	1.405	.01015
36.00	11.064	79.547	1.8386	.25572	1.8484	.25708	.02579	.00359	1.395	.01070
38.00	10.613	76.308	2.0223	.28127	2.0330	.28276	.02817	.00392	1.386	.01128
40.00	10.203	73.360	2.2136	.30787	2.2253	.30950	.03064	.00426	1.377	.01188
45.00	9.3221	67.026	2.7244	.37891	2.7386	.38089	.03717	.00517	1.357	.01254
50.00	8.6012	61.843	3.2806	.45627	3.2976	.45863	.04420	.00615	1.340	.01317
55.00	7.9996	57.517	3.8809	.53976	3.9008	.54254	.05169	.00719	1.325	.01384
60.00	7.4894	53.849	4.5242	.62923	4.5473	.63244	.05965	.00830	1.312	.01451
65.00	7.0511	50.697	5.2093	.72452	5.2357	.72819	.06804	.00946	1.300	.01518
70.00	6.6694	47.953	5.9353	.82549	5.9652	.82965	.07666	.01069	1.289	.01586
75.00	6.3353	45.551	6.7011	.93201	6.7348	.93666	.08609	.01197	1.278	.01654
80.00	6.0397	43.425	7.5058	1.0439	7.5433	1.0491	.09572	.01331	1.269	.01722
90.00	5.5395	39.829	9.1286	1.2835	9.2744	1.2899	.11611	.01615	1.252	.01790

CHROMIUM

PROTON ENERGY MEV	ENERGY LOSS MEV/GH/CH2	PROTON RANGE GH/CH2	PROTON RANGE CM	PROTON PATH LENGTH GH/CH2	PROTON PATH LENGTH CM	GH/CH2	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	5.1322	11.097	1.5434	11.152	1.5510	.13795	.01919	1.237	.12237
110.00	4.7939	13.105	1.8227	13.169	1.8316	.16116	.02241	1.224	.13682
120.00	4.5083	15.248	2.1207	15.322	2.1310	.18565	.02582	1.212	.15181
130.00	4.2639	17.519	2.4366	17.604	2.4484	.21136	.02940	1.201	.16725
140.00	4.0524	19.915	2.7498	20.011	2.7832	.23822	.03313	1.190	.18305
150.00	3.8674	22.430	3.1196	22.538	3.1346	.26618	.03702	1.181	.19914
160.00	3.7044	25.060	3.4855	25.181	3.5022	.29518	.04105	1.172	.21549
170.00	3.5595	27.802	3.8668	27.936	3.8853	.32517	.04523	1.164	.23209
180.00	3.4300	30.652	4.2631	30.798	4.2835	.35611	.04953	1.156	.24887
190.00	3.3135	33.605	4.6738	33.765	4.6962	.38794	.05396	1.149	.26577
200.00	3.2082	36.658	5.0985	36.833	5.1228	.42063	.05850	1.142	.28276
210.00	3.1125	39.809	5.5367	39.998	5.5631	.45414	.06316	1.135	.29978
220.00	3.0252	43.053	5.9880	43.238	6.0164	.48863	.06793	1.129	.31679
230.00	2.9452	46.389	6.4518	46.609	6.4824	.52347	.07281	1.123	.33375
240.00	2.8717	49.812	6.9279	50.048	6.9607	.55922	.07778	1.117	.35063
250.00	2.8039	53.320	7.4159	53.572	7.4509	.59555	.08284	1.112	.36739
260.00	2.7412	56.911	7.9153	57.180	7.9527	.63274	.08800	1.107	.38406
270.00	2.6831	60.582	8.4258	60.867	8.4656	.67045	.09325	1.101	.40064
280.00	2.6290	64.330	8.9472	64.633	8.9893	.70877	.09858	1.097	.41712
290.00	2.5786	68.153	9.4789	68.474	9.5235	.74765	.10399	1.092	.43347
300.00	2.5315	72.050	10.021	72.388	10.068	.78710	.10947	1.087	.44966
310.00	2.4875	76.017	10.573	76.374	10.622	.82707	.11503	1.083	.46565
320.00	2.4462	80.052	11.134	80.428	11.186	.86755	.12066	1.079	.48142
330.00	2.4074	84.155	11.704	84.549	11.759	.90851	.12636	1.075	.49694
340.00	2.3708	88.322	12.284	88.735	12.341	.94995	.13212	1.071	.51221
350.00	2.3364	92.551	12.872	92.984	12.932	.99194	.13795	1.067	.52720
360.00	2.3039	96.842	13.469	97.295	13.532	1.0342	.14383	1.063	.54197
370.00	2.2732	101.19	14.074	101.66	14.140	1.0769	.14978	1.059	.55655
380.00	2.2441	105.60	14.687	106.09	14.756	1.1200	.15578	1.056	.57093
390.00	2.2166	110.06	15.308	110.58	15.379	1.1636	.16183	1.052	.58509
400.00	2.1905	114.58	15.936	115.11	16.010	1.2075	.16794	1.049	.59902
410.00	2.1656	119.15	16.572	119.71	16.649	1.2517	.17409	1.046	.61268
420.00	2.1420	123.77	17.215	124.35	17.295	1.2963	.18030	1.043	.62602
430.00	2.1196	128.45	17.864	129.04	17.948	1.3413	.18655	1.039	.63903
440.00	2.0981	133.17	18.521	133.78	18.607	1.3866	.19284	1.036	.65173
450.00	2.0777	137.93	19.184	138.57	19.273	1.4321	.19918	1.033	.66410
460.00	2.0582	142.75	19.854	143.41	19.946	1.4780	.20556	1.031	.67614
470.00	2.0396	147.61	20.529	148.29	20.625	1.5242	.21198	1.028	.68786
480.00	2.0218	152.51	21.211	153.22	21.310	1.5706	.21844	1.025	.69926
490.00	2.0048	157.45	21.899	158.18	22.000	1.6173	.22494	1.022	.71033

CHROMIUM

PROTON ENERGY MEV	ENERGY LOSS MEV/CH	PROTON RANGE GM/CH ²	PROTON PATH LENGTH GM/CH ²	PROTON PATH LENGTH CH	OH/CH ²	PATH LENGTH STRAGGLING CH	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	1.9885	14.297	163.19	22.697	1.6643	.23147	1.020	.72109
510.00	1.9729	14.135	168.24	23.399	1.7115	.23804	1.017	.73153
520.00	1.9579	14.077	173.33	24.107	1.7590	.24465	1.015	.74166
530.00	1.9435	13.974	178.46	24.820	1.8067	.25128	1.012	.75147
540.00	1.9298	13.875	183.62	25.538	1.8546	.25795	1.010	.76099
550.00	1.9165	13.780	188.82	26.261	1.9028	.26455	1.008	.77020
560.00	1.9038	13.688	194.05	26.989	1.9512	.27137	1.005	.77912
570.00	1.8915	13.600	199.32	27.722	1.9998	.27813	1.003	.78775
580.00	1.8798	13.515	204.63	28.460	2.0485	.28491	1.001	.79609
590.00	1.8684	13.434	209.96	29.202	2.0975	.29173	.9990	.80416
600.00	1.8575	13.355	215.33	29.949	2.1467	.29856	.9969	.81195
620.00	1.8368	13.207	226.16	31.455	2.2456	.31232	.9929	.82674
640.00	1.8176	13.069	236.02	32.827	2.3431	.32616	.9891	.84052
660.00	1.7997	12.940	248.16	34.515	2.4433	.34010	.9854	.85332
680.00	1.7831	12.820	259.33	36.060	2.5462	.35413	.9818	.86522
700.00	1.7675	12.708	270.60	37.635	2.6476	.36823	.9784	.87624
720.00	1.7529	12.603	281.96	39.215	2.7495	.38241	.9752	.88645
740.00	1.7392	12.505	293.41	40.809	2.8520	.39666	.9720	.89589
760.00	1.7264	12.413	304.96	42.414	2.9550	.41098	.9690	.90461
780.00	1.7144	12.326	316.58	44.031	3.0584	.42537	.9661	.91266
800.00	1.7031	12.245	328.29	45.659	3.1623	.43982	.9633	.92008
820.00	1.6925	12.169	340.07	47.290	3.2666	.45432	.9606	.92691
840.00	1.6825	12.097	351.92	48.946	3.3713	.46889	.9580	.93319
860.00	1.6731	12.029	363.85	50.605	3.4764	.48350	.9554	.93897
880.00	1.6642	11.965	375.84	52.272	3.5818	.49817	.9530	.94428
900.00	1.6558	11.905	387.89	53.949	3.6876	.51288	.9507	.94915
920.00	1.6479	11.848	398.22	55.385	3.7937	.52764	.9484	.95362
940.00	1.6404	11.795	412.19	57.328	3.9002	.54245	.9466	.95771
960.00	1.6334	11.744	424.43	59.031	4.0070	.55730	.9441	.96146
1000.00	1.6204	11.651	449.21	62.476	4.2213	.58711	.9397	.96803

THE ELECTRON DENSITY OF CHROMIUM IS 2.701E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.117 BEV, AND THE MINIMUM ENERGY LOSS IS 1.5127 MEV/GH/CH²

COBALT

ADJUSTED
IONIZATION
POTENTIAL
292.5

ATOMIC
WEIGHT
58.933

ATOMS/
MOLECULE
1

ATOMIC
NUMBER
27

ELEMENT
CO

DENSITY = 8.9000 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS GM/CM2	HEV/CM	PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
			MG/CM2	MM	MG/CM2	MM	MG/CM2	MM		
.10	301.05	2679.3	.48287	.00054	.49426	.00056	.02147	.00002	2.305	0.
.15	290.59	2586.3	.65103	.00073	.66330	.00075	.02596	.00003	1.850	0.
.20	264.16	2351.0	.82961	.00093	.84367	.00095	.03043	.00003	2.666	0.
.30	232.36	2018.0	1.2301	.00138	1.2489	.00140	.04012	.00005	1.506	0.
.40	200.93	1788.3	1.6861	.00169	1.7105	.00192	.05076	.00006	1.424	0.
.50	177.74	1581.9	2.2122	.00249	2.2429	.00252	.06420	.00007	1.366	0.
.60	170.09	1513.0	2.7816	.00313	2.8189	.00317	.07837	.00009	1.322	0.
.70	155.77	1386.4	3.3866	.00381	3.4307	.00385	.09279	.00010	1.285	0.
.80	145.71	1296.8	4.0437	.00454	4.0949	.00460	.10844	.00012	1.252	0.
.90	136.65	1216.2	4.7453	.00533	4.8039	.00540	.12479	.00014	1.222	0.
1.00	127.58	1135.5	5.4942	.00617	5.5606	.00625	.14213	.00016	1.194	0.
1.20	114.41	1018.3	7.1370	.00802	7.2197	.00811	.17950	.00020	1.146	0.
1.40	104.22	927.52	8.9543	.01006	9.0546	.01017	.21969	.00025	1.102	0.
1.60	96.099	855.28	10.937	.01229	11.056	.01242	.26202	.00029	1.075	0.
1.80	89.354	795.25	13.078	.01469	13.217	.01485	.30646	.00034	1.046	0.
2.00	83.669	744.66	15.373	.01727	15.531	.01745	.35293	.00040	1.022	0.
2.20	78.791	701.24	17.815	.02002	17.995	.02022	.40134	.00045	.9999	0.
2.40	74.575	663.72	20.404	.02293	20.606	.02315	.45156	.00051	.9803	0.
2.60	70.863	630.68	23.134	.02599	23.359	.02625	.50355	.00057	.9629	0.
2.80	67.563	601.31	26.002	.02922	26.251	.02950	.55728	.00063	.9473	0.
3.00	64.639	575.29	29.004	.03259	29.277	.03290	.61267	.00069	.9328	0.
3.20	61.964	551.48	32.139	.03611	32.437	.03645	.66970	.00075	.9197	0.
3.40	59.534	529.85	35.406	.03978	35.731	.04015	.72842	.00082	.9076	0.
3.60	57.313	510.08	38.806	.04360	39.157	.04400	.78979	.00089	.8964	0.
3.80	55.273	491.93	42.332	.04756	42.711	.04799	.85116	.00096	.8859	.00001
4.00	53.392	475.19	45.986	.05167	46.392	.05213	.91559	.00103	.8763	.00001
4.20	51.651	459.69	49.767	.05592	50.203	.05641	.98201	.00110	.8671	.00001
4.40	50.033	445.29	53.673	.06031	54.138	.06083	1.0504	.00118	.8587	.00001
4.60	48.526	431.88	57.701	.06483	58.196	.06539	1.1206	.00126	.8506	.00002
4.80	47.119	419.36	61.854	.06950	62.380	.07009	1.1926	.00134	.8431	.00002

COBALT

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	HEV/CH	GM/CH2	CH	GM/CH2	CH	GM/CH2	PERCENT	PERCENT	PERCENT	
5.00	45.798	407.60	.06613	.00743	.06669	.00749	.00127	.00014	1.892	.8360	.00003
5.50	42.847	381.33	.07734	.00869	.07798	.00876	.00146	.00016	1.870	.8198	.00005
6.00	40.301	358.68	.08929	.01003	.09002	.01011	.00166	.00019	1.845	.8035	.00007
6.50	38.079	338.91	.10198	.01146	.10279	.01155	.00187	.00021	1.823	.7928	.00010
7.00	36.119	321.46	.11537	.01296	.11628	.01306	.00210	.00024	1.802	.7814	.00014
7.50	34.369	305.69	.12947	.01455	.13047	.01466	.00233	.00026	1.783	.7711	.00018
8.00	32.795	291.68	.14426	.01621	.14537	.01633	.00257	.00029	1.766	.7618	.00023
8.50	31.376	279.24	.15975	.01795	.16096	.01809	.00282	.00032	1.750	.7533	.00029
9.00	30.115	268.03	.17591	.01977	.17723	.01991	.00307	.00035	1.735	.7455	.00035
9.50	28.928	257.46	.19275	.02166	.19418	.02182	.00334	.00038	1.721	.7383	.00042
10.00	27.869	248.04	.21025	.02362	.21180	.02380	.00362	.00041	1.708	.7316	.00050
11.00	25.994	231.34	.24710	.02777	.24898	.02798	.00419	.00047	1.663	.7197	.00068
12.00	24.381	216.99	.28668	.03221	.28872	.03244	.00480	.00054	1.661	.7092	.00093
13.00	22.978	204.51	.32868	.03693	.33099	.03719	.00543	.00061	1.641	.6999	.00175
14.00	21.745	193.53	.37315	.04193	.37575	.04222	.00610	.00069	1.623	.6917	.00259
15.00	20.652	183.80	.42007	.04720	.42296	.04752	.00679	.00076	1.606	.6843	.00467
16.00	19.675	175.11	.46939	.05274	.47259	.05310	.00752	.00084	1.591	.6775	.00740
17.00	18.797	167.30	.52109	.05855	.52461	.05895	.00827	.00093	1.577	.6714	.00985
18.00	18.003	160.23	.57512	.06462	.57897	.06505	.00906	.00102	1.564	.6658	.01232
19.00	17.282	153.61	.63149	.07095	.63569	.07143	.00987	.00111	1.552	.6606	.01461
20.00	16.623	147.94	.69015	.07755	.69471	.07806	.01070	.00120	1.541	.6558	.01731
22.00	15.462	137.61	.81425	.09149	.81955	.09208	.01246	.00140	1.520	.6473	.02238
24.00	14.471	128.79	.94723	.10643	.95333	.10712	.01432	.00161	1.502	.6399	.02753
26.00	13.614	121.17	1.0890	.12236	1.0959	.12314	.01628	.00183	1.486	.6333	.03092
28.00	12.866	114.51	1.2393	.13925	1.2471	.14012	.01834	.00206	1.471	.6275	.03250
30.00	12.206	108.63	1.3980	.15708	1.4068	.15806	.02050	.00230	1.457	.6223	.03415
32.00	11.619	103.41	1.5650	.17585	1.5748	.17694	.02276	.00256	1.445	.6176	.03586
34.00	11.093	98.731	1.7403	.19553	1.7510	.19674	.02510	.00282	1.434	.6134	.03763
36.00	10.620	94.517	1.9235	.21612	1.9353	.21745	.02754	.00309	1.423	.6095	.03947
38.00	10.191	90.699	2.1147	.23761	2.1276	.23906	.03007	.00338	1.413	.6059	.04136
40.00	9.797	87.218	2.3138	.25997	2.3278	.26155	.03268	.00367	1.404	.6027	.04330
45.00	8.9602	79.746	2.8450	.31966	2.8620	.32158	.03959	.00445	1.383	.5955	.04837
50.00	8.2724	73.625	3.4231	.38461	3.4434	.38690	.04702	.00528	1.365	.5895	.05370
55.00	7.6980	68.512	4.0467	.45468	4.0705	.45735	.05493	.00617	1.350	.5844	.05930
60.00	7.2106	64.174	4.7145	.52972	4.7420	.53281	.06333	.00712	1.335	.5800	.06517
65.00	6.7915	60.444	5.4255	.60960	5.4569	.61314	.07217	.00811	1.323	.5761	.07129
70.00	6.4270	57.200	6.1785	.69421	6.2141	.69831	.08147	.00915	1.311	.5727	.07762
75.00	6.1067	54.350	6.9726	.78344	7.0126	.78793	.09118	.01025	1.300	.5697	.08415
80.00	5.8234	51.828	7.8068	.87717	7.8513	.88217	.10132	.01138	1.290	.5669	.09085
90.00	5.3437	47.559	9.5919	1.0777	9.6462	1.0898	.12277	.01379	1.273	.5623	.10467

COBALT

PROTON ENERGY MEV	ENERGY LOSS MEV/CM2	PROTON RANGE GM/CM2	PROTON RANGE CM	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	PATH LENGTH STRAGGLING GM/CM2	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	4.9533	11.527	1.2952	11.592	1.3024	1.4572	0.1637	1.257	.11893
110.00	4.6287	13.606	1.5288	13.682	1.5373	1.7009	0.1911	1.243	.13363
120.00	4.3546	15.823	1.7778	15.911	1.7877	1.9579	0.2200	1.231	.14883
130.00	4.1199	18.172	2.0418	18.273	2.0531	2.2276	0.2503	1.219	.16442
140.00	3.9166	20.650	2.3202	20.763	2.3330	2.5092	0.2819	1.208	.18032
150.00	3.7389	23.250	2.6124	23.378	2.6267	2.8023	0.3149	1.199	.19645
160.00	3.5821	25.969	2.9179	26.111	2.9338	3.1061	0.3490	1.190	.21281
170.00	3.4428	28.802	3.2362	28.960	3.2539	3.4202	0.3843	1.181	.22943
180.00	3.3182	31.746	3.5670	31.919	3.5864	3.7440	0.4207	1.173	.24623
190.00	3.2061	34.797	3.9097	34.986	3.9310	4.0772	0.4581	1.165	.26318
200.00	3.1047	37.950	4.2641	38.156	4.2872	4.4192	0.4965	1.158	.28021
210.00	3.0126	41.203	4.6296	41.426	4.6546	4.7697	0.5359	1.151	.29730
220.00	2.9285	44.553	5.0060	44.794	5.0330	5.1283	0.5762	1.145	.31443
230.00	2.8515	47.996	5.3928	48.255	5.4219	5.4946	0.6174	1.139	.33156
240.00	2.7807	51.529	5.7898	51.806	5.8209	5.8683	0.6594	1.133	.34865
250.00	2.7154	55.150	6.1966	55.446	6.2299	6.2490	0.7021	1.127	.36566
260.00	2.6550	58.855	6.6129	59.171	6.6484	6.6366	0.7457	1.122	.38257
270.00	2.5990	62.642	7.0385	62.978	7.0762	7.0305	0.7899	1.116	.39935
280.00	2.5469	66.509	7.4729	66.865	7.5129	7.4307	0.8349	1.111	.41598
290.00	2.4984	70.453	7.9161	70.830	7.9584	7.8368	0.8805	1.106	.43242
300.00	2.4530	74.472	8.3676	74.870	8.4123	8.2487	0.9268	1.102	.44867
310.00	2.4105	78.563	8.8273	78.982	8.8744	8.6660	0.9737	1.097	.46471
320.00	2.3707	82.725	9.2949	83.166	9.3445	9.0885	1.0212	1.093	.48054
330.00	2.3333	86.955	9.7702	87.418	9.8222	9.5161	1.0692	1.089	.49614
340.00	2.2981	91.251	10.253	91.737	10.307	9.9485	1.1178	1.084	.51150
350.00	2.2649	95.612	10.743	96.120	10.800	1.0386	1.1669	1.080	.52661
360.00	2.2336	100.03	11.240	100.57	11.300	1.0827	1.2165	1.077	.54148
370.00	2.2040	104.52	11.744	105.07	11.806	1.1273	1.2666	1.073	.55611
380.00	2.1760	109.06	12.254	109.64	12.319	1.1723	1.3172	1.069	.57050
390.00	2.1494	113.66	12.771	114.26	12.839	1.2177	1.3682	1.066	.58453
400.00	2.1242	118.32	13.294	118.94	13.365	1.2635	1.4196	1.062	.59850
410.00	2.1003	123.03	13.823	123.68	13.896	1.3096	1.4715	1.059	.61207
420.00	2.0776	127.79	14.358	128.47	14.434	1.3561	1.5237	1.056	.62534
430.00	2.0559	132.60	14.899	133.30	14.978	1.4030	1.5764	1.052	.63829
440.00	2.0353	137.44	15.446	138.19	15.527	1.4502	1.6294	1.049	.65093
450.00	2.0156	142.38	15.996	143.13	16.082	1.4977	1.6828	1.046	.66325
460.00	1.9968	147.34	16.555	148.12	16.642	1.5455	1.7365	1.043	.67525
470.00	1.9788	152.34	17.117	153.15	17.207	1.5936	1.7905	1.041	.68693
480.00	1.9617	157.39	17.685	158.22	17.778	1.6420	1.8449	1.038	.69830
490.00	1.9453	162.49	18.257	163.34	18.353	1.6906	1.8996	1.035	.70934

COBALT

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/GM/CM2	MEV/CH	GM/CM2	CM	GM/CM2	CM	GM/CM2	CM	PERCENT	PERCENT	
500.00	1.9296	17.173	167.62	18.634	168.50	18.933	1.7396	.19546	1.032	.5228	.72008
510.00	1.9145	17.039	172.80	19.416	173.71	19.518	1.7888	.20099	1.030	.5224	.73050
520.00	1.9001	16.911	178.01	20.092	178.95	20.107	1.8382	.20654	1.027	.5220	.74062
530.00	1.8862	16.788	183.27	20.592	184.23	20.700	1.8879	.21213	1.025	.5217	.75042
540.00	1.8739	16.669	188.56	21.187	189.55	21.298	1.9378	.21774	1.022	.5213	.75993
550.00	1.8602	16.556	193.89	21.786	194.91	21.900	1.9880	.22337	1.020	.5210	.76915
560.00	1.8479	16.446	199.26	22.389	200.30	22.506	2.0384	.22903	1.018	.5206	.77807
570.00	1.8361	16.342	204.66	22.996	205.73	23.116	2.0889	.23471	1.015	.5203	.78670
580.00	1.8248	16.241	210.10	23.606	211.20	23.730	2.1397	.24042	1.013	.5199	.79505
590.00	1.8139	16.143	215.57	24.221	216.69	24.347	2.1907	.24615	1.011	.5196	.80313
600.00	1.8033	16.050	221.07	24.839	222.22	24.969	2.2419	.25190	1.009	.5192	.81094
620.00	1.7834	15.873	232.16	26.086	233.37	26.222	2.3448	.26346	1.005	.5185	.82376
640.00	1.7649	15.708	243.38	27.346	244.65	27.488	2.4484	.27511	1.001	.5178	.83957
660.00	1.7477	15.555	254.71	28.619	256.04	28.768	2.5527	.28682	.9970	.5172	.85442
680.00	1.7316	15.412	266.15	29.905	267.53	30.060	2.6576	.29861	.9934	.5165	.86436
700.00	1.7166	15.278	277.69	31.202	279.13	31.363	2.7631	.31046	.9899	.5158	.87544
720.00	1.7026	15.153	289.33	32.510	290.83	32.670	2.8692	.32238	.9865	.5151	.88570
740.00	1.6894	15.036	301.07	33.828	302.63	34.003	2.9758	.33436	.9833	.5144	.89519
760.00	1.6771	14.926	312.89	35.156	314.51	35.338	3.0828	.34639	.9802	.5137	.90397
780.00	1.6656	14.823	324.80	36.494	326.48	36.683	3.1904	.35847	.9772	.5130	.91207
800.00	1.6547	14.727	336.79	37.842	338.52	38.036	3.2984	.37061	.9743	.5123	.91954
820.00	1.6445	14.636	348.86	39.197	350.65	39.399	3.4068	.38279	.9716	.5116	.92642
840.00	1.6349	14.550	361.00	40.561	362.85	40.770	3.5157	.39502	.9689	.5108	.93276
860.00	1.6258	14.470	373.21	41.933	375.12	42.148	3.6249	.40729	.9663	.5101	.93858
880.00	1.6173	14.394	385.48	43.313	387.46	43.534	3.7345	.41960	.9638	.5094	.94393
900.00	1.6093	14.323	397.83	44.700	399.86	44.928	3.8444	.43196	.9614	.5087	.94885
920.00	1.6017	14.255	410.23	46.094	412.33	46.329	3.9547	.44435	.9591	.5079	.95335
940.00	1.5945	14.191	422.70	47.495	424.86	47.737	4.0653	.45678	.9571	.5071	.95748
960.00	1.5878	14.131	435.24	48.904	437.46	49.153	4.1762	.46924	.9547	.5061	.96126
1000.00	1.5753	14.020	460.61	51.754	462.94	52.016	4.3989	.49426	.9502	.5037	.96789

THE ELECTRON DENSITY OF COBALT IS 2.760E 23 ELECTRONS PER GRAM
 THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.088 BEV, AND THE MINIMUM ENERGY LOSS IS 1.4775 MEV/GM/CM2

COPPER

ELEMENT CU
 ATOMIC NUMBER 29
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 63.540
 ADJUSTED IONIZATION POTENTIAL 320.0

DENSITY = 8.9200 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS HEV/CM2	HEV/CH	PROTON RANGE MG/CM2	MM	PROTON PATH LENGTH MG/CM2	MM	HG/CM2	PATH LENGTH STRAGGLING MM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	225.66	2012.9	.51904	.00058	.53200	.00060	.02338	.00003	4.394	2.436	0.
.15	227.21	2026.7	.73833	.00083	.75281	.00084	.03226	.00004	4.286	1.924	0.
.20	221.45	1975.3	.95829	.00107	.97569	.00109	.03926	.00004	4.024	1.784	0.
.30	200.95	1792.5	1.4250	.00160	1.4494	.00162	.05190	.00006	3.581	1.689	0.
.40	182.31	1626.2	1.9401	.00218	1.9721	.00221	.06457	.00007	3.273	1.635	0.
.50	167.45	1493.7	2.5047	.00281	2.5452	.00285	.07779	.00009	3.056	1.588	0.
.60	154.86	1381.4	3.1175	.00349	3.1664	.00355	.09246	.00010	2.920	1.544	0.
.70	144.04	1284.8	3.7782	.00424	3.8358	.00430	.10840	.00012	2.826	1.502	0.
.80	135.27	1206.6	4.4857	.00503	4.5923	.00510	.12533	.00014	2.753	1.463	0.
.90	128.44	1145.7	5.2348	.00587	5.3305	.00595	.14287	.00016	2.690	1.427	0.
1.00	121.60	1084.6	6.0257	.00676	6.1109	.00685	.16098	.00018	2.634	1.394	0.
1.20	109.47	976.47	7.7424	.00868	7.9471	.00880	.19970	.00022	2.545	1.335	0.
1.40	99.835	890.53	9.6373	.01080	9.7627	.01094	.24155	.00027	2.474	1.284	0.
1.60	92.062	821.19	11.704	.01312	11.851	.01329	.28617	.00032	2.415	1.241	0.
1.80	85.765	765.02	13.935	.01562	14.105	.01581	.33318	.00037	2.362	1.203	0.
2.00	80.408	717.24	16.321	.01830	16.514	.01851	.38231	.00043	2.315	1.171	0.
2.20	75.782	675.97	18.859	.02114	19.076	.02139	.43350	.00049	2.272	1.142	0.
2.40	71.762	640.11	21.548	.02416	24.791	.02443	.48667	.00055	2.233	1.116	0.
2.60	68.214	608.47	24.379	.02733	28.649	.02763	.54174	.00061	2.198	1.093	0.
2.80	65.080	580.51	27.355	.03067	27.652	.03100	.59864	.00067	2.165	1.073	0.
3.00	62.325	555.94	30.471	.03416	30.796	.03452	.65729	.00074	2.134	1.054	0.
3.20	59.778	533.22	33.718	.03780	34.071	.03820	.71754	.00080	2.106	1.037	0.
3.40	57.464	512.58	37.105	.04160	37.488	.04203	.77953	.00087	2.079	1.022	0.
3.60	55.350	493.72	40.622	.04554	41.035	.04600	.84322	.00095	2.055	1.007	0.
3.80	53.408	476.40	44.227	.04963	44.712	.05013	.90859	.00102	2.032	.9941	0.
4.00	51.618	460.43	48.044	.05386	48.521	.05440	.97562	.00109	2.011	.9818	.00001
4.20	49.959	445.64	51.954	.05824	52.463	.05881	1.0443	.00117	1.991	.9703	.00001
4.40	48.419	431.89	55.984	.06276	56.526	.06337	1.1150	.00125	1.973	.9595	.00001
4.60	46.982	419.08	60.145	.06743	60.722	.06807	1.1878	.00133	1.956	.9495	.00001
4.80	45.639	407.10	64.430	.07223	65.042	.07292	1.2624	.00142	1.941	.9400	.00002

COPPER

PRCTGN ENERGY MEV	ENERGY LOSS MEV/CH	PROTON RANGE CM	PROTON PATH LENGTH GM/CM2	GM/CM2	PROTON PATH LENGTH CH	GM/CM2	PATH LENGTH STRAGGLING CH	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	44.381	0.0772	0.6949	0.0779	0.0134	0.0015	1.927	.9311	.00002
5.50	41.553	0.0901	0.8114	0.0910	0.0154	0.0017	1.896	.9109	.00003
6.00	39.105	0.1039	0.9355	0.1049	0.0175	0.0020	1.870	.8933	.00005
6.50	36.863	0.1186	1.0671	0.1196	0.0197	0.0022	1.846	.8777	.00008
7.00	35.076	0.1340	1.2059	0.1352	0.0220	0.0025	1.825	.8637	.00011
7.50	33.399	0.1503	1.3521	0.1516	0.0244	0.0027	1.806	.8512	.00015
8.00	31.894	0.1673	1.5053	0.1688	0.0269	0.0030	1.788	.8399	.00019
8.50	30.533	0.1852	1.6656	0.1867	0.0295	0.0033	1.772	.8296	.00025
9.00	29.294	0.2038	1.8329	0.2055	0.0322	0.0036	1.756	.8202	.00031
9.50	28.161	0.2232	2.0070	0.2250	0.0350	0.0039	1.742	.8115	.00037
10.00	27.123	0.2433	2.1879	0.2453	0.0378	0.0042	1.729	.8034	.00045
11.00	25.292	0.2850	2.5700	0.2881	0.0436	0.0049	1.704	.7891	.00062
12.00	23.738	0.3313	2.9552	0.3339	0.0501	0.0056	1.682	.7766	.00083
13.00	22.384	0.3796	3.3423	0.3825	0.0567	0.0064	1.662	.7657	.00123
14.00	21.194	0.4308	3.8424	0.4340	0.0637	0.0071	1.644	.7560	.00167
15.00	20.138	0.4847	4.3560	0.4883	0.0709	0.0079	1.627	.7472	.00211
16.00	19.193	0.5414	4.8829	0.5454	0.0784	0.0088	1.612	.7394	.00267
17.00	18.344	0.6007	5.3979	0.6051	0.0862	0.0097	1.597	.7322	.00326
18.00	17.575	0.6627	5.9549	0.6676	0.0943	0.0106	1.584	.7256	.00386
19.00	16.875	0.7274	6.5358	0.7327	0.1027	0.0115	1.571	.7196	.00448
20.00	16.236	0.7947	7.1398	0.8004	0.1114	0.0125	1.560	.7141	.01472
22.00	15.109	0.9371	8.4180	0.9437	0.1295	0.0145	1.539	.7042	.01965
24.00	14.146	1.0896	9.7870	1.0972	0.1488	0.0167	1.520	.6956	.02466
26.00	13.313	1.2520	1.1245	1.2607	0.1690	0.0190	1.503	.6881	.02998
28.00	12.585	1.4242	1.2791	1.4340	0.1903	0.0213	1.488	.6814	.02955
30.00	11.942	1.6060	1.4423	1.6169	0.2126	0.0238	1.474	.6754	.03120
32.00	11.371	1.7973	1.6140	1.8094	0.2359	0.0264	1.461	.6700	.03290
34.00	10.859	1.9979	1.7941	2.0113	0.2601	0.0292	1.450	.6651	.03467
36.00	10.397	2.2076	1.9823	2.2223	0.2852	0.0320	1.439	.6607	.03650
38.00	9.9753	2.4265	2.1787	2.4425	0.3113	0.0349	1.429	.6566	.03838
40.00	9.5984	2.6542	2.3831	2.6716	0.3382	0.0379	1.419	.6529	.04032
45.00	8.7703	3.2619	2.9285	3.2830	0.4094	0.0459	1.398	.6447	.04536
50.00	8.1076	3.9229	3.5217	3.9481	0.4858	0.0545	1.379	.6379	.05068
55.00	7.5469	4.6358	4.1615	4.6653	0.5673	0.0636	1.363	.6321	.05625
60.00	7.0708	5.3991	4.8464	5.4332	0.6536	0.0733	1.349	.6270	.06211
65.00	6.6614	6.2114	5.5753	6.2503	0.7446	0.0835	1.335	.6227	.06822
70.00	6.3052	7.0716	6.3472	7.1157	0.8400	0.0942	1.323	.6188	.07455
75.00	5.9924	7.9786	7.1169	8.0280	0.9399	0.1054	1.312	.6154	.08109
80.00	5.7151	8.9312	8.0157	8.9862	1.0439	0.1170	1.302	.6123	.08781
90.00	5.2461	1.0969	9.1784	1.1036	1.2641	0.1417	1.284	.6071	.10171

COPPER

PRCTN ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH CM	PROTON PATH LENGTH GM/CM2	GM/CM2	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	4.8636	11.755	1.3178	11.826	1.4997	.01681	1.268	.11602
110.00	4.5461	13.870	1.5550	13.954	1.7497	.01961	1.254	.13094
120.00	4.2777	16.126	1.8079	16.223	2.0132	.02257	1.241	.14625
130.00	4.0479	18.517	2.0759	18.627	2.2897	.02567	1.229	.16193
140.00	3.8488	21.037	2.3584	21.162	2.5783	.02890	1.218	.17788
150.00	3.6746	23.682	2.6549	23.822	2.8785	.03227	1.208	.19402
160.00	3.5210	26.447	2.9649	26.603	3.1898	.03576	1.199	.21039
170.00	3.3845	29.328	3.2879	29.501	3.5114	.03937	1.190	.22701
180.00	3.2623	32.321	3.6234	32.511	3.8430	.04308	1.182	.24383
190.00	3.1524	35.423	3.9711	35.630	4.1841	.04691	1.174	.26080
200.00	3.0530	38.628	4.3305	38.854	4.5342	.05083	1.167	.27785
210.00	2.9627	41.935	4.7012	42.180	4.8929	.05485	1.160	.29499
220.00	2.8803	45.339	5.0829	45.603	5.2599	.05897	1.153	.31219
230.00	2.8047	48.838	5.4752	49.122	5.6347	.06317	1.147	.32941
240.00	2.7353	52.429	5.8777	52.733	6.0173	.06746	1.141	.34662
250.00	2.6713	56.108	6.2901	56.433	6.4065	.07182	1.135	.36378
260.00	2.6120	59.873	6.7122	60.219	6.8029	.07627	1.130	.38083
270.00	2.5571	63.720	7.1435	64.088	7.2058	.08078	1.124	.39773
280.00	2.5060	67.649	7.5840	68.039	7.6151	.08537	1.119	.41444
290.00	2.4583	71.656	8.0331	72.069	8.0304	.09003	1.114	.43095
300.00	2.4138	75.738	8.4908	76.174	8.4514	.09475	1.109	.44723
310.00	2.3722	79.894	8.9567	80.353	8.8781	.09953	1.105	.46330
320.00	2.3331	84.121	9.4306	84.604	9.3100	.10437	1.100	.47918
330.00	2.2964	88.417	9.9122	88.925	9.7471	.10927	1.096	.49483
340.00	2.2619	92.781	10.401	93.313	1.0189	.11423	1.092	.51026
350.00	2.2293	97.209	10.898	97.766	1.0636	.11924	1.088	.52544
360.00	2.1986	101.70	11.401	102.28	1.1087	.12430	1.084	.54037
370.00	2.1695	106.25	11.912	106.86	1.1543	.12940	1.080	.55504
380.00	2.1420	110.87	12.429	111.50	1.2003	.13456	1.076	.56944
390.00	2.1160	115.54	12.952	116.20	1.2467	.13976	1.073	.58357
400.00	2.0912	120.27	13.483	120.95	1.2934	.14500	1.069	.59741
410.00	2.0677	125.05	14.019	125.76	1.3406	.15029	1.066	.61095
420.00	2.0454	129.88	14.561	130.62	1.3881	.15562	1.063	.62419
430.00	2.0242	134.77	15.109	135.54	1.4360	.16098	1.059	.63711
440.00	2.0039	139.71	15.663	140.52	1.4842	.16639	1.056	.64973
450.00	1.9846	144.70	16.222	145.52	1.5327	.17182	1.053	.66203
460.00	1.9662	149.73	16.786	150.58	1.5815	.17730	1.050	.67402
470.00	1.9486	154.81	17.356	155.69	1.6306	.18281	1.047	.68569
480.00	1.9317	159.94	17.930	160.84	1.6801	.18835	1.045	.69705
490.00	1.9156	165.11	18.510	166.04	1.7298	.19392	1.042	.70809

COPPER

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CM	MEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	CM		
500.00	1.9002	16.950	170.32	19.094	171.28	19.202	1.7798	.19952	1.039	.71883
510.00	1.8854	16.818	175.57	19.603	176.57	19.795	1.8300	.20516	1.036	.72925
520.00	1.8713	16.692	180.87	20.277	181.89	20.391	1.8805	.21082	1.034	.73937
530.00	1.8577	16.571	186.20	20.875	187.26	20.993	1.9312	.21650	1.031	.74919
540.00	1.8446	16.454	191.58	21.477	192.66	21.598	1.9822	.22222	1.029	.75871
550.00	1.8321	16.342	196.99	22.084	198.10	22.208	2.0334	.22796	1.026	.76794
560.00	1.8201	16.235	202.43	22.694	203.57	22.822	2.0848	.23372	1.024	.77687
570.00	1.8085	16.132	207.91	23.309	209.09	23.440	2.1365	.23951	1.022	.78552
580.00	1.7974	16.033	213.43	23.927	214.63	24.062	2.1893	.24533	1.020	.79389
590.00	1.7867	15.937	218.98	24.549	220.21	24.687	2.2404	.25116	1.017	.80199
600.00	1.7763	15.845	224.56	25.175	225.83	25.317	2.2926	.25702	1.015	.80981
620.00	1.7568	15.671	235.82	26.438	237.15	26.536	2.3977	.26880	1.011	.82468
640.00	1.7387	15.509	247.20	27.714	248.59	27.869	2.5034	.28065	1.007	.83854
660.00	1.7218	15.358	258.70	29.002	260.15	29.165	2.6099	.29258	1.003	.85144
680.00	1.7060	15.218	270.31	30.304	271.82	30.473	2.7169	.30459	.9995	.86343
700.00	1.6913	15.086	282.02	31.617	283.60	31.793	2.8246	.31666	.9960	.87456
720.00	1.6775	14.964	293.83	32.941	295.47	33.124	2.9328	.32879	.9926	.88482
740.00	1.6646	14.849	305.74	34.275	307.44	34.466	3.0415	.34098	.9893	.89442
760.00	1.6526	14.741	317.73	35.620	319.50	35.818	3.1508	.35323	.9862	.90325
780.00	1.6412	14.640	329.81	36.974	331.64	37.180	3.2605	.36553	.9831	.91140
800.00	1.6306	14.545	341.97	38.338	343.87	38.550	3.3707	.37788	.9802	.91992
820.00	1.6206	14.456	354.21	39.710	356.17	39.930	3.4813	.39028	.9774	.92585
840.00	1.6112	14.372	366.52	41.090	368.55	41.318	3.5923	.40273	.9747	.93223
860.00	1.6023	14.293	378.91	42.479	381.00	42.715	3.7037	.41522	.9721	.93810
880.00	1.5940	14.218	391.36	43.875	393.52	44.117	3.8155	.42775	.9696	.94350
900.00	1.5861	14.148	403.88	45.278	406.11	45.528	3.9276	.44032	.9671	.94845
920.00	1.5786	14.082	416.47	46.689	418.76	46.946	4.0401	.45292	.9648	.95299
940.00	1.5716	14.019	429.11	48.107	431.47	48.371	4.1529	.46557	.9625	.95716
960.00	1.5650	13.960	441.83	49.533	444.25	49.804	4.2660	.47825	.9603	.96097
1000.00	1.5528	13.851	467.57	52.418	470.12	52.704	4.4930	.50370	.9557	.96765

THE ELECTRON DENSITY OF COPPER IS 2.750E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.074 BEV, AND THE MINIMUM ENERGY LOSS IS 1.4500 MEV/GM/CM2

FLUORINE

ADJUSTED
IONIZATION
POTENTIAL
120.7

ATOMIC
WEIGHT
18.998

ATOMS/
MOLECULE
2

ATOMIC
NUMBER
9

ELEMENT
F

DENSITY = 1.6952 MG/CM3

PROTON ENERGY MEV	ENERGY LOSS KEV/CM	PROTON RANGE MG/CM2 METER	PROTON PATH LENGTH MG/CM2 METER	PATH LENGTH STRAGGLING MG/CM2 METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION	
.10	599.65	20665	.20871	.00746	.00004	3.575	.9853
.15	536.17	29464	.29694	.00175	.00006	3.164	.7416
.20	481.58	39260	.39260	.00233	.00007	2.894	.6339
.30	395.92	62140	.62479	.00369	.00009	2.574	.5325
.40	336.41	89528	.89962	.00531	.00013	2.418	.4815
.50	296.75	12114	1.2169	.00718	.00017	2.343	.4496
.60	270.68	15657	1.5704	.00926	.00021	2.281	.4271
.70	251.90	19457	1.9537	.01153	.00026	2.219	.4099
.80	234.14	23559	2.3652	.01395	.00030	2.160	.3957
.90	213.37	28017	2.8125	.01659	.00035	2.116	.3835
1.00	192.59	32932	3.3055	.01950	.00041	2.090	.3728
1.20	169.91	43978	4.4135	.02604	.00054	2.055	.3557
1.40	152.78	56375	5.6569	.03337	.00067	2.016	.3428
1.60	139.22	70071	7.0305	.04147	.00082	1.977	.3326
1.80	128.15	85023	8.5300	.05032	.00098	1.942	.3242
2.00	118.91	10119	10.151	.05988	.00114	1.909	.3172
2.20	111.00	11855	11.892	.07015	.00132	1.879	.3111
2.40	104.34	13709	13.751	.08112	.00150	1.852	.3058
2.60	98.479	15678	15.725	.09249	.00169	1.827	.3011
2.80	93.321	17760	17.812	.10508	.00190	1.804	.2970
3.00	88.742	19952	20.011	.11805	.00210	1.783	.2932
3.20	84.646	22254	22.319	.13166	.00232	1.763	.2899
3.40	80.957	24665	24.736	.14592	.00255	1.745	.2867
3.60	77.613	27183	27.260	.16081	.00278	1.728	.2838
3.80	74.567	29806	29.890	.17632	.00302	1.713	.2812
4.00	71.778	32533	32.624	.19192	.00327	1.698	.2787
4.20	69.213	35364	35.462	.20920	.00352	1.684	.2764
4.40	66.846	38297	38.403	.22654	.00379	1.671	.2743
4.60	64.654	41332	41.445	.24449	.00406	1.659	.2723
4.80	62.616	44469	44.589	.26304	.00433	1.648	.2704

FLUORINE

PRCTON ENERGY MEV	ENERGY LOSS MEV/GH/CH2	PROTON RANGE GH/CH2	METER	PROTON PATH LENGTH GH/CH2	METER	PATH LENGTH STRAGGLING METER	GH/CH2	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	60.717	0.4770	.28142	.04783	.28216	.00078	.00462	1.637	.00039
5.50	56.486	0.5623	.33170	.05638	.33258	.00091	.00536	1.613	.00050
6.00	52.862	0.6536	.38559	.06553	.38660	.00104	.00615	1.591	.00062
6.50	49.718	0.7510	.44302	.07529	.44416	.00118	.00698	1.572	.00076
7.00	46.962	0.8543	.50394	.08564	.50523	.00133	.00786	1.555	.00092
7.50	44.525	0.9634	.56832	.09658	.56975	.00149	.00877	1.539	.00283
8.00	42.352	1.0783	.63611	.10810	.63772	.00165	.00973	1.525	.00507
8.50	40.402	1.1989	.70728	.12019	.70904	.00182	.01072	1.512	.00732
9.00	38.640	1.3252	.78179	.13285	.78371	.00199	.01176	1.500	.00956
9.50	37.008	1.4571	.85959	.14607	.86170	.00218	.01283	1.489	.01181
10.00	35.554	1.5947	.94072	.15995	.94301	.00236	.01395	1.479	.01405
11.00	32.994	1.8863	1.1128	.18909	1.1155	.00276	.01630	1.461	.01955
12.00	30.811	2.1994	1.2975	.22046	1.3006	.00319	.01879	1.445	.02305
13.00	28.924	2.5339	1.4948	.25399	1.4983	.00363	.02144	1.431	.02757
14.00	27.276	2.8894	1.7045	.28961	1.7085	.00411	.02422	1.418	.03209
15.00	25.823	3.2654	1.9263	.32730	1.9308	.00460	.02715	1.406	.03662
16.00	24.533	3.6620	2.1603	.36704	2.1652	.00512	.03022	1.395	.04117
17.00	23.377	4.0788	2.4062	.40881	2.4117	.00566	.03342	1.386	.04572
18.00	22.337	4.5157	2.6639	.45259	2.6699	.00623	.03675	1.377	.05029
19.00	21.395	4.9723	2.9332	.49835	2.9398	.00682	.04022	1.368	.05487
20.00	20.537	5.4485	3.2141	.54606	3.2213	.00743	.04382	1.360	.05946
22.00	19.032	6.4588	3.8101	.64731	3.8186	.00871	.05141	1.346	.06867
24.00	17.755	7.5453	4.4511	.75618	4.4609	.01009	.05950	1.334	.07792
26.00	16.655	8.7066	5.1362	.87256	5.1474	.01154	.06808	1.323	.08358
28.00	15.698	9.9416	5.8648	.99631	5.8774	.01308	.07713	1.312	.08954
30.00	14.858	1.1249	6.6361	1.1273	6.6503	.01469	.08666	1.303	.08758
32.00	14.113	1.2626	7.4495	1.2655	7.4654	.01638	.09665	1.295	.08968
34.00	13.448	1.4077	8.3044	1.4107	8.3221	.01815	.10708	1.287	.09186
36.00	12.851	1.5596	9.2004	1.5629	9.2199	.02000	.11796	1.279	.09409
38.00	12.311	1.7184	10.137	1.7220	10.158	.02191	.12927	1.273	.09637
40.00	11.820	1.8838	11.113	1.8878	11.136	.02390	.14101	1.266	.09861
45.00	10.770	2.3267	13.726	2.3315	13.754	.02918	.17216	1.252	.10773
50.00	9.9137	2.8101	16.578	2.8159	16.612	.03489	.20583	1.239	.11096
55.00	9.2016	3.3331	19.662	3.3399	19.703	.04101	.24190	1.228	.11743
60.00	8.5996	3.8544	22.974	3.9024	23.021	.04752	.28030	1.218	.12419
65.00	8.0836	4.4533	26.507	4.5024	26.561	.05440	.32094	1.208	.13171
70.00	7.6361	5.1288	30.256	5.1391	30.317	.06166	.36374	1.200	.13945
75.00	7.2443	5.8001	34.216	5.8117	34.284	.06927	.40864	1.192	.14589
80.00	6.8982	6.5063	38.382	6.5193	38.458	.07723	.45557	1.185	.15349
90.00	6.3141	8.0205	47.315	8.0365	47.409	.09413	.55527	1.171	.16905

FLUORINE

PRCTON ENERGY MEV	ENERGY LOSS HEV/CH2	PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
		GH/CH2	METER	GH/CH2	METER	GH/CH2	METER PERCENT		
100.00	5.8398	9.6659	57.021	9.6850	57.133	.11228	.66238	1.159	.18494
110.00	5.4468	11.437	67.470	11.460	67.602	.13162	.77648	1.149	.20117
120.00	5.1157	13.329	78.632	13.355	78.785	.15209	.89719	1.139	.21781
130.00	4.8329	15.338	90.480	15.368	90.656	.17361	1.0242	1.130	.23473
140.00	4.5885	17.458	102.99	17.492	103.19	.19614	1.1571	1.121	.25182
150.00	4.3750	19.687	116.14	19.725	116.36	.21963	1.2956	1.113	.26899
160.00	4.1871	22.020	129.90	22.062	130.15	.24403	1.4396	1.106	.28624
170.00	4.0203	24.453	144.26	24.500	144.53	.26930	1.5886	1.099	.30360
180.00	3.8712	26.984	159.19	27.036	159.49	.29539	1.7426	1.093	.32100
190.00	3.7373	29.609	174.67	29.666	175.00	.32227	1.9011	1.086	.33837
200.00	3.6163	32.325	190.69	32.386	191.05	.34990	2.0641	1.080	.35567
210.00	3.5064	35.128	207.23	35.195	207.62	.37826	2.2314	1.075	.37289
220.00	3.4062	38.017	224.27	38.089	224.70	.40730	2.4027	1.069	.39004
230.00	3.3145	40.988	241.80	41.066	242.26	.43699	2.5779	1.064	.40707
240.00	3.2303	44.039	259.79	44.123	260.29	.46732	2.7566	1.059	.42395
250.00	3.1526	47.167	278.25	47.257	278.78	.49825	2.9392	1.054	.44064
260.00	3.0808	50.371	297.15	50.466	297.71	.52975	3.1251	1.050	.45717
270.00	3.0142	53.647	316.47	53.748	317.07	.56181	3.3142	1.045	.47353
280.00	2.9523	56.993	336.21	57.100	336.84	.59440	3.5065	1.041	.48972
290.00	2.8947	60.408	356.36	60.521	357.03	.62750	3.7017	1.037	.50569
300.00	2.8408	63.889	376.89	64.009	377.60	.66109	3.8999	1.033	.52144
310.00	2.7905	67.434	397.81	67.561	398.55	.69515	4.1000	1.029	.53696
320.00	2.7432	71.042	419.09	71.175	419.88	.72967	4.3044	1.025	.55226
330.00	2.6989	74.711	440.73	74.851	441.56	.76461	4.5106	1.022	.56731
340.00	2.6571	78.439	462.72	78.585	463.59	.79998	4.7192	1.018	.58210
350.00	2.6178	82.224	485.05	82.377	485.96	.83575	4.9302	1.015	.59662
360.00	2.5806	86.064	507.71	86.225	508.66	.87191	5.1435	1.011	.61090
370.00	2.5455	89.959	530.69	90.127	531.67	.90844	5.3590	1.008	.62495
380.00	2.5123	93.907	553.97	94.081	555.00	.94533	5.5766	1.005	.63875
390.00	2.4808	97.905	577.56	98.087	578.63	.98256	5.7963	1.002	.65233
400.00	2.4513	101.95	601.44	102.14	602.56	1.0201	6.0100	.9987	.66563
410.00	2.4226	106.05	625.61	106.25	626.77	1.0580	6.2415	.9953	.67861
420.00	2.3956	110.19	650.05	110.40	651.26	1.0962	6.4669	.9930	.69122
430.00	2.3700	114.38	674.77	114.59	676.02	1.1347	6.6940	.9902	.70345
440.00	2.3455	118.62	699.74	118.84	701.04	1.1735	6.9229	.9875	.71531
450.00	2.3222	122.89	724.98	123.12	726.31	1.2126	7.1534	.9849	.72680
460.00	2.2999	127.21	750.46	127.45	751.84	1.2520	7.3855	.9823	.73792
470.00	2.2786	131.57	776.10	131.82	777.61	1.2916	7.6192	.9798	.74838
480.00	2.2583	135.97	802.14	136.23	803.62	1.3314	7.8543	.9774	.75909
490.00	2.2388	140.41	828.33	140.67	829.85	1.3715	8.0909	.9750	.76914

FLUORINE

PROCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	HEV/CH2	KEV/CH	GM/CH2	METER	GM/CH2	METER	GM/CH2	METER PERCENT		
500.00	2.2202	3.7636	144.89	854.74	145.16	856.31	1.4119	8.3289	.1835	.77884
510.00	2.2024	3.7333	149.41	881.37	149.68	882.99	1.4525	8.5683	.1833	.78828
520.00	2.1852	3.7043	153.96	908.22	154.24	909.88	1.4933	8.8090	.1831	.79723
530.00	2.1688	3.6765	158.54	935.27	158.83	936.98	1.5343	9.0509	.1830	.80593
540.00	2.1530	3.6497	163.16	962.52	163.46	964.28	1.5755	9.2941	.1828	.81431
550.00	2.1379	3.6240	167.81	989.97	168.12	991.78	1.6169	9.5384	.1825	.82238
560.00	2.1233	3.5993	172.50	1017.6	172.82	1019.5	1.6585	9.7840	.1824	.83015
570.00	2.1093	3.5756	177.22	1045.4	177.54	1047.3	1.7003	10.031	.1823	.83762
580.00	2.0958	3.5527	181.96	1073.4	182.30	1075.4	1.7423	10.278	.1821	.84456
590.00	2.0829	3.5307	186.74	1101.6	187.08	1103.6	1.7845	10.527	.1819	.85169
600.00	2.0704	3.5096	191.55	1130.0	191.90	1132.0	1.8269	10.777	.1818	.85832
620.00	2.0467	3.4694	201.25	1187.2	201.62	1189.4	1.9121	11.280	.1814	.87079
640.00	2.0247	3.4321	211.06	1245.1	211.44	1247.3	1.9979	11.786	.1811	.88226
660.00	2.0042	3.3974	220.97	1303.5	221.37	1305.9	2.0843	12.296	.1807	.89280
680.00	1.9850	3.3649	230.98	1362.6	231.40	1365.1	2.1713	12.809	.1804	.90247
700.00	1.9671	3.3346	241.08	1422.2	241.52	1424.8	2.2589	13.326	.1800	.91133
720.00	1.9504	3.3062	251.28	1482.3	251.73	1485.0	2.3469	13.845	.1797	.91945
740.00	1.9347	3.2795	261.56	1543.0	262.03	1545.7	2.4355	14.367	.1794	.92686
760.00	1.9199	3.2546	271.92	1604.1	272.41	1607.0	2.5245	14.892	.1790	.93364
780.00	1.9061	3.2311	282.36	1665.7	282.86	1668.6	2.6139	15.420	.1787	.93981
800.00	1.8931	3.2091	292.87	1727.7	293.39	1730.8	2.7038	15.950	.1783	.94545
820.00	1.8800	3.1883	303.45	1790.1	303.99	1793.3	2.7941	16.483	.1780	.95058
840.00	1.8693	3.1687	314.10	1852.9	314.66	1856.2	2.8847	17.018	.1777	.95524
860.00	1.8584	3.1503	324.81	1916.1	325.39	1919.5	2.9757	17.554	.1773	.95949
880.00	1.8482	3.1329	335.59	1979.7	336.19	1983.2	3.0671	18.093	.1770	.96334
900.00	1.8385	3.1165	346.43	2043.6	347.04	2047.3	3.1588	18.634	.1767	.96684
920.00	1.8293	3.1009	357.32	2107.9	357.95	2111.6	3.2508	19.177	.1763	.97002
940.00	1.8206	3.0863	368.28	2172.5	368.93	2176.4	3.3432	19.722	.1759	.97290
960.00	1.8124	3.0724	379.29	2237.5	379.96	2241.4	3.4358	20.268	.1755	.97551
1000.00	1.7973	3.0468	401.56	2368.9	402.27	2373.0	3.6219	21.366	.1745	.98005

THE ELECTRON DENSITY OF FLUORINE IS 2.854E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.226 BEV, AND THE MINIMUM ENERGY LOSS IS 1.6697 MEV/GM/CM2

GERMANIUM

ADJUSTED
IONIZATION
POTENTIAL
350.0

ATOMIC
HEIGHT
72.590

ATOMS/
MOLECULE
1

ATOMIC
NUMBER
32

ELEMENT
GE

DENSITY = 5.3600 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION	
	MEV/ GM/CM2	MEV/CM	MG/CM2	PH	MG/CM2	MM	MG/CM2	PERCENT			
.10	237.56	1273.3	.55850	.00104	.57358	.00107	.02560	.00005	4.463	2.629	0.
.15	228.14	1222.8	.77183	.00144	.78834	.00147	.03285	.00006	4.167	2.095	0.
.20	217.63	1166.5	.99330	.00185	1.0127	.00189	.03947	.00007	3.897	1.917	0.
.30	195.69	1048.9	1.4794	.00274	1.4971	.00279	.05216	.00010	3.484	1.785	0.
.40	175.49	940.63	2.0020	.00374	2.0370	.00380	.06526	.00012	3.204	1.717	0.
.50	159.12	852.88	2.5923	.00484	2.6361	.00492	.07929	.00015	3.008	1.664	0.
.60	146.05	782.83	3.2387	.00604	3.2919	.00614	.09425	.00018	2.863	1.617	0.
.70	138.06	740.00	3.9326	.00734	3.9955	.00745	.11040	.00021	2.763	1.576	0.
.80	129.32	693.16	4.6704	.00871	4.7433	.00885	.12753	.00024	2.689	1.537	0.
.90	119.51	640.55	5.4642	.01019	5.5475	.01035	.14629	.00027	2.617	1.501	0.
1.00	109.69	597.92	6.3264	.01180	6.4207	.01198	.16738	.00031	2.607	1.468	0.
1.20	96.611	533.91	8.2183	.01533	8.3359	.01555	.21332	.00040	2.559	1.412	0.
1.40	91.436	490.10	10.291	.01920	10.434	.01947	.26138	.00049	2.505	1.365	0.
1.60	84.693	453.95	12.541	.02340	12.709	.02371	.31163	.00058	2.452	1.326	0.
1.80	79.037	423.64	14.961	.02791	15.157	.02828	.36406	.00068	2.402	1.291	0.
2.00	74.200	397.71	17.545	.03273	17.769	.03315	.41862	.00078	2.356	1.261	0.
2.20	69.978	375.08	20.291	.03786	20.545	.03833	.47533	.00089	2.314	1.234	0.
2.40	65.342	355.59	23.199	.04328	23.483	.04381	.53415	.00100	2.275	1.210	0.
2.60	63.113	338.29	26.259	.04899	26.574	.04958	.59496	.00111	2.239	1.188	0.
2.80	60.289	323.15	29.469	.05498	29.818	.05563	.65761	.00123	2.209	1.169	0.
3.00	57.744	309.51	32.826	.06124	33.208	.06196	.72205	.00135	2.174	1.151	0.
3.20	55.435	297.13	36.328	.06778	36.745	.06855	.78828	.00147	2.145	1.134	0.
3.40	53.334	285.87	39.972	.07457	40.424	.07542	.85628	.00160	2.118	1.119	0.
3.60	51.425	275.64	43.758	.08164	44.246	.08255	.92603	.00173	2.093	1.105	0.
3.80	49.652	266.13	47.676	.08895	48.202	.08993	.99752	.00186	2.069	1.092	0.
4.00	48.030	257.44	51.725	.09652	52.300	.09757	1.0707	.00200	2.047	1.079	0.
4.20	46.527	249.38	55.928	.10434	56.531	.10547	1.1455	.00214	2.026	1.068	0.
4.40	45.120	241.89	60.251	.11241	60.895	.11361	1.2220	.00228	2.007	1.057	0.
4.60	43.824	234.89	64.710	.12073	65.394	.12200	1.3002	.00243	1.988	1.046	0.
4.80	42.602	228.35	69.298	.12929	70.024	.13064	1.3800	.00257	1.971	1.037	0.

GERMANIUM

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2 CM	PROTON PATH LENGTH CM GM/CM2	PATH LENGTH STRAGGLING CM PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	41.456	0.1381	0.7478	0.0027	1.954	0.0001
5.50	32.876	0.1611	0.8724	0.0031	1.917	0.0002
6.00	36.635	0.1856	1.0050	0.0035	1.887	0.0004
6.50	34.666	0.2116	1.1342	0.0040	1.861	0.0006
7.00	32.922	0.2390	1.2610	0.0044	1.838	0.0008
7.50	31.366	0.2678	1.3854	0.0049	1.818	0.0011
8.00	29.959	0.2980	1.5122	0.0054	1.799	0.0015
8.50	28.706	0.3295	1.6427	0.0059	1.783	0.0020
9.00	27.560	0.3625	1.7667	0.0065	1.767	0.0025
9.50	26.514	0.3967	1.8855	0.0070	1.753	0.0031
10.00	25.552	0.4322	2.0000	0.0076	1.740	0.0037
11.00	23.848	0.5073	2.2730	0.0088	1.715	0.0052
12.00	22.377	0.5875	2.6057	0.0100	1.694	0.0070
13.00	21.104	0.6727	3.0057	0.0114	1.674	0.0091
14.00	19.979	0.7629	3.4738	0.0127	1.656	0.0114
15.00	18.994	0.8580	4.0076	0.0142	1.640	0.0140
16.00	18.114	0.9579	4.6041	0.0157	1.625	0.0172
17.00	17.321	1.0625	5.2714	0.0173	1.610	0.0212
18.00	16.603	1.1717	6.0011	0.0189	1.597	0.0257
19.00	15.949	1.2856	6.7960	0.0205	1.585	0.0304
20.00	15.360	1.4039	7.6548	0.0223	1.573	0.0357
22.00	14.302	1.6540	9.9354	0.0259	1.552	0.0478
24.00	13.396	1.9219	1.0381	0.0297	1.533	0.0631
26.00	12.612	2.2071	1.1921	0.0337	1.516	0.0833
28.00	11.927	2.5093	1.3552	0.0379	1.501	0.1077
30.00	11.321	2.8283	1.5274	0.0424	1.487	0.1367
32.00	10.782	3.1639	1.7085	0.0470	1.474	0.1704
34.00	10.299	3.5157	1.8984	0.0518	1.462	0.2097
36.00	9.8637	3.8834	2.0968	0.0568	1.451	0.2536
38.00	9.4690	4.2670	2.3033	0.0619	1.441	0.3030
40.00	9.1093	4.6662	2.5193	0.0673	1.431	0.3579
45.00	8.3354	5.7308	3.0936	0.0814	1.410	0.4852
50.00	7.7008	6.8885	3.7185	0.0965	1.391	0.6371
55.00	7.1703	8.1366	4.3919	0.1126	1.375	0.8316
60.00	6.7195	9.4725	5.1127	0.1297	1.360	1.0889
65.00	6.3320	1.0892	5.8796	0.1477	1.347	1.4185
70.00	5.9948	1.2399	6.6916	0.1664	1.335	1.8105
75.00	5.6986	1.3985	7.5474	0.1863	1.323	2.2744
80.00	5.4362	1.5651	8.4461	0.2069	1.313	2.8161
90.00	4.9917	1.9214	10.368	0.2554	1.295	3.9760

GERMANIUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CH	GM/CH2	CH	GM/CH2	CH	GM/CH2	CH PERCENT		
100.00	4.6293	24.813	12.368	2.3074	12.450	2.3228	.15914	.02969	1.278	.11168
110.00	4.3276	23.196	14.589	2.7219	14.686	2.7400	.18559	.03463	1.264	.12623
120.00	4.0728	21.830	16.958	3.1638	17.070	3.1847	.21348	.03983	1.251	.14124
130.00	3.8547	20.561	19.467	3.6319	19.595	3.6558	.24271	.04528	1.239	.15664
140.00	3.6658	19.649	22.112	4.1253	22.257	4.1523	.27323	.05098	1.228	.17232
150.00	3.5005	18.763	24.986	4.6429	25.049	4.6733	.30496	.05690	1.217	.18821
160.00	3.3546	17.981	27.787	5.1841	27.968	5.2179	.33784	.06303	1.206	.20433
170.00	3.2250	17.286	30.809	5.7480	31.009	5.7853	.37183	.06937	1.199	.22071
180.00	3.1090	16.664	33.948	6.3336	34.168	6.3746	.40685	.07591	1.191	.23730
190.00	3.0046	16.105	37.200	6.9404	37.441	6.9852	.44287	.08263	1.183	.25403
200.00	2.9101	15.598	40.562	7.5675	40.823	7.6163	.47984	.08952	1.175	.27086
210.00	2.8243	15.138	44.029	8.2143	44.312	8.2672	.51771	.09659	1.168	.28776
220.00	2.7460	14.718	47.598	8.8802	47.903	8.9372	.55645	.10381	1.162	.30470
230.00	2.6742	14.334	51.266	9.5645	51.594	9.6257	.59600	.11119	1.155	.32164
240.00	2.6082	13.980	55.028	10.267	55.380	10.332	.63635	.11872	1.149	.33857
250.00	2.5473	13.654	58.884	10.986	59.260	11.056	.67745	.12639	1.143	.35537
260.00	2.4910	13.352	62.830	11.722	63.131	11.797	.71927	.13419	1.138	.37211
270.00	2.4387	13.072	66.863	12.474	67.288	12.554	.76178	.14212	1.132	.38874
280.00	2.3901	12.811	70.979	13.242	71.431	13.327	.80495	.15018	1.127	.40524
290.00	2.3449	12.568	75.177	14.026	75.655	14.115	.84875	.15835	1.122	.42157
300.00	2.3025	12.342	79.455	14.824	79.959	14.918	.89316	.16664	1.117	.43773
310.00	2.2629	12.129	83.809	15.636	84.340	15.735	.93816	.17503	1.112	.45371
320.00	2.2258	11.930	88.237	16.462	88.796	16.566	.98371	.18353	1.108	.46952
330.00	2.1909	11.743	92.738	17.302	93.325	17.411	1.0298	.19213	1.103	.48512
340.00	2.1580	11.567	97.309	18.155	97.924	18.269	1.0764	.20082	1.099	.50052
350.00	2.1271	11.401	101.95	19.020	102.59	19.140	1.1235	.20961	1.095	.51570
360.00	2.0978	11.244	106.65	19.898	107.33	20.023	1.1711	.21848	1.091	.53063
370.00	2.0702	11.096	111.42	20.788	112.12	20.919	1.2191	.22744	1.087	.54530
380.00	2.0440	10.956	116.25	21.689	116.99	21.826	1.2676	.23649	1.084	.55972
390.00	2.0193	10.823	121.15	22.602	121.91	22.744	1.3165	.24561	1.080	.57385
400.00	1.9957	10.697	126.10	23.526	126.89	23.673	1.3658	.25481	1.076	.58771
410.00	1.9734	10.577	131.11	24.460	131.93	24.614	1.4155	.26408	1.073	.60128
420.00	1.9522	10.464	136.17	25.405	137.02	25.564	1.4655	.27342	1.070	.61455
430.00	1.9320	10.355	141.29	26.359	142.17	26.525	1.5160	.28283	1.066	.62753
440.00	1.9127	10.252	146.46	27.324	147.38	27.495	1.5667	.29233	1.062	.64021
450.00	1.8943	10.154	151.68	28.298	152.63	28.476	1.6179	.30184	1.060	.65258
460.00	1.8768	10.060	156.95	29.282	157.93	29.465	1.6695	.31144	1.057	.66465
470.00	1.8600	9.9698	162.27	30.274	163.28	30.464	1.7211	.32110	1.056	.67641
480.00	1.8440	9.8840	167.64	31.275	168.68	31.471	1.7732	.33081	1.051	.68767
490.00	1.8287	9.8019	173.05	32.285	174.13	32.487	1.8255	.34058	1.048	.69902

GERMANIUM

PROTON ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE CM	PROTON PATH LENGTH CM	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	1.8141	178.51	179.62	1.8782	1.046	.70987
510.00	1.8000	184.01	185.15	1.9311	1.043	.72042
520.00	1.7865	189.55	190.73	1.9843	1.040	.73067
530.00	1.7736	195.13	196.35	2.0377	1.038	.74062
540.00	1.7612	200.76	202.01	2.0914	1.035	.75026
550.00	1.7493	206.42	207.70	2.1453	1.033	.75965
560.00	1.7379	212.12	213.44	2.1995	1.030	.76873
570.00	1.7269	217.06	219.21	2.2538	1.028	.77754
580.00	1.7163	223.63	225.02	2.3084	1.026	.78606
590.00	1.7061	229.44	230.86	2.3632	1.024	.79432
600.00	1.6963	235.28	236.74	2.4183	1.021	.80230
620.00	1.6777	247.07	248.60	2.5289	1.017	.81750
640.00	1.6605	258.98	250.58	2.6402	1.013	.83169
660.00	1.6444	271.01	272.69	2.7522	1.009	.84492
680.00	1.6294	283.16	284.91	2.8649	1.006	.85725
700.00	1.6154	295.41	297.23	2.9783	1.002	.86870
720.00	1.6023	307.77	309.67	3.0922	9985	.87934
740.00	1.5901	320.23	322.20	3.2066	9952	.88922
760.00	1.5786	332.78	334.82	3.3216	9921	.89834
780.00	1.5678	345.42	347.53	3.4370	9890	.90679
800.00	1.5577	358.14	360.33	3.5530	9860	.91460
820.00	1.5482	370.94	373.21	3.6694	9832	.92181
840.00	1.5393	383.83	386.17	3.7862	9804	.92846
860.00	1.5309	396.78	399.20	3.9034	9778	.93458
880.00	1.5229	409.81	412.30	4.0210	9752	.94021
900.00	1.5155	422.90	425.48	4.1389	9728	.94540
920.00	1.5084	436.07	438.72	4.2572	9704	.95016
940.00	1.5018	449.30	452.02	4.3759	9681	.95453
960.00	1.4955	462.60	465.40	4.4948	9658	.95854
1000.00	1.4839	489.52	492.47	4.7336	9612	.96556

THE ELECTRON DENSITY OF GERMANIUM IS 2.656E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.059 BEV, AND THE MINIMUM ENERGY LOSS IS 1.3947 MEV/GM/CM2

GOLD

ELEMENT NUMBER 79
 AU
 ATOMIC NUMBER 79
 ATOMS/MOLECULE 1
 ATOMIC HEIGHT 196.97
 ADJUSTED IONIZATION POTENTIAL 780.0

DENSITY = 19.320 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE MG/CM2	PROTON PATH LENGTH MM	MG/CM2	MG/CM2	PATH LENGTH STRAGGLING MM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	104.91	1.2502	.00065	1.3200	.00068	.06726	.00003	5.290	0.
.15	116.33	2247.5	.00088	1.7724	.00092	.08585	.00004	4.843	0.
.20	118.68	2292.9	.00109	2.1978	.00114	.09862	.00005	3.999	0.
.30	110.35	2132.0	.00153	3.0668	.00159	.12470	.00006	3.850	0.
.40	98.012	1893.6	.00201	4.0282	.00208	.15496	.00008	3.808	0.
.50	88.077	1701.6	.00254	5.1063	.00264	.18980	.00010	3.782	0.
.60	80.891	1562.8	.00313	6.0560	.00326	.22771	.00012	3.757	0.
.70	74.994	1448.9	.00378	7.2933	.00392	.26764	.00014	3.731	0.
.80	70.003	1352.5	.00446	8.6249	.00464	.30955	.00016	3.702	0.
.90	66.803	1280.6	.00519	10.035	.00539	.35236	.00018	3.672	0.
1.00	63.601	1228.0	.00596	11.517	.00619	.39550	.00020	3.641	0.
1.20	59.084	1141.5	.00759	14.671	.00788	.48238	.00025	3.576	0.
1.40	55.155	1065.6	.00935	18.063	.00969	.57145	.00030	3.512	0.
1.60	52.023	1005.1	.01122	21.683	.01162	.66566	.00034	3.449	0.
1.80	49.237	951.26	.01321	25.520	.01367	.76394	.00040	3.388	0.
2.00	46.761	903.42	.01536	29.563	.01583	.86589	.00045	3.330	0.
2.20	44.546	860.63	.01731	33.823	.01810	.97125	.00050	3.274	0.
2.40	42.567	822.39	.01982	38.287	.02046	1.0799	.00056	3.222	0.
2.60	40.780	787.86	.02223	42.955	.02296	1.1916	.00062	3.172	0.
2.80	39.158	756.53	.02475	47.826	.02555	1.3063	.00068	3.126	0.
3.00	37.679	727.95	.02738	52.895	.02825	1.4240	.00074	3.082	0.
3.20	36.324	701.75	.03010	58.159	.03105	1.5446	.00080	3.041	0.
3.40	35.080	677.74	.03293	63.616	.03395	1.6679	.00086	3.002	0.
3.60	33.922	655.38	.03585	69.268	.03695	1.7940	.00093	2.966	0.
3.80	32.863	634.92	.03888	75.109	.04005	1.9230	.00100	2.931	0.
4.00	31.882	615.96	.04200	81.134	.04325	2.0545	.00106	2.899	0.
4.20	30.968	598.30	.04521	87.335	.04654	2.1886	.00113	2.868	0.
4.40	30.114	581.80	.04852	93.734	.04993	2.3252	.00120	2.838	0.
4.60	29.313	566.33	.05192	100.30	.05342	2.4643	.00128	2.810	0.
4.80	28.559	551.76	.05541	107.05	.05700	2.6058	.00135	2.784	0.

GOLD

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2 CM	PROTON PATH LENGTH GM/CM2 CM	PATH LENGTH STRAGGLING GM/CM2 CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION			
5.00	27.549	538.05	.11721	.00607	.00275	.00014	2.346	2.759	0.
5.50	26.234	506.85	.13572	.00702	.00312	.00016	2.299	2.701	0.
6.00	24.862	480.32	.15119	.00804	.00351	.00018	2.258	2.649	0.
6.50	23.646	456.85	.17593	.00911	.00391	.00020	2.220	2.603	0.
7.00	22.563	435.93	.19759	.01023	.00432	.00022	2.188	2.561	.00001
7.50	21.592	417.15	.22325	.01140	.00476	.00025	2.161	2.522	.00001
8.00	20.822	402.27	.24382	.01262	.00521	.00027	2.135	2.487	.00002
8.50	20.010	386.60	.26831	.01389	.00567	.00029	2.112	2.455	.00002
9.00	19.272	372.33	.29374	.01520	.00614	.00032	2.091	2.425	.00002
9.50	18.589	359.15	.32017	.01657	.00663	.00034	2.071	2.398	.00002
10.00	17.973	347.24	.34757	.01799	.00714	.00037	2.053	2.371	.00002
11.00	16.875	326.02	.40506	.02097	.00818	.00042	2.020	2.324	.00004
12.00	15.722	307.60	.46602	.02412	.00928	.00048	1.991	2.284	.00006
13.00	15.091	291.55	.53064	.02747	.01042	.00054	1.964	2.245	.00010
14.00	14.355	277.34	.59861	.03098	.01161	.00060	1.940	2.213	.00016
15.00	13.697	264.63	.66993	.03468	.01284	.00066	1.917	2.184	.00023
16.00	13.108	253.24	.74455	.03854	.01412	.00073	1.896	2.156	.00033
17.00	12.575	242.94	.82241	.04257	.01543	.00080	1.876	2.132	.00045
18.00	12.090	233.57	.90365	.04677	.01679	.00087	1.858	2.109	.00059
19.00	11.647	225.01	.98789	.05113	.01818	.00094	1.841	2.088	.00076
20.00	11.240	217.16	1.0753	.05566	.01962	.00102	1.824	2.069	.00095
22.00	10.519	203.23	1.2593	.06518	.02260	.00117	1.795	2.034	.00139
24.00	9.8987	191.24	1.4555	.07533	.02573	.00133	1.769	2.004	.00191
26.00	9.3574	180.79	1.6634	.08609	.02900	.00150	1.744	1.977	.00287
28.00	8.8822	171.60	1.8828	.09745	.03241	.00168	1.722	1.953	.00426
30.00	8.4589	163.43	2.1136	.10940	.03596	.00186	1.702	1.932	.00570
32.00	8.1047	156.58	2.3557	.12193	.03964	.00205	1.683	1.912	.00720
34.00	7.7648	150.02	2.6081	.13499	.04342	.00225	1.665	1.894	.00875
36.00	7.4569	144.07	2.8706	.14858	.04733	.00245	1.649	1.878	.01034
38.00	7.1747	138.61	3.1438	.16273	.05135	.00266	1.633	1.863	.01199
40.00	6.9194	133.68	3.4281	.17744	.05550	.00287	1.619	1.849	.01368
45.00	6.3655	122.98	4.1827	.21650	.06643	.00344	1.588	1.819	.01808
50.00	5.9079	114.14	4.9980	.25870	.07812	.00404	1.563	1.794	.02272
55.00	5.5223	106.69	5.8744	.30406	.09052	.00469	1.541	1.772	.02760
60.00	5.1925	100.32	6.8083	.35242	.10359	.00536	1.522	1.753	.03273
65.00	4.9072	94.808	7.7999	.40372	.11731	.00607	1.504	1.736	.03808
70.00	4.6579	89.191	8.8459	.45786	.13166	.00681	1.488	1.722	.04365
75.00	4.4381	85.743	9.9461	.51481	.14660	.00759	1.474	1.709	.04940
80.00	4.2425	81.965	11.095	.57430	.16211	.00839	1.461	1.697	.05533
90.00	3.9093	75.528	13.554	.70153	.19479	.01008	1.437	1.677	.06766

GOLD

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CM2	MEV/CM	GM/CM2	CM	GM/CM2	CH	GM/CM2	CH	PERCENT	PERCENT	
100.00	3.6365	70.757	15.939	82498	16.200	83892	.22955	.01180	1.416	1.661	.06052
110.00	3.4096	65.874	18.732	96958	19.046	98581	.26624	.01378	1.390	1.647	.09388
120.00	3.2169	62.157	21.706	114235	22.067	114222	.30473	.01577	1.381	1.635	.10774
130.00	3.0513	58.952	24.850	132682	25.260	130795	.34493	.01785	1.365	1.625	.12202
140.00	2.9074	56.174	28.156	14973	28.618	14413	.38674	.02002	1.352	1.616	.13666
150.00	2.7811	53.732	31.619	16366	32.135	16633	.43008	.02226	1.338	1.608	.15159
160.00	2.6694	51.574	35.230	18235	35.803	18532	.47486	.02450	1.326	1.601	.16681
170.00	2.5700	49.682	38.990	20181	39.621	20908	.52102	.02697	1.315	1.595	.18233
180.00	2.4808	47.929	42.890	22200	43.582	22558	.56849	.02942	1.304	1.588	.19810
190.00	2.4084	46.376	46.925	24288	47.680	24679	.61719	.03195	1.294	1.584	.21406
200.00	2.3276	44.960	51.091	26445	51.911	26869	.66708	.03453	1.285	1.580	.23019
210.00	2.2613	43.689	55.384	28666	56.270	29125	.71808	.03717	1.276	1.576	.24639
220.00	2.2029	42.561	59.792	30948	60.746	31442	.77006	.03986	1.268	1.572	.26257
230.00	2.1472	41.484	64.324	33294	65.382	33824	.82302	.04260	1.259	1.568	.27871
240.00	2.0959	40.493	68.970	35699	70.067	36257	.87696	.04539	1.252	1.565	.29477
250.00	2.0486	39.579	73.712	38153	74.882	38759	.93185	.04823	1.244	1.562	.31074
260.00	2.0048	38.732	78.575	40670	79.820	41315	.98763	.05112	1.237	1.560	.32663
270.00	1.9641	37.946	83.538	43239	84.823	43923	1.0443	.05405	1.231	1.557	.34246
280.00	1.9263	37.215	88.604	45861	89.903	46582	1.1017	.05702	1.224	1.555	.35820
290.00	1.0910	36.533	93.767	48534	95.246	49299	1.1600	.06004	1.218	1.552	.37395
300.00	1.8580	35.896	99.024	51295	100.58	52062	1.2189	.06309	1.212	1.550	.38936
310.00	1.8271	35.299	104.35	54012	105.99	54862	1.2786	.06618	1.206	1.548	.40477
320.00	1.7971	34.720	109.79	56826	111.51	57718	1.3391	.06931	1.201	1.547	.42008
330.00	1.7699	34.194	115.32	59688	117.13	60625	1.4002	.07247	1.195	1.545	.43530
340.00	1.7442	33.699	120.92	62580	122.82	63570	1.4619	.07567	1.190	1.543	.45038
350.00	1.7201	33.232	126.61	65532	128.59	66558	1.5243	.07890	1.185	1.542	.46531
360.00	1.6972	32.790	132.37	68515	134.44	69587	1.5872	.08216	1.181	1.540	.48007
370.00	1.6756	32.373	138.21	71537	140.37	72655	1.6507	.08544	1.178	1.539	.49460
380.00	1.6552	31.979	144.18	74629	146.43	75794	1.7148	.08876	1.174	1.537	.50891
390.00	1.6359	31.605	150.17	77727	152.51	78939	1.7793	.09210	1.167	1.536	.52297
400.00	1.6175	31.250	156.22	80862	158.66	82122	1.8443	.09546	1.162	1.535	.53680
410.00	1.6001	30.913	162.35	84031	164.88	85340	1.9098	.09885	1.158	1.533	.55033
420.00	1.5835	30.592	168.54	87235	171.16	88592	1.9757	.10226	1.154	1.532	.56372
430.00	1.5677	30.287	174.74	90467	177.46	91854	2.0421	.10570	1.151	1.531	.57682
440.00	1.5526	29.997	181.04	93705	183.85	95161	2.1089	.10915	1.147	1.530	.58968
450.00	1.5383	29.720	187.41	97003	190.32	98510	2.1760	.11263	1.143	1.529	.60228
460.00	1.5246	29.455	193.84	100333	196.85	10189	2.2436	.11613	1.140	1.528	.61463
470.00	1.5115	29.202	200.33	10369	203.43	10530	2.3116	.11965	1.136	1.527	.62671
480.00	1.4990	28.961	206.87	10708	210.88	10874	2.3799	.12316	1.133	1.526	.63854
490.00	1.4870	28.730	213.47	11049	216.77	11220	2.4485	.12673	1.130	1.525	.65010

GOLD

PROTON ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE GM/CM ²	PROTON PATH LENGTH GM/CM ²	GM/CM ²	PATH LENGTH STRAGGLING GM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	1.4756	220.11	223.52	11.533	15030	1.525	.66140
510.00	1.4646	226.81	230.32	11.921	13389	1.524	.67357
520.00	1.4541	233.53	237.17	12.286	13749	1.523	.68321
530.00	1.4440	240.36	244.07	12.633	14111	1.522	.69371
540.00	1.4344	247.12	251.02	12.995	14475	1.521	.70396
550.00	1.4251	254.09	258.01	13.355	14839	1.520	.71394
560.00	1.4162	261.06	265.08	13.712	15205	1.519	.72367
570.00	1.4076	268.03	272.17	14.067	15573	1.518	.73313
580.00	1.3993	275.05	279.29	14.456	15942	1.517	.74234
590.00	1.3914	282.11	286.46	14.827	16312	1.517	.75130
600.00	1.3838	289.21	293.66	15.200	16683	1.516	.76001
620.00	1.3693	303.52	308.18	15.952	17429	1.514	.77669
640.00	1.3559	317.98	322.87	16.712	18179	1.513	.79242
660.00	1.3434	332.62	337.72	17.480	18933	1.511	.80722
680.00	1.3318	347.48	352.81	18.261	19691	1.509	.82113
700.00	1.3210	362.35	367.89	19.042	20453	1.507	.83419
720.00	1.3108	377.33	383.10	19.829	21218	1.506	.84642
740.00	1.3013	392.43	398.42	20.622	21986	1.505	.85787
760.00	1.2925	407.63	413.85	21.421	22757	1.503	.86857
780.00	1.2842	422.94	429.39	22.225	23531	1.501	.87856
800.00	1.2764	438.34	445.02	23.034	24307	1.500	.88788
820.00	1.2691	453.84	460.74	23.848	25086	1.498	.89656
840.00	1.2622	469.42	476.55	24.666	25867	1.497	.90463
860.00	1.2557	485.09	492.46	25.489	26651	1.495	.91214
880.00	1.2497	500.84	508.44	26.317	27436	1.494	.91911
900.00	1.2440	516.68	524.50	27.148	28224	1.492	.92557
920.00	1.2386	532.58	540.64	27.983	29014	1.490	.93156
940.00	1.2335	548.57	556.85	28.823	29805	1.488	.93711
960.00	1.2287	564.64	573.16	29.666	30598	1.485	.94224
1000.00	1.2200	597.15	606.42	31.372	32189	1.479	.95133

THE ELECTRON DENSITY OF GOLD IS 2.416E 23 ELECTRONS PER GRAM
 THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 1.01 SEV, AND THE MINIMUM ENERGY LOSS IS 1.1570 MEV/GM/CM²

HELIUM

ADJUSTED IONIZATION POTENTIAL 41.70
 ATOMIC WEIGHT 4.0026
 ATOMS/MOLECULE 1
 ATOMIC NUMBER 2
 ELEMENT HE

DENSITY = .17847 MG/CM3

PROCTON ENERGY MEV	ENERGY LOSS KEV/CM	PROTON RANGE METER	PROTON PATH LENGTH HG/CM2	PROTON PATH LENGTH METER	HG/CM ²	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	1096.1	.11435	.11450	.00642	.00289	.00016	.3077	0.
.15	954.64	.16297	.16334	.00915	.00385	.00022	.2295	0.
.20	832.61	.21898	.21938	.01229	.00489	.00027	.1527	0.
.30	661.65	.35435	.35480	.01988	.00734	.00041	.1567	0.
.40	554.41	.51971	.52044	.02916	.01024	.00057	.1387	0.
.50	477.81	.71417	.71509	.04007	.01355	.00076	.1277	0.
.60	422.19	.93698	.93810	.05256	.01727	.00097	.1202	0.
.70	374.95	1.1879	1.1893	.06664	.02133	.00120	.1146	0.
.80	341.01	1.4674	1.4690	.08231	.02592	.00145	.1103	0.
.90	313.93	1.7729	1.7748	.09944	.03079	.00173	.1068	0.
1.00	285.03	2.1074	2.1096	.11808	.03611	.00202	.1040	0.
1.20	248.54	2.8598	2.8625	.16040	.04800	.00269	.0995	.00001
1.40	221.03	3.7141	3.7176	.20831	.06113	.00343	.0963	.00032
1.60	199.47	4.6676	4.6720	.26178	.07548	.00423	.0938	.00084
1.80	182.07	5.7177	5.7239	.32066	.09102	.00510	.0917	.00007
2.00	167.71	6.8622	6.8684	.38485	.10772	.00604	.0900	.00011
2.20	155.63	8.0997	8.1069	.45424	.12557	.00704	.0885	.00016
2.40	145.32	9.4296	9.4378	.52882	.14454	.00810	.0873	.00023
2.60	136.40	10.8590	10.8679	.60847	.16462	.00922	.0862	.00031
2.80	128.60	12.3660	12.370	.69312	.18577	.01041	.0852	.00040
3.00	121.72	13.957	13.969	.78272	.20799	.01165	.0843	.00050
3.20	115.60	15.643	15.656	.87723	.23127	.01296	.0835	.00169
3.40	110.12	17.415	17.429	.97659	.25558	.01432	.0828	.00492
3.60	105.18	19.273	19.289	1.0808	.28092	.01574	.0821	.00813
3.80	100.70	21.215	21.232	1.1887	.30727	.01722	.0815	.01132
4.00	96.617	23.241	23.260	1.3023	.33461	.01875	.0809	.01448
4.20	92.882	25.352	25.372	1.4205	.36295	.02034	.0804	.01761
4.40	89.449	27.545	27.567	1.5434	.39227	.02198	.0799	.02073
4.60	86.283	29.820	29.844	1.6709	.42255	.02368	.0794	.02382
4.80	83.353	32.177	32.202	1.8044	.45380	.02543	.0790	.02690

HELIUM

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH METER	PATH LENGTH STRAGGLING GM/CM2	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	83.632	0.3462	1.9411	0.0049	0.2723	1.403	.02996
5.50	74.608	0.4106	2.3026	0.0057	0.3197	1.388	.0776
6.00	69.489	0.4801	2.6899	0.0066	0.3703	1.376	.0768
6.50	65.081	0.5544	3.1065	0.0076	0.4242	1.364	.0761
7.00	61.243	0.6336	3.5528	0.0086	0.4811	1.354	.0754
7.50	57.868	0.7176	4.0206	0.0097	0.5411	1.345	.06697
8.00	54.875	0.8063	4.5210	0.0108	0.6041	1.336	.07414
8.50	52.202	0.8996	5.0409	0.0120	0.6701	1.328	.08125
9.00	49.798	0.9977	5.5902	0.0132	0.7390	1.321	.08829
9.50	47.624	1.1003	6.1652	0.0145	0.8109	1.314	.09528
10.00	45.648	1.2075	6.7707	0.0158	0.8856	1.308	.10221
11.00	42.189	1.4354	8.0429	0.0186	1.0435	1.296	.11590
12.00	39.256	1.6811	9.4198	0.0216	1.2125	1.286	.12940
13.00	36.738	1.9445	10.895	0.0248	1.3923	1.277	.14270
14.00	34.549	2.2251	12.476	0.0283	1.5829	1.269	.15581
15.00	32.628	2.5229	14.136	0.0318	1.7839	1.261	.16874
16.00	30.927	2.8376	15.900	0.0356	1.9953	1.254	.18150
17.00	29.411	3.1691	17.769	0.0396	2.2169	1.248	.19409
18.00	28.050	3.5171	19.721	0.0437	2.4484	1.242	.20652
19.00	26.820	3.8815	21.764	0.0480	2.6899	1.236	.21878
20.00	25.704	4.2623	23.899	0.0525	2.9410	1.231	.23089
22.00	23.753	5.0719	28.438	0.0620	3.4721	1.221	.25463
24.00	22.103	5.9449	33.330	0.0721	4.0407	1.212	.27776
26.00	20.639	6.8801	38.551	0.0829	4.6460	1.204	.29080
28.00	19.462	7.8767	44.135	0.0944	5.2872	1.197	.29387
30.00	18.387	8.9338	50.058	0.1064	5.9635	1.191	.29702
32.00	17.437	1.0051	56.315	0.1191	6.6742	1.184	.30026
34.00	16.591	1.1226	62.902	0.1324	7.4188	1.179	.30356
36.00	15.832	1.2460	69.814	0.1463	8.1966	1.173	.30691
38.00	15.148	1.3751	77.048	0.1607	9.0069	1.168	.31030
40.00	14.528	1.5109	84.600	0.1758	9.8494	1.163	.31373
45.00	13.202	1.8712	104.84	0.2158	1.2092	1.153	.32236
50.00	12.126	2.2665	127.00	0.2592	1.4525	1.143	.33096
55.00	11.233	2.6951	151.01	0.3059	1.7140	1.134	.33970
60.00	10.480	3.1560	176.83	0.3557	1.9931	1.126	.34880
65.00	9.8363	3.6484	204.43	0.4085	2.2892	1.119	.35821
70.00	9.2791	4.1718	233.90	0.4643	2.6017	1.112	.36787
75.00	8.7921	4.7253	264.76	0.5230	2.9303	1.106	.37773
80.00	8.3625	5.3083	297.61	0.5844	3.2743	1.100	.38775
90.00	7.6391	6.5604	367.59	0.7151	4.0068	1.089	.40810

HELIUM

PROTON ENERGY MEV	ENERGY LOSS KEV/CM	PROTON RANGE METER	PROTON PATH LENGTH GM/CM ²	PROTON PATH LENGTH METER	GM/CM ²	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	7.0531	443.96	7.9281	444.23	.08559	4.7960	1.080	.42859
110.00	6.5686	526.30	9.3986	526.62	.10064	5.6388	1.071	.44956
120.00	6.1611	614.39	10.972	614.76	.11658	6.5323	1.063	.47137
130.00	5.8135	708.02	12.636	708.44	.13339	7.4740	1.055	.49384
140.00	5.5135	806.98	14.411	807.46	.15101	8.4614	1.048	.51680
150.00	5.2519	911.10	16.270	911.53	.16941	9.4924	1.041	.54006
160.00	5.0217	1020.2	18.218	1020.6	.18855	10.565	1.035	.56316
170.00	4.8177	1134.1	20.252	1134.7	.20840	11.677	1.029	.58563
180.00	4.6355	1252.6	22.368	1253.3	.22892	12.827	1.023	.60740
190.00	4.4719	1375.6	24.565	1376.4	.25008	14.012	1.018	.62841
200.00	4.3242	1503.0	26.824	1503.9	.27186	15.233	1.013	.64859
210.00	4.1902	1634.6	29.173	1635.5	.29422	16.486	1.008	.66737
220.00	4.0680	1770.3	31.612	1771.3	.31715	17.771	1.003	.68422
230.00	3.9563	1909.9	34.086	1911.0	.34062	19.086	.9987	.69926
240.00	3.8537	2053.3	36.667	2054.5	.36461	20.429	.9944	.71257
250.00	3.7591	2200.5	39.294	2201.7	.38909	21.801	.9902	.72424
260.00	3.6717	2351.2	41.966	2352.6	.41404	23.200	.9861	.73488
270.00	3.5907	2505.5	44.741	2506.9	.43946	24.624	.9822	.74566
280.00	3.5155	2663.1	47.529	2664.6	.46531	26.072	.9785	.75478
290.00	3.4454	2824.0	50.429	2825.6	.49158	27.544	.9748	.76405
300.00	3.3799	2988.2	53.360	2989.9	.51826	29.039	.9713	.77287
310.00	3.3187	3155.4	56.346	3157.2	.54533	30.556	.9678	.78187
320.00	3.2613	3325.6	59.386	3327.5	.57278	32.094	.9645	.79162
330.00	3.2074	3498.8	62.443	3500.3	.60059	33.652	.9613	.80201
340.00	3.1566	3674.8	65.621	3676.9	.62874	35.229	.9581	.81292
350.00	3.1088	3853.6	68.775	3855.8	.65723	36.826	.9551	.82423
360.00	3.0637	4035.1	72.054	4037.3	.68604	38.440	.9521	.83556
370.00	3.0211	4219.1	75.341	4221.5	.71517	40.072	.9492	.84660
380.00	2.9808	4405.8	78.630	4408.2	.74460	41.721	.9464	.85731
390.00	2.9425	4594.9	82.005	4597.4	.77431	43.386	.9437	.86767
400.00	2.9063	4786.4	85.423	4789.0	.80431	45.067	.9410	.87763
410.00	2.8718	4980.2	88.882	4983.0	.83458	46.763	.9385	.88705
420.00	2.8391	5176.4	92.434	5179.2	.86511	48.474	.9359	.89581
430.00	2.8079	5374.7	95.923	5377.7	.89590	50.199	.9335	.90395
440.00	2.7782	5575.3	99.502	5578.3	.92693	51.937	.9311	.91150
450.00	2.7498	5777.9	103.12	5781.1	.95819	53.689	.9287	.91851
460.00	2.7228	5982.6	106.77	5985.8	.98969	55.454	.9264	.92500
470.00	2.6969	6189.2	110.46	6192.6	1.0214	57.231	.9242	.93101
480.00	2.6722	6397.8	114.18	6401.3	1.0533	59.020	.9220	.93657
490.00	2.6486	6608.4	117.94	6612.0	1.0855	60.821	.9199	.94171

HELIUM

PROTON ENERGY HEV	ENERGY LOSS HEV/GM/CH2	PROTON RANGE		PROTON PATH LENGTH		GM/CM2	PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
		GM/CH2	METER	GM/CH2	METER		GM/CM2	METER PERCENT		
500.00	2.6259	121.73	6820.7	121.80	6824.4	1.1178	62.632	.9178	.0546	.94645
510.00	2.6042	125.55	7034.9	125.62	7038.7	1.1504	64.457	.9157	.0545	.95082
520.00	2.5834	129.40	7250.8	129.48	7254.7	1.1831	66.290	.9138	.0544	.95486
530.00	2.5634	133.29	7468.4	133.36	7472.5	1.2160	68.134	.9118	.0543	.95858
540.00	2.5442	137.20	7687.7	137.28	7691.9	1.2491	69.989	.9099	.0543	.96200
550.00	2.5258	141.15	7908.6	141.22	7912.9	1.2823	71.852	.9080	.0542	.96516
560.00	2.5081	145.12	8131.2	145.20	8135.6	1.3158	73.726	.9062	.0541	.96806
570.00	2.4910	149.12	8355.2	149.20	8359.7	1.3494	75.608	.9044	.0540	.97072
580.00	2.4746	153.14	8580.8	153.22	8585.4	1.3831	77.499	.9027	.0539	.97317
590.00	2.4588	157.19	8807.8	157.28	8812.6	1.4170	79.399	.9010	.0539	.97543
600.00	2.4436	161.27	9036.3	161.36	9041.2	1.4511	81.308	.8993	.0539	.97749
620.00	2.4148	169.50	9497.4	169.59	9502.5	1.5197	85.149	.8961	.0536	.98113
640.00	2.3879	177.83	9963.9	177.92	9969.2	1.5888	89.021	.8930	.0535	.98419
660.00	2.3629	186.24	10435.	186.34	10441.	1.6584	92.923	.8900	.0534	.98676
680.00	2.3395	194.74	10912.	194.85	10918.	1.7285	96.852	.8871	.0532	.98892
700.00	2.3177	203.33	11392.	203.44	11399.	1.7991	100.81	.8844	.0531	.99073
720.00	2.2972	211.99	11878.	212.11	11885.	1.8702	104.79	.8817	.0529	.99224
740.00	2.2780	220.73	12368.	220.85	12375.	1.9417	108.80	.8792	.0528	.99351
760.00	2.2595	229.54	12862.	229.66	12869.	2.0136	112.82	.8767	.0527	.99457
780.00	2.2430	238.42	13359.	238.55	13366.	2.0858	116.87	.8744	.0525	.99546
800.00	2.2270	247.37	13860.	247.50	13868.	2.1585	120.94	.8721	.0524	.99620
820.00	2.2119	256.38	14365.	256.51	14373.	2.2315	125.04	.8700	.0523	.99682
840.00	2.1978	265.44	14873.	265.58	14881.	2.3049	129.15	.8679	.0521	.99733
860.00	2.1844	274.57	15385.	274.71	15393.	2.3786	133.28	.8658	.0520	.99777
880.00	2.1717	283.75	15899.	283.90	15907.	2.4526	137.42	.8639	.0519	.99813
900.00	2.1598	292.98	16416.	293.14	16425.	2.5269	141.59	.8620	.0517	.99843
920.00	2.1484	302.27	16937.	302.43	16945.	2.6015	145.77	.8602	.0516	.99868
940.00	2.1377	311.61	17460.	311.77	17469.	2.6763	149.96	.8584	.0515	.99889
960.00	2.1276	321.00	17986.	321.16	17995.	2.7513	154.17	.8567	.0513	.99907
1000.00	2.1088	339.98	19050.	340.15	19059.	2.9026	162.64	.8533	.0509	.99934

THE ELECTRON DENSITY OF HELIUM IS 3.010E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.384 BEV, AND THE MINIMUM ENERGY LOSS IS 1.9391 MEV/GM/CH2

HYDROGEN(DIATOMIC)

ADJUSTED
IONIZATION
POTENTIAL
18.30

ATOMIC
WEIGHT
1.0080

ATOMS/
MOLECULE
2

ATOMIC
NUMBER
1

ELEMENT
H

DENSITY = .08988 MG/CM3

PROTON ENERGY HEV	ENERGY LOSS HEV/GM/CM2	PROTON RANGE MG/CM2	PROTON PATH LENGTH MG/CM2	PROTON PATH LENGTH METER	MG/CM2	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	3480.7	.03252	.03258	.00362	.00066	.00007	2.037	.1800
.15	2807.7	.04248	.04854	.00540	.00091	.00010	1.865	.1352
.20	2330.8	.06798	.00756	.00757	.00121	.00013	1.779	.1290
.30	1743.1	.11793	.11806	.01314	.00201	.00022	1.704	.1107
.40	1407.2	.18201	.18221	.02027	.00303	.00034	1.663	.1081
.50	1179.7	.25971	.25995	.02893	.00424	.00047	1.633	.1069
.60	1017.7	.35110	.35147	.03910	.00566	.00063	1.610	.1060
.70	910.67	.45483	.45531	.05066	.00722	.00080	1.585	.1053
.80	813.91	.57086	.57145	.06358	.00893	.00099	1.563	.1046
.90	748.89	.69865	.69938	.07781	.01079	.00120	1.543	.1039
1.00	683.81	.83832	.83919	.09337	.01280	.00142	1.525	.1032
1.20	591.74	1.1532	1.1543	.12843	.01728	.00192	1.497	.1020
1.40	523.10	1.5130	1.5146	.16851	.02230	.00240	1.472	.1008
1.60	469.79	1.9169	1.9188	.21349	.02783	.00310	1.451	.0998
1.80	427.07	2.3637	2.3660	.26325	.03388	.00377	1.432	.0988
2.00	392.02	2.8524	2.8552	.31767	.04043	.00450	1.416	.0979
2.20	362.69	3.3826	3.3859	.37671	.04746	.00528	1.402	.0971
2.40	337.75	3.9540	3.9578	.44035	.05497	.00612	1.389	.0964
2.60	316.27	4.5658	4.5702	.50848	.06295	.00700	1.378	.0957
2.80	297.56	5.2175	5.2225	.58105	.07140	.00794	1.367	.0951
3.00	281.09	5.9087	5.9143	.65802	.08031	.00893	1.358	.0945
3.20	266.49	6.6390	6.6453	.73935	.08966	.00998	1.349	.0939
3.40	253.44	7.4082	7.4151	.82500	.09946	.01107	1.341	.0934
3.60	241.71	8.2160	8.2237	.91496	.10970	.01221	1.334	.0929
3.80	231.10	9.0617	9.0700	1.0091	.12037	.01339	1.327	.0924
4.00	221.41	9.9450	9.9542	1.1075	.13148	.01463	1.321	.0920
4.20	212.63	10.866	10.876	1.2101	.14300	.01591	1.315	.0916
4.40	204.54	11.825	11.835	1.3168	.15495	.01724	1.309	.0912
4.60	197.09	12.820	12.832	1.4276	.16732	.01862	1.304	.0908
4.80	190.20	13.852	13.865	1.5412	.18010	.02004	1.299	.0905

HYDROGEN(DIATOMIC)

PROTON ENERGY MEV	ENERGY LOSS MEV/CH2	PROTON RANGE GH/CH2	PROTON RANGE METER	PROTON PATH LENGTH GH/CH2	PROTON PATH LENGTH METER	PATH LENGTH STRAGGLING METER	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	183.82	0.1492	1.6602	0.1493	1.6616	0.0019	0.2151	0.0901
5.50	169.72	0.1775	1.9751	0.1777	1.9769	0.0023	0.2537	0.0894
6.00	157.77	0.2081	2.3150	0.2083	2.3171	0.0027	0.2952	0.0887
6.50	147.51	0.2408	2.6796	0.2411	2.6820	0.0030	0.3393	0.0880
7.00	138.60	0.2758	3.0685	0.2760	3.0712	0.0035	0.3862	0.0874
7.50	130.78	0.3129	3.4816	0.3132	3.4846	0.0039	0.4357	0.0869
8.00	123.85	0.3522	3.9185	0.3525	3.9219	0.0044	0.4877	0.0864
8.50	117.68	0.3936	4.3791	0.3939	4.3828	0.0049	0.5424	0.0860
9.00	112.14	0.4371	4.8631	0.4375	4.8673	0.0054	0.5996	0.0856
9.50	107.13	0.4827	5.3704	0.4831	5.3749	0.0059	0.6593	0.0852
10.00	102.59	0.5304	5.9007	0.5308	5.9057	0.0065	0.7215	0.0848
11.00	94.653	0.6318	7.0298	0.6324	7.0358	0.0077	0.8532	0.0841
12.00	87.939	0.7414	8.2493	0.7421	8.2562	0.0089	0.9946	0.0835
13.00	82.184	0.8591	9.5578	0.8598	9.5658	0.0103	1.1454	0.0829
14.00	77.191	0.9846	10.954	0.9854	10.963	0.0117	1.3054	0.0825
15.00	72.817	1.1179	12.438	1.1188	12.448	0.0133	1.4746	0.0820
16.00	68.950	1.2590	14.008	1.2600	14.019	0.0149	1.6528	0.0816
17.00	65.507	1.4077	15.662	1.4089	15.675	0.0165	1.8398	0.0812
18.00	62.419	1.5640	17.402	1.5653	17.416	0.0183	2.0356	0.0808
19.00	59.634	1.7279	19.224	1.7293	19.240	0.0201	2.2400	0.0805
20.00	57.108	1.8991	21.130	1.9007	21.147	0.0220	2.4528	0.0802
22.00	52.700	2.2638	25.167	2.2656	25.207	0.0261	2.9037	0.0796
24.00	48.979	2.6574	29.566	2.6595	29.590	0.0304	3.3874	0.0791
26.00	45.793	3.0797	34.264	3.0821	34.291	0.0351	3.9033	0.0786
28.00	43.034	3.5301	39.276	3.5329	39.307	0.0400	4.4506	0.0782
30.00	40.619	4.0084	44.597	4.0115	44.632	0.0452	5.0287	0.0778
32.00	38.488	4.5140	50.223	4.5175	50.262	0.0507	5.6371	0.0774
34.00	36.592	5.0461	56.150	5.0507	56.193	0.0564	6.2752	0.0771
36.00	34.893	5.6043	62.375	5.6106	62.423	0.0624	6.9425	0.0768
38.00	33.363	6.1922	68.994	6.1969	68.946	0.0687	7.6385	0.0765
40.00	31.976	6.8042	75.703	6.8094	75.761	0.0752	8.3620	0.0763
45.00	28.018	8.4467	93.978	8.4531	94.049	0.0925	1.0294	0.0757
50.00	26.619	1.0246	114.00	1.0254	114.09	0.1114	1.2393	0.0751
55.00	24.633	1.2199	135.73	1.2209	135.83	0.1317	1.4652	0.0747
60.00	22.960	1.4302	159.12	1.4313	159.24	0.1534	1.7068	0.0742
65.00	21.531	1.6551	184.14	1.6563	184.28	0.1765	1.9634	0.0739
70.00	20.295	1.8942	210.75	1.8956	210.90	0.2008	2.2346	0.0735
75.00	19.216	2.1473	238.91	2.1489	239.09	0.2265	2.5200	0.0732
80.00	18.265	2.4141	268.60	2.4159	268.79	0.2534	2.8191	0.0729
90.00	16.666	2.9877	332.41	2.9898	332.65	0.3107	3.4569	0.0724

HYDROGEN(DIATOMIC)

PROTON ENERGY MEV	ENERGY LOSS HEV/CM/CH	PROTON RANGE GM/CM2 METER	PROTON PATH LENGTH GM/CM2 METER	PATH LENGTH STRAGGLING GM/CM2 METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	15.372	3.6127	3.6153	.03726	.0719	0.
110.00	14.303	4.2894	4.2903	.04387	.0715	0.
120.00	13.405	5.0094	5.0130	.05089	.0712	0.
130.00	12.640	5.7775	5.7816	.05830	.0708	0.
140.00	11.980	6.5900	6.5947	.06608	.0705	0.
150.00	11.405	7.4450	7.4506	.07420	.0703	0.
160.00	10.899	8.3420	8.3478	.08266	.0700	0.
170.00	10.451	9.2786	9.2851	.09144	.0697	0.
180.00	10.051	10.254	10.261	.10052	.0695	0.
190.00	9.6923	11.267	11.275	.10989	.0693	0.
200.00	9.3683	12.316	12.324	.11955	.0691	0.
210.00	9.0745	13.400	13.409	.12946	.0689	0.
220.00	8.8068	14.518	14.528	.13964	.0687	0.
230.00	8.5619	15.669	15.680	.15006	.0685	0.
240.00	8.3371	16.852	16.863	.16071	.0684	0.
250.00	8.1360	18.066	18.078	.17159	.0682	0.
260.00	7.9366	19.310	19.323	.18268	.0681	0.
270.00	7.7613	20.583	20.597	.19398	.0679	0.
280.00	7.5966	21.885	21.900	.20549	.0678	0.
290.00	7.4431	23.214	23.230	.21718	.0676	0.
300.00	7.2999	24.570	24.587	.22906	.0675	.00002
310.00	7.1659	25.952	25.969	.24112	.0673	.00093
320.00	7.0403	27.359	27.377	.25335	.0672	.00202
330.00	6.9228	28.791	28.810	.26574	.0671	.00330
340.00	6.8114	30.246	30.266	.27830	.0670	.00477
350.00	6.7068	31.725	31.746	.29100	.0668	.00644
360.00	6.6082	33.226	33.248	.30386	.0667	.00832
370.00	6.5149	34.749	34.772	.31686	.0666	.01039
380.00	6.4267	36.294	36.318	.33000	.0665	.01268
390.00	6.3431	37.859	37.884	.34327	.0664	.01517
400.00	6.2638	39.445	39.471	.35667	.0662	.01787
410.00	6.1884	41.050	41.077	.37019	.0661	.02079
420.00	6.1168	42.674	42.702	.38384	.0660	.02393
430.00	6.0486	44.317	44.346	.39760	.0659	.02728
440.00	5.9836	45.978	46.009	.41147	.0658	.03085
450.00	5.9216	47.657	47.689	.42546	.0657	.03464
460.00	5.8624	49.354	49.386	.43955	.0656	.03864
470.00	5.8059	51.067	51.100	.45374	.0655	.04287
480.00	5.7518	52.796	52.831	.46804	.0654	.04731
490.00	5.7000	54.542	54.577	.48243	.0653	.05198

HYDROGEN(DIATOMIC)

PROTON ENERGY MEV	ENERGY LOSS HEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH METER	GM/CM2	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	5.6505	56.303	6268.3	.49691	55.285	.0652	.05686
510.00	5.6030	58.079	6461.8	.51148	56.907	.0651	.06210
520.00	5.5574	59.870	6661.1	.52814	58.539	.0650	.06786
530.00	5.5137	61.675	6862.0	.54089	60.179	.0649	.07413
540.00	5.4717	63.495	7064.4	.55572	61.829	.0648	.08091
550.00	5.4313	65.328	7268.4	.57064	63.489	.0647	.08819
560.00	5.3925	67.175	7473.8	.58563	65.156	.0646	.09596
570.00	5.3552	69.035	7680.7	.60069	66.833	.0645	.10422
580.00	5.3192	70.907	7889.1	.61583	68.517	.0645	.11295
590.00	5.2846	72.792	8098.8	.63105	70.210	.0644	.12216
600.00	5.2512	74.689	8309.9	.64633	71.910	.0643	.13181
620.00	5.1880	78.519	8736.0	.67710	75.334	.0641	.15277
640.00	5.1292	82.394	9167.1	.70813	78.787	.0639	.17601
660.00	5.0743	86.312	9603.0	.73941	82.267	.0637	.20136
680.00	5.0230	90.272	10044.	.77092	85.773	.0636	.22862
700.00	4.9750	94.270	10488.	.80266	89.304	.0634	.25758
720.00	4.9300	98.306	10938.	.83461	92.858	.0632	.28801
740.00	4.8878	102.38	11391.	.86676	96.436	.0631	.31965
760.00	4.8481	106.48	11847.	.89911	100.03	.0629	.35211
780.00	4.8108	110.62	12308.	.93165	103.65	.0627	.38426
800.00	4.7757	114.79	12772.	.96436	107.29	.0626	.41586
820.00	4.7425	118.99	13239.	.99724	110.95	.0624	.44682
840.00	4.7113	123.22	13710.	1.0303	114.63	.0623	.47707
860.00	4.6818	127.48	14183.	1.0635	118.32	.0621	.50656
880.00	4.6538	131.76	14660.	1.0968	122.03	.0620	.53522
900.00	4.6274	136.07	15139.	1.1303	125.76	.0618	.56299
920.00	4.6024	140.41	15622.	1.1640	129.51	.0616	.58984
940.00	4.5787	144.77	16107.	1.1978	133.26	.0615	.61574
960.00	4.5563	149.15	16594.	1.2317	137.04	.0613	.64064
1000.00	4.5147	158.01	17580.	1.2999	144.62	.0608	.68740

THE ELECTRON DENSITY OF HYDROGEN(DIATOMIC) IS 5.977E 23 ELECTRONS PER GRAM
 THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.501 BEV, AND THE MINIMUM ENERGY LOSS IS 4.1218 HEV/GM/CM2

IRON

ELEMENT FE
 ATOMIC NUMBER 26
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 55.847
 ADJUSTED IONIZATION POTENTIAL 273.0

DENSITY = 7.8700 GM/CM3

PROCTON ENERGY MFV	ENERGY LOSS HEV/CM2	HEV/CH	PROTON RANGE HG/CM2	MM	PROTON PATH LENGTH HG/CM2	MM	PROTON PATH LENGTH STRAGGLING HG/CM2	MM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	330.91	2604.3	.46769	.00059	.47840	.00061	.02066	.00003	4.318	2.239	0.
.15	314.43	2474.6	.62194	.00079	.63339	.00080	.02430	.00003	3.837	1.807	0.
.20	295.35	2324.4	.78449	.00100	.79743	.00101	.02791	.00004	3.500	1.623	0.
.30	263.65	2074.9	1.1389	.00145	1.1556	.00147	.03531	.00004	3.056	1.448	0.
.40	227.15	1787.7	1.5424	.00196	1.5635	.00199	.04386	.00006	2.805	1.349	0.
.50	197.26	1552.4	2.0115	.00256	2.0376	.00259	.05527	.00007	2.712	1.279	0.
.60	179.80	1415.0	2.5380	.00322	2.5695	.00326	.06849	.00009	2.665	1.227	0.
.70	161.81	1273.4	3.1174	.00396	3.1548	.00401	.08301	.00011	2.631	1.185	0.
.80	149.10	1173.4	3.7573	.00477	3.8020	.00483	.09917	.00013	2.609	1.151	0.
.90	141.43	1113.0	4.4387	.00564	4.4890	.00570	.11568	.00015	2.577	1.122	0.
1.00	133.75	1052.6	5.1592	.00656	5.2165	.00663	.13237	.00017	2.538	1.098	0.
1.20	119.72	942.22	6.7285	.00855	6.8004	.00864	.16766	.00021	2.465	1.056	0.
1.40	109.03	858.04	8.4060	.01076	8.5535	.01087	.20539	.00026	2.401	1.022	0.
1.60	100.40	790.12	10.364	.01317	10.468	.01330	.24530	.00031	2.343	.9941	0.
1.80	93.257	733.93	12.414	.01577	12.535	.01593	.28727	.00037	2.292	.9697	0.
2.00	87.257	686.71	14.615	.01857	14.755	.01875	.33120	.00042	2.245	.9484	0.
2.20	82.153	646.54	16.959	.02155	17.118	.02175	.37696	.00048	2.202	.9296	0.
2.40	77.748	611.87	19.442	.02470	19.622	.02493	.42442	.00054	2.163	.9127	0.
2.60	73.838	581.11	22.062	.02823	22.262	.02829	.47360	.00060	2.127	.8977	0.
2.80	70.365	553.77	24.817	.03153	25.038	.03181	.52446	.00067	2.095	.8841	0.
3.00	67.252	529.28	27.703	.03520	27.946	.03551	.57698	.00073	2.065	.8714	0.
3.20	64.442	507.16	30.719	.03903	30.985	.03937	.63115	.00080	2.037	.8600	0.
3.40	61.888	487.06	33.862	.04303	34.153	.04340	.68703	.00087	2.012	.8493	0.
3.60	59.555	468.70	37.133	.04718	37.448	.04758	.74498	.00095	1.989	.8395	.00001
3.80	57.413	451.84	40.529	.05150	40.868	.05193	.80495	.00102	1.970	.8303	.00001
4.00	55.438	436.29	44.050	.05597	44.415	.05644	.86685	.00110	1.952	.8218	.00001
4.20	53.611	421.92	47.693	.06060	48.084	.06110	.93063	.00118	1.935	.8138	.00001
4.40	51.915	408.57	51.457	.06538	51.876	.06592	.99824	.00127	1.920	.8063	.00002
4.60	50.333	396.12	55.343	.07032	55.789	.07089	1.0636	.00135	1.907	.7992	.00002
4.80	48.862	384.54	59.347	.07541	59.822	.07601	1.1328	.00144	1.894	.7925	.00003

IRON

PRCTON ENERGY MEV	ENERGY LOSS MEV/GM/CM	PROTON RANGE GM/CM2 CM	PROTON PATH LENGTH GM/CM2 CM	PATH LENGTH STRAGGLING GM/CM2 CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	47.446	0.6347	0.0807	0.06397	0.00120	0.0003
5.50	44.406	0.7429	0.0944	0.07487	0.00139	0.0005
6.00	41.752	0.8583	0.1091	0.08649	0.00158	0.0008
6.50	39.434	0.9800	0.1246	0.09882	0.00179	0.0011
7.00	37.382	1.1102	0.1411	0.11185	0.00200	0.0015
7.50	35.551	1.2465	0.1584	0.12557	0.00222	0.0019
8.00	33.921	1.3896	0.1766	0.13997	0.00245	0.0025
8.50	32.441	1.5394	0.1956	0.15505	0.00269	0.0031
9.00	31.125	1.6959	0.2155	0.17079	0.00294	0.0037
9.50	29.922	1.8585	0.2362	0.18716	0.00319	0.0045
10.00	28.819	2.0279	0.2577	0.20420	0.00346	0.0053
11.00	26.867	2.3852	0.3031	0.24016	0.00401	0.0072
12.00	25.190	2.7675	0.3516	0.27862	0.00459	0.0098
13.00	23.732	3.1742	0.4033	0.31954	0.00520	0.0202
14.00	22.451	3.6050	0.4581	0.36289	0.00584	0.0336
15.00	21.316	4.0596	0.5158	0.40862	0.00651	0.0580
16.00	20.302	4.5377	0.5766	0.45671	0.00721	0.0825
17.00	19.392	5.0388	0.6403	0.50712	0.00793	0.1071
18.00	18.569	5.5628	0.7068	0.55983	0.00868	0.1320
19.00	17.822	6.1136	0.7763	0.61482	0.00945	0.1571
20.00	17.139	6.6786	0.8486	0.67206	0.01027	0.1824
22.00	15.937	7.8827	1.0016	0.79316	0.01196	0.2334
24.00	14.912	9.1736	1.1656	0.92290	0.01375	0.2852
26.00	14.026	1.0549	1.3405	1.0614	0.01564	0.3193
28.00	13.252	1.2009	1.5259	1.2081	0.01763	0.3515
30.00	12.570	1.3551	1.7218	1.3631	0.01971	0.3515
32.00	11.964	1.5173	1.9279	1.5263	0.02189	0.3686
34.00	11.421	1.6875	2.1442	1.6974	0.02415	0.3863
36.00	10.931	1.8656	2.3705	1.8765	0.02650	0.4047
38.00	10.488	2.0514	2.6066	2.0633	0.02894	0.4235
40.00	10.085	2.2448	2.8524	2.2578	0.03147	0.4429
45.00	8.3187	2.7552	3.5065	2.7770	0.03814	0.4936
50.00	6.9091	3.3233	4.2227	3.3421	0.04532	0.5449
55.00	5.7466	3.9297	4.9933	3.9518	0.05297	0.6029
60.00	4.8140	4.5794	5.8188	4.6049	0.06108	0.6616
65.00	4.0819	5.2711	6.6977	5.3003	0.06964	0.7226
70.00	3.5060	6.0038	7.6287	6.0368	0.07863	0.7858
75.00	3.0762	6.7765	8.6137	6.8137	0.08803	0.8509
80.00	2.7839	7.5885	9.6443	7.6299	0.09783	0.9176
90.00	2.4903	9.3262	1.1850	9.3767	0.11860	1.0551

IRON

PROTON ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	GM/CM2	PATH LENGTH STRAGGLING CH	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	2.0282	11.210	11.271	1.4321	.14082	.5345	.11967
110.00	4.7540	13.235	13.305	1.6906	.16442	.5315	.13427
120.00	4.4719	15.394	15.476	1.9664	.18932	.5289	.14938
130.00	4.2303	17.682	17.776	2.2587	.21545	.5267	.16490
140.00	4.0211	20.096	20.202	2.5669	.24275	.5247	.18075
150.00	3.8383	22.629	22.748	2.8905	.27115	.5230	.19664
160.00	3.6770	25.279	25.411	3.2286	.30060	.5214	.21317
170.00	3.5337	28.040	28.186	3.5815	.33105	.5200	.22976
180.00	3.4055	30.968	31.070	3.9478	.36246	.5188	.24653
190.00	3.2902	33.961	34.058	4.3275	.39476	.5176	.26345
200.00	3.1860	36.955	37.147	4.7201	.42794	.5166	.28044
210.00	3.0912	40.126	40.334	5.1250	.46193	.5156	.29749
220.00	3.0048	43.391	43.616	5.5420	.49672	.5147	.31457
230.00	2.9256	46.748	46.989	5.9707	.53226	.5139	.33163
240.00	2.8528	50.192	50.451	6.4105	.56851	.5131	.34863
250.00	2.7857	53.722	53.999	6.8613	.60546	.5124	.36555
260.00	2.7236	57.335	57.630	7.3227	.64306	.5118	.38237
270.00	2.6660	61.027	61.341	7.7944	.68129	.5111	.39908
280.00	2.6125	64.798	65.130	8.2758	.72013	.5105	.41565
290.00	2.5626	68.644	68.996	8.7669	.75955	.5100	.43205
300.00	2.5160	72.563	72.934	9.2574	.79952	.5094	.44827
310.00	2.4723	76.553	76.944	9.7469	.84003	.5089	.46429
320.00	2.4314	80.611	81.023	10.2295	.88104	.5084	.48009
330.00	2.3930	84.736	85.169	10.722	.92255	.5079	.49566
340.00	2.3568	88.927	89.380	11.2157	.96453	.5074	.51092
350.00	2.3227	93.180	93.655	11.7090	1.0070	.5070	.52606
360.00	2.2905	97.494	97.990	12.201	1.0498	.5066	.54089
370.00	2.2601	101.87	102.39	12.694	1.0931	.5061	.55550
380.00	2.2313	106.30	106.84	13.187	1.1368	.5057	.56989
390.00	2.2040	110.79	111.35	13.680	1.1807	.5053	.58403
400.00	2.1781	115.33	115.91	14.1728	1.2254	.5049	.59792
410.00	2.1535	119.92	120.53	14.6654	1.2702	.5045	.61152
420.00	2.1301	124.57	125.20	15.1588	1.3154	.5042	.62481
430.00	2.1078	129.26	129.92	15.6508	1.3609	.5038	.63779
440.00	2.0866	134.01	134.69	16.1414	1.4067	.5034	.65045
450.00	2.0664	138.80	139.50	16.6306	1.4528	.5031	.66279
460.00	2.0471	143.64	144.37	17.1184	1.4993	.5027	.67481
470.00	2.0287	148.52	149.27	17.6044	1.5460	.5024	.68651
480.00	2.0110	153.45	154.22	18.0898	1.5930	.5020	.69789
490.00	1.9942	158.42	159.22	18.5741	1.6403	.5017	.70895

IRON

PRCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CM	MEV/CH	GM/CM2	CM	GM/CH2	CM	GM/CH2	PERCENT		
500.00	1.9760	15.567	163.43	20.766	164.22	20.871	1.6878	.21446	.5013	.71970
510.00	1.9625	15.445	168.48	21.408	169.33	21.516	1.7356	.22054	.5010	.73914
520.00	1.9477	15.328	173.57	22.055	174.44	22.166	1.7837	.22664	.5006	.76026
530.00	1.9335	15.216	178.70	22.706	179.60	22.820	1.8319	.23277	.5003	.78008
540.00	1.9198	15.109	183.86	23.363	184.79	23.480	1.8904	.23894	.5000	.79960
550.00	1.9067	15.006	189.06	24.023	190.01	24.144	1.9292	.24513	.4996	.76883
560.00	1.8941	14.906	194.30	24.689	195.28	24.813	1.9781	.25135	.4993	.77776
570.00	1.8820	14.811	199.57	25.359	200.57	25.436	2.0273	.25759	.4989	.78640
580.00	1.8703	14.719	204.88	26.033	205.90	26.163	2.0766	.26386	.4986	.79476
590.00	1.8591	14.631	210.21	26.711	211.27	26.844	2.1262	.27016	.4983	.80284
600.00	1.8483	14.546	215.58	27.393	216.66	27.530	2.1759	.27648	.4979	.81166
620.00	1.8278	14.385	226.41	28.769	227.54	28.913	2.2759	.28919	.4973	.82549
640.00	1.8088	14.235	237.36	30.160	238.54	30.310	2.3766	.30198	.4966	.83932
660.00	1.7911	14.096	248.42	31.565	249.66	31.722	2.4780	.31486	.4960	.85218
680.00	1.7745	13.966	259.58	32.984	260.87	33.148	2.5799	.32782	.4953	.86413
700.00	1.7591	13.844	270.85	34.415	272.19	34.586	2.6825	.34085	.4946	.87521
720.00	1.7447	13.731	282.21	35.859	283.61	36.037	2.7856	.35395	.4940	.88549
740.00	1.7312	13.624	293.66	37.314	295.12	37.499	2.8892	.36711	.4933	.89498
760.00	1.7185	13.524	305.21	38.781	306.72	38.973	2.9933	.38034	.4926	.90376
780.00	1.7066	13.431	316.83	40.258	318.40	40.457	3.0978	.39362	.4919	.91186
800.00	1.6954	13.343	328.53	41.745	330.16	41.951	3.2028	.40697	.4913	.91974
820.00	1.6849	13.260	340.31	43.242	341.99	43.455	3.3082	.42036	.4906	.92727
840.00	1.6750	13.182	352.16	44.747	353.90	44.968	3.4141	.43381	.4899	.93357
860.00	1.6657	13.109	364.08	46.262	365.87	46.490	3.5203	.44730	.4892	.93840
880.00	1.6569	13.040	376.07	47.785	377.91	48.020	3.6268	.46084	.4885	.94375
900.00	1.6487	12.975	388.12	49.316	390.02	49.558	3.7337	.47443	.4878	.94867
920.00	1.6409	12.914	400.23	50.855	402.19	51.104	3.8410	.48805	.4871	.95318
940.00	1.6335	12.855	412.41	52.403	414.42	52.659	3.9485	.50172	.4863	.95732
960.00	1.6265	12.801	424.65	53.958	426.72	54.221	4.0564	.51542	.4854	.96110
1000.00	1.6137	12.700	449.42	57.105	451.60	57.382	4.2730	.54294	.4830	.96774

THE ELECTRON DENSITY OF IRON IS 2.805E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.100 SEV, AND THE MINIMUM ENERGY LOSS IS 1.5124 MEV/GH/CM2

KRYPTON

ADJUSTED
IONIZATION
POTENTIAL
358.4

ATOMS/
MOLECULE
1

ATOMIC
WEIGHT
83.800

ELEMENT
NUMBER
36

KR

DENSITY = 3.4900 MG/CM³

PROCTON ENERGY MEV	ENERGY LOSS HEV/ GM/CM ²	PROCTON RANGE HG/CM ²	PROCTON RANGE METER	PROTON PATH LENGTH HG/CM ²	PROTON PATH LENGTH METER	MG/CM ²	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	284.78	.40305	.00115	.41500	.00119	.01886	.00005	4.546	0.
.15	247.87	.58999	.00169	.60304	.00173	.02425	.00007	4.022	0.
.20	220.01	.80146	.00230	.81704	.00234	.03117	.00009	3.815	0.
.30	182.07	1.2958	.00371	1.3189	.00378	.04742	.00014	3.596	0.
.40	158.48	1.8771	.00538	1.9095	.00547	.06552	.00019	3.432	0.
.50	143.02	2.5320	.00726	2.5750	.00738	.08454	.00024	3.283	0.
.60	131.99	3.2491	.00931	3.3035	.00947	.10391	.00030	3.145	0.
.70	122.95	4.0220	.01152	4.0585	.01171	.12356	.00035	3.022	0.
.80	116.01	4.8469	.01389	4.9259	.01411	.14347	.00041	2.913	0.
.90	110.00	5.7188	.01639	5.6108	.01665	.16406	.00047	2.823	0.
1.00	105.99	6.6405	.01903	6.7459	.01933	.18590	.00053	2.756	0.
1.20	94.346	8.6347	.02474	8.7680	.02512	.23336	.00067	2.658	0.
1.40	86.696	10.819	.03100	10.982	.03147	.28365	.00081	2.583	0.
1.60	80.356	13.187	.03779	13.381	.03834	.33720	.00097	2.520	0.
1.80	75.102	15.730	.04507	15.956	.04572	.39338	.00113	2.465	0.
2.00	70.699	18.445	.05285	18.704	.05359	.45178	.00129	2.415	0.
2.20	66.843	21.320	.06109	21.614	.06193	.51229	.00147	2.370	0.
2.40	63.441	24.356	.06979	24.686	.07073	.57491	.00165	2.329	0.
2.60	60.416	27.551	.07894	27.917	.07999	.63962	.00183	2.291	0.
2.80	57.716	30.901	.08854	31.306	.08970	.70637	.00202	2.256	0.
3.00	55.283	34.403	.09858	34.847	.09985	.77513	.00222	2.224	0.
3.20	53.079	38.057	.10904	38.541	.11043	.84586	.00242	2.195	0.
3.40	51.068	41.858	.11994	42.384	.12144	.91853	.00263	2.167	0.
3.60	49.223	45.807	.13125	46.375	.13288	.99314	.00285	2.142	0.
3.80	47.530	49.896	.14297	50.508	.14472	1.0696	.00306	2.118	0.
4.00	45.986	54.132	.15511	54.788	.15699	1.1480	.00329	2.095	0.
4.20	44.528	58.506	.16764	59.209	.16965	1.2282	.00352	2.074	0.
4.40	43.206	63.023	.18058	63.771	.18272	1.3101	.00375	2.054	0.
4.60	41.971	67.671	.19390	68.466	.19618	1.3937	.00399	2.036	0.
4.80	40.814	72.456	.20761	73.299	.21003	1.4790	.00424	2.018	.00901

KRYPTON

PRCTON ENERGY HEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	GM/CM2	KEV/CH	GM/CM2	METER	GM/CM2	METER	GM/CM2	METER PERCENT	PERCENT	PERCENT	
5.00	39.728	138.65	.07737	.22170	.07827	.22426	.00157	.00449	2.001	1.141	.00001
5.50	37.282	130.11	.09025	.25859	.09127	.26151	.00177	.00513	1.962	1.118	.00001
6.00	35.169	122.74	.10393	.29779	.10508	.30109	.00203	.00580	1.927	1.098	.00002
6.50	33.312	116.26	.11840	.33926	.11970	.34297	.00227	.00650	1.896	1.080	.00004
7.00	31.660	110.49	.13366	.38299	.13510	.38711	.00252	.00723	1.869	1.063	.00005
7.50	30.187	105.35	.14969	.42892	.15128	.43346	.00279	.00800	1.845	1.049	.00008
8.00	28.860	100.72	.16648	.47702	.16822	.48201	.00307	.00879	1.824	1.035	.00011
8.50	27.658	96.525	.18402	.52729	.18592	.53273	.00336	.00962	1.806	1.023	.00014
9.00	26.563	92.706	.20231	.57969	.20438	.58561	.00366	.01047	1.789	1.011	.00018
9.50	25.562	89.212	.22133	.63419	.22357	.64060	.00396	.01136	1.773	1.000	.00023
10.00	24.643	86.003	.24108	.69077	.24349	.69768	.00428	.01227	1.759	.9906	.00028
11.00	23.012	80.310	.28274	.81015	.28552	.81811	.00495	.01418	1.733	.9728	.00041
12.00	21.608	75.412	.32723	.93761	.33039	.94668	.00565	.01620	1.711	.9573	.00057
13.00	20.386	71.146	.37449	1.0730	.37806	1.0833	.00639	.01832	1.691	.9435	.00074
14.00	19.310	67.391	.42449	1.2163	.42848	1.2277	.00717	.02054	1.673	.9312	.00095
15.00	18.353	64.052	.47719	1.3673	.48162	1.3800	.00798	.02285	1.655	.9202	.00118
16.00	17.496	61.062	.53255	1.5259	.53744	1.5400	.00882	.02527	1.641	.9107	.00211
17.00	16.729	58.384	.59055	1.6921	.59592	1.7075	.00969	.02777	1.627	.9011	.00352
18.00	16.029	55.941	.65115	1.8657	.65701	1.8826	.01060	.03037	1.613	.8927	.00569
19.00	15.452	53.754	.71430	2.0467	.72068	2.0650	.01154	.03306	1.601	.8851	.00788
20.00	14.829	51.752	.77992	2.2347	.78683	2.2545	.01251	.03584	1.590	.8781	.01009
22.00	13.815	48.214	.91863	2.6322	.92666	2.6552	.01453	.04164	1.568	.8655	.01456
24.00	12.947	45.185	1.0671	3.0575	1.0763	3.0839	.01667	.04778	1.549	.8546	.01910
26.00	12.194	42.558	1.2251	3.5104	1.2356	3.5403	.01893	.05423	1.532	.8450	.02215
28.00	11.535	40.257	1.3925	3.9900	1.4043	4.0237	.02129	.06101	1.516	.8364	.02363
30.00	10.952	38.223	1.5692	4.4963	1.5823	4.5338	.02376	.06809	1.502	.8288	.02518
32.00	10.433	36.411	1.7549	5.0285	1.7695	5.0702	.02634	.07548	1.489	.8219	.02678
34.00	9.9677	34.787	1.9496	5.5862	1.9656	5.6321	.02902	.08316	1.476	.8156	.02845
36.00	9.5478	33.322	2.1531	6.1694	2.1707	6.2198	.03190	.09113	1.465	.8100	.03016
38.00	9.1671	31.993	2.3654	6.7775	2.3845	6.8325	.03469	.09938	1.455	.8048	.03194
40.00	8.8200	30.782	2.5862	7.4102	2.6070	7.4700	.03766	.10792	1.445	.8000	.03376
45.00	8.0729	28.174	3.1750	9.0976	3.2003	9.1700	.04553	.13045	1.423	.7895	.03850
50.00	7.4643	26.050	3.8152	10.932	3.8452	11.018	.05396	.15461	1.403	.7808	.04350
55.00	6.9510	24.259	4.5047	12.907	4.5398	13.008	.06293	.18030	1.386	.7733	.04874
60.00	6.5151	22.738	5.2427	15.022	5.2833	15.138	.07242	.20751	1.371	.7670	.05425
65.00	6.1399	21.428	6.0283	17.273	6.0745	17.406	.08242	.23617	1.357	.7613	.06000
70.00	5.8134	20.289	6.8594	19.655	6.9417	19.804	.09292	.26624	1.344	.7564	.06597
75.00	5.5263	19.287	7.7355	22.165	7.7911	22.333	.10389	.29767	1.333	.7521	.07213
80.00	5.2723	18.400	8.6557	24.801	8.7209	24.988	.11531	.33041	1.322	.7482	.07646
90.00	4.8420	16.898	10.623	30.439	10.702	30.666	.13948	.39965	1.303	.7415	.09158

KRYPTON

PROTON ENERGY MEV	ENERGY LOSS KEV/CH	PROTON RANGE GM/CM2	PROTON PATH LENGTH METER	GM/CM2	GM/CM2	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	4.4910	12.755	36.817	12.849	16530	47364	1.286	.10518
110.00	4.1991	15.043	43.103	15.154	19269	55212	1.272	.11925
120.00	3.9523	17.482	50.091	17.610	22155	63482	1.258	.13380
130.00	3.7410	20.066	57.495	20.212	25181	72151	1.246	.14874
140.00	3.5574	22.789	65.298	22.955	28339	81201	1.235	.16398
150.00	3.3971	25.647	73.486	25.832	31623	90611	1.224	.17946
160.00	3.2558	28.634	82.045	28.840	35026	1.0036	1.214	.19518
170.00	3.1302	31.745	90.961	31.974	38542	1.1043	1.205	.21117
180.00	3.0178	34.977	100.22	35.228	42165	1.2082	1.197	.22736
190.00	2.9166	38.325	109.81	38.600	45890	1.3149	1.189	.24372
200.00	2.8250	41.786	119.73	42.084	49713	1.4244	1.181	.26018
210.00	2.7418	45.353	129.95	45.676	53629	1.5366	1.174	.27671
220.00	2.6659	49.026	140.48	49.375	57633	1.6514	1.167	.29325
230.00	2.5963	52.802	151.29	53.177	61722	1.7686	1.161	.30976
240.00	2.5323	56.675	162.39	57.077	65893	1.8860	1.154	.32622
250.00	2.4733	60.644	173.76	61.073	70141	2.0098	1.148	.34259
260.00	2.4167	64.705	185.40	65.162	74463	2.1336	1.143	.35888
270.00	2.3680	68.855	197.29	69.341	78856	2.2595	1.137	.37513
280.00	2.3209	73.091	209.43	73.607	83316	2.3873	1.132	.39131
290.00	2.2770	77.412	221.81	77.957	87842	2.5170	1.127	.40738
300.00	2.2359	81.814	234.42	82.389	92431	2.6485	1.122	.42334
310.00	2.1975	86.294	247.26	86.901	97079	2.7816	1.117	.43915
320.00	2.1615	90.851	260.32	91.489	1.0179	2.9165	1.113	.45482
330.00	2.1276	95.483	273.59	96.153	1.0655	3.0529	1.108	.47033
340.00	2.0958	100.19	287.07	100.89	1.1136	3.1908	1.104	.48565
350.00	2.0657	104.96	300.74	105.69	1.1623	3.3302	1.100	.50077
360.00	2.0374	109.80	314.62	110.57	1.2114	3.4710	1.096	.51567
370.00	2.0106	114.71	328.68	115.51	1.2610	3.6132	1.092	.53033
380.00	1.9852	119.68	342.92	120.52	1.3111	3.7566	1.088	.54473
390.00	1.9612	124.71	357.34	125.58	1.3616	3.9013	1.084	.55886
400.00	1.9384	129.81	371.94	130.71	1.4125	4.0472	1.081	.57272
410.00	1.9167	134.96	386.70	135.90	1.4638	4.1942	1.077	.58631
420.00	1.8961	140.17	401.63	141.15	1.5155	4.3424	1.074	.59963
430.00	1.8765	145.44	416.72	146.45	1.5676	4.4916	1.070	.61266
440.00	1.8578	150.75	431.96	151.80	1.6200	4.6419	1.067	.62541
450.00	1.8400	156.13	447.36	157.21	1.6728	4.7931	1.064	.63787
460.00	1.8230	161.55	462.89	162.67	1.7259	4.9453	1.061	.65005
470.00	1.8067	167.02	478.58	168.18	1.7794	5.0985	1.058	.66193
480.00	1.7912	172.54	494.40	173.74	1.8331	5.2525	1.055	.67352
490.00	1.7763	178.11	510.35	179.35	1.8872	5.4074	1.052	.68482

KRYPTON

PRCTON ENERGY HEV	ENERGY LOSS HEV/GH/CH2	PROTON RANGE GH/CH2	PROTON RANGE METER	PROTON PATH LENGTH GH/CH2	PROTON PATH LENGTH METER	PATH LENGTH STRAGGLING GH/CH2	PATH LENGTH STRAGGLING METER	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	1.7621	183.73	526.44	185.00	530.09	1.9415	5.5632	.6882	.69583
510.00	1.7485	189.39	542.65	190.70	546.41	1.9962	5.7197	.6878	.70654
520.00	1.7354	195.09	558.99	196.44	562.86	2.0511	5.8770	.6874	.71697
530.00	1.7229	200.83	575.45	202.22	579.43	2.1063	6.0351	.6869	.72711
540.00	1.7108	206.62	592.03	208.05	596.12	2.1617	6.1939	.6865	.73696
550.00	1.6993	212.44	608.72	213.91	612.92	2.2173	6.3534	.6861	.74654
560.00	1.6882	218.31	625.52	219.81	629.84	2.2732	6.5136	.6857	.75583
570.00	1.6775	224.21	642.43	225.76	646.87	2.3294	6.6744	.6853	.76486
580.00	1.6672	230.15	659.45	231.74	664.00	2.3857	6.8359	.6849	.77361
590.00	1.6574	236.12	676.57	237.75	681.24	2.4423	6.9980	.6845	.78289
600.00	1.6478	242.13	693.79	243.80	698.57	2.4991	7.1607	.6841	.79031
620.00	1.6298	254.26	728.53	256.01	733.54	2.6133	7.4879	.6832	.80598
640.00	1.6131	266.51	763.64	268.34	768.89	2.7282	7.8172	.6824	.82066
660.00	1.5975	278.89	799.10	280.80	804.58	2.8438	8.1485	.6816	.83439
680.00	1.5830	291.38	834.90	293.38	840.62	2.9601	8.4818	.6808	.84721
700.00	1.5694	303.98	871.02	306.07	876.98	3.0771	8.8169	.6800	.85916
720.00	1.5567	316.70	907.44	318.86	913.64	3.1946	9.1537	.6791	.87028
740.00	1.5448	329.51	944.15	331.76	950.60	3.3128	9.4921	.6783	.88063
760.00	1.5337	342.42	981.13	344.75	987.83	3.4314	9.8321	.6775	.89024
780.00	1.5233	355.41	1018.4	357.84	1025.3	3.5506	10.174	.6767	.89915
800.00	1.5135	368.50	1055.9	371.01	1063.1	3.6702	10.516	.6758	.90740
820.00	1.5043	381.67	1093.6	384.27	1101.0	3.7903	10.860	.6750	.91504
840.00	1.4956	394.92	1131.6	397.60	1139.3	3.9108	11.206	.6742	.92211
860.00	1.4874	408.25	1169.8	411.01	1177.7	4.0318	11.552	.6733	.92863
880.00	1.4797	421.64	1208.1	424.50	1216.3	4.1531	11.900	.6725	.93465
900.00	1.4725	435.13	1246.8	438.07	1255.2	4.2748	12.249	.6716	.94020
920.00	1.4657	448.67	1285.6	451.70	1294.3	4.3969	12.598	.6707	.94531
940.00	1.4592	462.27	1324.6	465.39	1333.5	4.5193	12.949	.6697	.95032
960.00	1.4531	475.95	1363.8	479.16	1372.9	4.6420	13.301	.6685	.95434
1000.00	1.4419	503.63	1443.1	507.01	1452.7	4.8884	14.007	.6654	.96193

THE ELECTRON DENSITY OF KRYPTON IS 2.588E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.052 BEV, AND THE MINIMUM ENERGY LOSS IS 3.3557 MEV/GH/CH2

LEAD

ADJUSTED
IONIZATION
POTENTIAL
810.0

ATOMIC
WEIGHT
207.19

ATOMS/
MOLECULE
1

ATOMIC
NUMBER
82

ELEMENT
PB

DENSITY = 11.340 GM/CM³

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM ²	PROTON RANGE MG/CM ²	PROTON PATH LENGTH MM	MG/CM ²	MG/CM ²	PATH LENGTH STRAGGLING MM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	121.90	1.2924	.00114	1.2668	.00121	.07000	5.122	5.445	0.
.15	127.51	1.6887	.00149	1.7678	.00156	.08295	4.692	4.473	0.
.20	126.11	2.0732	.00183	2.1620	.00191	.09343	4.321	4.111	0.
.30	113.18	2.8805	.00254	2.9959	.00264	.11567	3.861	3.850	0.
.40	99.802	3.7904	.00334	3.9383	.00347	.14470	3.674	3.755	0.
.50	90.308	4.8082	.00424	4.9932	.00440	.17847	3.574	3.705	0.
.60	82.632	5.9256	.00523	6.1513	.00542	.21523	3.499	3.669	0.
.70	77.074	7.1349	.00629	7.4042	.00653	.25399	3.430	3.638	0.
.80	70.991	8.4403	.00744	8.7561	.00772	.29514	3.371	3.607	0.
.90	67.040	9.8395	.00868	10.205	.00900	.33857	3.318	3.578	0.
1.00	63.087	11.326	.00999	11.743	.01036	.38351	3.266	3.549	0.
1.20	58.206	14.519	.01280	15.045	.01327	.47561	3.161	3.494	0.
1.40	54.152	17.969	.01585	18.610	.01641	.56882	3.057	3.442	0.
1.60	50.732	21.669	.01911	22.430	.01978	.66578	2.968	3.390	0.
1.80	47.812	25.610	.02258	26.495	.02336	.76883	2.902	3.340	0.
2.00	45.273	29.790	.02626	30.794	.02716	.87689	2.848	3.292	0.
2.20	43.075	34.177	.03014	35.324	.03115	.98930	2.801	3.246	0.
2.40	41.186	38.791	.03421	40.074	.03534	1.1049	2.757	3.203	0.
2.60	39.479	43.617	.03846	45.041	.03972	1.2234	2.716	3.162	0.
2.80	37.929	48.637	.04289	50.205	.04427	1.3449	2.679	3.124	0.
3.00	36.515	53.865	.04750	55.580	.04901	1.4691	2.643	3.086	0.
3.20	35.219	59.292	.05229	61.158	.05393	1.5961	2.610	3.052	0.
3.40	34.027	64.917	.05725	66.938	.05903	1.7259	2.578	3.019	0.
3.60	32.925	70.739	.06238	72.917	.06430	1.8584	2.549	2.987	0.
3.80	31.905	76.748	.06768	79.086	.06974	1.9936	2.521	2.957	0.
4.00	30.956	82.948	.07315	85.450	.07535	2.1315	2.494	2.928	0.
4.20	30.071	89.343	.07879	92.012	.08114	2.2719	2.469	2.901	0.
4.40	29.245	95.912	.08458	98.751	.08708	2.4150	2.445	2.875	0.
4.60	28.471	102.67	.09054	105.68	.09320	2.5605	2.423	2.850	0.
4.80	27.745	109.62	.09667	112.81	.09948	2.7086	2.401	2.826	0.

LEAD

PRCTCN ENERGY MEV	ENERGY LOSS MEV/CH	PROTON RANGE GH/CM2	PROTON RANGE CM	PROTON PATH LENGTH GH/CM2	PROTON PATH LENGTH CM	PATH LENGTH STRAGGLING GH/CM2	PATH LENGTH STRAGGLING CM	MULTIPLYING SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	27.062	306.88	.11673	.01029	.12010	.01059	.00286	.00025	2.381
5.50	25.518	289.37	.13531	.01193	.13914	.01227	.00325	.00029	2.333
6.00	24.162	274.00	.15498	.01367	.15928	.01405	.00365	.00032	2.290
6.50	22.974	260.53	.17571	.01549	.18052	.01592	.00406	.00036	2.252
7.00	21.910	248.46	.19752	.01742	.20283	.01789	.00450	.00040	2.217
7.50	20.976	237.87	.22029	.01943	.22614	.01994	.00494	.00044	2.187
8.00	20.131	228.29	.24410	.02153	.25050	.02209	.00541	.00048	2.160
8.50	19.363	219.58	.26888	.02371	.27584	.02432	.00589	.00052	2.136
9.00	18.662	211.62	.29462	.02598	.30215	.02664	.00639	.00056	2.115
9.50	18.016	204.32	.32122	.02833	.32940	.02905	.00690	.00061	2.095
10.00	17.424	197.59	.34990	.03077	.35764	.03154	.00743	.00065	2.076
11.00	16.360	185.53	.40692	.03588	.41691	.03676	.00852	.00075	2.043
12.00	15.526	176.07	.46838	.04130	.47969	.04230	.00965	.00085	2.012
13.00	14.716	166.80	.53325	.04702	.54594	.04814	.01083	.00095	1.983
14.00	13.998	158.74	.60150	.05304	.61560	.05429	.01205	.00107	1.958
15.00	13.361	151.52	.67312	.05936	.68870	.06073	.01332	.00117	1.934
16.00	12.788	145.02	.74839	.06597	.76519	.06748	.01463	.00129	1.912
17.00	12.270	139.14	.82659	.07289	.84527	.07454	.01599	.00141	1.892
18.00	11.797	133.78	.90803	.08007	.92834	.08186	.01739	.00153	1.873
19.00	11.367	128.90	.99260	.08753	1.0146	.08947	.01883	.00166	1.856
20.00	10.971	124.42	1.0806	.09529	1.1043	.09738	.02031	.00179	1.839
22.00	10.270	116.46	1.2654	.11158	1.2927	.11399	.02338	.00206	1.809
24.00	9.6660	109.61	1.4626	.12897	1.4937	.13172	.02661	.00235	1.782
26.00	9.1401	103.62	1.6713	.14738	1.7064	.15048	.02999	.00264	1.757
28.00	8.6772	98.399	1.8922	.16686	1.9314	.17031	.03351	.00295	1.735
30.00	8.2656	93.732	2.1240	.18730	2.1675	.19114	.03717	.00328	1.715
32.00	7.8957	89.537	2.3671	.20874	2.4151	.21298	.04096	.00361	1.696
34.00	7.5678	85.819	2.6213	.23115	2.6739	.23579	.04489	.00396	1.679
36.00	7.2705	82.447	2.8862	.25452	2.9437	.25958	.04894	.00432	1.663
38.00	7.0162	79.564	3.1611	.27876	3.2235	.28426	.05310	.00468	1.647
40.00	6.7662	76.728	3.4470	.30396	3.5145	.30992	.05737	.00506	1.632
45.00	6.2246	70.587	4.2040	.37072	4.2851	.37787	.06857	.00605	1.600
50.00	5.7780	65.523	5.0243	.44306	5.1198	.45148	.08055	.00710	1.573
55.00	5.4023	61.262	5.9046	.52068	6.0154	.53046	.09327	.00822	1.550
60.00	5.0810	57.618	6.8432	.60346	6.9703	.61466	.10668	.00941	1.530
65.00	4.8027	54.463	7.8389	.69126	7.9831	.70398	.12076	.01065	1.513
70.00	4.5593	51.703	8.8903	.78398	9.0524	.79827	.13547	.01195	1.497
75.00	4.3447	49.269	9.9952	.88141	10.176	.89736	.15080	.01330	1.482
80.00	4.1538	47.105	11.153	.98347	11.353	1.0011	.16671	.01470	1.468
90.00	3.8288	43.419	13.617	1.2008	13.859	1.2221	.20023	.01766	1.445

LEAD

PROTON ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE CM	PROTON PATH LENGTH GM/CM2	GM/CM2	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION%
190.00	3.5622	16.282	16.568	1.4610	.02090	1.424	.08011
110.00	3.3395	19.137	19.470	1.7169	.02412	1.405	.09344
120.00	3.1514	22.166	22.549	1.9885	.02760	1.388	.10727
130.00	2.9895	25.374	25.808	2.2759	.03124	1.373	.12151
140.00	2.8488	28.745	29.236	2.5781	.03502	1.358	.13611
150.00	2.7254	32.275	32.825	2.8946	.03893	1.345	.15099
160.00	2.6162	35.962	36.571	3.2249	.04298	1.333	.16616
170.00	2.5189	39.796	40.467	3.5685	.04715	1.321	.18163
180.00	2.4317	43.773	44.508	3.9248	.05144	1.311	.19734
190.00	2.3530	47.882	48.684	4.2931	.05584	1.301	.21325
200.00	2.2818	52.130	53.000	4.6737	.06035	1.291	.22931
210.00	2.2170	56.505	57.446	5.0657	.06495	1.282	.24544
220.00	2.1577	61.005	62.018	5.4689	.06966	1.274	.26155
230.00	2.1035	65.617	66.704	5.8822	.07444	1.265	.27758
240.00	2.0533	70.353	71.516	6.3065	.07931	1.258	.29352
250.00	2.0069	75.200	76.441	6.7438	.08426	1.250	.30935
260.00	1.9660	80.141	81.461	7.1835	.08930	1.243	.32512
270.00	1.9262	85.202	86.603	7.6369	.09441	1.236	.34087
280.00	1.8892	90.335	91.848	8.0995	.09959	1.230	.35658
290.00	1.8546	95.626	97.194	8.5709	.10485	1.223	.37224
300.00	1.8223	100.98	102.64	9.0507	.11017	1.217	.38781
310.00	1.7921	106.43	108.17	9.5390	.11556	1.211	.40329
320.00	1.7637	111.95	113.78	10.033	.12101	1.206	.41869
330.00	1.7360	117.57	119.49	10.537	.12652	1.201	.43397
340.00	1.7109	123.29	125.30	11.050	.13209	1.195	.44914
350.00	1.6872	129.09	131.19	11.569	.13772	1.190	.46416
360.00	1.6649	134.95	137.15	12.094	.14340	1.186	.47899
370.00	1.6438	140.90	143.19	12.627	.14913	1.181	.49356
380.00	1.6237	146.93	149.31	13.167	.15490	1.176	.50787
390.00	1.6048	153.02	155.50	13.713	.16073	1.172	.52191
400.00	1.5868	159.26	161.84	14.272	.16659	1.167	.53569
410.00	1.5697	165.50	168.18	14.830	.17250	1.163	.54921
420.00	1.5535	171.80	174.58	15.395	.17845	1.159	.56249
430.00	1.5380	178.17	181.05	15.966	.18443	1.155	.57554
440.00	1.5233	184.60	187.58	16.542	.19046	1.151	.58835
450.00	1.5092	191.10	194.16	17.123	.19652	1.148	.60031
460.00	1.4958	197.65	200.84	17.710	.20261	1.144	.61221
470.00	1.4830	204.26	207.55	18.303	.20874	1.141	.62326
480.00	1.4708	210.87	214.26	18.895	.21490	1.137	.63405
490.00	1.4591	217.59	221.09	19.496	.22109	1.134	.64458

LEAD

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	PATH LENGTH STRAGGLING GM/CM2	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	1.4479	16.419	224.36	19.785	2.5772	.22731	1.131	.65986
510.00	1.4371	16.297	231.16	20.384	2.6484	.23356	1.128	.67087
520.00	1.4269	16.181	238.03	20.990	2.7198	.23984	1.125	.68162
530.00	1.4170	16.069	244.95	21.601	2.7913	.24615	1.122	.69210
540.00	1.4075	15.961	251.92	22.215	2.8631	.25248	1.119	.70233
550.00	1.3984	15.858	258.93	22.834	2.9351	.25883	1.116	.71230
560.00	1.3897	15.759	265.99	23.456	3.0075	.26521	1.113	.72202
570.00	1.3813	15.664	273.10	24.083	3.0800	.27161	1.110	.73148
580.00	1.3732	15.572	280.24	24.713	3.1529	.27803	1.107	.74068
590.00	1.3655	15.484	287.43	25.347	3.2260	.28448	1.105	.74964
600.00	1.3580	15.399	294.70	25.987	3.2993	.29094	1.102	.75835
620.00	1.3438	15.239	309.32	27.277	3.4466	.30394	1.097	.77504
640.00	1.3307	15.090	324.18	28.587	3.5948	.31700	1.091	.79078
660.00	1.3185	14.952	339.06	29.899	3.7438	.33014	1.087	.80560
680.00	1.3071	14.823	354.07	31.223	3.8935	.34334	1.082	.81954
700.00	1.2965	14.702	369.20	32.558	4.0439	.35660	1.078	.83262
720.00	1.2866	14.590	384.43	33.903	4.1950	.36993	1.074	.84489
740.00	1.2773	14.485	399.83	35.253	4.3466	.38330	1.070	.85638
760.00	1.2686	14.386	415.31	36.624	4.4989	.39673	1.066	.86713
780.00	1.2605	14.294	430.90	37.998	4.6517	.41020	1.063	.87716
800.00	1.2529	14.207	446.58	39.381	4.8050	.42372	1.059	.88653
820.00	1.2457	14.126	462.36	40.773	4.9589	.43729	1.056	.89525
840.00	1.2389	14.050	478.23	42.172	5.1131	.45089	1.053	.90338
860.00	1.2326	13.978	494.18	43.579	5.2679	.46454	1.049	.91094
880.00	1.2266	13.910	510.22	44.993	5.4230	.47822	1.046	.91796
900.00	1.2210	13.846	526.35	46.415	5.5786	.49194	1.043	.92447
920.00	1.2157	13.786	542.54	47.843	5.7345	.50569	1.041	.93052
940.00	1.2107	13.730	558.82	49.279	5.8908	.51947	1.038	.93612
960.00	1.2060	13.676	575.17	50.721	6.0474	.53328	1.035	.94130
1000.00	1.1974	13.579	608.28	53.640	6.3616	.56099	1.030	.95048

THE ELECTRON DENSITY OF LEAD IS 2.384E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 1.916 MEV, AND THE MINIMUM ENERGY LOSS IS 1.1338 MEV/GM/CM2

LITHIUM

ATOMIC NUMBER 3
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 6.9390
 ADJUSTED IONIZATION POTENTIAL 38.80

DENSITY = .53000 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS GM/CM2	ENERGY LOSS HEV/CH	PROTON RANGE MG/CM2	PROTON RANGE MM	PROTON PATH LENGTH MG/CM2	PROTON PATH LENGTH MM	MG/CM2	PATH LENGTH STRAGGLING MM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	751.84	398.48	.13672	.00256	.13730	.00259	.00385	.00007	2.806	.4211	0.
.15	675.80	358.17	.20679	.00300	.20741	.00391	.00557	.00011	2.688	.3009	0.
.20	606.44	321.41	.28476	.00537	.28548	.00539	.00725	.00014	2.540	.2516	0.
.30	495.71	262.73	.46737	.00882	.46834	.00884	.01087	.00021	2.320	.2067	0.
.40	418.70	221.91	.68718	.01297	.68846	.01299	.01501	.00028	2.180	.1845	0.
.50	363.27	192.53	.94386	.01780	.94527	.01784	.01970	.00037	2.084	.1707	0.
.60	320.54	169.89	1.23367	.02333	1.2387	.02337	.02494	.00047	2.013	.1615	0.
.70	288.06	152.67	1.5552	.02953	1.5676	.02958	.03070	.00058	1.958	.1530	0.
.80	261.99	138.85	1.9288	.03639	1.9317	.03645	.03696	.00070	1.914	.1482	0.
.90	253.44	134.33	2.3159	.04370	2.3192	.04376	.04325	.00082	1.865	.1435	0.
1.00	244.87	129.78	2.7173	.05127	2.7211	.05134	.04918	.00093	1.808	.1397	0.
1.20	214.46	113.66	3.5909	.06775	3.5937	.06784	.06179	.00117	1.718	.1332	.00001
1.40	191.27	101.37	4.5792	.08640	4.5851	.08651	.07613	.00144	1.660	.1278	.00001
1.60	172.96	91.669	5.6794	.10716	5.6844	.10729	.09207	.00174	1.619	.1234	.00002
1.80	158.11	83.798	6.8889	.12998	6.8971	.13013	.10952	.00207	1.588	.1197	.00004
2.00	145.80	77.273	8.2062	.15483	8.2158	.15501	.12839	.00242	1.563	.1165	.00007
2.20	135.41	71.769	9.6291	.18168	9.6400	.18189	.14862	.00280	1.542	.1138	.00010
2.40	126.53	67.059	11.156	.21050	11.169	.21073	.17019	.00321	1.524	.1115	.00014
2.60	118.83	62.577	12.787	.24126	12.801	.24153	.19305	.00364	1.508	.1095	.00020
2.80	112.08	59.404	14.519	.27395	14.535	.27424	.21717	.00410	1.494	.1077	.00025
3.00	106.13	56.247	16.352	.30853	16.369	.30885	.24253	.00458	1.482	.1060	.00031
3.20	100.82	53.436	18.284	.34499	18.304	.34535	.26910	.00508	1.470	.1046	.00038
3.40	96.066	50.915	20.316	.38331	20.337	.38371	.29686	.00560	1.460	.1033	.00046
3.60	91.775	48.641	22.444	.42348	22.467	.42391	.32581	.00615	1.450	.1022	.00071
3.80	87.883	46.578	24.670	.46547	24.695	.46594	.35591	.00672	1.441	.1011	.00277
4.00	84.335	44.698	26.991	.50927	27.018	.50978	.38716	.00730	1.433	.1001	.00481
4.20	81.086	42.976	29.409	.55488	29.438	.55543	.41954	.00792	1.425	.0992	.00684
4.40	78.099	41.392	31.920	.60226	31.951	.60285	.45305	.00855	1.418	.0984	.00886
4.60	75.342	39.932	34.525	.65142	34.559	.65206	.48766	.00920	1.411	.0976	.01088
4.80	72.790	38.579	37.224	.70234	37.260	.70302	.52336	.00987	1.405	.0969	.01288

LITHIUM

PROCTON ENERGY HEV	ENERGY LOSS		PROTON RANGE		PROCTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	GM/CM2	MEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	PERCENT		
5.00	70.420	37.323	.04002	.07550	.04005	.07557	.00056	1.398	.0962	.01488
5.50	65.170	34.540	.04740	.08943	.04744	.08951	.00066	1.385	.0948	.01985
6.00	60.706	32.174	.05534	.10442	.05540	.10452	.00076	1.272	.0935	.02478
6.50	56.960	30.136	.06385	.12048	.06391	.12059	.00087	1.361	.0924	.02968
7.00	53.510	28.360	.07291	.13757	.07298	.13770	.00099	1.351	.0914	.03456
7.50	50.564	26.799	.08252	.15570	.08260	.15584	.00111	1.342	.0905	.03940
8.00	47.950	25.414	.09267	.17485	.09276	.17501	.00124	1.335	.0898	.04422
8.50	45.615	24.176	.10336	.19502	.10345	.19519	.00137	1.325	.0890	.04903
9.00	43.516	23.063	.11458	.21618	.11468	.21637	.00151	1.316	.0884	.05381
9.50	41.617	22.057	.12632	.23834	.12643	.23855	.00166	1.311	.0878	.05857
10.00	39.890	21.142	.13858	.26148	.13870	.26171	.00181	1.305	.0873	.06331
11.00	36.866	19.539	.16466	.31068	.16480	.31095	.00213	1.294	.0863	.07275
12.00	34.504	18.181	.19278	.36373	.19294	.36403	.00248	1.284	.0855	.08213
13.00	32.102	17.014	.22291	.42058	.22310	.42094	.00284	1.274	.0848	.09145
14.00	30.189	16.000	.25502	.48118	.25520	.48158	.00323	1.266	.0841	.10072
15.00	28.509	15.110	.28910	.54547	.28934	.54592	.00364	1.258	.0836	.10993
16.00	27.023	14.322	.32511	.61342	.32536	.61393	.00407	1.251	.0830	.11908
17.00	25.697	13.619	.36305	.68499	.36335	.68556	.00452	1.245	.0826	.12819
18.00	24.507	12.988	.40288	.76014	.40321	.76077	.00499	1.239	.0821	.13724
19.00	23.432	12.419	.44459	.83884	.44495	.83953	.00549	1.233	.0817	.14624
20.00	22.456	11.902	.48816	.92105	.48856	.92180	.00600	1.228	.0814	.15519
22.00	20.750	10.998	.58082	1.0959	.58129	1.0968	.00708	1.218	.0807	.17294
24.00	19.308	10.233	.68074	1.2844	.68129	1.2854	.00824	1.209	.0801	.19047
26.00	18.071	9.5778	.78780	1.4864	.78842	1.4876	.00947	1.201	.0796	.20056
28.00	16.999	9.0093	.90188	1.7017	.90260	1.7030	.01078	1.194	.0792	.20315
30.00	16.059	8.5112	1.0229	1.9300	1.0237	1.9315	.01216	1.167	.0787	.20582
32.00	15.228	8.0710	1.1507	2.1712	1.1516	2.1729	.01360	1.181	.0784	.20856
34.00	14.489	7.6790	1.2853	2.4252	1.2863	2.4271	.01512	1.175	.0780	.21137
36.00	13.826	7.3276	1.4266	2.6917	1.4277	2.6938	.01670	1.170	.0777	.21424
38.00	13.228	7.0106	1.5744	2.9706	1.5756	2.9729	.01836	1.165	.0774	.21716
40.00	12.685	6.7232	1.7287	3.2618	1.7301	3.2643	.02007	1.160	.0771	.22011
45.00	11.527	6.1093	2.1425	4.0424	2.1441	4.0455	.02464	1.149	.0765	.22762
50.00	10.566	5.6106	2.5953	4.8968	2.5973	4.9005	.02960	1.140	.0760	.23519
55.00	9.8059	5.1971	3.0861	5.8228	3.0884	5.8272	.03493	1.131	.0756	.24235
60.00	9.1480	4.8485	3.6140	6.8189	3.6167	6.8240	.04061	1.123	.0752	.25104
65.00	8.5855	4.5503	4.1782	7.8833	4.1813	7.8892	.04665	1.116	.0748	.25942
70.00	8.0987	4.2923	4.7777	9.0145	4.7812	9.0212	.05302	1.109	.0745	.26804
75.00	7.6732	4.0668	5.4118	10.211	5.4158	10.218	.05972	1.103	.0742	.27686
80.00	7.2979	3.8679	6.0797	11.471	6.0842	11.480	.06673	1.097	.0740	.28584
90.00	6.6660	3.5330	7.5144	14.178	7.5199	14.188	.09166	1.086	.0735	.30413

LITHIUM

PROTON ENERGY MEV	ENERGY LOSS MEV/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PATH LENGTH STRAGGLING GM/CM2	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	6.1541	9.0762	9.0828	.09775	.0731	.32263
110.00	5.7310	10.760	10.769	.11493	.0728	.34158
120.00	5.3751	12.562	12.571	.13315	.0725	.36127
130.00	5.0715	14.477	14.488	.15235	.0722	.38157
140.00	4.8095	16.502	16.513	.17249	.0719	.40234
150.00	4.5811	18.631	18.645	.19351	.0717	.42344
160.00	4.3801	20.863	20.878	.21538	.0715	.44460
170.00	4.2020	23.193	23.210	.23806	.0713	.46553
180.00	4.0429	25.618	25.637	.26151	.0711	.48616
190.00	3.9001	28.136	28.156	.28559	.0710	.50640
200.00	3.7711	30.742	30.764	.31058	.0708	.52620
210.00	3.6541	33.435	33.458	.33615	.0706	.54512
220.00	3.5475	36.211	36.236	.36235	.0705	.56280
230.00	3.4500	39.068	39.095	.38918	.0704	.57923
240.00	3.3604	42.003	42.032	.41660	.0702	.59445
250.00	3.2778	45.014	45.046	.44458	.0701	.60847
260.00	3.2015	48.100	48.133	.47311	.0700	.62171
270.00	3.1308	51.256	51.292	.50216	.0699	.63455
280.00	3.0651	54.483	54.521	.53172	.0697	.64699
290.00	3.0040	57.776	57.817	.56176	.0696	.65902
300.00	2.9468	61.135	61.178	.59226	.0695	.67064
310.00	2.8934	64.558	64.603	.62321	.0694	.68232
320.00	2.8433	68.043	68.090	.65459	.0693	.69449
330.00	2.7962	71.587	71.637	.68638	.0692	.70707
340.00	2.7519	75.190	75.242	.71858	.0691	.72000
350.00	2.7102	78.849	78.904	.75115	.0690	.73319
360.00	2.6708	82.564	82.621	.78410	.0689	.74640
370.00	2.6336	86.332	86.391	.81741	.0688	.75942
380.00	2.5984	90.152	90.214	.85106	.0688	.77222
390.00	2.5650	94.023	94.088	.88504	.0687	.78470
400.00	2.5334	97.944	98.011	.91934	.0686	.79701
410.00	2.5033	101.91	101.98	.95396	.0685	.80880
420.00	2.4747	105.93	106.00	.98888	.0684	.82001
430.00	2.4475	109.99	110.06	1.0241	.0683	.83065
440.00	2.4216	114.09	114.17	1.0596	.0682	.84074
450.00	2.3968	118.24	118.32	1.0953	.0681	.85030
460.00	2.3732	122.43	122.52	1.1313	.0681	.85936
470.00	2.3507	126.66	126.75	1.1676	.0680	.86792
480.00	2.3291	130.93	131.02	1.2041	.0679	.87602
490.00	2.3084	135.24	135.34	1.2409	.0678	.88367

LITHIUM

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM	PROTON RANGE GM/CM2	PROTON PATH LENGTH CM	PROTON PATH LENGTH GM/CH2	PATH LENGTH STRAGGLING CM	PATH LENGTH STRAGGLING PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	2.2867	139.59	263.38	139.69	2.4111	.9148	.0677	.89089
510.00	2.2697	143.98	271.65	144.07	2.4814	.9128	.0677	.89770
520.00	2.2516	148.40	280.18	148.50	2.5520	.9108	.0676	.90411
530.00	2.2331	152.85	288.40	152.96	2.6231	.9089	.0675	.91016
540.00	2.2162	157.34	296.87	157.45	2.6946	.9070	.0674	.91586
550.00	2.2000	161.88	305.64	161.99	2.7665	.9052	.0673	.92122
560.00	2.1844	166.44	314.03	166.55	2.8388	.9034	.0673	.92626
570.00	2.1694	171.03	322.69	171.14	2.9114	.9016	.0672	.93099
580.00	2.1550	175.65	331.41	175.77	2.9844	.8999	.0671	.93544
590.00	2.1411	180.30	340.19	180.42	3.0578	.8983	.0670	.93962
600.00	2.1277	184.98	349.02	185.10	3.1315	.8966	.0670	.94354
620.00	2.1022	194.43	366.84	194.56	3.2798	.8935	.0668	.95068
640.00	2.0785	203.99	394.88	204.12	3.4294	.8904	.0667	.95694
660.00	2.0564	213.65	403.11	213.79	3.5802	.8875	.0665	.96244
680.00	2.0357	223.41	421.54	223.56	3.7321	.8848	.0664	.96726
700.00	2.0163	233.31	440.20	233.46	3.8851	.8820	.0662	.97148
720.00	1.9982	243.27	458.99	243.43	4.0391	.8794	.0661	.97516
740.00	1.9811	253.31	477.95	253.48	4.1941	.8769	.0659	.97838
760.00	1.9651	263.44	497.06	263.62	4.3501	.8746	.0658	.98119
780.00	1.9499	273.66	516.33	273.83	4.5069	.8723	.0657	.98364
800.00	1.9357	283.94	535.74	284.13	4.6647	.8701	.0655	.98578
820.00	1.9223	294.31	555.30	294.50	4.8233	.8680	.0654	.98763
840.00	1.9096	304.74	574.98	304.94	4.9827	.8660	.0652	.98925
860.00	1.8976	315.24	594.80	315.45	5.1429	.8641	.0651	.99066
880.00	1.8862	325.81	614.74	326.02	5.3038	.8622	.0649	.99188
900.00	1.8754	336.44	634.80	336.66	5.4654	.8604	.0648	.99294
920.00	1.8653	347.14	654.98	347.36	5.6278	.8587	.0647	.99387
940.00	1.8556	357.89	675.27	358.12	5.7908	.8570	.0645	.99467
960.00	1.8464	368.71	695.68	368.95	5.9545	.8554	.0643	.99537
1000.00	1.8294	390.59	736.96	390.84	6.2838	.8521	.0639	.99650

THE ELECTRON DENSITY OF LITHIUM IS 2.605E 23 ELECTRONS PER GRAM
 THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.398 BEV, AND THE MINIMUM ENERGY LOSS IS 1.6594 MEV/GM/CH2

MAGNESIUM

ADJUSTED
IONIZATION
POTENTIAL
156.5

ATOMIC
WEIGHT
24.312

ATOMS/
MOLECULE
1

ATOMIC
NUMBER
12

ELEMENT
MG

DENSITY = 1.7400 GM/CM3

PROCTON ENERGY MEV	ENERGY LOSS MEV/ GM/CM2	PROTON RANGE MG/CM2	PROTON PATH LENGTH HM	PROTON PATH LENGTH MG/CM2	PROTON PATH LENGTH HM	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL	PATH LENGTH STRAGGLING HM	MG/CM2	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	423.98	.25314	.00145	.25630	.00147			.00968	.00006	3.777	1.231	0.
.15	393.92	.37512	.00216	.37862	.00218			.01357	.00008	3.584	.9233	0.
.20	368.88	.50559	.00291	.50977	.00293			.01701	.00010	3.337	.8193	0.
.30	325.28	.79237	.00455	.79825	.00459			.02352	.00014	2.946	.7357	0.
.40	290.58	1.1161	.00641	1.1239	.00646			.03019	.00017	2.586	.6911	0.
.50	262.67	1.4763	.00848	1.4861	.00854			.03722	.00021	2.504	.6580	0.
.60	238.71	1.8737	.01077	1.8856	.01084			.04476	.00026	2.374	.6307	0.
.70	218.98	2.3088	.01327	2.3229	.01335			.05308	.00031	2.285	.6075	0.
.80	202.66	2.7812	.01598	2.7976	.01608			.06227	.00036	2.226	.5874	0.
.90	192.61	3.2845	.01888	3.3033	.01898			.07194	.00041	2.178	.5700	0.
1.00	182.55	3.8156	.02193	3.8369	.02205			.08186	.00047	2.133	.5545	0.
1.20	162.44	4.9752	.02859	5.0016	.02875			.10342	.00059	2.068	.5201	0.
1.40	146.75	6.2675	.03602	6.2994	.03620			.12717	.00073	2.019	.5060	0.
1.60	134.14	7.6883	.04419	7.7260	.04440			.15300	.00088	1.980	.4879	0.
1.80	123.79	9.2410	.05311	9.2849	.05336			.18073	.00104	1.947	.4724	.00001
2.00	115.03	10.907	.06268	10.957	.06297			.21029	.00121	1.919	.4592	.00001
2.20	107.60	12.700	.07299	12.757	.07331			.24157	.00139	1.894	.4477	.00002
2.40	101.20	14.612	.08398	14.676	.08435			.27450	.00158	1.870	.4377	.00003
2.60	95.624	16.640	.09563	16.712	.09604			.30900	.00178	1.849	.4289	.00003
2.80	90.702	18.780	.10793	18.859	.10839			.34503	.00198	1.829	.4210	.00005
3.00	86.321	21.032	.12087	21.119	.12137			.38255	.00220	1.811	.4140	.00006
3.20	82.392	23.395	.13445	23.490	.13500			.42153	.00242	1.794	.4077	.00007
3.40	78.847	25.867	.14866	25.971	.14926			.46194	.00265	1.779	.4020	.00008
3.60	75.631	28.449	.16350	28.562	.16415			.50376	.00290	1.764	.3966	.00010
3.80	72.699	31.141	.17897	31.264	.17968			.54697	.00314	1.750	.3919	.00012
4.00	70.013	33.933	.19502	34.065	.19577			.59153	.00340	1.737	.3874	.00014
4.20	67.543	36.833	.21169	36.975	.21250			.63743	.00366	1.724	.3833	.00016
4.40	65.263	39.837	.22895	39.989	.22982			.68466	.00393	1.712	.3795	.00018
4.60	63.150	42.939	.24678	43.101	.24771			.73318	.00421	1.701	.3759	.00020
4.80	61.350	46.145	.26520	46.317	.26619			.78261	.00450	1.690	.3726	.00023

MAGNESIUM

PROTON ENERGY MEV	ENERGY LOSS MEV/GH/CH2	PROTON RANGE GH/CH2	PROTON PATH LENGTH CM	GM/CH2	GM/CH2	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
3.00	59.508	103.54	.04962	.02852	.00083	.00048	1.680	.00026
5.50	55.407	96.402	.05834	.03353	.00097	.00055	1.655	.00033
6.00	51.895	90.297	.06743	.03889	.00111	.00064	1.634	.00042
6.50	48.848	84.996	.07733	.04444	.00125	.00072	1.615	.00052
7.00	46.177	80.347	.08783	.05065	.00141	.00081	1.598	.00064
7.50	43.813	76.234	.09892	.05685	.00157	.00090	1.582	.00077
8.00	41.704	72.546	.11058	.06377	.00174	.00100	1.568	.00180
8.50	39.811	69.271	.12261	.07082	.00192	.00110	1.555	.00327
9.00	38.100	66.293	.13608	.07821	.00210	.00121	1.543	.00504
9.50	36.545	63.588	.14948	.08591	.00229	.00132	1.532	.00690
10.00	35.125	61.118	.16343	.09393	.00249	.00143	1.521	.00875
11.00	32.625	56.767	.19300	.11092	.00290	.00167	1.502	.01247
12.00	30.490	53.053	.22401	.12915	.00334	.00192	1.485	.01620
13.00	28.645	49.842	.25776	.14861	.00380	.00218	1.470	.01995
14.00	27.032	47.035	.29362	.16927	.00429	.00247	1.456	.02370
15.00	25.609	44.559	.33154	.19113	.00480	.00276	1.444	.02748
16.00	24.343	42.357	.37149	.21415	.00534	.00307	1.433	.03126
17.00	23.198	40.365	.41472	.23834	.00590	.00339	1.422	.03507
18.00	22.179	38.592	.45891	.26368	.00648	.00373	1.413	.03889
19.00	21.255	36.984	.50488	.29016	.00709	.00407	1.404	.04272
20.00	20.414	35.520	.55291	.31777	.00772	.00444	1.396	.04657
22.00	18.935	32.948	.65279	.37627	.00904	.00520	1.381	.05430
24.00	17.676	30.760	.76410	.43914	.01045	.00600	1.367	.06210
26.00	16.595	28.876	.87939	.50628	.01194	.00686	1.355	.06698
28.00	15.652	27.234	1.0022	.57764	.01351	.00777	1.344	.06885
30.00	14.822	25.790	1.1332	.65128	.01517	.00872	1.334	.07079
32.00	14.086	24.509	1.2713	.73271	.01690	.00971	1.325	.07281
34.00	13.428	23.365	1.4164	.81403	.01871	.01075	1.317	.07489
36.00	12.837	22.337	1.5684	.90390	.02059	.01183	1.309	.07704
38.00	12.303	21.407	1.7272	.99538	.02255	.01296	1.302	.07924
40.00	11.817	20.561	1.8926	1.0907	.02458	.01412	1.295	.08149
45.00	10.775	18.749	2.3352	1.3457	.02996	.01722	1.279	.08731
50.00	9.9253	17.270	2.8179	1.6239	.03577	.02056	1.266	.09336
55.00	9.2177	16.039	3.3397	1.9246	.04199	.02413	1.254	.09966
60.00	8.6191	14.997	3.8996	2.2472	.04861	.02793	1.243	.10626
65.00	8.1056	14.104	4.4966	2.5912	.05560	.03196	1.233	.11311
70.00	7.6600	13.328	5.1299	2.9560	.06297	.03619	1.224	.12019
75.00	7.2696	12.649	5.7985	3.3413	.07069	.04063	1.216	.12746
80.00	6.9246	12.049	6.5017	3.7465	.07876	.04526	1.208	.13490
90.00	6.3420	11.035	8.1088	4.6148	.09588	.05510	1.194	.15016

MAGNESIUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CM2	MEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	CM		
100.00	5.8686	10.211	9.6455	5.5434	9.6706	5.5578	.11426	.06567	1.182	.16579
110.00	5.4762	9.5285	11.407	6.3555	11.436	6.5724	.13383	.07691	1.170	.18177
120.00	5.1453	8.9528	13.287	7.6562	13.321	7.6559	.15452	.08881	1.160	.19815
130.00	4.8625	8.4608	15.282	8.7830	15.322	8.8055	.17627	.10131	1.150	.21480
140.00	4.6186	8.0354	17.389	9.9934	17.433	10.019	.19903	.11439	1.142	.23163
150.00	4.4045	7.6638	19.601	11.265	19.651	11.294	.22275	.12802	1.134	.24853
160.00	4.2163	7.3364	21.917	12.596	21.973	12.628	.24737	.14217	1.126	.26571
170.00	4.0493	7.0459	24.332	13.984	24.393	14.019	.27286	.15682	1.119	.28271
180.00	3.9001	6.7862	26.843	15.427	26.910	15.466	.29918	.17194	1.112	.29996
190.00	3.7660	6.5528	29.446	16.923	29.520	16.966	.32628	.18752	1.105	.31725
200.00	3.6447	6.3418	32.139	18.471	32.220	18.517	.35413	.20352	1.099	.33450
210.00	3.5346	6.1503	34.919	20.069	35.007	20.119	.38269	.21994	1.093	.35175
220.00	3.4342	5.9756	37.783	21.714	37.878	21.769	.41195	.23675	1.088	.36994
230.00	3.3423	5.8156	40.728	23.407	40.830	23.465	.44185	.25394	1.082	.38820
240.00	3.2578	5.6687	43.752	25.145	43.861	25.207	.47239	.27149	1.077	.40362
250.00	3.1800	5.5332	46.851	26.926	46.988	26.993	.50352	.28938	1.072	.42032
260.00	3.1080	5.4079	50.025	28.821	50.149	28.821	.53523	.30760	1.067	.43720
270.00	3.0412	5.2917	53.270	30.815	53.402	30.691	.56748	.32614	1.063	.45391
280.00	2.9792	5.1838	56.584	32.920	56.725	32.600	.60027	.34498	1.058	.47045
290.00	2.9213	5.0831	59.966	34.463	60.115	34.549	.63355	.36412	1.054	.48679
300.00	2.8673	4.9892	63.413	36.445	63.570	36.535	.66734	.38353	1.050	.50290
310.00	2.8168	4.9012	66.924	38.462	67.039	38.557	.70159	.40321	1.046	.51878
320.00	2.7694	4.8188	70.496	40.515	70.670	40.615	.73629	.42315	1.042	.53444
330.00	2.7249	4.7413	74.128	42.602	74.310	42.707	.77141	.44334	1.038	.54986
340.00	2.6830	4.6685	77.818	44.723	78.009	44.833	.80696	.46377	1.034	.56502
350.00	2.6435	4.5998	81.564	46.876	81.764	46.991	.84290	.48442	1.031	.57991
360.00	2.6063	4.5349	85.364	49.060	85.574	49.181	.87923	.50530	1.027	.59452
370.00	2.5711	4.4737	89.218	51.275	89.437	51.401	.91592	.52639	1.024	.60887
380.00	2.5378	4.4157	93.124	53.520	93.352	53.651	.95297	.54769	1.021	.62294
390.00	2.5062	4.3607	97.080	55.793	97.318	55.930	.99037	.56918	1.018	.63671
400.00	2.4762	4.3086	101.09	58.095	101.33	58.237	1.0281	.59086	1.015	.65019
410.00	2.4477	4.2591	105.14	60.424	105.39	60.571	1.0661	.61273	1.012	.66333
420.00	2.4207	4.2120	109.24	62.779	109.50	62.933	1.1045	.63477	1.009	.67612
430.00	2.3949	4.1672	113.38	65.161	113.66	65.320	1.1431	.65698	1.006	.68855
440.00	2.3704	4.1245	117.57	67.567	117.85	67.732	1.1821	.67936	1.003	.70063
450.00	2.3470	4.0838	121.80	69.998	122.09	70.168	1.2213	.70190	1.000	.71235
460.00	2.3246	4.0449	126.07	72.453	126.37	72.629	1.2608	.72459	.9977	.72372
470.00	2.3033	4.0078	130.38	74.931	130.70	75.113	1.3005	.74743	.9951	.73473
480.00	2.2829	3.9722	134.73	77.431	135.06	77.619	1.3405	.77041	.9926	.74540
490.00	2.2634	3.9383	139.12	79.954	139.46	80.147	1.3807	.79353	.9901	.75572

MAGNESIUM

PRCTCN ENERGY HFV	ENERGY LOSS MEV/CM	PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION		
		MEV/CM	GM/CM2	GM/CM2	CM	GM/CM2	CM				
500.00	2.2447	3.9050	143.55	82.497	1.43.89	82.697	1.4212	.81679	.9877	.2418	.76571
510.00	2.2268	3.3743	148.01	85.062	148.37	85.268	1.4619	.84018	.9853	.2415	.77536
520.00	2.2096	3.0447	152.51	87.647	152.87	87.859	1.5028	.86369	.9830	.2413	.78488
530.00	2.1931	3.8160	157.04	90.252	157.42	90.470	1.5439	.88732	.9808	.2411	.79368
540.00	2.1773	3.7885	161.60	92.876	161.99	93.100	1.5853	.91107	.9786	.2409	.80237
550.00	2.1621	3.7621	166.20	95.518	166.60	95.749	1.6268	.93494	.9765	.2407	.81074
560.00	2.1475	3.7367	170.83	98.179	171.24	98.416	1.6685	.95892	.9744	.2405	.81881
570.00	2.1335	3.7122	175.49	100.86	175.92	101.10	1.7104	.98300	.9723	.2403	.82659
580.00	2.1199	3.6887	180.18	103.55	180.62	103.80	1.7525	1.0072	.9703	.2400	.83408
590.00	2.1069	3.6661	184.90	106.27	185.35	106.52	1.7948	1.0315	.9683	.2398	.84128
600.00	2.0944	3.6443	189.65	109.00	190.11	109.26	1.8372	1.0559	.9664	.2396	.84822
620.00	2.0707	3.6030	199.24	114.50	199.71	114.78	1.9226	1.1049	.9627	.2392	.86129
640.00	2.0486	3.5646	208.93	120.07	209.43	120.36	2.0086	1.1543	.9591	.2388	.87336
660.00	2.0281	3.5288	218.72	125.70	219.24	126.00	2.0951	1.2041	.9556	.2384	.88448
680.00	2.0089	3.4955	228.60	131.38	229.15	131.69	2.1823	1.2542	.9523	.2379	.89472
700.00	1.9910	3.4643	238.58	137.12	239.15	137.44	2.2699	1.3046	.9492	.2375	.90412
720.00	1.9742	3.4351	248.65	142.90	249.24	143.24	2.3581	1.3552	.9463	.2371	.91276
740.00	1.9585	3.4077	258.79	148.73	259.41	149.09	2.4467	1.4062	.9432	.2367	.92067
760.00	1.9437	3.3821	269.02	154.61	269.66	154.98	2.5358	1.4574	.9404	.2363	.92792
780.00	1.9299	3.3580	279.33	160.53	279.99	160.91	2.6253	1.5088	.9377	.2358	.93454
800.00	1.9169	3.3353	289.70	166.50	290.39	166.89	2.7153	1.5605	.9351	.2354	.94060
820.00	1.9046	3.3140	300.15	172.50	300.86	172.91	2.8056	1.6124	.9325	.2350	.94612
840.00	1.8931	3.2940	310.66	178.54	311.39	178.96	2.8963	1.6645	.9301	.2346	.95116
860.00	1.8822	3.2750	321.23	184.62	321.99	185.05	2.9873	1.7168	.9278	.2342	.95576
880.00	1.8720	3.2572	331.87	190.73	332.65	191.18	3.0787	1.7694	.9255	.2338	.95994
900.00	1.8623	3.2404	342.56	196.87	343.36	197.33	3.1704	1.8221	.9233	.2333	.96374
920.00	1.8531	3.2244	353.31	203.05	354.14	203.55	3.2624	1.8749	.9212	.2329	.96719
940.00	1.8445	3.2094	364.12	209.26	364.97	209.75	3.3547	1.9280	.9192	.2324	.97033
960.00	1.8363	3.1951	374.98	215.51	375.86	216.01	3.4473	1.9812	.9172	.2319	.97319
1000.00	1.8211	3.1688	396.96	228.14	397.88	228.67	3.6333	2.0881	.9132	.2306	.97813

THE ELECTRON DENSITY OF MAGNESIUM IS 2.974E 23 ELECTRONS PER GRAM
 THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.188 BEV, AND THE MINIMUM ENERGY LOSS IS 1.6887 MEV/GM/CM2

MANGANESE

ELEMENT NUMBER 25
 ATOMIC NUMBER 25
 ATOMS/MOLECULE 1.
 ATOMIC WEIGHT 54.938
 ADJUSTED IONIZATION POTENTIAL 253.0

DENSITY = 7.4300 GM/CM³

PRCTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE MG/CM2	PROTON PATH LENGTH MM	PROTON PATH LENGTH MG/CM2	ATOMS/MOLECULE	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL	PATH LENGTH STRAGGLING MM	MG/CM2	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	337.51	2507.7	.00061	.46253	1.	54.938	253.0	.01984	.00003	4.290	2.172	0.
.15	313.72	2330.9	.00081	.60542	1.	54.938	253.0	.02339	.00003	3.796	1.743	0.
.20	294.83	2190.6	.00103	.76837	1.	54.938	253.0	.02698	.00004	3.457	1.559	0.
.30	257.72	1914.9	.00152	1.1270	1.	54.938	253.0	.03452	.00005	3.021	1.386	0.
.40	221.75	1647.6	.00207	1.5614	1.	54.938	253.0	.04383	.00006	2.807	1.291	0.
.50	194.78	1447.2	.00272	2.0438	1.	54.938	253.0	.05574	.00008	2.727	1.226	0.
.60	176.73	1313.1	.00344	2.5836	1.	54.938	253.0	.06924	.00009	2.680	1.177	0.
.70	160.11	1189.6	.00423	3.1775	1.	54.938	253.0	.08395	.00011	2.642	1.138	0.
.80	151.71	1127.2	.00509	3.8264	1.	54.938	253.0	.09976	.00013	2.607	1.106	0.
.90	143.39	1065.4	.00600	4.5033	1.	54.938	253.0	.11512	.00015	2.556	1.050	0.
1.00	135.06	1003.5	.00695	5.2227	1.	54.938	253.0	.13093	.00018	2.507	1.056	0.
1.20	120.91	898.37	.00905	6.7900	1.	54.938	253.0	.16469	.00022	2.426	1.015	0.
1.40	109.92	816.70	.01136	8.437	1.	54.938	253.0	.20105	.00027	2.358	.9808	0.
1.60	101.08	751.04	.01390	10.427	1.	54.938	253.0	.23975	.00032	2.299	.9519	0.
1.80	93.828	697.14	.01664	12.482	1.	54.938	253.0	.28059	.00038	2.246	.9274	0.
2.00	87.770	652.13	.01959	14.688	1.	54.938	253.0	.32340	.00044	2.202	.9059	0.
2.20	82.609	613.78	.02273	17.038	1.	54.938	253.0	.36804	.00050	2.160	.8871	0.
2.40	78.096	580.25	.02606	19.529	1.	54.938	253.0	.41445	.00056	2.122	.8704	0.
2.60	74.128	550.77	.02957	22.158	1.	54.938	253.0	.46262	.00062	2.088	.8554	0.
2.80	70.603	524.58	.03326	24.925	1.	54.938	253.0	.51250	.00069	2.056	.8417	0.
3.00	67.444	501.11	.03714	27.824	1.	54.938	253.0	.56409	.00076	2.027	.8294	0.
3.20	64.591	479.91	.04119	30.855	1.	54.938	253.0	.61757	.00083	2.002	.8179	0.
3.40	62.000	460.66	.04541	34.016	1.	54.938	253.0	.67321	.00091	1.979	.8076	.00001
3.60	59.634	443.08	.04981	37.305	1.	54.938	253.0	.73090	.00098	1.959	.7978	.00001
3.80	57.463	426.95	.05438	40.723	1.	54.938	253.0	.79056	.00106	1.941	.7889	.00001
4.00	55.464	412.10	.05911	44.266	1.	54.938	253.0	.85213	.00115	1.925	.7805	.00001
4.20	53.613	398.34	.06402	47.936	1.	54.938	253.0	.91556	.00123	1.910	.7728	.00002
4.40	51.901	385.63	.06909	51.727	1.	54.938	253.0	.98079	.00132	1.896	.7655	.00002
4.60	50.310	373.81	.07432	55.642	1.	54.938	253.0	1.0478	.00141	1.883	.7586	.00003
4.80	48.828	362.79	.07971	59.677	1.	54.938	253.0	1.1164	.00150	1.871	.7522	.00003

MANGANESE

PRCTON ENERGY MEV	ENERGY LOSS MEV/CH2	MEV/CH	PROTON RANGE GM/CH2	CH	PROTON PATH LENGTH GM/CH2	CH	PROTON PATH LENGTH GM/CH2	CH	PATH LENGTH STRAGGLING GM/CH2	CH	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	47.443	352.50	.06336	.00853	.06383	.00859	.00119	.00016	1.859	.746C	.00004		
5.50	44.345	329.49	.07419	.00999	.07474	.01006	.00137	.00018	1.833	.7222	.00006		
6.00	41.673	309.63	.08576	.01154	.08638	.01163	.00156	.00021	1.809	.7201	.00009		
6.50	39.331	292.23	.09803	.01319	.09873	.01329	.00176	.00024	1.787	.7093	.00012		
7.00	37.262	276.86	.11102	.01494	.11180	.01505	.00198	.00027	1.768	.6996	.00016		
7.50	35.454	263.42	.12470	.01678	.12557	.01690	.00220	.00030	1.749	.6909	.00021		
8.00	33.801	251.14	.13906	.01872	.14001	.01884	.00243	.00033	1.733	.6829	.00027		
8.50	32.344	240.31	.15410	.02074	.15515	.02088	.00266	.00036	1.717	.6757	.00033		
9.00	31.020	230.48	.16979	.02285	.17094	.02301	.00291	.00039	1.702	.6690	.00040		
9.50	29.812	221.50	.18614	.02505	.18738	.02522	.00316	.00043	1.689	.6630	.00048		
10.00	28.706	213.28	.20313	.02734	.20447	.02752	.00343	.00046	1.676	.6573	.00056		
11.00	26.748	198.74	.23903	.03217	.24058	.03238	.00397	.00053	1.652	.6472	.00075		
12.00	25.067	186.25	.27745	.03734	.27924	.03758	.00455	.00061	1.630	.6382	.00104		
13.00	23.606	175.40	.31835	.04285	.32037	.04312	.00516	.00069	1.611	.6304	.00029		
14.00	22.324	165.87	.36167	.04868	.36393	.04898	.00580	.00078	1.593	.6234	.00431		
15.00	21.189	157.43	.40741	.05483	.40994	.05517	.00647	.00087	1.577	.6170	.00678		
16.00	20.176	149.31	.45552	.06131	.45832	.06169	.00716	.00096	1.563	.6113	.00927		
17.00	19.267	143.15	.50598	.06810	.50906	.06851	.00789	.00106	1.549	.6061	.01178		
18.00	18.446	137.05	.55875	.07520	.56213	.07566	.00864	.00116	1.537	.6013	.01432		
19.00	17.700	131.51	.61379	.08261	.61747	.08311	.00942	.00127	1.525	.5969	.01687		
20.00	17.019	126.45	.67111	.09032	.67511	.09086	.01022	.00138	1.514	.5929	.01944		
22.00	15.820	117.55	.79242	.10665	.79709	.10728	.01191	.00160	1.495	.5856	.02463		
24.00	14.799	109.95	.92251	.12416	.92789	.12488	.01371	.00184	1.477	.5793	.02990		
26.00	13.916	103.40	1.0612	.14283	1.0673	.14365	.01560	.00210	1.461	.5737	.03336		
28.00	13.146	97.672	1.2084	.16263	1.2153	.16356	.01759	.00237	1.447	.5688	.03623		
30.00	12.466	92.625	1.3638	.18356	1.3716	.18460	.01967	.00265	1.434	.5644	.03658		
32.00	11.862	88.135	1.5275	.20558	1.5361	.20674	.02185	.00294	1.422	.5604	.03828		
34.00	11.322	84.124	1.6992	.22870	1.7087	.22998	.02412	.00325	1.411	.5568	.04005		
36.00	10.836	80.511	1.8789	.25288	1.8893	.25429	.02647	.00356	1.401	.5535	.04188		
38.00	10.396	77.239	2.0664	.27812	2.0778	.27965	.02892	.00389	1.392	.5504	.04377		
40.00	9.9946	74.260	2.2616	.30439	2.2741	.30607	.03145	.00423	1.383	.5476	.04570		
45.00	9.1331	67.859	2.7829	.37455	2.7981	.37659	.03814	.00513	1.363	.5415	.05376		
50.00	8.4279	62.619	3.3505	.45094	3.3686	.45337	.04533	.00610	1.346	.5364	.05809		
55.00	7.8393	58.246	3.9630	.53338	3.9842	.53623	.05301	.00713	1.330	.5320	.06169		
60.00	7.3401	54.537	4.6193	.62170	4.6436	.62500	.06115	.00823	1.317	.5283	.06754		
65.00	6.9111	51.350	5.3181	.71577	5.3462	.71954	.06974	.00939	1.305	.5250	.07363		
70.00	6.5380	48.577	6.0586	.81543	6.0904	.81971	.07877	.01060	1.293	.5220	.07993		
75.00	6.2103	46.143	6.8397	.92056	6.8755	.92536	.08821	.01187	1.283	.5195	.08641		
80.00	5.9209	43.992	7.6604	1.0310	7.7002	1.0364	.09807	.01320	1.274	.5171	.09305		
90.00	5.4312	40.354	9.4574	1.2675	9.4659	1.2740	.11893	.01601	1.256	.5132	.10673		

MANGANESE

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH	MEV/CH	GM/CH2	CM	GM/CH2	CM	GM/CH2	CM		
100.00	5.0324	37.391	11.323	1.5239	11.381	1.5317	.14127	.01901	.5098	.12077
110.00	4.7011	34.929	13.370	1.7995	13.438	1.8086	.16500	.02221	.5071	.13526
120.00	4.4214	32.851	15.554	2.0934	15.633	2.1041	.19004	.02558	.5047	.15026
130.00	4.1820	31.072	17.870	2.4051	17.960	2.4172	.21633	.02912	.5026	.16569
140.00	3.9748	29.532	20.312	2.7337	20.414	2.7475	.24379	.03281	.5006	.18147
150.00	3.7936	28.136	22.875	3.0788	22.990	3.0942	.27238	.03666	.4992	.19752
160.00	3.6338	26.999	25.557	3.4397	25.685	3.4569	.30202	.04065	.4977	.21382
170.00	3.4919	25.945	28.351	3.8158	28.493	3.8348	.33267	.04477	.4965	.23036
180.00	3.3650	25.002	31.255	4.2066	31.411	4.2276	.36429	.04903	.4953	.24710
190.00	3.2508	24.153	34.285	4.6117	34.435	4.6346	.39682	.05341	.4942	.26397
200.00	3.1476	23.386	37.377	5.0305	37.562	5.0555	.43023	.05790	.4933	.28092
210.00	3.0538	22.689	40.587	5.4626	40.788	5.4897	.46447	.06251	.4924	.29791
220.00	2.9682	22.054	43.894	5.9076	44.110	5.9368	.49950	.06723	.4916	.31492
230.00	2.8898	21.471	47.292	6.3650	47.525	6.3964	.53530	.07205	.4908	.33190
240.00	2.8178	20.936	50.780	6.8345	51.030	6.8681	.57182	.07696	.4901	.34881
250.00	2.7513	20.442	54.355	7.3156	54.622	7.3516	.60904	.08197	.4894	.36552
260.00	2.6899	19.986	58.014	7.8080	58.299	7.8464	.64693	.08707	.4886	.38234
270.00	2.6329	19.562	61.754	8.3114	62.057	8.3522	.68546	.09226	.4882	.39896
280.00	2.5799	19.168	65.573	8.8254	65.894	8.8687	.72459	.09752	.4877	.41546
290.00	2.5305	18.801	69.468	9.3497	69.808	9.3955	.76432	.10287	.4871	.43181
300.00	2.4843	18.459	73.438	9.8840	73.797	9.9323	.80460	.10829	.4866	.44799
310.00	2.4411	18.138	77.480	10.428	77.858	10.479	.84543	.11379	.4862	.46398
320.00	2.4006	17.837	81.591	10.981	81.989	11.035	.88677	.11935	.4857	.47974
330.00	2.3626	17.554	85.770	11.544	86.169	11.600	.92862	.12498	.4852	.49528
340.00	2.3268	17.288	90.015	12.115	90.454	12.174	.97094	.13068	.4848	.51056
350.00	2.2930	17.037	94.324	12.695	94.783	12.757	1.0137	.13644	.4844	.52558
360.00	2.2612	16.801	98.695	13.283	99.175	13.348	1.0569	.14225	.4840	.54037
370.00	2.2311	16.577	103.13	13.880	103.63	13.947	1.1006	.14813	.4836	.55496
380.00	2.2026	16.365	107.62	14.484	108.14	14.554	1.1446	.15406	.4832	.56933
390.00	2.1756	16.165	112.16	15.096	112.71	15.169	1.1891	.16004	.4828	.58348
400.00	2.1500	15.974	116.77	15.715	117.33	15.792	1.2339	.16607	.4825	.59738
410.00	2.1256	15.793	121.42	16.342	122.01	16.421	1.2791	.17216	.4821	.61101
420.00	2.1025	15.621	126.13	16.976	126.74	17.058	1.3247	.17829	.4817	.62432
430.00	2.0804	15.458	130.89	17.616	131.52	17.701	1.3706	.18448	.4814	.63731
440.00	2.0595	15.302	135.70	18.263	136.35	18.352	1.4168	.19068	.4810	.64999
450.00	2.0394	15.153	140.55	18.917	141.23	19.008	1.4633	.19695	.4807	.66235
460.00	2.0203	15.011	145.46	19.577	146.16	19.671	1.5102	.20325	.4804	.67438
470.00	2.0021	14.876	150.41	20.243	151.13	20.341	1.5572	.20959	.4800	.68610
480.00	1.9846	14.746	155.44	20.915	156.15	21.016	1.6047	.21598	.4797	.69749
490.00	1.9679	14.622	160.44	21.593	161.21	21.697	1.6524	.22240	.4794	.70857

MANGANESE

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM	PROTON RANGE GM/CM2	PROTON RANGE CM	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	PATH LENGTH STRAGGLING GM/CM2	PATH LENGTH STRAGGLING PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	1.9520	165.51	22.276	166.31	22.384	1.7004	.22885	.4790	.71933
510.00	1.9367	170.63	22.965	171.45	23.076	1.7486	.23534	.4787	.72978
520.00	1.9220	175.79	23.660	176.64	23.774	1.7970	.24186	.4794	.73992
530.00	1.9079	180.99	24.359	181.86	24.476	1.8457	.24842	.4781	.74975
540.00	1.8944	186.23	25.064	187.12	25.194	1.8947	.25500	.4778	.75928
550.00	1.8814	191.50	25.774	192.42	25.897	1.9439	.26162	.4774	.76851
560.00	1.8689	196.81	26.488	197.75	26.615	1.9932	.26827	.4771	.77745
570.00	1.8569	202.15	27.207	203.12	27.338	2.0428	.27494	.4768	.78610
580.00	1.8454	207.53	27.931	208.52	28.065	2.0926	.28164	.4765	.79446
590.00	1.8342	212.94	28.659	213.96	28.796	2.1426	.28837	.4762	.80255
600.00	1.8235	218.38	29.392	219.42	29.532	2.1928	.29513	.4759	.81037
620.00	1.8033	229.36	30.869	230.45	31.017	2.2937	.30671	.4752	.82522
640.00	1.7845	240.46	32.363	241.60	32.517	2.3954	.32239	.4746	.83905
660.00	1.7669	251.67	33.872	252.87	34.033	2.4977	.33616	.4740	.85192
680.00	1.7506	262.99	35.396	264.24	35.564	2.6006	.35001	.4733	.86387
700.00	1.7353	274.41	36.933	275.72	37.108	2.7041	.36394	.4727	.87496
720.00	1.7210	285.93	38.484	287.29	38.666	2.8081	.37795	.4721	.88524
740.00	1.7076	297.55	40.047	298.96	40.236	2.9127	.39202	.4714	.89474
760.00	1.6951	309.25	41.622	310.71	41.819	3.0178	.40617	.4708	.90353
780.00	1.6833	321.04	43.208	322.55	43.412	3.1234	.42037	.4701	.91164
800.00	1.6722	332.91	44.806	334.48	45.017	3.2294	.43464	.4695	.91912
820.00	1.6618	344.85	46.413	346.48	46.632	3.3358	.44897	.4688	.92601
840.00	1.6520	356.87	48.031	358.55	48.257	3.4427	.46335	.4682	.93235
850.00	1.6428	368.96	49.658	370.69	49.891	3.5499	.47778	.4675	.93819
880.00	1.6341	381.11	51.294	382.90	51.535	3.6575	.49226	.4668	.94355
900.00	1.6259	393.34	52.939	395.18	53.187	3.7655	.50679	.4662	.94847
920.00	1.6181	405.62	54.592	407.52	54.848	3.8738	.52137	.4655	.95299
940.00	1.6108	417.97	56.254	419.92	56.517	3.9824	.53593	.4647	.95713
960.00	1.6039	430.39	57.926	432.39	58.196	4.0913	.55065	.4639	.96092
1000.00	1.5912	455.51	61.306	457.62	61.591	4.3101	.58002	.4616	.96757

THE ELECTRON DENSITY OF MANGANESE IS 2.742E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.112 BEV, AND THE MINIMUM ENERGY LOSS IS 1.4900 MEV/GM/CM2

MOLYBDENUM

ADJUSTED
IONIZATION
POTENTIAL
420.0

ATOMIC
WEIGHT
95.940

ATOMS/
MOLECULE
1

ATOMIC
NUMBER
42

ELEMENT
MO

DENSITY = 10.200 GM/CM3

PRCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION	
	MEV/ GM/CM2	MEV/CM	GM/CM2	MM	GM/CM2	MM	MM	PERCENT			
.10	267.17	2725.2	.70846	.00069	.73222	.00072	.03407	.00003	4.653	3.245	0.
.15	235.90	2406.2	.90619	.00089	.93126	.00091	.03789	.00004	4.069	2.692	0.
.20	211.46	2156.9	1.1270	.00110	1.1550	.00113	.04288	.00004	3.713	2.429	0.
.30	176.80	1803.4	1.6373	.00161	1.6741	.00164	.05737	.00006	3.427	2.195	0.
.40	154.19	1572.8	2.2337	.00219	2.2814	.00224	.07549	.00007	3.309	2.091	0.
.50	138.41	1411.8	2.9068	.00285	2.9670	.00291	.09560	.00009	3.222	2.028	0.
.60	126.34	1288.7	3.6500	.00358	3.7238	.00365	.11702	.00011	3.143	1.982	0.
.70	116.38	1187.0	4.4605	.00437	4.5490	.00446	.13959	.00014	3.069	1.944	0.
.80	109.06	1112.4	5.3340	.00523	5.4379	.00533	.16306	.00016	2.999	1.910	0.
.90	102.47	1045.2	6.2632	.00614	6.3832	.00626	.18711	.00018	2.931	1.880	0.
1.00	95.878	977.96	7.2554	.00711	7.3924	.00725	.21228	.00021	2.872	1.852	0.
1.20	87.335	890.82	9.4081	.00922	9.5808	.00939	.26505	.00026	2.766	1.803	0.
1.40	80.574	821.86	11.757	.01153	11.968	.01173	.32052	.00031	2.678	1.759	0.
1.60	75.011	765.11	14.293	.01401	14.543	.01426	.37965	.00037	2.612	1.721	0.
1.80	70.404	718.12	17.005	.01667	17.296	.01696	.44219	.00043	2.557	1.685	0.
2.00	66.356	676.83	19.890	.01956	20.224	.01983	.50728	.00050	2.508	1.653	0.
2.20	62.821	640.78	22.944	.02249	23.323	.02287	.57494	.00056	2.465	1.624	0.
2.40	59.722	609.17	26.163	.02565	26.588	.02607	.64502	.00063	2.426	1.597	0.
2.60	56.971	581.11	29.548	.02897	30.019	.02943	.71737	.00070	2.390	1.572	0.
2.80	54.511	556.01	33.088	.03244	33.609	.03295	.79289	.00078	2.356	1.549	0.
3.00	52.293	533.39	36.787	.03607	37.357	.03662	.86848	.00085	2.325	1.527	0.
3.20	50.279	512.84	40.635	.03984	41.257	.04045	.94711	.00093	2.296	1.507	0.
3.40	48.434	494.03	44.637	.04376	45.311	.04442	1.0277	.00101	2.268	1.488	0.
3.60	46.736	476.71	48.788	.04783	49.516	.04855	1.1104	.00109	2.242	1.471	0.
3.80	45.174	460.77	53.086	.05204	53.869	.05281	1.1950	.00117	2.218	1.454	0.
4.00	43.701	445.75	57.530	.05640	58.370	.05723	1.2814	.00126	2.195	1.438	0.
4.20	42.397	432.45	62.118	.06090	63.015	.06178	1.3699	.00134	2.174	1.424	0.
4.40	41.179	420.02	66.848	.06554	67.803	.06647	1.4601	.00143	2.153	1.410	0.
4.60	40.039	408.40	71.710	.07030	72.726	.07130	1.5520	.00152	2.134	1.397	0.
4.80	38.970	397.49	76.717	.07521	77.793	.07627	1.6455	.00161	2.115	1.384	0.

MOLYBDENUM

PROTON ENERGY NEV	ENERGY LOSS MEV/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH CM	PROTON PATH LENGTH GM/CM2	PATH LENGTH STRAGGLING CM	PATH LENGTH STRAGGLING PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	37.965	0.8186	0.0803	0.8299	0.00174	2.097	1.372	0.
5.50	35.696	0.9528	0.0934	0.9658	0.00199	2.056	1.345	0.
6.00	33.718	1.0954	0.1074	1.1100	0.00224	2.019	1.320	0.00001
6.50	31.975	1.2465	0.1222	1.2624	0.00251	1.986	1.299	0.00002
7.00	30.421	1.4045	0.1377	1.4227	0.00278	1.956	1.279	0.00003
7.50	29.054	1.5709	0.1540	1.5910	0.00307	1.929	1.260	0.00004
8.00	27.820	1.7448	0.1711	1.7668	0.00336	1.904	1.244	0.00006
8.50	26.699	1.9264	0.1889	1.9503	0.00367	1.880	1.229	0.00009
9.00	25.675	2.1154	0.2074	2.1414	0.00398	1.859	1.214	0.00012
9.50	24.741	2.3117	0.2266	2.3398	0.00430	1.839	1.201	0.00015
10.00	23.881	2.5142	0.2466	2.5455	0.00464	1.821	1.189	0.00019
11.00	22.347	2.9459	0.2886	2.9787	0.00533	1.790	1.167	0.00030
12.00	21.020	3.4009	0.3334	3.4404	0.00607	1.763	1.148	0.00042
13.00	19.858	3.8857	0.3809	3.9301	0.00684	1.740	1.131	0.00058
14.00	18.832	4.3978	0.4312	4.4474	0.00765	1.720	1.115	0.00075
15.00	17.917	4.9372	0.4840	4.9922	0.00849	1.701	1.101	0.00096
16.00	17.100	5.5031	0.5395	5.5637	0.00937	1.685	1.088	0.00118
17.00	16.363	6.0953	0.5976	6.1617	0.01029	1.670	1.077	0.00143
18.00	15.695	6.7135	0.6582	6.7859	0.01123	1.655	1.066	0.00184
19.00	15.087	7.3576	0.7213	7.4361	0.01221	1.642	1.056	0.00370
20.00	14.529	8.0268	0.7869	8.1117	0.01322	1.630	1.047	0.00576
22.00	13.544	9.4401	0.9255	9.5385	0.01533	1.608	1.031	0.00993
24.00	12.699	1.0952	1.0737	1.1065	0.01757	1.588	1.017	0.01418
26.00	11.966	1.2561	1.2314	1.2688	0.01992	1.570	1.005	0.01707
28.00	11.329	1.4264	1.3984	1.4407	0.02238	1.554	0.9939	0.01852
30.00	10.766	1.6059	1.5744	1.6219	0.02495	1.539	0.9841	0.02004
32.00	10.263	1.7946	1.7594	1.8122	0.02763	1.525	0.9753	0.02162
34.00	9.8116	1.9921	1.9531	2.0116	0.03041	1.512	0.9673	0.02325
36.00	9.4037	2.1986	2.1555	2.2199	0.03330	1.500	0.9600	0.02494
38.00	9.0333	2.4137	2.3664	2.4370	0.03628	1.489	0.9533	0.02668
40.00	8.6954	2.6374	2.5857	2.6626	0.03936	1.478	0.9471	0.02846
45.00	7.9666	3.1702	3.1702	3.2641	0.04748	1.455	0.9337	0.03311
50.00	7.3677	3.8813	3.8052	3.9175	0.05619	1.434	0.9225	0.03800
55.00	6.8861	4.5788	4.4890	4.6210	0.06544	1.416	0.9129	0.04314
60.00	6.4395	5.3248	5.2204	5.3734	0.07523	1.400	0.9047	0.04853
65.00	6.0720	6.1181	5.9981	6.1735	0.08553	1.385	0.8975	0.05416
70.00	5.7520	6.9574	6.8210	7.0200	0.09633	1.372	0.8912	0.06000
75.00	5.4706	7.8417	7.6879	7.9117	0.10760	1.360	0.8857	0.06603
80.00	5.2211	8.7697	8.5977	8.8476	0.11933	1.349	0.8807	0.07223
90.00	4.8012	10.753	1.0543	10.848	0.14413	1.329	0.8722	0.08508

MOLYBDENUM

PROTON ENERGY HEV	ENERGY LOSS MEV/CH2	PROTON RANGE GM/CM2	PROTON PATH LENGTH CM	PROTON PATH LENGTH GM/CM2	PATH LENGTH STRAGGLING C	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	4.4554	12.899	1.2646	13.012	.01672	.8651	.09840
110.00	4.1674	15.204	1.4905	15.335	.01947	.8592	.11219
120.00	3.9241	17.657	1.7311	17.809	.02235	.8542	.12647
130.00	3.7156	20.256	1.9859	20.430	.02539	.8498	.14115
140.00	3.5348	22.994	2.2543	23.191	.02855	.8460	.15615
150.00	3.3765	25.866	2.5359	26.086	.03184	.8427	.17141
160.00	3.2359	28.868	2.8302	29.112	.03524	.8397	.18693
170.00	3.1127	31.749	3.1366	32.263	.03875	.8371	.20270
180.00	3.0010	35.239	3.4548	35.536	.04221	.8348	.21870
190.00	2.9009	38.602	3.7846	38.927	.04610	.8327	.23485
200.00	2.8104	42.078	4.1253	42.430	.04992	.8307	.25113
210.00	2.7281	45.660	4.4765	46.042	.05383	.8289	.26744
220.00	2.6530	49.348	4.8380	49.759	.05782	.8273	.28373
230.00	2.5841	53.137	5.2095	53.579	.06191	.8259	.29995
240.00	2.5208	57.024	5.5906	57.498	.06607	.8245	.31608
250.00	2.4624	61.006	5.9810	61.512	.07030	.8232	.33209
260.00	2.4084	65.080	6.3804	65.619	.07461	.8221	.34803
270.00	2.3582	69.243	6.7885	69.616	.07899	.8209	.36430
280.00	2.3116	73.492	7.2051	74.099	.08344	.8199	.37994
290.00	2.2681	77.824	7.6298	78.467	.08795	.8190	.39585
300.00	2.2275	82.224	8.0612	82.903	.09252	.8180	.41169
310.00	2.1894	86.716	8.5016	87.431	.09715	.8172	.42744
320.00	2.1537	91.204	8.9494	92.035	.10184	.8163	.44307
330.00	2.1202	95.926	9.4045	96.715	.10658	.8155	.45855
340.00	2.0887	100.64	9.8666	101.47	.11138	.8148	.47388
350.00	2.0589	105.42	10.336	106.29	.11622	.8140	.48903
360.00	2.0308	110.27	10.811	111.18	.12111	.8133	.50397
370.00	2.0043	115.19	11.293	116.14	.12605	.8127	.51876
380.00	1.9791	120.17	11.782	121.16	.13103	.8120	.53309
390.00	1.9553	125.21	12.276	126.24	.13606	.8114	.54727
400.00	1.9327	130.32	12.776	131.38	.14112	.8108	.56117
410.00	1.9113	135.48	13.282	136.58	.14623	.8102	.57480
420.00	1.8908	140.70	13.794	141.84	.15137	.8096	.58817
430.00	1.8714	145.97	14.311	147.16	.15655	.8090	.60128
440.00	1.8529	151.30	14.833	152.53	.16176	.8085	.61411
450.00	1.8353	156.67	15.360	157.95	.16701	.8079	.62667
460.00	1.8184	162.10	15.893	163.42	.17229	.8074	.63895
470.00	1.8023	167.58	16.430	168.95	.17761	.8069	.65094
480.00	1.7869	173.11	16.972	174.52	.18295	.8064	.66266
490.00	1.7722	178.69	17.518	180.14	.18832	.8058	.67409

MOLYBDENUM

PROTON ENERGY MEV	ENERGY LOSS MEV/CH	PROTON RANGE GH/CH2 CM	PROTON PATH LENGTH GH/CH2 CH	PATH LENGTH STRAGGLING GH/CH2 CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	1.7581	184.31	185.80	1.9760	.3053	.68524
510.00	1.7446	189.97	191.51	2.0314	.8048	.69610
520.00	1.7317	195.68	197.27	2.0870	.8043	.70669
530.00	1.7193	201.43	203.06	2.1429	.8039	.71699
540.00	1.7073	207.22	208.90	2.1991	.8034	.72702
550.00	1.6959	213.05	214.77	2.2555	.8029	.73676
560.00	1.6849	218.92	220.69	2.3121	.8024	.74624
570.00	1.6743	224.84	226.64	2.3690	.8019	.75544
580.00	1.6642	230.76	232.63	2.4261	.8015	.76438
590.00	1.6544	236.74	238.66	2.4834	.8010	.77305
600.00	1.6449	242.76	244.72	2.5409	.8005	.78146
620.00	1.6271	254.39	256.94	2.6565	.7996	.79752
640.00	1.6105	267.14	269.29	2.7729	.7986	.81259
660.00	1.5951	279.52	281.77	2.8900	.7977	.82671
680.00	1.5807	292.02	294.36	3.0077	.7968	.83992
700.00	1.5673	304.63	307.07	3.1261	.7959	.85226
720.00	1.5548	317.34	319.88	3.2450	.7949	.86377
740.00	1.5430	330.15	332.79	3.3646	.7940	.87449
760.00	1.5320	343.06	345.80	3.4846	.7931	.88467
780.00	1.5217	356.05	358.90	3.6051	.7921	.89373
800.00	1.5120	369.19	372.13	3.7262	.7913	.90233
820.00	1.5029	382.36	385.40	3.8476	.7904	.91030
840.00	1.4943	395.61	398.75	3.9695	.7894	.91768
860.00	1.4862	408.93	412.18	4.0918	.7884	.92451
880.00	1.4787	422.32	425.67	4.2145	.7875	.93082
900.00	1.4715	435.78	439.24	4.3375	.7865	.93664
920.00	1.4648	449.31	452.87	4.4609	.7855	.94201
940.00	1.4584	462.91	466.57	4.5846	.7843	.94696
960.00	1.4524	476.58	480.35	4.7087	.7830	.95152
1000.00	1.4414	504.32	508.28	4.9577	.7791	.95952

THE ELECTRON DENSITY OF MOLYBDENUM IS 2.638E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.029 BEV, AND THE MINIMUM ENERGY LOSS IS 1.3540 MEV/GH/CM2

NEON

ELEMENT NE
 ATOMIC NUMBER 10
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 20.183
 ADJUSTED IONIZATION POTENTIAL 140.0

DENSITY = .89999 MG/CM3

PRCTON ENERGY	ENERGY LOSS	PROTON RANGE	PROTON PATH LENGTH	MG/CM2	METER	MG/CM2	METER	MG/CM2	METER	MG/CM2	METER	MG/CM2	METER	MG/CM2	METER	MG/CM2	METER	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	435.83	30906	.00343	.31240	.00347	.01140	.00013	3.649	1.069	0.								0.	
.15	438.74	42313	.00470	.42674	.00474	.01427	.00016	3.343	.8466	0.								0.	
.20	417.72	53939	.00599	.54351	.00604	.01665	.00018	3.063	.7579	0.								0.	
.30	364.68	79330	.00881	.79865	.00887	.02139	.00024	2.678	.6689	0.								0.	
.40	319.66	1.0851	.01206	1.0918	.01213	.02676	.00030	2.451	.6153	0.								0.	
.50	284.03	1.4158	.01573	1.4240	.01582	.03307	.00037	2.322	.5764	0.								0.	
.60	256.16	1.7853	.01984	1.7951	.01995	.04041	.00045	2.251	.5460	0.								0.	
.70	232.91	2.1929	.02437	2.2044	.02449	.04859	.00054	2.204	.5215	0.								0.	
.80	214.01	2.6390	.02932	2.6523	.02947	.05756	.00064	2.170	.5011	0.								0.	
.90	202.68	3.1320	.03463	3.1320	.03480	.06695	.00074	2.138	.4840	0.								0.	
1.00	191.34	3.6230	.04026	3.6401	.04045	.07652	.00085	2.102	.4693	0.								0.	
1.20	169.54	4.7316	.05257	4.7527	.05281	.09719	.00108	2.045	.4449	0.								0.	
1.40	152.62	5.9726	.06636	5.9981	.06665	.11999	.00133	2.001	.4255	0.								0.	
1.60	139.23	7.3419	.08158	7.3722	.08191	.14476	.00161	1.964	.4097	.00001								.00001	
1.80	128.33	8.8349	.09817	8.8701	.09856	.17129	.00190	1.931	.3965	.00001								.00001	
2.00	119.22	10.448	.11609	10.488	.11654	.19948	.00222	1.902	.3854	.00002								.00002	
2.20	111.47	12.178	.13531	12.224	.13582	.22926	.00255	1.876	.3759	.00003								.00003	
2.40	104.79	14.024	.15562	14.075	.15640	.26059	.00290	1.851	.3676	.00004								.00004	
2.60	99.418	15.979	.17754	16.036	.17818	.29331	.00326	1.829	.3604	.00005								.00005	
2.80	94.223	18.040	.20045	18.104	.20116	.32717	.00364	1.807	.3539	.00006								.00006	
3.00	89.612	20.210	.22456	20.280	.22534	.36250	.00403	1.787	.3481	.00008								.00008	
3.20	85.488	22.491	.24991	22.569	.25077	.39926	.00444	1.769	.3429	.00010								.00010	
3.40	81.774	24.880	.27645	24.964	.27739	.43742	.00486	1.752	.3381	.00012								.00012	
3.60	78.410	27.370	.30411	27.462	.30513	.47694	.00530	1.737	.3339	.00014								.00014	
3.80	75.346	29.962	.33292	30.061	.33402	.51780	.00575	1.722	.3299	.00016								.00016	
4.00	72.541	32.661	.36290	32.769	.36409	.55997	.00622	1.709	.3263	.00019								.00019	
4.20	69.963	35.463	.39404	35.578	.39531	.60344	.00670	1.696	.3228	.00022								.00022	
4.40	67.584	38.360	.42623	38.484	.42760	.64817	.00720	1.684	.3197	.00024								.00024	
4.60	65.380	41.367	.45963	41.498	.46110	.69416	.00771	1.673	.3168	.00028								.00028	
4.80	63.333	44.463	.49403	44.603	.49559	.74139	.00824	1.662	.3141	.00031								.00031	

PRCTON ENERGY HEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	HEV/CH2	KEV/CH	GM/CH2	METER	GM/CH2	METER	GM/CM2	METER PERCENT		
5.00	61.424	55.281	0.4766	52956	0.4781	53122	.00079	.00878	1.652	.00034
5.50	57.173	51.455	0.5608	62311	.05625	62502	.00092	.01018	1.629	.00044
6.00	53.530	48.176	0.6510	72334	.06530	72552	.00105	.01167	1.608	.00055
6.50	50.369	45.332	0.7471	83011	.07493	83257	.00119	.01323	1.590	.00068
7.00	47.597	42.837	0.8490	94332	.08515	94609	.00134	.01488	1.573	.00082
7.50	45.145	40.630	0.9566	1.0629	.09594	1.0660	.00149	.01660	1.558	.00099
8.00	42.958	38.662	1.0699	1.1888	.10730	1.1922	.00166	.01840	1.544	.00245
8.50	40.994	36.894	1.1888	1.3209	.11922	1.3247	.00183	.02028	1.531	.00456
9.00	39.219	35.297	1.3132	1.4591	.13169	1.4632	.00200	.02223	1.519	.00666
9.50	37.608	33.846	1.4431	1.6034	.14471	1.6079	.00218	.02425	1.508	.00877
10.00	36.136	32.522	1.5784	1.7538	.15828	1.7586	.00237	.02635	1.498	.01087
11.00	33.546	30.191	1.8651	2.0724	.18702	2.0780	.00277	.03075	1.480	.01509
12.00	31.315	28.183	2.1731	2.4146	.21789	2.4211	.00319	.03543	1.463	.01932
13.00	29.411	26.469	2.5020	2.7800	.25087	2.7874	.00364	.04039	1.449	.02355
14.00	27.747	24.972	2.8513	3.1682	.28589	3.1765	.00411	.04562	1.436	.02780
15.00	26.279	23.651	3.2209	3.5780	.32293	3.5881	.00460	.05111	1.424	.03206
16.00	24.974	22.476	3.6106	4.0118	.36199	4.0222	.00512	.05685	1.413	.03633
17.00	23.805	21.425	4.0197	4.4664	.40300	4.4779	.00566	.06285	1.403	.04061
18.00	22.752	20.477	4.4485	4.9429	.44599	4.9555	.00622	.06909	1.394	.04491
19.00	21.798	19.618	4.8967	5.4408	.49091	5.4546	.00680	.07558	1.386	.04921
20.00	20.929	18.836	5.3638	5.9598	.53773	5.9749	.00741	.08231	1.378	.05353
22.00	19.405	17.464	6.3547	7.0608	.63705	7.0784	.00868	.09649	1.363	.06220
24.00	18.109	16.298	7.4200	8.2445	.74383	8.2649	.01004	.11160	1.350	.07091
26.00	16.993	15.294	8.5580	9.5090	.85790	9.5323	.01149	.12762	1.339	.07629
28.00	16.022	14.420	9.7679	10.853	.97917	10.880	.01301	.14452	1.328	.07823
30.00	15.168	13.651	1.1049	12.276	1.1075	12.306	.01461	.16229	1.319	.08024
32.00	14.412	12.970	1.2399	13.776	1.2428	13.810	.01628	.18091	1.310	.08233
34.00	13.736	12.362	1.3818	15.353	1.3851	15.390	.01803	.20037	1.302	.08449
36.00	13.128	11.815	1.5304	17.004	1.5340	17.045	.01996	.22064	1.294	.08670
38.00	12.579	11.321	1.6857	18.730	1.6897	18.775	.02175	.24171	1.287	.08897
40.00	12.080	10.872	1.8476	20.530	1.8520	20.578	.02372	.26357	1.281	.09129
45.00	11.011	9.9101	2.2808	25.342	2.2861	25.401	.02894	.32157	1.266	.09728
50.00	10.139	9.1254	2.7534	30.594	2.7598	30.664	.03458	.38420	1.253	.10349
55.00	9.4140	8.4725	3.2645	36.272	3.2720	36.356	.04062	.45130	1.241	.10994
60.00	8.8004	7.9203	3.8130	42.367	3.8217	42.464	.04704	.52268	1.231	.11669
65.00	8.2743	7.4468	4.3980	48.867	4.4080	48.978	.05384	.59820	1.221	.12359
70.00	7.8180	7.0361	5.0186	55.763	5.0300	55.889	.06099	.67773	1.213	.13092
75.00	7.4183	6.6764	5.6741	63.046	5.6866	63.187	.06850	.76112	1.205	.13834
80.00	7.0651	6.3585	6.3635	70.706	6.3777	70.864	.07634	.84826	1.197	.14593
90.00	6.4689	5.8219	7.8414	87.128	7.8588	87.321	.09300	1.0333	1.183	.16148

NEON

PROTON ENERGY HEV	ENERGY LOSS HEV/CH	PROTON RANGE GM/CM2	PROTON RANGE METER	PATH LENGTH GM/CM2	PATH LENGTH METER	GM/CM2	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	5.9846	9.4468	104.97	9.4677	105.20	11088	1.2320	1.171	.17737
110.00	5.5832	11.175	124.16	11.199	124.44	12993	1.4437	1.160	.19361
120.00	5.2450	13.020	144.67	13.048	144.98	15007	1.6675	1.150	.21024
130.00	4.9559	14.978	166.43	15.011	166.79	17125	1.9028	1.141	.22716
140.00	4.7061	17.046	189.40	17.082	189.81	19342	2.1491	1.132	.24424
150.00	4.4878	19.218	213.53	19.259	214.00	21652	2.4059	1.124	.26140
160.00	4.2956	21.491	238.80	21.538	239.31	24052	2.6725	1.117	.27865
170.00	4.1251	23.863	265.15	23.914	265.72	26536	2.9485	1.110	.29603
180.00	3.9726	26.329	292.54	26.385	293.17	29101	3.2335	1.103	.31346
190.00	3.8356	28.886	320.96	28.948	321.64	31743	3.5271	1.097	.33088
200.00	3.7118	31.531	350.35	31.598	351.10	34459	3.8288	1.091	.34824
210.00	3.5994	34.262	380.69	34.335	381.50	37245	4.1383	1.085	.36555
220.00	3.4969	37.075	411.95	37.154	412.83	40098	4.4553	1.079	.38281
230.00	3.4031	39.969	444.10	40.053	445.04	43015	4.7795	1.074	.39998
240.00	3.3168	42.939	477.11	43.030	478.12	45993	5.1104	1.069	.41702
250.00	3.2373	45.985	510.95	46.082	512.03	49031	5.4479	1.064	.43389
260.00	3.1636	49.104	545.60	49.207	546.75	52124	5.7917	1.059	.45061
270.00	3.0937	52.293	581.04	52.403	582.26	55272	6.1414	1.055	.46717
280.00	3.0324	55.550	617.23	55.667	618.53	58472	6.4929	1.050	.48354
290.00	2.9733	58.874	654.16	58.998	655.54	61721	6.8580	1.046	.49970
300.00	2.9182	62.262	691.81	62.393	693.26	65018	7.2243	1.042	.51564
310.00	2.8666	65.713	730.15	65.851	731.68	68361	7.5958	1.038	.53134
320.00	2.8183	69.224	769.17	69.369	770.78	71748	7.9721	1.034	.54681
330.00	2.7729	72.794	808.84	72.947	810.53	75178	8.3532	1.031	.56204
340.00	2.7301	76.422	849.14	76.581	850.91	78648	8.7388	1.027	.57700
350.00	2.6898	80.105	890.06	80.272	891.92	82157	9.1287	1.023	.59169
360.00	2.6518	83.842	931.58	84.016	933.52	85704	9.5228	1.020	.60612
370.00	2.6159	87.631	973.69	87.813	975.71	89288	9.9210	1.017	.62030
380.00	2.5819	91.471	1016.4	91.661	1018.5	92907	10.323	1.014	.63423
390.00	2.5497	95.361	1059.6	95.559	1061.8	96559	10.729	1.010	.64789
400.00	2.5191	99.299	1103.3	99.505	1105.6	10024	11.138	1.007	.66127
410.00	2.4900	103.28	1147.6	103.50	1150.0	10326	11.551	1.004	.67432
420.00	2.4624	107.31	1192.4	107.54	1194.9	10754	11.968	1.002	.68700
430.00	2.4361	111.39	1237.7	111.62	1240.2	11148	12.387	.9988	.69931
440.00	2.4111	115.51	1283.4	115.75	1286.1	11529	12.810	.9960	.71125
450.00	2.3872	119.67	1329.7	119.91	1332.4	11912	13.235	.9934	.72283
460.00	2.3644	123.87	1376.3	124.12	1379.2	12297	13.664	.9907	.73404
470.00	2.3426	128.11	1423.4	128.37	1426.4	12686	14.095	.9882	.74489
480.00	2.3218	132.39	1471.0	132.66	1474.0	13077	14.530	.9857	.75539
490.00	2.3019	136.71	1519.0	136.99	1522.1	13470	14.967	.9833	.76553

NEON

PROTON ENERGY MEV	ENERGY LOSS NEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH METER	GM/CM2	PATH LENGTH STRAGGLING GM/CM2	METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	2.2828	141.06	141.35	1570.6	1.3865	15.406	.9809	.2049	.77533
510.00	2.0545	1567.3	145.45	1616.1	1.4263	15.848	.9786	.2047	.78478
520.00	2.0381	1616.1	149.87	1665.3	1.4663	16.292	.9763	.2045	.79391
530.00	2.0233	1665.3	154.33	1714.8	1.5065	16.739	.9741	.2043	.80271
540.00	2.0072	1714.8	158.80	1764.7	1.5469	17.187	.9720	.2041	.81119
550.00	1.9926	1764.7	163.35	1815.0	1.5874	17.638	.9698	.2039	.81935
560.00	1.9787	1815.0	167.90	1865.6	1.6282	18.092	.9678	.2037	.82721
570.00	1.9653	1865.6	172.49	1916.5	1.6692	18.547	.9657	.2036	.83478
580.00	1.9523	1916.5	177.10	1967.8	1.7103	19.004	.9638	.2034	.84205
590.00	1.9399	1967.8	181.75	2019.4	1.7517	19.463	.9618	.2032	.84904
600.00	1.9280	2019.4	186.42	2071.4	1.7931	19.924	.9599	.2030	.85576
623.00	1.9165	2071.4	195.85	2176.1	1.3766	20.851	.9562	.2026	.86841
640.00	1.8947	2176.1	205.38	2282.0	1.9607	21.785	.9527	.2022	.88005
660.00	1.8744	2282.0	215.02	2389.1	2.0453	22.726	.9493	.2018	.89076
680.00	1.8555	2389.1	224.74	2497.2	2.1305	23.673	.9461	.2015	.90060
700.00	1.8379	2497.2	234.56	2606.3	2.2163	24.625	.9429	.2011	.90961
720.00	1.8214	2606.3	244.47	2716.4	2.3025	25.584	.9399	.2007	.91787
740.00	1.8067	2716.4	254.46	2827.3	2.3892	26.547	.9370	.2003	.92542
760.00	1.7915	2827.3	264.53	2939.2	2.4763	27.515	.9343	.2000	.93232
780.00	1.7780	2939.2	274.67	3051.9	2.5639	28.488	.9316	.1996	.93962
800.00	1.7653	3051.9	284.88	3165.4	2.6519	29.465	.9290	.1992	.94437
820.00	1.7533	3165.4	295.16	3279.6	2.7402	30.447	.9265	.1989	.94960
840.00	1.7420	3279.6	305.51	3394.6	2.8289	31.433	.9241	.1985	.95436
860.00	1.7314	3394.6	315.92	3510.2	2.9180	32.423	.9218	.1981	.95870
880.00	1.7214	3510.2	326.38	3626.5	3.0074	33.416	.9196	.1977	.96263
900.00	1.7120	3626.5	336.91	3743.5	3.0972	34.413	.9175	.1974	.96621
920.00	1.7031	3743.5	347.49	3861.1	3.1872	35.414	.9154	.1970	.96945
940.00	1.6947	3861.1	358.13	3979.3	3.2775	36.417	.9134	.1966	.97240
960.00	1.6867	3979.3	368.83	4098.2	3.3682	37.424	.9114	.1961	.97507
980.00	1.6792	4098.2	390.47	4338.6	3.5502	39.447	.9074	.1950	.97970
1000.00	1.6653	4338.6							

THE ELECTRON DENSITY OF NEON IS 2.985E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.203 BEV, AND THE MINIMUM ENERGY LOSS IS 1.7215 MEV/GM/CM2

NICKEL

ELEMENT NUMBER 28
 ATOMIC WEIGHT 58.710
 ADJUSTED IONIZATION POTENTIAL 312.0
 ATOMS/MOLECULE 1
 DENSITY = 8.9000 GM/CM³

PROCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CM	MEV/CH	MG/CM ²	MM	MG/CM ²	MM	MG/CM ²	MM	PERCENT	PERCENT	
.10	253.07	2252.3	.49803	.00056	.51013	.00057	.02229	.00003	4.370	2.371	0.
.15	252.42	2246.5	.69459	.00078	.70795	.00080	.02927	.00003	4.135	1.887	0.
.20	251.26	2236.2	.89073	.00100	.90649	.00102	.03483	.00004	3.843	1.739	0.
.30	234.47	2086.8	1.2950	.00146	1.3164	.00148	.04432	.00005	3.367	1.621	0.
.40	206.16	1834.8	1.7431	.00196	1.7705	.00199	.05423	.00006	3.063	1.549	0.
.50	181.60	1616.2	2.2542	.00253	2.2883	.00257	.06627	.00007	2.896	1.489	0.
.60	164.93	1467.9	2.8260	.00328	2.8672	.00332	.08070	.00009	2.814	1.439	0.
.70	151.54	1348.7	3.4509	.00388	3.4998	.00393	.09660	.00011	2.760	1.397	0.
.80	141.13	1256.1	4.1291	.00464	4.1860	.00470	.11375	.00013	2.717	1.360	0.
.90	134.97	1201.2	4.8446	.00544	4.9098	.00552	.13111	.00015	2.670	1.327	0.
1.00	128.80	1146.3	5.5953	.00629	5.6688	.00637	.14846	.00017	2.619	1.298	0.
1.20	115.71	1029.8	7.2183	.00811	7.3094	.00821	.18502	.00021	2.531	1.247	0.
1.40	105.45	938.47	9.0128	.01013	9.1225	.01025	.22451	.00025	2.461	1.203	0.
1.60	97.375	866.64	10.969	.01233	11.099	.01247	.26645	.00030	2.401	1.165	0.
1.80	90.648	806.77	13.078	.01469	13.228	.01486	.31053	.00035	2.347	1.133	0.
2.00	84.935	755.92	15.339	.01723	15.510	.01743	.35663	.00040	2.299	1.104	0.
2.20	80.036	712.32	17.743	.01994	17.937	.02015	.40469	.00045	2.256	1.079	0.
2.40	75.821	674.81	20.288	.02280	20.505	.02304	.45459	.00051	2.217	1.057	0.
2.60	72.078	641.49	22.971	.02581	23.211	.02608	.50618	.00057	2.181	1.037	0.
2.80	68.749	611.87	25.789	.02898	26.054	.02927	.55949	.00063	2.147	1.018	0.
3.00	65.764	585.30	28.738	.03229	29.029	.03262	.61450	.00069	2.117	1.002	0.
3.20	63.069	561.31	31.818	.03575	32.136	.03611	.67116	.00075	2.089	.9865	0.
3.40	60.619	539.51	35.029	.03936	35.373	.03974	.72946	.00082	2.062	.9726	0.
3.60	58.380	519.59	38.364	.04311	38.736	.04352	.78937	.00089	2.038	.9597	0.
3.80	56.324	501.29	41.821	.04699	42.222	.04744	.85088	.00096	2.015	.9478	.00001
4.00	54.427	484.40	45.406	.05102	45.835	.05150	.91410	.00103	1.994	.9366	.00001
4.20	52.670	468.77	49.114	.05518	49.573	.05570	.97932	.00110	1.975	.9263	.00001
4.40	51.038	454.24	52.940	.05948	53.429	.06003	1.0465	.00118	1.959	.9166	.00001
4.60	49.516	440.69	56.888	.06392	57.409	.06450	1.1155	.00125	1.943	.9075	.00002
4.80	48.094	428.03	60.955	.06849	61.507	.06911	1.1863	.00133	1.929	.8988	.00002

NICKEL

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CH	GM/CH2	CM	GM/CH2	CM	GM/CH2	CM	PERCENT	PERCENT	
5.00	46.761	416.17	.06514	.00732	.06572	.00738	.00126	.00014	1.915	.8908	.00002
5.50	43.765	399.51	.07611	.00855	.07678	.00863	.00145	.00016	1.886	.8724	.00004
6.00	41.181	366.51	.08987	.00995	.08857	.00995	.00165	.00019	1.860	.8562	.00006
6.50	38.924	346.42	.10021	.01126	.10106	.01136	.00186	.00021	1.837	.8419	.00009
7.00	36.934	328.71	.11331	.01273	.11426	.01284	.00207	.00023	1.816	.8291	.00012
7.50	35.162	312.94	.12709	.01428	.12813	.01440	.00230	.00026	1.797	.8175	.00016
8.00	33.569	298.77	.14154	.01590	.14269	.01603	.00254	.00029	1.779	.8070	.00021
8.50	32.127	285.93	.15666	.01764	.15792	.01774	.00278	.00031	1.763	.7975	.00027
9.00	30.815	274.26	.17245	.01938	.17382	.01953	.00304	.00034	1.748	.7888	.00033
9.50	29.628	263.69	.18888	.02122	.19037	.02139	.00330	.00037	1.734	.7807	.00040
10.00	28.527	253.89	.20595	.02314	.20756	.02332	.00357	.00040	1.721	.7733	.00048
11.00	26.620	236.92	.24203	.02719	.24388	.02740	.00414	.00046	1.696	.7599	.00065
12.00	24.979	222.31	.28057	.03152	.28268	.03176	.00473	.00053	1.674	.7483	.00088
13.00	23.550	209.60	.32154	.03613	.32393	.03640	.00536	.00060	1.654	.7381	.00149
14.00	22.294	198.41	.36492	.04100	.36760	.04130	.00601	.00068	1.636	.7289	.00213
15.00	21.179	188.50	.41066	.04614	.41364	.04648	.00670	.00075	1.619	.7207	.00348
16.00	20.183	179.63	.45872	.05154	.46202	.05191	.00741	.00083	1.604	.7133	.00586
17.00	19.287	171.66	.50908	.05720	.51270	.05761	.00815	.00092	1.590	.7066	.00826
18.00	18.476	164.44	.56174	.06312	.56570	.06356	.00892	.00100	1.576	.7003	.01067
19.00	17.739	157.88	.61665	.06929	.62096	.06977	.00971	.00109	1.564	.6947	.01311
20.00	17.066	151.88	.67377	.07570	.67845	.07623	.01053	.00118	1.553	.6895	.01556
22.00	15.879	141.32	.79460	.08928	.80004	.08989	.01225	.00138	1.532	.6801	.02052
24.00	14.865	132.30	.92406	.10383	.93031	.10453	.01408	.00158	1.513	.6720	.02555
26.00	13.988	124.49	1.0620	.11932	1.0691	.12012	.01600	.00180	1.497	.6648	.02889
28.00	13.221	117.67	1.2082	.13575	1.2162	.13665	.01802	.00202	1.482	.6585	.03048
30.00	12.545	111.65	1.3626	.15310	1.3716	.15411	.02013	.00226	1.468	.6528	.03213
32.00	11.944	106.30	1.5251	.17136	1.5350	.17247	.02234	.00251	1.455	.6477	.03384
34.00	11.406	101.51	1.6954	.19050	1.7064	.19173	.02464	.00277	1.444	.6431	.03562
36.00	10.920	97.191	1.8736	.21052	1.8857	.21187	.02702	.00304	1.433	.6388	.03746
38.00	10.481	93.277	2.0595	.23141	2.0727	.23288	.02949	.00331	1.423	.6350	.03935
40.00	10.080	89.713	2.2530	.25315	2.2673	.25475	.03205	.00360	1.414	.6314	.04130
45.00	9.2182	82.042	2.7693	.31115	2.7866	.31311	.03881	.00436	1.393	.6236	.04637
50.00	8.5126	75.762	3.3310	.37427	3.3516	.37659	.04606	.00518	1.374	.6171	.05171
55.00	7.9231	70.516	3.9367	.44233	3.9610	.44505	.05380	.00605	1.358	.6115	.05732
60.00	7.4228	65.063	4.5854	.51521	4.6134	.51836	.06200	.00697	1.344	.6067	.06321
65.00	6.9924	62.032	5.2929	.59279	5.3078	.59668	.07064	.00794	1.331	.6026	.06934
70.00	6.6181	58.901	6.0070	.67494	6.0431	.67971	.07971	.00896	1.319	.5989	.07570
75.00	6.2891	55.973	6.7779	.76156	6.8135	.76612	.08920	.01002	1.308	.5956	.08225
80.00	5.9980	53.382	7.5876	.85254	7.6329	.85762	.09909	.01113	1.298	.5927	.08898
90.00	5.5053	48.997	9.3702	1.0472	9.3753	1.0534	.12002	.01349	1.280	.5876	.10289

NICKEL

PROTON ENERGY MEV	ENERGY LOSS MEV/CH	PROTON RANGE GM/CH ²	PROTON PATH LENGTH GM/CH ²	GM/CH ²	PROTON PATH LENGTH CH	GM/CH ²	PATH LENGTH STRAGGLING CH	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	5.1036	11.198	11.263	1.2656	1.4241	0.1600	1.264	.5835	.11725	
116.00	4.7700	13.215	13.292	1.4935	1.6617	0.1867	1.250	.5799	.13208	
120.00	4.4881	15.365	15.455	1.7365	1.9124	0.2149	1.237	.5743	.14738	
130.00	4.2467	17.645	17.746	1.9940	2.1753	0.2444	1.226	.5720	.16306	
140.00	4.0376	20.047	20.162	2.2654	2.4498	0.2753	1.215	.5700	.17903	
150.00	3.8548	22.569	22.538	2.5503	2.7353	0.3073	1.205	.5682	.19521	
160.00	3.6935	25.205	25.349	2.8482	3.0314	0.3406	1.196	.5666	.21161	
170.00	3.5501	27.952	28.112	3.1586	3.3373	0.3750	1.187	.5651	.22827	
180.00	3.4219	30.806	30.982	3.4811	3.6528	0.4104	1.179	.5638	.24513	
190.00	3.3065	33.744	33.955	3.8152	3.9773	0.4469	1.171	.5638	.26212	
200.00	3.2021	36.821	37.029	4.1606	4.3104	0.4843	1.164	.5626	.27921	
210.00	3.1073	39.974	40.200	4.5168	4.6518	0.5227	1.157	.5615	.29636	
220.00	3.0208	43.221	43.464	4.8836	5.0009	0.5619	1.151	.5605	.31356	
230.00	2.9415	46.557	46.819	5.2606	5.3576	0.6020	1.144	.5595	.33077	
240.00	2.8686	49.981	50.262	5.6474	5.7214	0.6429	1.133	.5586	.34796	
250.00	2.8014	53.490	53.790	6.0439	6.0921	0.6845	1.133	.5578	.36508	
260.00	2.7392	57.081	57.401	6.4495	6.4693	0.7269	1.127	.5570	.38210	
270.00	2.6815	60.751	61.091	6.8641	6.8528	0.7700	1.122	.5563	.39897	
280.00	2.6279	64.498	64.858	7.2874	7.2423	0.8137	1.117	.5556	.41566	
290.00	2.5779	68.319	68.701	7.7192	7.6376	0.8582	1.112	.5549	.43217	
300.00	2.5312	72.213	72.616	8.1591	8.0384	0.9032	1.107	.5543	.44846	
310.00	2.4875	76.177	76.601	8.6069	8.4444	0.9488	1.102	.5537	.46454	
320.00	2.4465	80.209	80.655	9.0624	8.8596	0.9950	1.098	.5532	.48041	
330.00	2.4079	84.307	84.776	9.5253	9.2717	1.0418	1.094	.5526	.49606	
340.00	2.3717	88.469	88.960	9.9955	9.6924	1.0890	1.090	.5521	.51148	
350.00	2.3375	92.694	93.208	10.473	1.0118	1.1368	1.085	.5516	.52664	
360.00	2.3053	96.978	97.516	10.957	1.0547	1.1851	1.082	.5511	.54155	
370.00	2.2748	101.32	101.88	11.448	1.0981	1.2338	1.078	.5506	.55622	
380.00	2.2459	105.72	106.31	11.945	1.1419	1.2830	1.074	.5501	.57063	
390.00	2.2186	110.18	110.79	12.448	1.1860	1.3326	1.071	.5497	.58476	
400.00	2.1926	114.69	115.32	12.957	1.2306	1.3827	1.067	.5492	.59863	
410.00	2.1680	119.25	119.91	13.473	1.2755	1.4331	1.064	.5488	.61219	
420.00	2.1445	123.86	124.55	13.994	1.3207	1.4839	1.060	.5484	.62545	
430.00	2.1222	128.53	129.23	14.521	1.3663	1.5351	1.057	.5480	.63840	
440.00	2.1010	133.24	133.97	15.053	1.4122	1.5867	1.054	.5476	.65103	
450.00	2.0807	137.99	138.75	15.590	1.4584	1.6386	1.051	.5472	.66334	
466.00	2.0614	142.80	143.58	16.133	1.5049	1.6908	1.048	.5468	.67534	
470.00	2.0429	147.64	148.45	16.680	1.5516	1.7434	1.045	.5464	.68701	
480.00	2.0252	152.53	153.37	17.233	1.5987	1.7963	1.042	.5460	.69838	
490.00	2.0083	157.47	158.33	17.790	1.6460	1.8495	1.040	.5456	.70942	

NICKEL

PROCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/GM/CM2	MEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	CM	PERCENT	PERCENT	
500.00	1.9921	17.730	162.44	18.252	163.33	18.352	1.6936	.19029	1.037	.5452	.72015
510.00	1.9766	17.592	167.45	18.815	168.37	18.918	1.7415	.19567	1.034	.5448	.73057
520.00	1.9618	17.460	172.50	19.382	173.45	19.488	1.7895	.20107	1.032	.5445	.74069
530.00	1.9475	17.333	177.59	19.954	178.56	20.063	1.8378	.20650	1.029	.5441	.75050
540.00	1.9338	17.211	182.72	20.530	183.72	20.642	1.8864	.21195	1.027	.5437	.76000
550.00	1.9207	17.094	187.88	21.110	188.90	21.225	1.9351	.21743	1.024	.5433	.76922
560.00	1.9080	16.982	193.07	21.694	194.13	21.812	1.9841	.22293	1.022	.5430	.77814
570.00	1.8959	16.874	198.30	22.281	199.39	22.403	2.0333	.22846	1.020	.5426	.78677
580.00	1.8842	16.770	203.57	22.873	204.68	22.997	2.0827	.23401	1.018	.5422	.79513
590.00	1.8730	16.669	208.86	23.468	210.00	23.596	2.1322	.23958	1.015	.5419	.80320
600.00	1.8621	16.573	214.19	24.066	215.35	24.197	2.1820	.24517	1.013	.5415	.81101
620.00	1.8417	16.391	224.93	25.273	226.16	25.411	2.2820	.25641	1.009	.5408	.82584
640.00	1.8226	16.221	235.79	26.493	237.07	26.637	2.3827	.26772	1.005	.5401	.83966
660.00	1.8049	16.063	246.76	27.726	248.10	27.876	2.4841	.27911	1.001	.5393	.85251
680.00	1.7883	15.915	257.84	28.970	259.23	29.127	2.5861	.29057	.9976	.5386	.86446
700.00	1.7729	15.779	269.01	30.226	270.47	30.389	2.6886	.30209	.9941	.5379	.87553
720.00	1.7584	15.659	280.28	31.492	281.79	31.662	2.7917	.31367	.9907	.5372	.88580
740.00	1.7449	15.530	291.64	32.768	293.21	32.945	2.8952	.32531	.9874	.5364	.89530
760.00	1.7322	15.417	303.08	34.054	304.72	34.238	2.9993	.33700	.9843	.5357	.90408
780.00	1.7203	15.311	314.61	35.350	316.30	35.540	3.1038	.34874	.9813	.5350	.91216
800.00	1.7091	15.211	326.22	36.653	327.97	36.850	3.2088	.36054	.9784	.5342	.91965
820.00	1.6986	15.118	337.89	37.966	339.71	38.169	3.3141	.37237	.9756	.5335	.92654
840.00	1.6888	15.030	349.64	39.286	351.52	39.496	3.4199	.38425	.9729	.5328	.93287
860.00	1.6794	14.947	361.46	40.614	363.40	40.831	3.5260	.39618	.9703	.5320	.93870
880.00	1.6707	14.869	373.35	41.949	375.34	42.173	3.6325	.40814	.9678	.5313	.94405
900.00	1.6624	14.795	385.29	43.291	387.35	43.522	3.7393	.42014	.9654	.5305	.94896
920.00	1.6546	14.726	397.30	44.640	399.42	44.876	3.8464	.43218	.9630	.5297	.95347
940.00	1.6472	14.660	409.37	45.997	411.55	46.241	3.9538	.44425	.9607	.5289	.95760
960.00	1.6403	14.599	421.51	47.360	423.74	47.612	4.0616	.45636	.9585	.5279	.96138
1000.00	1.6275	14.485	446.06	50.119	448.42	50.384	4.2779	.48066	.9540	.5259	.96800

THE ELECTRON DENSITY OF NICKEL IS 2.873E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.078 BEV, AND THE MINIMUM ENERGY LOSS IS 1.5276 MEV/GM/CM2

NITROGEN (DIATOMIC)

ADJUSTED
IONIZATION
POTENTIAL
86.70

ATOMIC
WEIGHT
14.007

ATOMS/
MOLECULE
2

ATOMIC
NUMBER
7

ELEMENT
N

DENSITY = 1.2504 MG/CM3

PRCTON ENERGY MEV	ENERGY LOSS HEV/ GM/CM2	PROTON RANGE MG/CM2	PROTON RANGE METER	PROTON PATH LENGTH MG/CM2	PROTON PATH LENGTH METER	PATH LENGTH STRAGGLING MG/CM2	PATH LENGTH STRAGGLING METER	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	774.81	13462	.00108	.13572	.00109	.00461	.00004	3.399	.8112
.15	693.26	20273	.00162	.20391	.00163	.00596	.00005	2.923	.5794
.20	506.52	27960	.00224	.28096	.00225	.00742	.00006	2.643	.4811
.30	478.65	46564	.00372	.46748	.00374	.01139	.00009	2.437	.3923
.40	401.55	69372	.00555	.69616	.00557	.01641	.00013	2.357	.3516
.50	344.76	96228	.00770	.96544	.00772	.02223	.00018	2.303	.3279
.60	307.28	12696	.01015	1.2736	.01015	.02873	.00023	2.256	.3121
.70	277.95	16108	.01288	1.6156	.01292	.03563	.00028	2.205	.3007
.80	254.00	19862	.01588	1.9920	.01593	.04301	.00034	2.159	.2918
.90	238.30	23913	.01912	2.3981	.01918	.05070	.00041	2.114	.2846
1.00	222.58	28246	.02259	2.8325	.02265	.05861	.00047	2.069	.2784
1.20	196.24	37812	.03024	3.7914	.03032	.07570	.00061	1.997	.2682
1.40	176.18	48563	.03884	4.8689	.03894	.09441	.00076	1.939	.2602
1.60	160.33	60454	.04835	6.0608	.04847	.11461	.00092	1.891	.2535
1.80	147.44	73449	.05874	7.3632	.05889	.13623	.00109	1.850	.2479
2.00	136.71	87516	.06999	8.7730	.07016	.15922	.00127	1.815	.2430
2.20	127.61	10263	.08208	10.288	.08228	.18353	.00147	1.784	.2388
2.40	119.78	11879	.09500	11.907	.09522	.20913	.00167	1.756	.2350
2.60	112.96	13595	.10873	13.627	.10898	.23600	.00189	1.732	.2317
2.80	106.96	15412	.12326	15.447	.12354	.26410	.00211	1.710	.2287
3.00	101.62	17327	.13857	17.366	.13889	.29343	.00235	1.690	.2259
3.20	96.852	19340	.15467	19.383	.15501	.32396	.00259	1.671	.2234
3.40	92.553	21448	.17153	21.496	.17191	.35567	.00284	1.653	.2211
3.60	88.658	23653	.18916	23.705	.18958	.38855	.00311	1.639	.2190
3.80	85.110	25951	.20754	25.008	.20799	.42260	.00338	1.625	.2170
4.00	81.863	28343	.22667	28.404	.22716	.45779	.00366	1.612	.2152
4.20	78.875	30828	.24654	30.894	.24707	.49411	.00395	1.599	.2135
4.40	76.126	33404	.26715	33.475	.26771	.53155	.00425	1.588	.2119
4.60	73.577	36071	.28848	36.148	.28909	.57010	.00456	1.577	.2104
4.80	71.210	38830	.31054	38.911	.31119	.60976	.00488	1.567	.2090

NITROGEN (DIATOMIC)

PRCTCN ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH METER	GM/CM2	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	59.006	0.168	0.4176	33401	0.0065	0.0520	1.558	0.0052
5.50	64.101	0.4919	0.4929	39418	0.0076	0.0605	1.536	0.0065
6.00	59.828	0.5726	0.5738	45887	0.0087	0.0696	1.517	0.0081
6.50	56.214	0.6587	0.6600	52686	0.0099	0.0792	1.501	0.0247
7.00	53.049	0.7501	0.7516	60108	0.0112	0.0893	1.485	0.0508
7.50	50.251	0.8468	0.8484	67853	0.0125	0.0999	1.473	0.0768
8.00	47.759	0.9487	0.9505	76019	0.0139	0.1110	1.461	0.1027
8.50	45.525	1.0558	1.0578	84599	0.0153	0.1226	1.449	0.1286
9.00	43.508	1.1680	1.1702	93590	0.0168	0.1347	1.439	0.1545
9.50	41.679	1.2852	1.2876	1.0298	0.0184	0.1472	1.429	0.1804
10.00	40.011	1.4075	1.4101	1.1277	0.0200	0.1602	1.420	0.2063
11.00	37.080	1.6668	1.6699	1.3355	0.0235	0.1876	1.404	0.2580
12.00	34.585	1.9458	1.9494	1.5590	0.0271	0.2167	1.390	0.3097
13.00	32.433	2.2440	2.2481	1.7979	0.0310	0.2477	1.378	0.3614
14.00	30.557	2.5613	2.5660	2.0521	0.0351	0.2804	1.366	0.4131
15.00	28.906	2.8974	2.9026	2.3213	0.0394	0.3148	1.356	0.4649
16.00	27.440	3.2520	3.2578	2.6054	0.0439	0.3509	1.347	0.5168
17.00	26.130	3.6250	3.6314	2.9042	0.0486	0.3886	1.338	0.5687
18.00	24.952	4.0160	4.0231	3.2175	0.0535	0.4280	1.330	0.6207
19.00	23.885	4.4251	4.4328	3.5451	0.0586	0.4689	1.323	0.6727
20.00	22.916	4.8519	4.8604	3.8871	0.0640	0.5115	1.316	0.7247
22.00	21.216	5.7587	5.7682	4.6131	0.0752	0.6012	1.303	0.8290
24.00	19.776	6.7338	6.7453	5.3945	0.0872	0.6971	1.292	0.9334
26.00	18.537	7.7773	7.7905	6.2304	0.0999	0.7989	1.282	0.9964
28.00	17.461	8.8878	8.9028	7.1200	0.1133	0.9064	1.273	1.0170
30.00	16.516	1.0064	1.0081	8.0622	0.1275	1.0197	1.265	1.0384
32.00	15.680	1.1305	1.1324	9.0565	0.1424	1.1385	1.259	1.0605
34.00	14.933	1.2611	1.2632	10.102	0.1579	1.2628	1.250	1.0832
36.00	14.263	1.3980	1.4003	11.199	0.1741	1.3924	1.243	1.1066
38.00	13.658	1.5411	1.5436	12.345	0.1910	1.5273	1.237	1.1306
40.00	13.109	1.6903	1.6931	13.540	0.2085	1.6674	1.231	1.1550
45.00	11.934	2.0900	2.0934	16.742	0.2550	2.0395	1.218	1.2180
50.00	10.977	2.5265	2.5307	20.239	0.3054	2.4421	1.207	1.2829
55.00	10.182	2.9993	3.0041	24.025	0.3594	2.8740	1.196	1.3502
60.00	9.5101	3.5070	3.5126	28.091	0.4169	3.3341	1.187	1.4202
65.00	8.9349	4.0489	4.0553	32.432	0.4778	3.8215	1.178	1.4926
70.00	8.4364	4.6242	4.6315	37.040	0.5421	4.3353	1.170	1.5669
75.00	8.0002	5.2321	5.2404	41.844	0.6095	4.8745	1.163	1.6429
80.00	7.6150	5.8720	5.8812	47.035	0.6800	5.4385	1.156	1.7201
90.00	6.9655	7.2448	7.2561	58.030	0.8300	6.6376	1.144	1.8770

NITROGEN (DIATOMIC)

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	KEV/CH	GM/CH2	METER	GM/CM2	METER	GM/CM2	METER PERCENT		
100.00	6.4386	8.0508	8.7373	69.876	8.7509	69.985	.09912	.79270	1.133	.20354
110.00	6.0023	7.5052	10.345	82.733	10.361	82.860	.11631	.93017	1.123	.21959
120.00	5.6349	7.0459	12.063	96.473	12.082	96.621	.13451	1.0757	1.113	.23599
130.00	5.3212	6.6536	13.888	111.06	13.909	111.24	.15366	1.2289	1.105	.25262
140.00	5.0502	6.3148	15.815	126.48	15.839	126.67	.17372	1.3893	1.097	.26937
150.00	4.8137	6.0191	17.841	142.68	17.868	142.90	.19465	1.5567	1.089	.28613
160.00	4.6055	5.7587	19.962	159.65	19.993	159.89	.21640	1.7306	1.092	.30298
170.00	4.4208	5.5277	22.176	177.35	22.209	177.62	.23893	1.9108	1.076	.31996
180.00	4.2558	5.3216	24.479	195.77	24.516	196.06	.26221	2.0970	1.070	.33703
190.00	4.1076	5.1331	26.867	214.87	26.908	215.19	.28619	2.2688	1.064	.35412
200.00	3.9737	4.9687	29.340	234.64	29.384	234.99	.31086	2.4861	1.058	.37117
210.00	3.8521	4.8167	31.892	255.06	31.940	255.44	.33618	2.6886	1.053	.38824
220.00	3.7413	4.6782	34.523	276.10	34.575	276.51	.36212	2.8960	1.047	.40540
230.00	3.6399	4.5513	37.229	297.74	37.285	298.19	.38866	3.1083	1.042	.42260
240.00	3.5467	4.4348	40.009	319.97	40.069	320.45	.41576	3.3250	1.038	.43979
250.00	3.4609	4.3275	42.859	342.77	42.923	343.28	.44341	3.5462	1.033	.45694
260.00	3.3815	4.2282	45.779	366.11	45.847	366.66	.47159	3.7715	1.029	.47395
270.00	3.3079	4.1362	48.765	389.99	48.837	390.57	.50026	4.0008	1.024	.49072
280.00	3.2395	4.0507	51.815	414.39	51.892	415.01	.52942	4.2340	1.020	.50723
290.00	3.1758	3.9710	54.929	439.29	55.010	439.94	.55904	4.4709	1.016	.52345
300.00	3.1163	3.8967	58.103	464.68	58.189	465.37	.58911	4.7113	1.012	.53938
310.00	3.0607	3.8270	61.337	490.54	61.427	491.26	.61960	4.9552	1.009	.55496
320.00	3.0085	3.7618	64.628	516.96	64.723	517.62	.65050	5.2024	1.005	.57017
330.00	2.9594	3.7005	67.975	543.62	68.075	544.42	.68180	5.4527	1.002	.58500
340.00	2.9133	3.6428	71.376	570.82	71.481	571.66	.71348	5.7060	.9981	.59943
350.00	2.8699	3.5885	74.829	598.44	74.939	599.32	.74553	5.9623	.9948	.61347
360.00	2.8288	3.5372	78.334	626.47	76.19	627.39	.77793	6.2214	.9916	.62724
370.00	2.7901	3.4887	81.889	654.90	82.009	655.86	.81064	6.4832	.9885	.64087
380.00	2.7534	3.4428	85.492	683.72	85.617	684.72	.84373	6.7477	.9855	.65432
390.00	2.7186	3.3993	.142	712.91	89.272	713.95	.87711	7.0147	.9825	.66759
400.00	2.6856	3.3581	92.838	742.46	92.973	743.55	.91080	7.2841	.9796	.68125
410.00	2.6543	3.3189	96.578	772.38	96.719	773.50	.94478	7.5558	.9768	.69342
420.00	2.6245	3.2817	100.36	802.64	100.51	803.81	.97905	7.8299	.9741	.70581
430.00	2.5961	3.2462	104.19	833.23	104.34	834.45	1.0136	8.1061	.9714	.71784
440.00	2.5691	3.2124	108.05	864.16	108.21	865.41	1.0484	8.3845	.9688	.72949
450.00	2.5433	3.1802	111.96	895.40	112.12	896.70	1.0835	8.6649	.9663	.74078
460.00	2.5187	3.1494	115.91	926.95	116.07	928.30	1.1188	8.9473	.9638	.75170
470.00	2.4952	3.1200	119.89	958.81	120.06	960.20	1.1543	9.2316	.9614	.76226
480.00	2.4728	3.0919	123.91	990.96	124.09	992.40	1.1901	9.5177	.9591	.77246
490.00	2.4513	3.0651	127.97	1023.4	128.15	1024.9	1.2261	9.8057	.9568	.78230

NITROGEN (DIATOMIC)

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH G1 M2	PROTON PATH LENGTH METER	PATH LENGTH STRAGGLING GM/CM2	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	2.4307	132.06	132.25	1057.6	1.2623	.1445	.79181
510.00	2.4109	136.18	136.38	1090.7	1.2988	.1444	.80097
520.00	2.3920	140.34	140.54	1124.0	1.3354	.1442	.80979
530.00	2.3739	144.53	144.74	1157.6	1.3722	.1441	.81829
540.00	2.3564	148.75	148.97	1191.4	1.4093	.1439	.82647
550.00	2.3397	153.01	153.23	1225.4	1.4465	.1438	.83434
560.00	2.3236	157.29	157.52	1259.7	1.4839	.1437	.84190
570.00	2.3081	161.60	161.83	1294.3	1.5214	.1435	.84917
580.00	2.2932	165.94	166.18	1329.0	1.5592	.1434	.85614
590.00	2.2788	170.31	170.56	1364.0	1.5971	.1432	.86284
600.00	2.2650	174.71	174.96	1399.2	1.6351	.1431	.86926
620.00	2.2389	183.58	183.84	1470.2	1.7117	.1428	.88132
640.00	2.2145	192.53	192.82	1542.1	1.7889	.1425	.89238
660.00	2.1918	201.61	201.90	1614.7	1.8666	.1422	.90251
680.00	2.1706	210.77	211.07	1688.0	1.9449	.1420	.91178
700.00	2.1508	220.02	220.33	1762.1	2.0237	.1417	.92024
720.00	2.1323	229.34	229.67	1836.7	2.1029	.1414	.92796
740.00	2.1149	238.75	239.09	1912.1	2.1826	.1411	.93498
760.00	2.0986	248.23	248.58	1988.0	2.2627	.1409	.94137
780.00	2.0832	257.78	258.15	2064.5	2.3432	.1406	.94718
800.00	2.0688	267.40	267.78	2141.6	2.4242	.1403	.95244
820.00	2.0552	277.09	277.48	2219.1	2.5054	.1400	.95721
840.00	2.0424	286.84	287.24	2297.2	2.5871	.1398	.96153
860.00	2.0303	296.65	297.07	2375.8	2.6691	.1395	.96543
880.00	2.0189	306.52	306.95	2454.8	2.7514	.1392	.96896
900.00	2.0082	316.45	316.89	2534.3	2.8340	.1389	.97214
920.00	1.9980	326.42	326.88	2614.2	2.9170	.1387	.97501
940.00	1.9884	336.45	336.92	2694.5	3.0002	.1384	.97760
960.00	1.9793	346.54	347.02	2775.3	3.0837	.1380	.97993
1000.00	1.9625	366.94	367.45	2938.6	3.2515	.1372	.98393

THE ELECTRON DENSITY OF NITROGEN (DIATOMIC) IS 3.011E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.276 BEV, AND THE MINIMUM ENERGY LOSS IS 1.8170 MEV/GM/CM2

OSMIUM

ELEMENT OS
 ATOMIC NUMBER 76
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 190.20
 ADJUSTED IONIZATION POTENTIAL 751.4

DENSITY = 22.300 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
		MG/CM2	MM	MG/CM2	MM	MG/CM2	MM		
.10	113.68	1.2063	.00054	1.2716	.00057	.06445	.00003	5.134	0.
.15	120.35	1.6283	.00072	1.6990	.00076	.08025	.00004	4.164	0.
.20	120.65	2.0320	.00090	2.1139	.00094	.09344	.00004	3.874	0.
.30	111.51	2.8617	.00127	2.9722	.00132	.12048	.00005	3.719	0.
.40	95.978	3.7794	.00168	3.9237	.00174	.15060	.00007	3.677	0.
.50	88.515	4.8113	.00214	4.9957	.00222	.18498	.00008	3.652	0.
.60	81.139	5.9516	.00265	6.1757	.00274	.22250	.00010	3.629	0.
.70	75.552	7.1844	.00319	7.4531	.00331	.26164	.00012	3.605	0.
.80	69.585	8.5134	.00378	8.8293	.00392	.30292	.00013	3.578	0.
.90	67.586	9.9212	.00441	10.286	.00457	.34498	.00015	3.550	0.
1.00	65.585	11.374	.00506	11.789	.00524	.38516	.00017	3.521	0.
1.20	61.002	14.435	.00642	14.952	.00665	.46477	.00021	3.458	0.
1.40	57.012	17.723	.00788	18.346	.00815	.54944	.00024	3.392	0.
1.60	53.552	21.258	.00944	21.969	.00976	.63929	.00028	3.327	0.
1.80	50.533	24.974	.01110	25.817	.01147	.73351	.00033	3.264	0.
2.00	47.688	28.926	.01286	29.883	.01328	.83159	.00037	3.203	0.
2.20	45.527	33.091	.01471	34.166	.01518	.93322	.00041	3.146	0.
2.40	43.441	37.470	.01665	38.666	.01718	1.0383	.00046	3.093	0.
2.60	41.566	42.054	.01869	43.374	.01928	1.1465	.00051	3.043	0.
2.80	39.872	46.841	.02082	48.288	.02146	1.2579	.00056	2.997	0.
3.00	38.334	51.827	.02303	53.404	.02374	1.3721	.00061	2.953	0.
3.20	36.933	57.011	.02534	58.721	.02610	1.4893	.00066	2.912	0.
3.40	35.650	62.388	.02773	64.233	.02855	1.6093	.00072	2.874	0.
3.60	34.469	67.957	.03020	69.942	.03109	1.7319	.00077	2.838	0.
3.80	33.374	73.713	.03276	75.840	.03371	1.8573	.00083	2.804	0.
4.00	32.356	79.655	.03540	81.926	.03641	1.9853	.00088	2.772	0.
4.20	31.411	85.763	.03813	88.201	.03920	2.1159	.00094	2.742	0.
4.40	30.505	92.097	.04093	94.665	.04207	2.2493	.00100	2.713	0.
4.60	29.698	98.597	.04382	101.32	.04503	2.3852	.00106	2.686	0.
4.80	28.939	105.26	.04678	108.14	.04806	2.5234	.00112	2.660	0.

OSMIUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PRGTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CH	GH/CH2	CH	GH/CH2	CH	GH/CH2	CH		
5.00	28.393	638.85	.11207	.00498	.11510	.00512	.00266	.00012	2.637	0.
5.50	26.742	601.69	.12984	.00577	.13328	.00592	.00302	.00013	2.581	0.
6.00	25.303	569.31	.14866	.00661	.15252	.00678	.00339	.00015	2.530	0.
6.50	24.037	540.83	.16851	.00749	.17281	.00760	.00378	.00017	2.485	.00001
7.00	22.912	515.52	.18938	.00842	.19412	.00863	.00419	.00019	2.444	.00003
7.50	21.906	492.88	.21123	.00939	.21644	.00962	.00452	.00021	2.407	.00005
8.00	20.993	472.35	.23406	.01040	.23975	.01066	.00507	.00023	2.373	.00006
8.50	20.182	454.09	.25785	.01146	.26404	.01173	.00552	.00025	2.343	.00006
9.00	19.441	437.43	.28255	.01256	.28925	.01286	.00600	.00027	2.314	.00007
9.50	18.762	422.14	.30828	.01370	.31550	.01402	.00648	.00029	2.288	.00007
10.00	18.137	408.09	.33484	.01488	.34259	.01523	.00698	.00031	2.264	.00008
11.00	17.524	383.03	.39069	.01736	.39956	.01776	.00801	.00036	2.219	.00009
12.00	16.062	361.39	.45004	.02000	.46007	.02045	.00909	.00040	2.180	.00012
13.00	15.218	342.40	.51282	.02279	.52406	.02329	.01022	.00045	2.145	.00017
14.00	14.473	325.64	.57897	.02573	.59147	.02629	.01139	.00051	2.114	.00023
15.00	13.808	310.68	.64842	.02882	.66223	.02943	.01260	.00058	2.086	.00031
16.00	13.211	297.24	.72110	.03205	.73628	.03272	.01386	.00062	2.061	.00042
17.00	12.671	285.09	.79698	.03542	.81356	.03616	.01515	.00067	2.037	.00055
18.00	12.180	274.05	.87611	.03894	.89414	.03974	.01649	.00073	2.016	.00070
19.00	11.732	263.97	.95827	.04259	.97779	.04346	.01786	.00079	1.997	.00087
20.00	11.321	254.72	1.0435	.04639	1.0646	.04731	.01928	.00086	1.979	.00107
22.00	10.592	238.32	1.2231	.05436	1.2473	.05544	.02222	.00099	1.946	.00153
24.00	9.9641	224.19	1.4145	.06287	1.4421	.06409	.02530	.00112	1.917	.00207
26.00	9.4138	211.81	1.6175	.07189	1.6487	.07328	.02853	.00127	1.892	.00304
28.00	8.9598	201.60	1.8320	.08142	1.8669	.08297	.03189	.00142	1.869	.00444
30.00	8.5340	192.01	2.0565	.09140	2.0953	.09312	.03537	.00157	1.849	.00588
32.00	8.1530	183.44	2.2929	.10190	2.3356	.10381	.03897	.00173	1.831	.00738
34.00	7.8101	175.73	2.5392	.11285	2.5861	.11494	.04270	.00190	1.814	.00894
36.00	7.4982	168.71	2.7963	.12428	2.8475	.12656	.04656	.00207	1.799	.01054
38.00	7.2165	162.37	3.0640	.13618	3.1197	.13865	.05055	.00225	1.785	.01219
40.00	6.9586	156.57	3.3414	.14851	3.4017	.15119	.05468	.00243	1.772	.01389
45.00	6.3997	143.99	4.0796	.18132	4.1520	.18453	.06552	.00291	1.743	.01832
50.00	5.9378	133.60	4.8786	.21682	4.9639	.22062	.07711	.00343	1.719	.02299
55.00	5.5486	124.84	5.7366	.25496	5.8357	.25937	.08940	.00397	1.699	.02789
60.00	5.2162	117.36	6.6519	.29564	6.7656	.30069	.10236	.00455	1.681	.03305
65.00	4.9287	110.90	7.6229	.33880	7.7521	.34454	.11596	.00515	1.665	.03843
70.00	4.6777	105.25	8.6488	.38426	8.7911	.39071	.13018	.00579	1.652	.04402
75.00	4.4561	100.26	9.7250	.43222	9.8871	.43943	.14499	.00644	1.640	.04980
80.00	4.2588	95.622	10.855	.48245	11.035	.49044	.16038	.00713	1.629	.05576
90.00	3.9234	88.276	13.267	.58964	13.484	.59928	.19280	.00857	1.610	.06813

OSMIUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CM	GH/CH2	CH	GH/CH2	CH	GM/CM2	CM		
100.00	3.6502	82.130	15.869	70528	16.126	71671	.22727	.01010	1.409	.08103
110.00	3.4218	76.989	18.658	82922	18.957	84254	.26363	.01172	1.391	.09443
120.00	3.2280	72.630	21.623	96101	21.968	97636	.30183	.01341	1.374	.10833
130.00	3.0614	68.861	24.758	11033	25.150	11178	.34171	.01519	1.359	.12266
140.00	2.9167	65.625	28.053	12468	28.495	12664	.38320	.01703	1.345	.13735
150.00	2.7897	62.768	31.507	14003	32.002	14223	.42622	.01894	1.332	.15234
160.00	2.6774	60.242	35.113	15606	35.661	15850	.47068	.02092	1.320	.16762
170.00	2.5774	57.992	38.864	17273	39.469	17542	.51651	.02296	1.309	.18320
180.00	2.4878	55.976	42.755	19002	43.418	19297	.56364	.02505	1.298	.19903
190.00	2.4071	54.159	46.782	20792	47.505	21113	.61201	.02720	1.288	.21507
200.00	2.3339	52.512	50.940	22640	51.725	22989	.66156	.02940	1.279	.23126
210.00	2.2695	51.064	55.223	24544	56.072	24921	.71217	.03165	1.270	.24753
220.00	2.2085	49.691	59.620	26498	60.534	26904	.76377	.03395	1.262	.26381
230.00	2.1525	48.432	64.144	28503	65.126	28945	.81640	.03628	1.254	.28007
240.00	2.1010	47.273	68.768	30564	69.819	31031	.87002	.03867	1.246	.29627
250.00	2.0535	46.203	73.516	32674	74.636	33172	.92457	.04109	1.239	.31239
260.00	2.0095	45.213	78.370	34831	79.562	35361	.98001	.04356	1.232	.32841
270.00	1.9686	44.294	83.326	37034	84.592	37597	1.03633	.04606	1.225	.34433
280.00	1.9306	43.439	88.385	39282	89.726	39876	1.09334	.04860	1.219	.36011
290.00	1.8952	42.642	93.538	41573	94.956	42203	1.15133	.05117	1.212	.37574
300.00	1.8621	41.897	98.769	43897	100.26	44562	1.2100	.05378	1.207	.39120
310.00	1.8301	41.178	104.11	46270	105.68	46970	1.2693	.05642	1.201	.40653
320.00	1.8010	40.523	109.54	48686	111.20	49421	1.3295	.05909	1.196	.42177
330.00	1.7736	39.907	115.06	51136	116.79	51907	1.3902	.06179	1.190	.43690
340.00	1.7479	39.328	120.65	53623	122.47	54431	1.4517	.06452	1.185	.45189
350.00	1.7237	38.782	126.33	56146	128.23	56991	1.5137	.06727	1.180	.46674
360.00	1.7007	38.267	132.08	58704	134.07	59586	1.5762	.07005	1.176	.48142
370.00	1.6791	37.780	137.97	61319	140.04	62239	1.6394	.07286	1.171	.49592
380.00	1.6586	37.318	143.87	63944	146.03	64903	1.7030	.07569	1.166	.51022
390.00	1.6392	36.881	149.85	66601	152.10	67593	1.7672	.07854	1.162	.52431
400.00	1.6207	36.466	155.86	69272	158.20	70309	1.8318	.08142	1.158	.53818
410.00	1.6032	36.072	161.96	71982	164.38	73059	1.8970	.08431	1.154	.55183
420.00	1.5865	35.697	168.14	74728	170.65	75845	1.9625	.08722	1.150	.56523
430.00	1.5707	35.340	174.38	77502	176.99	78660	2.0285	.09016	1.146	.57839
440.00	1.5556	35.001	180.68	80304	183.38	81503	2.0950	.09311	1.142	.59130
450.00	1.5412	34.677	187.05	83132	189.84	84373	2.1618	.09608	1.137	.60395
460.00	1.5274	34.367	193.47	85986	196.35	87269	2.2290	.09907	1.133	.61634
470.00	1.5143	34.072	199.95	88866	202.93	90191	2.2966	.10207	1.132	.62846
480.00	1.5017	33.789	206.48	91770	209.56	93137	2.3645	.10509	1.128	.64032
490.00	1.4897	33.519	213.07	94698	216.24	96108	2.4328	.10813	1.125	.65192

OSMIUM

PROTON ENERGY MEV	ENERGY LOSS HEV/GM/CM2	PROTON RANGE GM/CM2	PROTON RANGE CM	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	GM/CM2	PATH LENGTH STRAGGLING CM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	1.4782	219.71	9.7649	222.98	9.9102	2.5014	.11117	1.122	1.466	.66325
510.00	1.4672	226.40	10.062	229.77	10.212	2.5704	.11424	1.119	1.465	.67431
520.00	1.4567	233.14	10.362	236.61	10.516	2.6396	.11732	1.116	1.464	.68510
530.00	1.4465	239.96	10.665	243.53	10.823	2.7092	.12041	1.112	1.463	.69562
540.00	1.4369	246.80	10.969	250.46	11.132	2.7790	.12351	1.110	1.462	.70588
550.00	1.4275	253.68	11.275	257.44	11.442	2.8491	.12663	1.107	1.461	.71587
560.00	1.4186	260.61	11.582	264.47	11.754	2.9195	.12976	1.104	1.461	.72561
570.00	1.4100	267.57	11.892	271.54	12.068	2.9901	.13289	1.101	1.460	.73508
580.00	1.4017	274.59	12.204	278.65	12.384	3.0610	.13605	1.099	1.459	.74429
590.00	1.3937	281.64	12.517	285.80	12.702	3.1321	.13921	1.096	1.458	.75325
600.00	1.3860	288.73	12.832	293.00	13.022	3.2035	.14238	1.093	1.457	.76195
620.00	1.3715	303.03	13.468	307.50	13.667	3.3469	.14875	1.088	1.456	.77863
640.00	1.3581	317.47	14.110	322.16	14.318	3.4911	.15516	1.084	1.455	.79433
660.00	1.3455	332.06	14.758	336.95	14.976	3.6361	.16161	1.079	1.453	.80911
680.00	1.3339	346.77	15.412	351.88	15.639	3.7819	.16808	1.075	1.451	.82228
700.00	1.3230	361.65	16.073	366.97	16.310	3.9283	.17459	1.070	1.450	.83600
720.00	1.3128	376.75	16.745	382.29	16.990	4.0754	.18113	1.066	1.447	.84819
740.00	1.3033	391.83	17.415	397.58	17.670	4.2231	.18770	1.062	1.446	.85959
760.00	1.2944	407.02	18.090	412.99	18.355	4.3714	.19429	1.058	1.444	.87024
780.00	1.2860	422.31	18.769	428.50	19.044	4.5203	.20090	1.055	1.444	.88017
800.00	1.2782	437.71	19.454	444.11	19.738	4.6696	.20754	1.051	1.442	.88943
820.00	1.2708	453.19	20.142	459.81	20.436	4.8194	.21420	1.048	1.441	.89805
840.00	1.2639	468.76	20.834	475.60	21.138	4.9697	.22088	1.045	1.439	.90606
860.00	1.2574	484.41	21.529	491.48	21.844	5.1204	.22757	1.042	1.438	.91351
880.00	1.2513	500.15	22.229	507.44	22.553	5.2715	.23429	1.039	1.436	.92042
900.00	1.2456	515.97	22.932	523.48	23.266	5.4230	.24102	1.036	1.435	.92682
920.00	1.2402	531.87	23.639	539.60	23.982	5.5749	.24777	1.033	1.433	.93276
940.00	1.2351	547.84	24.349	555.79	24.702	5.7271	.25454	1.030	1.431	.93825
960.00	1.2303	563.90	25.062	572.07	25.425	5.8797	.26132	1.028	1.428	.94332
1000.00	1.2215	596.40	26.506	605.00	26.889	6.1857	.27492	1.022	1.422	.95230

THE ELECTRON DENSITY OF OSMIUM IS 2.407E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 1.929 BEV, AND THE MINIMUM ENERGY LOSS IS 1.1570 MEV/GM/CM2

OXYGEN (DIATOMIC)

ELEMENT NUMBER 8
 ATOMIC NUMBER 8
 ATOMS/MOLECULE 2
 ATOMIC WEIGHT 15.999
 ADJUSTED IONIZATION POTENTIAL 88.90

DENSITY = 1.4290 MG/CM3

FRCTON ENERGY MEV	ENERGY LOSS KEV/CM	PROTON RANGE MG/CM2	PROTON PATH LENGTH METER	PROTON PATH LENGTH MG/CM2	MG/CM2	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	610.76	.16607	.00116	.16750	.00585	.00004	.8995	0.
.15	600.68	.24849	.00174	.25013	.00779	.00005	.6536	0.
.20	543.55	.33570	.00235	.33758	.00950	.00007	.5575	0.
.30	450.79	.53741	.00376	.53994	.01340	.00009	.4683	0.
.40	381.69	.77832	.00545	.78163	.01840	.00013	.4231	0.
.50	334.64	1.0580	.00740	1.0621	.02427	.00017	.3945	0.
.60	301.66	1.3721	.00960	1.3772	.03066	.00021	.3741	0.
.70	271.73	1.7201	.01204	1.7263	.03759	.00026	.357	0.
.80	252.03	2.1012	.01470	2.1085	.04498	.00031	.34	0.
.90	237.50	2.5085	.01755	2.5170	.05254	.00037	.336	0.
1.00	222.95	2.9420	.02059	2.9517	.06029	.00042	.3271	0.
1.20	196.26	3.8976	.02728	3.9099	.07714	.00054	.3124	0.
1.40	175.97	4.9731	.03480	4.9881	.09579	.00067	.3008	0.
1.60	159.94	6.1641	.04314	6.1821	.11609	.00081	.2913	.00001
1.80	146.92	7.4669	.05225	7.4882	.13793	.00097	.2834	.00001
2.00	136.11	8.8792	.06214	8.9038	.16121	.00113	.2767	.00002
2.20	126.98	10.398	.07276	10.426	.18589	.00130	.2709	.00003
2.40	119.13	12.021	.08412	12.053	.21191	.00148	.2659	.00005
2.60	112.31	13.747	.09620	13.783	.23923	.00167	.2615	.00007
2.80	106.32	15.574	.10898	15.614	.26781	.00187	.2575	.00008
3.00	101.00	17.500	.12246	17.545	.29764	.00208	.2540	.00011
3.20	96.249	19.525	.13663	19.574	.32869	.00230	.2508	.00013
3.40	91.973	21.647	.15148	21.700	.36094	.00253	.2479	.00015
3.60	88.100	23.865	.16700	23.923	.39437	.00276	.2453	.00018
3.80	84.575	26.177	.18318	26.240	.42896	.00300	.2429	.00021
4.00	81.350	28.583	.20002	28.652	.46471	.00325	.2406	.00024
4.20	78.387	31.083	.21752	31.157	.50160	.00351	.2385	.00028
4.40	75.654	33.675	.23565	33.755	.53961	.00378	.2366	.00031
4.60	73.124	36.359	.25443	36.444	.57874	.00405	.2348	.00035
4.80	70.775	39.133	.27385	39.225	.61898	.00433	.2331	.00039

OXYGEN (DIATOMIC)

PRCTON ENERGY HEV	ENERGY LOSS HEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH METER	PATH LENGTH STRAGGLING GM/CM2	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	68.588	0.4200	0.4210	.29458	.00066	.2315	.00043
5.50	63.721	0.4955	0.4966	.34676	.00077	.2279	.00055
6.00	59.559	0.5766	0.5779	.40347	.00088	.2248	.00068
6.50	55.955	0.6630	0.6645	.46399	.00100	.2221	.00084
7.00	52.800	0.7549	0.7566	.52827	.00113	.2196	.00225
7.50	49.960	0.8521	0.8540	.59629	.00127	.2174	.00458
8.00	47.491	0.9546	0.9567	.66801	.00141	.2154	.00650
8.50	45.275	1.0621	1.0644	.74328	.00155	.2136	.00922
9.00	43.276	1.1750	1.1774	.82222	.00171	.2120	.01155
9.50	41.462	1.2928	1.2956	.90471	.00186	.2104	.01357
10.00	39.807	1.4157	1.4187	.99279	.00203	.2090	.01619
11.00	36.898	1.6763	1.6798	1.1755	.00237	.2065	.02084
12.00	34.421	1.9566	1.9606	1.3720	.00274	.2043	.02549
13.00	32.284	2.2562	2.2608	1.5821	.00313	.2024	.03016
14.00	30.420	2.5749	2.5800	1.8055	.00355	.2007	.03483
15.00	28.779	2.9123	2.9181	2.0421	.00398	.1991	.03951
16.00	27.323	3.2684	3.2740	2.2917	.00443	.1977	.04420
17.00	26.020	3.6429	3.6500	2.5543	.00491	.1964	.04890
18.00	24.849	4.0356	4.0435	2.8296	.00541	.1953	.05361
19.00	23.768	4.4462	4.4549	3.1175	.00592	.1942	.05833
20.00	22.824	4.8747	4.8841	3.4179	.00646	.1932	.06306
22.00	21.134	5.7844	5.7955	4.0556	.00754	.1915	.07254
24.00	19.700	6.7636	6.7765	4.7421	.00880	.1899	.08206
26.00	18.468	7.8108	7.8256	5.4762	.01008	.1885	.08785
28.00	17.397	8.9252	8.9419	6.2575	.01143	.1873	.08980
30.00	16.457	1.0106	1.0124	7.0850	.01286	.1862	.09183
32.00	15.624	1.1351	1.1372	7.9582	.01435	.1852	.09393
34.00	14.881	1.2661	1.2684	8.8600	.01592	.1843	.09609
36.00	14.214	1.4034	1.4060	9.8390	.01755	.1835	.09832
38.00	13.612	1.5470	1.5498	10.845	.01925	.1828	.10059
40.00	13.065	1.6967	1.6998	11.895	.02101	.1821	.10291
45.00	11.895	2.0976	2.1014	14.706	.02569	.1805	.10890
50.00	10.942	2.5356	2.5402	17.744	.03075	.1792	.11507
55.00	10.150	3.0097	3.0150	21.099	.03618	.1781	.12148
60.00	9.4808	3.5189	3.5251	24.625	.04197	.1771	.12818
65.00	8.9078	4.0623	4.0695	28.428	.04809	.1763	.13514
70.00	8.4112	4.6393	4.6475	32.465	.05455	.1755	.14232
75.00	7.9765	5.2490	5.2582	36.796	.06133	.1748	.14970
80.00	7.5928	5.8966	5.9009	41.294	.06842	.1742	.15723
90.00	6.9456	7.2672	7.2798	50.943	.08349	.1731	.17266

OXYGEN (DIATOMIC)

PROTON ENERGY HEV	ENERGY LOSS HEV/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH METER	GM/CM2	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	6.4205	8.7637	8.7788	61.433	.09969	.69760	1.136	.18840
110.00	5.9856	10.375	10.393	72.731	.11696	.81847	1.125	.20448
120.00	5.6195	12.098	12.119	84.805	.13524	.94642	1.116	.22097
130.00	5.3068	13.927	13.951	97.461	.15449	1.0811	1.107	.23776
140.00	5.0367	15.859	15.886	111.17	.17464	1.2221	1.099	.25473
150.00	4.8010	17.890	17.921	125.41	.19566	1.3692	1.092	.27179
160.00	4.5934	20.017	20.051	140.31	.21751	1.5221	1.085	.28893
170.00	4.4093	22.236	22.274	155.87	.24014	1.6805	1.078	.30617
180.00	4.2449	24.544	24.586	172.05	.26352	1.8441	1.072	.32343
190.00	4.0971	26.939	26.984	188.83	.28761	2.0127	1.065	.34066
200.00	3.9636	29.417	29.466	206.20	.31238	2.1860	1.060	.35781
210.00	3.8424	31.976	32.029	224.14	.33781	2.3640	1.055	.37485
220.00	3.7320	34.613	34.670	242.62	.36386	2.5463	1.049	.39181
230.00	3.6308	37.325	37.388	261.63	.39051	2.7327	1.044	.40862
240.00	3.5380	40.111	40.178	281.16	.41772	2.9232	1.040	.42527
250.00	3.4524	42.968	43.040	301.19	.44549	3.1175	1.035	.44171
260.00	3.3732	45.894	45.970	321.70	.47378	3.3155	1.031	.45798
270.00	3.2999	48.887	48.968	342.67	.50257	3.5170	1.026	.47411
280.00	3.2317	51.945	52.031	364.11	.53185	3.7218	1.022	.49006
290.00	3.1682	55.065	55.156	385.98	.56159	3.9300	1.018	.50581
300.00	3.1088	58.247	58.343	408.28	.59178	4.1412	1.014	.52135
310.00	3.0533	61.488	61.580	430.99	.62239	4.3555	1.011	.53667
320.00	3.0013	64.786	64.893	454.11	.65342	4.5726	1.007	.55177
330.00	2.9524	68.140	68.252	477.62	.68484	4.7925	1.003	.56665
340.00	2.9064	71.549	71.666	501.51	.71665	5.0150	1.000	.58127
350.00	2.8631	75.010	75.133	525.77	.74882	5.2402	.9967	.59563
360.00	2.8222	78.522	78.651	550.39	.78135	5.4678	.9934	.60977
370.00	2.7835	82.085	82.219	575.36	.81421	5.6978	.9903	.62372
380.00	2.7470	85.696	85.836	600.67	.84741	5.9301	.9872	.63747
390.00	2.7123	89.354	89.499	626.31	.88092	6.1646	.9843	.65099
400.00	2.6794	93.057	93.209	652.27	.91474	6.4012	.9814	.66427
410.00	2.6482	96.806	96.963	678.54	.94885	6.6400	.9786	.67725
420.00	2.6185	100.60	100.76	705.12	.98325	6.8807	.9758	.68985
430.00	2.5902	104.43	104.60	731.99	1.0179	7.1233	.9731	.70207
440.00	2.5632	108.31	108.48	759.15	1.0529	7.3678	.9705	.71393
450.00	2.5375	112.22	112.40	786.59	1.0881	7.6141	.9680	.72541
460.00	2.5130	116.17	116.36	814.30	1.1235	7.8621	.9655	.73653
470.00	2.4896	120.11	120.36	842.28	1.1592	8.1118	.9631	.74729
480.00	2.4672	124.20	124.40	870.52	1.1951	8.3632	.9607	.75769
490.00	2.4457	128.26	128.47	899.00	1.2312	8.6161	.9584	.76774

OXYGEN (DIATOMIC)

PROTON ENERGY MEV	ENERGY LOSS MEV/GH/CH2	PROTON RANGE GH/CH2	PROTON PATH LENGTH GH/CH2	PROTON PATH LENGTH METER	GM/CM2	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	2.4232	132.36	132.57	927.74	1.2676	8.0705	.1613	.77744
510.00	2.4055	136.49	136.71	956.71	1.3042	9.1264	.1611	.78681
520.00	2.3867	140.66	140.89	985.92	1.3439	9.3838	.1610	.79584
530.00	2.3686	144.86	145.09	1015.4	1.3779	9.6425	.1608	.80454
540.00	2.3512	149.09	149.33	1045.0	1.4151	9.9026	.1607	.81292
550.00	2.3345	153.35	153.60	1074.9	1.4524	10.164	.1605	.82099
560.00	2.3184	157.65	157.90	1105.0	1.4900	10.427	.1604	.82876
570.00	2.3030	161.97	162.23	1135.2	1.5277	10.690	.1602	.83623
580.00	2.2881	166.32	166.58	1165.7	1.5655	10.956	.1601	.84342
590.00	2.2738	170.69	170.97	1196.4	1.6036	11.222	.1599	.85072
600.00	2.2601	175.10	175.38	1227.3	1.6418	11.489	.1598	.85696
620.00	2.2340	183.99	184.28	1289.6	1.7187	12.027	.1595	.86944
640.00	2.2097	192.97	193.28	1352.6	1.7961	12.569	.1592	.88093
660.00	2.1871	202.06	202.38	1416.2	1.8741	13.115	.1589	.89149
680.00	2.1659	211.23	211.57	1480.5	1.9527	13.665	.1586	.90119
700.00	2.1462	220.50	220.85	1545.5	2.0317	14.218	.1583	.91008
720.00	2.1277	229.84	230.21	1611.0	2.1112	14.774	.1580	.91822
740.00	2.1104	239.27	239.65	1677.0	2.1912	15.334	.1577	.92567
760.00	2.0941	248.77	249.16	1743.6	2.2716	15.896	.1574	.93247
780.00	2.0788	258.34	258.75	1810.7	2.3524	16.462	.1571	.93869
800.00	2.0644	267.98	268.40	1878.2	2.4336	17.030	.1568	.94435
820.00	2.0509	277.69	278.12	1946.3	2.5152	17.601	.1565	.94952
840.00	2.0381	287.46	287.91	2014.7	2.5971	18.174	.1562	.95422
860.00	2.0261	297.29	297.75	2083.6	2.6794	18.750	.1559	.95850
880.00	2.0147	307.17	307.65	2152.9	2.7620	19.328	.1556	.96240
900.00	2.0040	317.12	317.61	2222.6	2.8449	19.908	.1553	.96594
920.00	1.9939	327.11	327.62	2292.7	2.9281	20.491	.1550	.96915
940.00	1.9843	337.17	337.69	2363.1	3.0116	21.075	.1547	.97207
960.00	1.9752	347.27	347.81	2433.9	3.0954	21.661	.1543	.97472
1000.00	1.9584	367.71	368.28	2577.2	3.2638	22.840	.1535	.97934

THE ELECTRON DENSITY OF OXYGEN (DIATOMIC) IS 3.013E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.272 BEV, AND THE MINIMUM ENERGY LOSS IS 1.8137 MEV/GH/CM2

PLATINUM

ELEMENT PT
 ATOMIC NUMBER 78
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 195.09
 ADJUSTED IONIZATION POTENTIAL 771.0

DENSITY * 21.450 GM/CM3

PRCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		MG/CH2		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/GM2	HEV/CM	MG/CH2	MM	MG/CH2	MM	MG/CH2	MM	PERCENT	PERCENT		
.10	107.83	2313.1	1.2351	.0058	1.3033	.0061	.06630	.00003	5.087	5.238	0.	
.15	117.67	2524.0	1.6729	.0078	1.7471	.0081	.08384	.00004	4.799	4.243	0.	
.20	119.34	2559.8	2.0831	.0097	2.1689	.0101	.09657	.00005	4.452	3.956	0.	
.30	110.74	2375.3	2.9189	.00136	3.0343	.00141	.12292	.00006	4.051	3.803	0.	
.40	98.334	2109.3	3.8423	.06179	3.9924	.00186	.15306	.00007	3.834	3.760	0.	
.50	85.223	1892.4	4.8785	.00227	5.0677	.00236	.18765	.00009	3.703	3.734	0.	
.60	80.974	1736.9	6.0261	.00261	6.2525	.00291	.22533	.00011	3.604	3.709	0.	
.70	75.180	1612.6	7.2565	.00338	7.5340	.00351	.26489	.00012	3.516	3.683	0.	
.80	69.864	1498.6	8.5873	.00400	8.9130	.00416	.30648	.00014	3.439	3.655	0.	
.90	67.021	1437.6	9.9973	.00466	10.373	.00484	.34897	.00016	3.364	3.626	0.	
1.00	64.178	1376.6	11.471	.00535	11.899	.00555	.39110	.00018	3.287	3.595	0.	
1.20	59.884	1284.5	14.591	.00680	15.125	.00705	.47487	.00022	3.140	3.531	0.	
1.40	56.088	1203.1	17.933	.00836	18.577	.00866	.56107	.00026	3.020	3.466	0.	
1.60	52.754	1131.6	21.500	.01002	22.257	.01038	.65265	.00030	2.932	3.402	0.	
1.80	49.825	1068.8	25.238	.01179	26.161	.01220	.74874	.00035	2.862	3.339	0.	
2.00	47.255	1013.6	29.290	.01366	30.283	.01412	.84882	.00040	2.803	3.280	0.	
2.20	44.973	964.68	33.506	.01562	34.622	.01614	.95249	.00044	2.751	3.223	0.	
2.40	42.933	920.92	37.934	.01769	39.176	.01826	1.0595	.00049	2.705	3.170	0.	
2.60	41.098	881.54	42.568	.01985	43.939	.02048	1.1698	.00055	2.662	3.120	0.	
2.80	39.424	845.64	47.406	.02210	48.909	.02280	1.2833	.00060	2.624	3.074	0.	
3.00	37.917	813.33	52.444	.02445	54.683	.02521	1.3997	.00065	2.588	3.030	0.	
3.20	36.539	783.76	57.680	.02689	59.457	.02772	1.5191	.00071	2.555	2.989	0.	
3.40	35.277	756.69	63.110	.02942	65.028	.03032	1.6414	.00077	2.524	2.950	0.	
3.60	34.115	731.77	68.733	.03204	70.796	.03301	1.7663	.00082	2.495	2.914	0.	
3.80	33.041	708.74	74.544	.03475	76.754	.03578	1.8940	.00088	2.468	2.879	0.	
4.00	32.045	687.36	80.541	.03755	82.901	.03865	2.0243	.00094	2.442	2.847	0.	
4.20	31.116	667.44	86.722	.04043	89.236	.04160	2.1572	.00101	2.417	2.816	0.	
4.40	30.247	648.80	93.086	.04340	95.756	.04464	2.2926	.00107	2.394	2.787	0.	
4.60	29.433	631.35	99.630	.04645	102.46	.04777	2.4306	.00113	2.372	2.760	0.	
4.80	28.674	615.05	106.36	.04958	109.35	.05098	2.5712	.00120	2.351	2.734	0.	

PLATINUM

PROTON ENERGY MEV	ENERGY LOSS HEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH CM	PROTON PATH LENGTH GM/CM2	PAYH LENGTH STRAGGLING CM	PAYH LENGTH STRAGGLING GM/CM2	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	27.937	.11326	.60528	.11642	.0013	.00271	2.709	0.
5.50	26.349	.13127	.06612	.13485	.0014	.00308	2.652	0.
6.00	25.104	.15035	.00701	.15437	.0016	.00346	2.601	0.
6.50	23.852	.17029	.00794	.17476	.0018	.00386	2.556	.00001
7.00	22.739	.19130	.00892	.19623	.0020	.00427	2.515	.00001
7.50	21.744	.21334	.00995	.21876	.0022	.00470	2.477	.00002
8.00	20.846	.23628	.01102	.24219	.0024	.00514	2.443	.00003
8.50	20.034	.26032	.01214	.26675	.0026	.00561	2.410	.00003
9.00	19.286	.28522	.01330	.29217	.0028	.00608	2.381	.00003
9.50	18.617	.31107	.01450	.31857	.0031	.00657	2.354	.00004
10.00	17.998	.33787	.01575	.34593	.0033	.00708	2.328	.00004
11.00	16.896	.39400	.01837	.40321	.0038	.00812	2.283	.00006
12.00	15.941	.45383	.02116	.46425	.0043	.00922	2.243	.00008
13.00	15.107	.51780	.02410	.52857	.0048	.01036	2.207	.00012
14.00	14.368	.58359	.02721	.59656	.0054	.01154	2.175	.00018
15.00	13.710	.65353	.03047	.66767	.0060	.01277	2.146	.00026
16.00	13.119	.72674	.03388	.74248	.0065	.01404	2.120	.00036
17.00	12.584	.80313	.03744	.82032	.0072	.01535	2.096	.00048
18.00	12.098	.88266	.04115	.90135	.0078	.01670	2.074	.00063
19.00	11.654	.96537	.04501	.98561	.0084	.01809	2.054	.00080
20.00	11.246	1.0511	.04900	1.0730	.0091	.01952	2.035	.00099
22.00	10.524	1.2318	.05743	1.2570	.0105	.02250	2.001	.00143
24.00	9.9020	1.4244	.06640	1.4530	.0119	.02562	1.972	.00197
26.00	9.3598	1.6285	.07592	1.6609	.0135	.02888	1.946	.00293
28.00	8.8805	1.8442	.08598	1.8803	.0151	.03229	1.922	.00432
30.00	8.4827	2.0710	.09655	2.1111	.0167	.03582	1.902	.00576
32.00	8.1044	2.3083	.10761	2.3525	.0184	.03947	1.883	.00726
34.00	7.7645	2.5540	.11916	2.6046	.0202	.04324	1.866	.00881
36.00	7.4564	2.8142	.13120	2.8672	.0220	.04714	1.850	.01041
38.00	7.1745	3.0831	.14373	3.1407	.0238	.05115	1.835	.01205
40.00	6.9188	3.3625	.15676	3.4249	.0258	.05531	1.822	.01374
45.00	6.3643	4.1045	.19135	4.1794	.0309	.06624	1.792	.01816
50.00	5.9061	4.9069	.22876	4.9952	.0363	.07791	1.758	.02281
55.00	5.5201	5.7694	.26897	5.8720	.0421	.09030	1.746	.02770
60.00	5.1900	6.6891	.31185	6.8067	.0482	.10336	1.728	.03283
65.00	4.9045	7.6646	.35733	7.7981	.0546	.11707	1.712	.03819
70.00	4.6551	8.6946	.40534	8.8448	.0613	.13140	1.699	.04377
75.00	4.4352	9.7754	.45573	9.9430	.0682	.14633	1.685	.04953
80.00	4.2394	10.910	.50865	11.096	.0754	.16183	1.674	.05547
90.00	3.9064	13.332	.62153	13.556	.0907	.19449	1.654	.06781

PLATINUM

PROTON ENERGY MEV	ENERGY LOSS MEV/CH2	PROTON RANGE GH/CH2	PROTON RANGE CH	PROTON PATH LENGTH GH/CH2	PROTON PATH LENGTH CH	GH/CH2	PATH LENGTH STRAGGLING CH	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	3.6337	77.943	15.944	16.209	75568	22923	0.1069	1.414	.08066
110.00	3.4068	73.076	18.744	19.033	68827	26589	0.1240	1.396	.09406
120.00	3.2141	68.942	21.721	22.077	1.0292	30436	0.1419	1.379	.10793
130.00	3.0485	65.391	24.868	25.273	1.1782	34453	0.1606	1.363	.12223
140.00	2.9046	62.303	28.178	28.635	1.3349	38632	0.1801	1.349	.13689
150.00	2.7783	59.595	31.643	32.153	1.4990	42964	0.2003	1.336	.15184
160.00	2.666	57.200	35.281	35.827	1.6702	47441	0.2124	1.324	.16708
170.00	2.5672	55.067	39.026	39.627	1.8485	52055	0.2427	1.313	.18262
180.00	2.4781	53.155	42.931	43.615	2.0333	56800	0.2648	1.302	.19841
190.00	2.3978	51.432	46.971	47.717	2.2246	61669	0.2875	1.292	.21440
200.00	2.3250	49.871	51.144	51.953	2.4221	66657	0.3108	1.283	.23055
210.00	2.2610	48.499	55.442	56.317	2.6255	71756	0.3345	1.274	.24677
220.00	2.2003	47.196	59.856	60.799	2.8345	76948	0.3587	1.266	.26298
230.00	2.1446	46.002	64.394	65.406	3.0492	82244	0.3834	1.257	.27916
240.00	2.0934	44.903	69.027	70.139	3.2695	87638	0.4086	1.250	.29527
250.00	2.0461	43.888	73.794	74.949	3.4941	93127	0.4342	1.243	.31129
260.00	2.0023	42.949	78.663	79.823	3.7246	98706	0.4602	1.235	.32722
270.00	1.9616	42.077	83.636	84.941	3.9600	1.0437	0.4866	1.229	.34308
280.00	1.9238	41.265	88.710	90.222	4.2001	1.1012	0.5134	1.222	.35884
290.00	1.8885	40.509	93.981	95.541	4.4448	1.1594	0.5405	1.216	.37448
300.00	1.8556	39.802	99.126	100.87	4.6931	1.2184	0.5660	1.210	.38998
310.00	1.8247	39.139	104.48	106.10	4.9466	1.2781	0.5959	1.205	.40536
320.00	1.7958	38.498	109.93	111.83	5.2042	1.3386	0.6240	1.199	.42065
330.00	1.7676	37.914	115.46	117.25	5.4663	1.3997	0.6525	1.194	.43584
340.00	1.7419	37.364	121.08	122.95	5.7320	1.4615	0.6813	1.189	.45089
350.00	1.7177	36.845	126.77	128.73	6.0014	1.5238	0.7104	1.184	.46580
360.00	1.6949	36.357	132.54	134.59	6.2746	1.5868	0.7398	1.179	.48053
370.00	1.6734	35.894	138.39	140.53	6.5513	1.6503	0.7694	1.174	.49505
380.00	1.6530	35.456	144.37	146.60	6.8343	1.7143	0.7992	1.169	.50936
390.00	1.6336	35.042	150.37	152.68	7.1180	1.7789	0.8293	1.165	.52343
400.00	1.6153	34.648	156.43	158.84	7.4050	1.8439	0.8596	1.161	.53727
410.00	1.5979	34.274	162.52	165.02	7.6933	1.9094	0.8902	1.157	.55087
420.00	1.5813	33.918	168.70	171.30	7.9858	1.9753	0.9209	1.153	.56424
430.00	1.5655	33.580	174.96	177.65	8.2821	2.0417	0.9518	1.149	.57736
440.00	1.5505	33.257	181.29	184.07	8.5813	2.1085	0.9830	1.146	.59023
450.00	1.5361	32.950	187.67	190.55	8.8833	2.1757	1.0143	1.142	.60285
460.00	1.5224	32.656	194.11	197.08	9.1881	2.2433	1.0458	1.139	.61521
470.00	1.5094	32.376	200.61	203.68	9.4955	2.3113	1.0775	1.135	.62731
480.00	1.4969	32.108	207.16	210.33	9.8056	2.3796	1.1094	1.131	.63915
490.00	1.4849	31.852	213.77	217.04	10.118	2.4483	1.1414	1.128	.65072

PLATINUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CH	GM/CM2	CM	GM/CH2	CM	GM/CM2	CM	PERCENT	PERCENT	
500.00	1.4735	31.606	220.43	10.276	283.79	10.433	2.5173	1.1735	1.125	1.505	.66203
510.00	1.4625	31.371	227.14	10.589	230.60	10.751	2.5866	1.2059	1.122	1.504	.67307
520.00	1.4520	31.146	233.90	10.904	237.46	11.071	2.6562	1.2383	1.119	1.503	.68385
530.00	1.4420	30.930	240.70	11.222	244.37	11.393	2.7251	1.2709	1.116	1.502	.69436
540.00	1.4323	30.723	247.56	11.541	251.33	11.717	2.7963	1.3037	1.113	1.501	.70461
550.00	1.4230	30.524	254.49	11.864	258.37	12.045	2.8668	1.3365	1.110	1.501	.71460
560.00	1.4141	30.332	261.44	12.188	265.42	12.374	2.9376	1.3695	1.107	1.500	.72432
570.00	1.4055	30.148	268.42	12.514	272.51	12.704	3.0086	1.4026	1.104	1.499	.73379
580.00	1.3973	29.972	275.45	12.842	279.64	13.037	3.0799	1.4358	1.101	1.498	.74300
590.00	1.3894	29.802	282.53	13.171	286.82	13.372	3.1514	1.4692	1.099	1.497	.75196
600.00	1.3817	29.638	289.64	13.503	294.04	13.708	3.2231	1.5026	1.096	1.496	.76067
620.00	1.3673	29.328	303.97	14.171	308.59	14.386	3.3673	1.5698	1.091	1.495	.77735
640.00	1.3539	29.041	318.46	14.846	323.28	15.072	3.5123	1.6374	1.086	1.493	.79307
660.00	1.3414	28.773	333.08	15.528	338.12	15.763	3.6581	1.7054	1.082	1.492	.80766
680.00	1.3298	28.524	347.87	16.218	353.14	16.463	3.8046	1.7737	1.077	1.491	.82176
700.00	1.3190	28.292	362.80	16.918	368.37	17.174	3.9518	1.8423	1.073	1.488	.83480
720.00	1.3088	28.074	377.93	17.630	383.61	17.884	4.0996	1.9113	1.069	1.486	.84702
740.00	1.2994	27.871	393.03	18.353	398.95	18.599	4.2481	1.9805	1.065	1.485	.85845
760.00	1.2905	27.681	408.26	19.083	414.41	19.320	4.3972	2.0500	1.062	1.484	.86913
780.00	1.2822	27.503	423.59	19.748	429.96	20.043	4.5468	2.1197	1.057	1.482	.87911
800.00	1.2744	27.336	439.02	20.467	445.62	20.775	4.6960	2.1897	1.054	1.481	.88840
820.00	1.2671	27.179	454.54	21.191	461.37	21.509	4.8474	2.2599	1.051	1.479	.89766
840.00	1.2602	27.032	470.15	21.919	477.20	22.247	4.9965	2.3303	1.047	1.478	.90512
860.00	1.2538	26.893	485.85	22.650	493.13	22.990	5.1499	2.4009	1.044	1.476	.91280
880.00	1.2477	26.763	501.63	23.386	509.13	23.736	5.3018	2.4717	1.041	1.475	.91955
900.00	1.2420	26.641	517.48	24.125	525.22	24.486	5.4541	2.5427	1.038	1.473	.92600
920.00	1.2366	26.525	533.42	24.868	541.38	25.239	5.6067	2.6138	1.036	1.471	.93197
940.00	1.2316	26.417	549.44	25.615	557.63	25.997	5.7596	2.6851	1.033	1.469	.93750
960.00	1.2268	26.314	565.54	26.365	573.95	26.758	5.9129	2.7566	1.030	1.467	.94261
1000.00	1.2186	26.127	598.11	27.884	606.97	28.297	6.2205	2.9000	1.025	1.460	.95166

THE ELECTRON DENSITY OF PLATINUM IS 2.409E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 1.925 BEV, AND THE MINIMUM ENERGY LOSS IS 1.1530 MEV/GM/CM2

RADIUM

ELEMENT NUMBER 88
 ATOMIC NUMBER 88
 ATOMS/MOLECULE 1
 ATOMIC HEIGHT 226.11
 ADJUSTED IONIZATION POTENTIAL #69.1

DENSITY * 5.0000 GM/CM3

PROCTON ENERGY MEV	ENERGY LOSS GM/CM2	HEV/CM	PROTON RANGE GM/CM2	PROTON RANGE CM	PROTON PATH LENGTH MM	PROTON PATH LENGTH MM	HG/CH2	PROTON PATH LENGTH MM	HG/CH2	PATH LENGTH STRAGGLING MM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	119.24	596.20	1.3778	.00276	1.4620	.00292	.07560	.00015	5.171	5.751	0.	0.	
.15	124.73	623.64	1.17832	.00357	1.6719	.00374	.08642	.00018	4.725	4.739	0.	0.	
.20	123.36	616.79	2.1763	.00435	2.2750	.00455	.09920	.00020	4.360	4.338	0.	0.	
.30	110.71	553.55	3.0015	.00600	3.1374	.00625	.12059	.00024	3.859	4.028	0.	0.	
.40	97.624	488.12	3.9310	.00786	4.0909	.00818	.14737	.00029	3.602	3.908	0.	0.	
.50	88.337	441.69	4.9705	.00994	5.1693	.01034	.18083	.00036	3.498	3.846	0.	0.	
.60	80.829	404.14	6.1118	.01222	6.3533	.01271	.21850	.00044	3.439	3.804	0.	0.	
.70	75.392	376.96	7.3463	.01469	7.6341	.01527	.25880	.00052	3.390	3.770	0.	0.	
.80	69.442	347.21	8.6792	.01736	9.0162	.01803	.30193	.00060	3.349	3.738	0.	0.	
.90	65.538	327.69	10.108	.02022	10.497	.02099	.34764	.00070	3.312	3.708	0.	0.	
1.00	61.624	308.12	11.627	.02325	12.072	.02414	.39513	.00079	3.273	3.680	0.	0.	
1.20	56.335	281.68	14.909	.02982	15.470	.03094	.49402	.00099	3.193	3.626	0.	0.	
1.40	52.123	260.62	18.479	.03896	19.164	.03833	.59578	.00119	3.109	3.576	0.	0.	
1.60	48.665	243.33	22.323	.0465	22.140	.04628	.70042	.00140	3.027	3.527	0.	0.	
1.80	45.758	228.79	26.429	.05286	27.383	.05477	.80796	.00162	2.951	3.481	0.	0.	
2.00	43.254	216.27	36.783	.06157	31.879	.06376	.92082	.00184	2.888	3.437	0.	0.	
2.20	41.085	205.43	35.381	.07076	36.624	.07325	1.0398	.00208	2.839	3.394	0.	0.	
2.40	39.169	195.85	40.217	.08043	41.613	.08323	1.1640	.00233	2.797	3.354	0.	0.	
2.60	37.463	187.31	45.283	.09057	46.837	.09367	1.2928	.00259	2.760	3.316	0.	0.	
2.80	35.932	179.66	50.574	.10115	52.289	.10458	1.4256	.00285	2.726	3.280	0.	0.	
3.00	34.605	173.02	56.080	.11216	57.961	.11592	1.5614	.00312	2.695	3.246	0.	0.	
3.20	33.352	166.76	61.796	.12359	63.848	.12770	1.7012	.00340	2.665	3.213	0.	0.	
3.40	32.209	161.05	67.723	.13545	69.945	.13990	1.8440	.00369	2.634	3.182	0.	0.	
3.60	31.158	155.79	73.863	.14773	76.268	.15254	1.9898	.00398	2.602	3.153	0.	0.	
3.80	30.187	150.93	80.208	.16041	82.792	.16556	2.1386	.00428	2.583	3.125	0.	0.	
4.00	29.236	146.18	86.741	.17348	89.514	.17923	2.2903	.00458	2.559	3.098	0.	0.	
4.20	28.434	142.17	93.493	.18659	96.456	.19291	2.4454	.00489	2.535	3.072	0.	0.	
4.40	27.681	138.40	100.43	.20086	103.59	.20717	2.6027	.00521	2.513	3.048	0.	0.	
4.60	26.974	134.87	107.54	.21528	110.90	.22179	2.7623	.00552	2.491	3.025	0.	0.	
4.80	26.307	131.54	114.86	.22972	118.42	.23683	2.9242	.00585	2.469	3.002	0.	0.	

RADIUM

PROTON ENERGY MEV	ENERGY LOSS HEV/CH	PROTON RANGE CH	PROTON PATH LENGTH GM/CH2	PROTON PATH LENGTH CH	PATH LENGTH STRAGGLING CH	PATH LENGTH PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	25.678	0.2447	0.12611	0.02522	0.00309	0.0062	2.981	0.
5.50	24.250	0.2838	0.14616	0.02923	0.00351	0.0070	2.931	0.
6.00	22.997	0.3250	0.16734	0.03347	0.00394	0.0079	2.885	0.
6.50	21.888	0.3685	0.18964	0.03793	0.00439	0.0088	2.844	0.
7.00	20.930	0.4141	0.21302	0.04260	0.00486	0.0097	2.805	0.
7.50	20.012	0.4618	0.23748	0.04750	0.00533	0.0107	2.770	0.
8.00	19.210	0.5116	0.26298	0.05260	0.00583	0.0117	2.737	0.
8.50	18.479	0.5634	0.28951	0.05790	0.00633	0.0127	2.708	0.
9.00	17.812	0.6172	0.31709	0.06342	0.00685	0.0137	2.678	0.
9.50	17.189	0.6730	0.34582	0.06914	0.00739	0.0148	2.651	0.
10.00	16.634	0.7308	0.37526	0.07505	0.00795	0.0159	2.626	0.
11.00	15.639	0.8520	0.43730	0.08742	0.00910	0.0182	2.581	0.0001
12.00	14.779	0.9807	0.50312	0.10062	0.01031	0.0206	2.540	0.0003
13.00	14.023	1.1165	0.57260	0.11452	0.01157	0.0231	2.503	0.0005
14.00	13.353	1.2595	0.64571	0.12914	0.01288	0.0258	2.470	0.0009
15.00	12.751	1.4095	0.72239	0.14448	0.01424	0.0285	2.440	0.0015
16.00	12.217	1.5664	0.80254	0.16031	0.01565	0.0313	2.413	0.0023
17.00	11.732	1.7299	0.88608	0.17722	0.01709	0.0342	2.387	0.0032
18.00	11.291	1.8997	0.97297	0.19459	0.01858	0.0372	2.363	0.0044
19.00	10.886	2.0766	1.06632	0.21264	0.02011	0.0402	2.342	0.0058
20.00	10.564	2.2597	1.1567	0.23134	0.02167	0.0433	2.321	0.0074
22.00	9.8940	2.6427	1.3523	0.27045	0.02489	0.0498	2.284	0.0113
24.00	9.3164	3.0512	1.5607	0.31215	0.02828	0.0566	2.251	0.0161
26.00	8.8121	3.4839	1.7815	0.35630	0.03182	0.0636	2.221	0.0253
28.00	8.3690	3.9465	2.0145	0.40289	0.03551	0.0710	2.196	0.0391
30.00	7.9756	4.4203	2.2592	0.45184	0.03935	0.0787	2.172	0.0534
32.00	7.6236	4.9244	2.5163	0.50326	0.04333	0.0867	2.150	0.0683
34.00	7.3065	5.4397	2.7841	0.55683	0.04744	0.0949	2.129	0.0837
36.00	7.0192	5.9771	3.0632	0.61264	0.05169	0.1034	2.111	0.0996
38.00	6.7552	6.5680	3.3542	0.67085	0.05608	0.1122	2.094	0.1160
40.00	6.5174	7.1586	3.6553	0.73106	0.06059	0.1212	2.079	0.1328
45.00	6.0007	8.7206	4.4559	0.89116	0.07241	0.1448	2.045	0.1766
50.00	5.5886	1.0496	5.3203	1.0641	0.08488	0.1698	2.016	0.2227
55.00	5.2272	1.2244	6.2462	1.2492	0.09807	0.1961	1.991	0.2712
60.00	4.9177	1.4180	7.2326	1.4465	0.11200	0.2240	1.969	0.3220
65.00	4.6502	1.6233	8.2781	1.6556	0.12664	0.2533	1.950	0.3752
70.00	4.4160	1.8400	9.3812	1.8762	0.14194	0.2839	1.933	0.4304
75.00	4.2093	2.0681	10.543	2.1086	0.15780	0.3158	1.918	0.4875
80.00	4.0252	2.3067	11.758	2.3515	0.17443	0.3489	1.904	0.5464
90.00	3.7119	2.8156	14.348	2.8625	0.20929	0.4186	1.881	0.6689

RADIUM

PROTON ENERGY MEV	ENERGY LOSS MEV/CH2	PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
		GM/CH2	CM	GM/CH2	CH	GM/CH2	PERCENT		
100.00	3.4548	16.823	3.3647	17.142	3.4285	.24635	.04927	1.437	.07967
110.00	3.2396	19.752	3.9503	20.123	4.0246	.28547	.05709	1.419	.09296
120.00	3.0567	22.676	4.5751	23.302	4.6605	.32654	.06531	1.402	.10676
130.00	2.9004	26.178	5.2356	26.663	5.3326	.36942	.07388	1.386	.12100
140.00	2.7646	29.647	5.9295	30.193	6.0387	.41399	.08280	1.371	.13560
150.00	2.6453	33.284	6.6569	33.894	6.7789	.46017	.09203	1.356	.15051
160.00	2.5398	37.065	7.4130	37.741	7.5481	.50786	.10157	1.346	.16568
170.00	2.4457	41.010	8.2020	41.795	8.3509	.55698	.11140	1.334	.18100
180.00	2.3614	45.101	9.0201	45.917	9.1833	.60748	.12150	1.323	.19667
190.00	2.2853	49.330	9.8660	50.220	10.044	.65928	.13186	1.313	.21240
200.00	2.2164	53.697	10.739	54.662	10.932	.71232	.14246	1.303	.22823
210.00	2.1537	58.197	11.639	59.241	11.846	.76653	.15331	1.294	.24414
220.00	2.0963	62.821	12.564	63.944	12.789	.82180	.16437	1.285	.26012
230.00	2.0437	67.570	13.514	68.775	13.755	.87826	.17565	1.277	.27614
240.00	1.9975	72.438	14.488	73.728	14.746	.93559	.18712	1.269	.29215
250.00	1.9526	77.413	15.483	78.788	15.758	.99381	.19876	1.261	.30813
260.00	1.9110	82.507	16.501	83.970	16.794	1.0530	.21060	1.254	.32406
270.00	1.8725	87.698	17.540	89.270	17.850	1.1130	.22261	1.247	.33992
280.00	1.8366	92.991	18.596	94.624	18.925	1.1740	.23479	1.241	.35569
290.00	1.8031	98.386	19.677	100.12	20.024	1.2357	.24714	1.234	.37134
300.00	1.7718	103.89	20.770	105.72	21.144	1.2983	.25965	1.228	.38686
310.00	1.7414	109.49	21.898	111.42	22.283	1.3616	.27232	1.222	.40224
320.00	1.7139	115.21	23.042	117.23	23.447	1.4257	.28514	1.216	.41751
330.00	1.6880	120.99	24.198	123.11	24.623	1.4905	.29810	1.211	.43262
340.00	1.6637	126.86	25.372	129.08	25.816	1.5560	.31119	1.205	.44759
350.00	1.6408	132.76	26.551	135.08	27.016	1.6220	.32441	1.201	.46239
360.00	1.6191	138.70	27.757	141.21	28.243	1.6887	.33775	1.196	.47694
370.00	1.5987	144.67	28.993	147.50	29.500	1.7560	.35120	1.191	.49132
380.00	1.5793	151.16	30.231	153.79	30.759	1.8238	.36476	1.186	.50549
390.00	1.5609	157.42	31.484	160.16	32.033	1.8922	.37843	1.181	.51943
400.00	1.5435	163.75	32.751	166.61	33.322	1.9610	.39220	1.177	.53314
420.00	1.5269	170.16	34.032	173.12	34.629	2.0304	.40607	1.173	.54662
430.00	1.5112	176.63	35.327	179.71	35.941	2.1032	.42003	1.169	.55988
440.00	1.4962	183.17	36.635	186.36	37.271	2.1704	.43409	1.165	.57291
450.00	1.4819	189.78	37.955	193.07	38.615	2.2412	.44823	1.161	.58571
460.00	1.4683	196.44	39.289	199.85	39.971	2.3123	.46246	1.157	.59826
470.00	1.4553	203.17	40.634	206.69	41.339	2.3858	.47676	1.155	.61057
480.00	1.4429	209.96	41.991	213.60	42.719	2.4557	.49114	1.150	.62262
490.00	1.4310	216.80	43.360	220.55	44.111	2.5260	.50560	1.146	.63443
490.00	1.4197	223.70	44.740	227.57	45.514	2.6006	.52013	1.143	.64599

RADIUM

PROTON ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE		PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
		GM/CM ²	CM	GM/CM ²	CM	GM/CM ²	CM		
500.00	1.4088	230.65	46.130	234.64	46.928	2.6736	.53473	1.139	.65729
510.00	1.3984	237.70	47.540	241.61	48.361	2.7470	.54939	1.136	.66833
520.00	1.3885	244.79	48.959	249.02	49.805	2.8206	.56412	1.133	.67912
530.00	1.3789	251.90	50.381	256.25	51.251	2.8945	.57891	1.130	.68945
540.00	1.3697	259.06	51.812	263.53	52.706	2.9688	.59376	1.127	.69992
550.00	1.3609	266.27	53.254	270.86	54.172	3.0433	.60866	1.124	.70995
560.00	1.3525	273.52	54.704	278.23	55.647	3.1181	.62363	1.121	.71971
570.00	1.3443	280.82	56.163	285.65	57.131	3.1932	.63864	1.118	.72923
580.00	1.3365	288.16	57.631	293.12	58.623	3.2685	.65371	1.115	.73849
590.00	1.3290	295.54	59.108	300.62	60.125	3.3441	.66883	1.112	.74751
600.00	1.3217	302.96	60.592	308.17	61.634	3.4200	.68399	1.110	.75328
620.00	1.3080	317.93	63.586	323.39	64.678	3.5723	.71446	1.105	.77310
640.00	1.2953	333.04	66.609	338.76	67.752	3.7255	.74510	1.100	.78898
660.00	1.2835	348.31	69.662	354.28	70.856	3.8795	.77590	1.095	.80394
680.00	1.2725	363.71	72.742	369.94	73.987	4.0343	.80686	1.091	.81802
700.00	1.2622	379.24	75.848	385.73	77.145	4.1898	.83796	1.086	.83124
720.00	1.2526	394.89	78.978	401.64	80.328	4.3459	.86919	1.082	.84364
740.00	1.2436	410.67	82.135	417.68	83.537	4.5027	.90054	1.078	.85527
760.00	1.2352	426.55	85.311	433.83	86.766	4.6601	.93201	1.074	.86614
780.00	1.2274	442.54	88.508	450.08	90.016	4.8180	.96360	1.070	.87650
800.00	1.2200	458.63	91.726	466.43	93.287	4.9764	.99528	1.067	.88578
820.00	1.2131	474.81	94.962	482.68	96.577	5.1353	1.0271	1.063	.89462
840.00	1.2068	491.09	98.218	499.43	99.885	5.2947	1.0589	1.060	.90285
860.00	1.2005	507.46	101.49	516.07	103.21	5.4545	1.0909	1.057	.91050
880.00	1.1947	523.91	104.78	532.79	106.56	5.6146	1.1230	1.054	.91761
900.00	1.1893	540.44	108.09	549.59	109.92	5.7754	1.1551	1.051	.92422
920.00	1.1843	557.05	111.41	566.47	113.29	5.9354	1.1873	1.048	.93034
940.00	1.1795	573.72	114.74	583.41	116.68	6.0977	1.2195	1.045	.93601
960.00	1.1750	590.47	118.09	600.42	120.08	6.2594	1.2519	1.042	.94125
1000.00	1.1667	624.60	124.96	635.31	127.06	6.5837	1.167	1.036	.95052

THE ELECTRON DENSITY OF RADIUM IS 2.345E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 1.904 SEV, AND THE MINIMUM ENERGY LOSS IS 1.1067 MEV/GM/CM²

SELENIUM

ADJUSTED
IONIZATION
POTENTIAL
338.7

ATOMIC
WEIGHT
78.960

ATOMS/
MOLECULE
1

ATOMIC
NUMBER
34

ELEMENT
SE

DENSITY = 4.2550 GM/CM³

PROTON ENERGY MEV	ENERGY LOSS MEV/CH2	PROTON RANGE MG/CH2	PROTON PATH LENGTH MM	PROTON PATH LENGTH MM	HG/CH2	MG/CH2	PATH LENGTH STRAGGLING MM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION	
.10	272.25	1309.5	.00122	.50331	.00126	.02727	.00006	4.506	2.755	0.
.15	246.57	1186.0	.00142	.79821	.00166	.03207	.00007	4.018	2.233	0.
.20	224.72	1080.9	.00206	1.0106	.00216	.03770	.00008	3.731	2.012	0.
.30	191.02	918.81	.00325	1.4944	.00311	.05072	.00011	3.394	1.824	0.
.40	168.14	808.75	.00420	2.0540	.00427	.06548	.00014	3.188	1.738	0.
.50	153.11	736.46	.00547	2.6334	.00557	.08121	.00017	3.032	1.681	0.
.60	142.95	687.59	.00686	3.3552	.00698	.09720	.00020	2.897	1.636	0.
.70	134.66	647.71	.00834	4.0759	.00847	.11326	.00024	2.779	1.597	0.
.80	125.27	602.55	.00992	4.8448	.01007	.13051	.00027	2.694	1.561	0.
.90	116.33	559.53	.01161	5.6731	.01179	.14972	.00031	2.639	1.528	0.
1.00	107.37	516.47	.01345	6.5675	.01365	.17114	.00036	2.606	1.497	0.
1.20	97.494	463.94	.01747	8.1259	.01773	.21783	.00045	2.556	1.443	0.
1.40	89.731	431.61	.02166	10.517	.02216	.26584	.00055	2.502	1.399	0.
1.60	83.237	400.37	.02662	12.983	.02699	.31795	.00066	2.449	1.361	0.
1.80	77.728	373.87	.03174	15.471	.03217	.37128	.00077	2.400	1.328	0.
2.00	73.002	351.14	.03720	18.128	.03769	.42682	.00089	2.354	1.298	0.
2.20	68.906	331.44	.04300	20.949	.04355	.48453	.00101	2.313	1.271	0.
2.40	65.320	314.19	.04913	23.931	.04974	.54435	.00113	2.272	1.246	0.
2.60	62.144	299.91	.05559	27.072	.05625	.60623	.00126	2.239	1.226	0.
2.80	59.303	285.25	.06237	30.367	.06313	.67016	.00139	2.207	1.206	0.
3.00	56.747	272.96	.06947	33.916	.07030	.73611	.00153	2.177	1.188	0.
3.20	54.470	262.00	.07687	37.415	.07778	.80400	.00167	2.149	1.171	0.
3.40	52.367	251.88	.08458	41.160	.08557	.87360	.00182	2.123	1.156	0.
3.60	50.486	242.84	.09259	45.052	.09336	.94540	.00197	2.098	1.142	0.
3.80	48.756	234.51	.10090	49.085	.10205	1.0187	.00212	2.075	1.128	0.
4.00	47.156	226.82	.10948	53.254	.11071	1.0938	.00227	2.054	1.116	0.
4.20	45.673	219.69	.11836	57.566	.11938	1.1706	.00243	2.033	1.104	0.
4.40	44.291	213.04	.12752	62.015	.12891	1.2491	.00260	2.014	1.093	0.
4.60	43.003	206.85	.13695	66.596	.13845	1.3293	.00276	1.996	1.083	.00001
4.80	41.809	201.10	.14667	71.314	.14826	1.4112	.00293	1.979	1.073	.00001

SELENIUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CH	GH/CH2	CH	GH/CH2	CH	GH/CH2	PERCENT		
3.00	40.689	195.71	.07535	.01567	.07616	.01583	.00149	.00031	1.064	.00001
5.50	38.167	183.58	.08793	.01828	.08866	.01847	.00171	.00036	1.043	.00002
6.00	35.976	173.04	.10131	.02106	.10236	.02128	.00194	.00040	1.024	.00003
6.50	34.051	163.78	.11548	.02401	.11665	.02425	.00217	.00045	1.007	.00005
7.00	32.344	155.58	.13042	.02711	.13172	.02739	.00242	.00050	.9922	.00707
7.50	30.820	148.24	.14612	.03038	.14757	.03068	.00268	.00056	.9785	.00009
8.00	29.449	141.65	.16258	.03380	.16417	.03413	.00295	.00061	.9661	.00013
8.50	28.208	135.68	.17979	.03738	.18152	.03774	.00323	.00067	.9547	.00017
9.00	27.081	130.26	.19773	.04111	.19962	.04150	.00353	.00073	.9442	.00021
9.50	26.051	125.31	.21640	.04499	.21844	.04541	.00383	.00080	.9345	.00026
10.00	25.107	120.77	.23579	.04902	.23800	.04948	.00414	.00086	.9256	.00032
11.00	23.435	112.72	.27671	.05753	.27925	.05806	.00479	.00100	.9094	.00046
12.00	21.996	105.80	.32043	.06662	.32332	.06722	.00547	.00114	.8953	.00062
13.00	20.739	99.759	.36690	.07626	.37017	.07696	.00619	.00129	.8828	.00081
14.00	19.634	94.459	.41609	.08650	.41975	.08727	.00695	.00144	.8717	.00103
15.00	18.659	89.752	.46795	.09729	.47201	.09813	.00774	.00161	.8616	.00127
16.00	17.782	85.532	.52244	.10862	.52694	.10955	.00856	.00178	.8526	.00262
17.00	17.004	81.790	.57953	.12048	.58447	.12151	.00941	.00196	.8444	.00461
18.00	16.300	78.461	.63911	.13287	.64430	.13399	.01030	.00214	.8368	.00703
19.00	15.658	75.314	.70127	.14579	.70714	.14701	.01121	.00233	.8299	.00927
20.00	15.071	72.492	.76591	.15923	.77227	.16056	.01215	.00253	.8235	.01153
22.00	14.035	67.507	.90250	.18763	.90989	.18917	.01413	.00294	.8121	.01611
24.00	13.148	63.241	1.0487	.21803	1.0572	.21979	.01622	.00337	.8021	.02076
26.00	12.379	59.544	1.2044	.25040	1.2141	.25240	.01842	.00383	.7934	.02387
28.00	11.707	56.308	1.3694	.28471	1.3803	.28696	.02073	.00431	.7855	.02537
30.00	11.112	53.451	1.5436	.32092	1.5557	.32343	.02315	.00481	.7787	.02593
32.00	10.584	50.907	1.7268	.35899	1.7402	.36175	.02567	.00534	.7724	.02855
34.00	10.110	48.627	1.9188	.39891	1.9336	.40200	.02829	.00588	.7667	.03023
36.00	9.6821	46.571	2.1196	.44066	2.1338	.44404	.03101	.00645	.7615	.03197
38.00	9.2997	44.731	2.3288	.48416	2.3466	.48785	.03383	.00703	.7568	.03375
40.00	8.9461	43.031	2.5466	.52943	2.5659	.53344	.03674	.00764	.7524	.03553
45.00	8.1853	39.371	3.1275	.65021	3.1509	.65506	.04444	.00924	.7429	.04038
50.00	7.5616	36.371	3.7592	.78155	3.7871	.78733	.05270	.01096	.7349	.04543
55.00	7.0402	33.864	4.4404	.92315	4.4729	.92992	.06149	.01278	.7281	.05073
60.00	6.5976	31.734	5.1694	1.0747	5.2071	1.0825	.07081	.01472	.7223	.05630
65.00	6.2163	29.901	5.9452	1.2360	5.9882	1.2449	.08064	.01676	.7171	.06210
70.00	5.8851	28.307	6.7666	1.4088	6.8152	1.4169	.09094	.01891	.7126	.06813
75.00	5.5941	26.908	7.6327	1.5868	7.6871	1.5982	.10171	.02115	.7087	.07456
80.00	5.3363	25.668	8.5419	1.7759	8.6025	1.7885	.11293	.02348	.7051	.08076
90.00	4.8998	23.568	10.487	2.1802	10.961	2.1955	.13667	.02841	.6990	.09401

SELENIUM

PROTON ENERGY HEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	HEV/CM ²	HEV/CM	GM/CM ²	CM	GM/CM ²	CM	GM/CM ²	CM		
100.00	4.5438	21.856	12.594	2,6183	12.682	2,6366	.16205	.03369	1.278	.10774
110.00	4.2478	20.432	14.857	3,0887	17.968	3,1102	.18897	.03929	1.253	.12194
120.00	3.9977	19.229	17.249	3,5902	17.388	3,6150	.21735	.04519	1.250	.13652
130.00	3.7831	18.197	19.825	4,1216	19.961	4,1499	.24712	.05138	1.235	.15168
140.00	3.5975	17.304	22.519	4,6817	22.673	4,7138	.27819	.05784	1.227	.16704
150.00	3.4352	16.523	25.346	5,2694	25.519	5,3054	.31050	.06455	1.217	.18282
160.00	3.2919	15.834	28.301	5,8839	28.494	5,9239	.34396	.07151	1.207	.19845
170.00	3.1646	15.222	31.380	6,5239	31.593	6,5682	.37858	.07871	1.198	.21454
180.00	3.0508	14.674	34.577	7,1886	34.811	7,2373	.41424	.08612	1.190	.23082
190.00	2.9482	14.181	37.890	7,8774	38.146	7,9306	.45091	.09374	1.182	.24729
200.00	2.8555	13.738	41.315	8,5894	41.593	8,6473	.48855	.10157	1.175	.26385
210.00	2.7713	13.330	44.847	9,3238	45.149	9,3865	.52710	.10958	1.167	.28047
220.00	2.6943	12.960	48.484	10,080	48.809	10,147	.56654	.11778	1.161	.29713
230.00	2.6239	12.621	52.221	10,857	52.571	10,929	.60681	.12616	1.154	.31377
240.00	2.5591	12.309	56.055	11,654	56.430	11,732	.64789	.13470	1.148	.33039
250.00	2.4993	12.022	59.984	12,471	60.385	12,554	.68973	.14339	1.142	.34690
260.00	2.4440	11.756	64.005	13,307	64.433	13,395	.73231	.15225	1.137	.36335
270.00	2.3927	11.509	68.113	14,161	68.567	14,255	.77559	.16124	1.131	.37973
280.00	2.3450	11.279	72.308	15,033	72.789	15,133	.81954	.17038	1.126	.39600
290.00	2.3005	11.066	76.586	15,922	77.095	16,028	.86414	.17963	1.121	.41216
300.00	2.2590	10.866	80.944	16,828	81.482	16,940	.90935	.18905	1.116	.42816
310.00	2.2201	10.679	85.381	17,751	85.947	17,868	.95516	.19858	1.111	.44402
320.00	2.1836	10.503	89.894	18,689	90.489	18,813	1.0015	.20822	1.107	.45971
330.00	2.1493	10.338	94.479	19,642	95.105	19,772	1.0485	.21798	1.102	.47523
340.00	2.1171	10.183	99.137	20,611	99.793	20,747	1.0959	.22784	1.098	.49056
350.00	2.0867	10.037	103.86	21,590	104.55	21,736	1.1439	.23781	1.094	.50588
360.00	2.0580	9.8990	108.66	22,590	109.38	22,739	1.1923	.24788	1.090	.52058
370.00	2.0309	9.7685	113.52	23,601	114.27	23,756	1.2412	.25805	1.086	.53522
380.00	2.0052	9.6430	118.44	24,624	119.22	24,787	1.2906	.26831	1.082	.54961
390.00	1.9809	9.5279	123.43	25,661	124.24	25,830	1.3403	.27866	1.079	.56374
400.00	1.9578	9.4169	128.47	26,710	129.32	26,886	1.3905	.28909	1.075	.57759
410.00	1.9358	9.3114	133.58	27,771	134.46	27,953	1.4411	.29961	1.072	.59116
420.00	1.9150	9.2110	138.74	28,844	139.65	29,033	1.4921	.31021	1.068	.60446
430.00	1.8951	9.1156	143.95	29,928	144.90	29,125	1.5435	.32089	1.065	.61746
440.00	1.8762	9.0246	149.22	31,023	150.20	31,227	1.5952	.33164	1.062	.63018
450.00	1.8582	8.9378	154.54	32,130	155.56	32,341	1.6472	.34246	1.059	.64261
460.00	1.8410	8.8550	159.92	33,247	160.97	33,465	1.6996	.35335	1.056	.65474
470.00	1.8245	8.7759	165.34	34,374	166.42	34,599	1.7523	.36431	1.053	.66658
480.00	1.8088	8.7003	170.81	35,511	171.93	35,744	1.8054	.37533	1.050	.67812
490.00	1.7938	8.6280	176.32	36,658	177.48	36,898	1.8587	.38642	1.047	.68936

SELENIUM

PROTON ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE CM	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	PATH LENGTH STRAGGLING CH	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	1.7794	181.69	183.08	38.061	3.9757	.6497	.70031
520.00	1.7656	187.49	188.72	39.234	4.0877	.6493	.71097
540.00	1.7523	193.14	194.40	40.416	4.2003	.6489	.72133
560.00	1.7397	198.83	200.13	41.607	4.3134	.6485	.73140
580.00	1.7275	204.56	205.90	42.806	4.4271	.6481	.74119
600.00	1.7158	210.34	211.71	44.014	4.5412	.6477	.75069
620.00	1.7045	216.15	217.55	45.230	4.6559	.6473	.75992
640.00	1.6937	221.99	223.44	46.453	4.7710	.6469	.76886
660.00	1.6833	227.88	229.36	47.684	4.8866	.6465	.77753
680.00	1.6733	233.80	235.32	48.923	5.0027	.6461	.78594
700.00	1.6637	239.76	241.31	50.169	5.1191	.6458	.79408
720.00	1.6545	245.77	247.34	51.422	5.2353	.6450	.80199
740.00	1.6455	251.81	253.40	52.682	5.3533	.6442	.80959
760.00	1.6368	257.89	259.52	53.947	5.4721	.6434	.81687
780.00	1.6285	264.01	265.69	55.223	5.5917	.6426	.82382
800.00	1.6207	270.17	271.96	56.508	5.7121	.6418	.83042
820.00	1.6127	276.37	278.28	57.801	5.8332	.6411	.83667
840.00	1.6050	282.61	284.64	59.101	5.9549	.6403	.84257
860.00	1.5976	288.89	291.04	60.407	6.0772	.6395	.84811
880.00	1.5904	295.21	297.48	61.720	6.2001	.6387	.85329
900.00	1.5834	301.57	303.96	63.039	6.3236	.6379	.85811
920.00	1.5766	308.00	310.48	64.364	6.4476	.6371	.86257
940.00	1.5700	314.48	317.04	65.694	6.5721	.6363	.86667
960.00	1.5636	321.01	323.64	67.029	6.6971	.6355	.87042
980.00	1.5574	327.59	330.28	68.369	6.8226	.6347	.87382
1000.00	1.5514	334.22	336.96	69.714	6.9486	.6338	.87687
800.00	1.5276	364.99	367.33	76.368	7.5219	.6379	.90959
820.00	1.5183	378.04	380.46	79.099	7.7683	.6371	.91709
840.00	1.5095	391.17	393.68	81.846	8.0157	.6363	.92402
860.00	1.5012	404.38	406.97	84.609	8.2639	.6355	.93041
880.00	1.4934	417.66	420.33	87.386	8.5129	.6347	.93631
900.00	1.4861	431.01	433.76	90.179	8.7627	.6338	.94174
920.00	1.4792	444.44	447.27	92.987	9.0132	.6330	.94675
940.00	1.4726	457.92	460.84	95.808	9.2645	.6320	.95134
960.00	1.4664	471.49	474.48	98.644	9.5164	.6309	.95557
980.00	1.4604	485.12	488.16	101.494	9.7691	.6298	.95942
1000.00	1.4551	498.82	502.08	104.338	1.0022	.6279	.96298

THE ELECTRON DENSITY OF SELENIUM IS 2.594E 23 ELECTRONS PER GRAM
 THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.064 BEV, AND THE MINIMUM ENERGY LOSS IS 1.3671 MEV/GM/CM2

SILICON

ELEMENT **SI** ATOMIC NUMBER **14** ATOMS/MOLECULE **1** ADJUSTED IONIZATION POTENTIAL **170.0**
 ATOMIC WEIGHT **28.086**

DENSITY = 2.3300 GM/CM³

PROTON ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE MG/CM ²	PROTON PATH LENGTH MM	MG/CM ²	PATH LENGTH STRAGGLING MM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	432.01	1006.6	.00122	.20803	.00124	3.884	1.387	0.
.15	382.61	891.48	.00174	.41094	.00176	3.609	1.063	0.
.20	350.19	815.95	.00233	.54734	.00235	3.402	.9426	0.
.30	303.29	706.67	.00364	.85907	.00367	3.082	.8457	0.
.40	270.91	631.21	.00513	1.2046	.00517	2.848	.7972	0.
.50	245.55	572.14	.00678	1.5925	.00683	2.672	.7622	0.
.60	223.98	521.87	.00860	2.0193	.00867	2.539	.7334	0.
.70	206.41	480.94	.01039	2.4843	.01066	2.435	.7088	0.
.80	191.79	446.87	.01273	2.9869	.01282	2.352	.6872	0.
.90	184.06	428.86	.01500	3.5187	.01510	2.278	.6683	0.
1.00	176.32	410.82	.01737	4.0741	.01749	2.215	.6513	0.
1.20	157.68	367.40	.02250	5.2751	.02254	2.123	.6215	0.
1.40	142.82	332.78	.02820	6.6101	.02837	2.054	.5962	0.
1.60	131.14	305.57	.03445	8.0727	.03465	2.019	.5747	0.
1.80	121.22	282.43	.04125	9.6661	.04149	1.983	.5562	0.
2.00	112.90	263.05	.04854	11.372	.04881	1.954	.5404	.00001
2.20	105.76	246.43	.05637	13.204	.05667	1.927	.5263	.00001
2.40	99.598	232.06	.06471	15.156	.06505	1.903	.5141	.00002
2.60	94.156	219.30	.07355	17.223	.07392	1.881	.5033	.00002
2.80	89.340	208.16	.08287	19.404	.08328	1.861	.4936	.00003
3.00	85.060	198.19	.09267	21.698	.09312	1.843	.4851	.00004
3.20	81.237	189.26	.10296	24.104	.10345	1.826	.4771	.00005
3.40	77.759	181.20	.11371	26.620	.11425	1.810	.4701	.00006
3.60	74.628	173.88	.12492	29.246	.12552	1.795	.4634	.00007
3.80	71.761	167.20	.13664	31.983	.13727	1.781	.4574	.00008
4.00	69.132	161.08	.14877	34.820	.14944	1.766	.4520	.00010
4.20	66.710	155.43	.16137	37.768	.16209	1.755	.4469	.00011
4.40	64.472	150.22	.17441	40.818	.17518	1.744	.4421	.00013
4.60	62.397	145.30	.18788	43.969	.18871	1.732	.4377	.00015
4.80	60.466	140.89	.20183	47.231	.20271	1.721	.4337	.00017

SILICON

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	GM/CM2	PATH LENGTH STRAGGLING CM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	58.665	0.5037	0.05050	0.2171	0.0087	0.0037	1.711	.4298	.00019
5.50	54.652	0.5917	0.05942	0.2550	0.0100	0.0043	1.688	.4212	.00025
6.00	51.211	0.6860	0.06888	0.2956	0.0115	0.0049	1.666	.4138	.00033
6.50	48.223	0.7862	0.07862	0.3374	0.0130	0.0056	1.647	.4072	.00041
7.00	45.603	0.8916	0.08962	0.3831	0.0146	0.0063	1.630	.4015	.00051
7.50	43.351	1.0101	0.10086	0.4312	0.0163	0.0070	1.613	.3964	.00062
8.00	41.275	1.1224	0.11268	0.4817	0.0180	0.0077	1.598	.3917	.00132
8.50	39.410	1.2459	0.12508	0.5347	0.0198	0.0085	1.584	.3875	.00231
9.00	37.724	1.3752	0.13805	0.5925	0.0217	0.0093	1.572	.3837	.00330
9.50	36.193	1.5102	0.15160	0.6506	0.0236	0.0101	1.560	.3802	.00430
10.00	34.794	1.6506	0.16568	0.7111	0.0257	0.0110	1.549	.3770	.00595
11.00	32.331	1.9480	0.19552	0.8392	0.0299	0.0128	1.528	.3712	.00929
12.00	30.227	2.2670	0.22754	0.9766	0.0344	0.0148	1.511	.3662	.01265
13.00	28.407	2.6074	0.26168	1.1190	0.0391	0.0168	1.495	.3619	.01602
14.00	26.816	2.9686	0.29793	1.2787	0.0441	0.0189	1.480	.3580	.01940
15.00	25.412	3.3506	0.33625	1.4431	0.0493	0.0212	1.467	.3546	.02281
16.00	24.163	3.7529	0.37662	1.6164	0.0548	0.0235	1.453	.3514	.02622
17.00	23.044	4.1792	0.41903	1.7984	0.0605	0.0260	1.444	.3486	.02966
18.00	22.035	4.6181	0.46341	1.9889	0.0665	0.0285	1.434	.3460	.03311
19.00	21.120	5.0802	0.50977	2.1879	0.0726	0.0312	1.425	.3437	.03658
20.00	20.286	5.5620	0.55811	2.3953	0.0790	0.0339	1.416	.3415	.04006
22.00	18.823	6.5850	0.60533	2.8349	0.0925	0.0397	1.400	.3376	.04708
24.00	17.572	7.6800	0.77058	3.3072	0.1068	0.0458	1.388	.3343	.05416
26.00	16.501	8.8515	0.88009	3.8116	0.1219	0.0523	1.373	.3313	.05964
28.00	15.567	1.0096	1.0130	4.3475	0.1379	0.0592	1.362	.3287	.06044
30.00	14.745	1.1413	1.1413	4.8982	0.1547	0.0664	1.351	.3263	.06231
32.00	14.016	1.2800	1.2800	5.4936	0.1723	0.0739	1.342	.3242	.06426
34.00	13.365	1.4257	1.4303	6.1191	0.1906	0.0818	1.333	.3223	.06626
36.00	12.779	1.5784	1.5835	6.7742	0.2097	0.0900	1.324	.3206	.06833
38.00	12.249	1.7378	1.7434	7.4583	0.2295	0.0985	1.317	.3189	.07046
40.00	11.767	1.9039	1.9100	8.1713	0.2501	0.1073	1.309	.3175	.07263
45.00	10.733	2.3480	2.3554	1.0109	0.3046	0.1307	1.293	.3142	.07828
50.00	9.8996	2.8324	2.8413	1.2194	0.3634	0.1560	1.279	.3115	.08416
55.00	9.1867	3.3558	3.3663	1.4447	0.4263	0.1830	1.266	.3092	.09029
60.00	8.5919	3.9174	3.9294	1.6865	0.4932	0.2117	1.255	.3072	.09672
65.00	8.0815	4.5160	4.5290	1.9441	0.5635	0.2420	1.245	.3054	.10339
70.00	7.6385	5.1509	5.1666	2.2174	0.6383	0.2740	1.236	.3039	.11029
75.00	7.2503	5.8211	5.8367	2.5059	0.7163	0.3074	1.227	.3025	.11738
80.00	6.9071	6.5258	6.5455	2.8092	0.7978	0.3424	1.219	.3012	.12464
90.00	6.3274	8.0360	8.0601	3.4593	0.9706	0.4166	1.204	.2991	.13954

SILICON

PROTON ENERGY MEV	ENERGY LOSS MEV/GH/CM2	PROTON RANGE GH/CM2	PROTON PATH LENGTH GH/CM2	PATH LENGTH STRAGGLING CH	GM/CM2	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	5.8562	9.6737	9.7046	0.4962	1.1561	.15481
110.00	5.4355	11.440	11.474	0.5809	1.180	.17045
120.00	5.1360	13.323	13.362	0.6704	1.169	.18350
130.00	4.8544	15.321	15.366	0.7646	1.159	.20286
140.00	4.5108	17.430	17.481	0.8630	1.150	.21921
150.00	4.1981	19.645	19.703	0.9656	1.142	.23608
160.00	3.9107	21.963	22.027	1.0720	1.134	.25289
170.00	3.6442	24.380	24.451	1.1823	1.127	.26987
180.00	3.3955	26.893	26.971	1.2960	1.120	.28697
190.00	3.1618	29.499	29.584	1.4131	1.113	.30413
200.00	2.9409	32.194	32.287	1.5335	1.107	.32129
210.00	2.7312	34.976	35.077	1.6569	1.101	.33845
220.00	2.5311	37.841	37.950	1.7833	1.095	.35564
230.00	2.3394	40.788	40.905	1.9125	1.089	.37280
240.00	2.1552	43.813	43.938	2.0444	1.084	.38991
250.00	1.9776	46.914	47.048	2.1789	1.079	.40691
260.00	1.8058	50.088	50.232	2.3159	1.074	.42379
270.00	1.6392	53.333	53.487	2.4552	1.070	.44054
280.00	1.4773	56.653	56.812	2.5967	1.065	.45712
290.00	1.3208	60.033	60.204	2.7405	1.061	.47351
300.00	1.1693	63.480	63.661	2.8864	1.056	.48969
310.00	1.0228	66.992	67.182	3.0342	1.052	.50565
320.00	0.8813	70.564	70.764	3.1840	1.048	.52139
330.00	0.7448	74.196	74.405	3.3356	1.045	.53690
340.00	0.6133	77.885	78.107	3.4891	1.041	.55214
350.00	0.4868	81.632	81.863	3.6442	1.037	.56712
360.00	0.3653	85.433	85.674	3.8010	1.034	.58184
370.00	0.2488	89.287	89.539	3.9594	1.030	.59628
380.00	0.1371	93.192	93.455	4.1193	1.027	.61045
390.00	0.0306	97.148	97.421	4.2807	1.024	.62433
400.00	0.0283	101.135	101.44	4.4435	1.021	.63792
410.00	0.0261	105.150	105.50	4.6076	1.018	.65118
420.00	0.0239	109.191	109.61	4.7731	1.015	.66410
430.00	0.0218	113.244	113.76	4.9399	1.012	.67668
440.00	0.0197	117.315	117.89	5.1080	1.009	.68891
450.00	0.0176	121.402	122.20	5.2772	1.006	.70079
460.00	0.0155	125.503	126.48	5.4476	1.004	.71232
470.00	0.0134	129.614	130.81	5.6191	1.001	.72352
480.00	0.0113	133.734	135.17	5.7917	0.9984	.73437
490.00	0.0092	137.864	139.57	5.9653	0.9959	.74489

SILICON

PROTON ENERGY MEV	ENERGY LOSS HEV/ GM/CM2	PROTON RANGE CM/CM2	PROTON RANGE CM	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	PATH LENGTH STRAGGLING GM/CM2	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
570.00	2.2442	143.60	61.633	144.01	61.805	1.4306	.61400	.2783	.75507
510.00	2.2262	148.07	53.548	148.48	63.725	1.4715	.63156	.2780	.76492
520.00	2.2090	152.56	65.478	152.99	65.661	1.5127	.64922	.2778	.77445
536.00	2.1925	157.10	67.423	157.53	67.611	1.5541	.66598	.2776	.78367
540.00	2.1766	161.66	69.383	162.11	69.576	1.5956	.68482	.2773	.79257
550.00	2.1613	166.26	71.356	166.72	71.554	1.6374	.70275	.2771	.80116
560.00	2.1467	170.89	73.343	171.36	73.547	1.6794	.72077	.2769	.80945
570.00	2.1326	175.55	75.344	176.04	75.553	1.7216	.73887	.2767	.81745
580.00	2.1190	180.24	77.358	180.74	77.572	1.7639	.75705	.2764	.82516
590.00	2.1059	184.96	79.384	185.48	79.604	1.8065	.77530	.2762	.83259
600.00	2.0933	189.72	81.423	190.24	81.648	1.8492	.79364	.2760	.83974
620.00	2.0694	199.30	85.536	199.85	85.773	1.9351	.83052	.2755	.85326
640.00	2.0471	208.99	89.696	209.57	89.943	2.0217	.86768	.2751	.86577
660.00	2.0264	218.79	93.899	219.39	94.138	2.1089	.90511	.2746	.87733
680.00	2.0070	228.68	98.145	223.31	98.415	2.1967	.94279	.2741	.88799
700.00	1.9889	238.66	102.43	233.32	102.71	2.2850	.98071	.2737	.89781
720.00	1.9719	248.74	106.75	249.42	107.05	2.3739	1.01888	.2732	.90684
740.00	1.9560	258.89	111.11	259.60	111.42	2.4633	1.0572	.2728	.91514
760.00	1.9410	269.13	115.51	269.87	115.82	2.5532	1.0958	.2723	.92275
780.00	1.9269	279.45	119.93	280.21	120.26	2.6435	1.1345	.2719	.92973
800.00	1.9137	289.84	124.39	290.63	124.73	2.7342	1.1735	.2714	.93613
820.00	1.9012	300.30	128.88	301.11	129.23	2.8254	1.2126	.2710	.94197
840.00	1.8894	310.82	133.40	311.67	133.76	2.9170	1.2519	.2705	.94732
860.00	1.8783	321.41	137.95	322.29	138.32	3.0089	1.2914	.2700	.95219
880.00	1.8678	332.07	142.52	332.97	142.90	3.1013	1.3310	.2696	.95664
900.00	1.8579	342.78	147.12	343.71	147.51	3.1940	1.3708	.2691	.96070
920.00	1.8485	353.56	151.74	354.51	152.15	3.2870	1.4107	.2686	.96440
940.00	1.8396	364.39	156.39	365.37	156.81	3.3804	1.4508	.2681	.96776
960.00	1.8312	375.28	161.07	376.29	161.50	3.4741	1.4910	.2676	.97082
1000.00	1.8156	397.32	170.52	398.38	170.98	3.6624	1.5718	.2661	.97613

THE ELECTRON DENSITY OF SILICON IS 3.00SE 23 ELECTRONS PER GRAH

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.175 BEV, AND THE MINIMUM ENERGY LOSS IS 1.8758 MEV/GM/CM2

SILVER

ELEMENT AG
 ATOMIC NUMBER 47
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 107.87
 ADJUSTED IONIZATION POTENTIAL 465.0

DENSITY = 10.500 GM/CM3

PROTON ENERGY HEV	ENERGY LOSS HEV/GM/CM2	PROTON RANGE HG/CM2 MM	PROTON PATH LENGTH HG/CM2 MM	PROTON PATH LENGTH MM	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL	PATH LENGTH STRAGGLING MM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	252.50	.78282	.81154	.00077	107.87	465.0	.03840	3.540	0.
.15	225.93	.99058	1.0208	.00097	107.87	465.0	.04250	2.958	0.
.20	204.33	1.2199	1.2534	.00119	107.87	465.0	.04739	2.675	0.
.30	172.41	1.7446	1.7878	.00170	107.87	465.0	.05984	2.415	0.
.40	150.62	2.3545	2.4098	.00230	107.87	465.0	.07702	2.295	0.
.50	134.57	3.0438	3.1130	.00296	107.87	465.0	.09736	2.222	0.
.60	121.63	3.8107	3.8951	.00371	107.87	465.0	.12001	2.168	0.
.70	110.90	4.6559	4.7571	.00453	107.87	465.0	.14479	2.126	0.
.80	103.26	5.5750	5.6940	.00542	107.87	465.0	.17121	2.090	0.
.90	97.942	6.5496	6.6874	.00637	107.87	465.0	.19797	2.059	0.
1.00	92.620	7.5809	7.7380	.00737	107.87	465.0	.22515	2.031	0.
1.20	84.231	9.8066	10.005	.00953	107.87	465.0	.28147	1.981	0.
1.40	77.506	12.241	12.483	.01189	107.87	465.0	.34013	1.936	0.
1.60	72.232	14.873	15.161	.01444	107.87	465.0	.40088	1.896	0.
1.80	67.620	17.688	18.023	.01716	107.87	465.0	.46442	1.859	0.
2.00	63.693	20.689	21.074	.02007	107.87	465.0	.53203	1.826	0.
2.20	60.299	23.862	24.296	.02314	107.87	465.0	.60310	1.795	0.
2.40	57.326	27.213	27.702	.02638	107.87	465.0	.67720	1.767	0.
2.60	54.692	30.732	31.277	.02979	107.87	465.0	.75402	1.740	0.
2.80	52.337	34.415	35.016	.03335	107.87	465.0	.83337	1.716	0.
3.00	50.214	38.261	38.920	.03707	107.87	465.0	.91511	1.693	0.
3.20	48.287	42.260	42.979	.04093	107.87	465.0	.99912	1.672	0.
3.40	46.528	46.424	47.204	.04496	107.87	465.0	1.08553	1.652	0.
3.50	44.911	50.737	51.580	.04912	107.87	465.0	1.17337	1.633	0.
3.60	43.427	55.200	56.107	.05344	107.87	465.0	1.2642	1.616	0.
4.00	42.055	59.814	60.786	.05789	107.87	465.0	1.3567	1.599	0.
4.20	40.783	64.581	65.620	.06151	107.87	465.0	1.4511	1.584	0.
4.40	39.599	69.488	70.595	.06523	107.87	465.0	1.5475	1.569	0.
4.60	38.495	74.541	75.718	.06918	107.87	465.0	1.6459	1.555	0.
4.80	37.460	79.738	80.986	.07321	107.87	465.0	1.7461	1.541	0.

SILVER

PRCTON ENERGY MEV	ENERGY LOSS MEV/ GM/CM2	PROTON RANGE GM/CM2	PROTON RANGE CM	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	PATH LENGTH STRAGGLING GM/CM2	PATH LENGTH STRAGGLING PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	36.488	0.8508	0.0810	0.8640	0.0823	0.0185	2.139	1.529	0.
5.50	34.291	0.9903	0.0243	1.0054	0.0958	0.0020	1.100	1.499	0.
6.00	32.387	1.1385	0.01084	1.1555	0.1100	0.0023	2.065	1.473	0.
6.50	30.715	1.2951	0.01233	1.3141	0.1252	0.0025	1.450	1.450	0.0001
7.00	29.255	1.4598	0.01390	1.4810	0.1410	0.0028	2.003	1.428	0.0002
7.50	27.946	1.6326	0.01555	1.6559	0.1577	0.0031	1.976	1.409	0.0003
8.00	26.766	1.8132	0.01727	1.8388	0.1751	0.0034	1.951	1.391	0.0004
8.50	25.694	2.0017	0.01906	2.0296	0.1933	0.0037	1.927	1.375	0.0006
9.00	24.715	2.1978	0.02093	2.2280	0.2122	0.0040	1.906	1.359	0.0008
9.50	23.821	2.4014	0.02287	2.4341	0.2318	0.0044	1.886	1.345	0.0011
10.00	22.994	2.6126	0.02469	2.6478	0.2522	0.0047	1.867	1.332	0.0014
11.00	21.540	3.0568	0.02911	3.0973	0.2950	0.0054	1.833	1.308	0.0022
12.00	20.278	3.5301	0.03362	3.5761	0.3406	0.0061	1.802	1.287	0.0033
13.00	19.178	4.0316	0.03840	4.0834	0.3889	0.0075	1.776	1.268	0.0046
14.00	18.205	4.5610	0.04344	4.6188	0.4399	0.0089	1.753	1.251	0.0062
15.00	17.337	5.1179	0.04874	5.1819	0.4935	0.0085	1.732	1.236	0.0080
16.00	16.557	5.7019	0.05430	5.7724	0.5498	0.0094	1.714	1.222	0.0101
17.00	15.853	6.3126	0.06012	6.3699	0.6086	0.0103	1.698	1.209	0.0124
18.00	15.213	6.9455	0.06619	7.0338	0.6699	0.0113	1.683	1.197	0.0154
19.00	14.630	7.6129	0.07250	7.7043	0.7337	0.0122	1.669	1.184	0.0229
20.00	14.095	8.3024	0.07907	8.4012	0.8001	0.0131	1.656	1.176	0.0329
22.00	13.149	9.7571	0.09292	9.8715	0.9401	0.0153	1.632	1.158	0.0728
24.00	12.336	1.1312	0.10773	1.1443	1.0898	0.0176	1.612	1.143	0.1133
26.00	11.632	1.2966	0.12348	1.3114	1.2409	0.0199	1.593	1.129	0.1711
28.00	11.014	1.4715	0.14015	1.4882	1.4173	0.02346	1.577	1.116	0.2355
30.00	10.466	1.6560	0.15771	1.6745	1.5948	0.02614	1.561	1.105	0.3105
32.00	9.9758	1.8498	0.17617	1.8703	1.7812	0.02894	1.547	1.095	0.3830
34.00	9.5413	2.0528	0.19551	2.0754	1.9765	0.03184	1.534	1.086	0.4622
36.00	9.1480	2.2648	0.21570	2.2895	2.1805	0.03485	1.522	1.078	0.5488
38.00	8.7912	2.4857	0.23674	2.5126	2.3930	0.03796	1.511	1.070	0.6359
40.00	8.4653	2.7153	0.25860	2.7445	2.6138	0.04117	1.500	1.063	0.7235
45.00	7.7615	3.3289	0.35685	3.3621	3.2020	0.04962	1.476	1.048	0.8994
50.00	7.1822	3.9507	0.4812	4.0325	3.8404	0.05866	1.455	1.035	0.9377
55.00	6.6965	4.7653	0.6489	4.7539	4.5276	0.06827	1.436	1.024	0.9985
60.00	6.2831	5.4693	0.8089	5.5254	5.2623	0.07842	1.419	1.015	0.9517
65.00	5.9266	6.2813	0.9822	6.3451	6.0430	0.08910	1.404	1.006	0.9073
70.00	5.6159	7.1402	1.1602	7.2123	6.8688	0.10028	1.390	0.992	0.8650
75.00	5.3427	8.0448	1.3517	8.1255	7.7386	0.11196	1.378	0.9827	0.8247
80.00	5.1003	8.9940	1.5557	9.0837	8.6511	0.12410	1.366	0.9870	0.6860
90.00	4.6892	11.022	1.0497	11.131	1.0601	0.14975	1.345	0.9772	0.8132

SILVER

PROTON ENERGY MEV	ENERGY LOSS HEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH CH	GM/CM2	PROTON PATH LENGTH CH	GM/CM2	PATH LENGTH STRAGGLING CH	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	4.3534	13.217	1.2588	13.346	1.2711	1.7712	0.1687	.9691	.09453
120.00	4.0737	15.572	1.4830	15.723	1.4974	2.0609	0.1963	.9623	.10822
140.00	3.8395	16.078	1.7217	16.253	1.7384	2.3654	0.2253	.9565	.12441
160.00	3.6361	20.731	1.9744	20.930	1.9934	2.6843	0.2556	.9515	.13701
180.00	3.4599	23.927	2.2407	23.752	2.2621	3.0168	0.2873	.9471	.15195
200.00	3.3056	26.457	2.5197	26.709	2.5437	3.3623	0.3202	.9433	.16716
220.00	3.1694	29.519	2.8113	29.799	2.8380	3.7200	0.3543	.9400	.18264
240.00	3.0483	32.709	3.1151	33.018	3.1446	4.0894	0.3895	.9369	.19838
260.00	2.9399	36.020	3.4305	36.360	3.4628	4.4692	0.4257	.9342	.21434
280.00	2.8422	39.449	3.7571	39.860	3.7924	4.8608	0.4629	.9317	.23045
300.00	2.7533	42.991	4.0944	43.394	4.1328	5.2619	0.5011	.9295	.24669
320.00	2.6730	46.646	4.4424	47.082	4.4840	5.6727	0.5403	.9275	.26297
340.00	2.5997	50.405	4.8005	50.876	4.8454	6.0926	0.5802	.9256	.27922
360.00	2.5325	54.268	5.1684	54.774	5.2166	6.5211	0.6211	.9239	.29540
380.00	2.4706	58.230	5.5468	58.772	5.5974	6.9580	0.6627	.9224	.31148
400.00	2.4136	62.289	5.9323	62.868	5.9874	7.4028	0.7050	.9209	.32743
420.00	2.3609	66.441	6.3277	67.057	6.3864	7.8552	0.7481	.9196	.34333
440.00	2.3110	70.683	6.7317	71.339	6.7941	8.3148	0.7919	.9183	.35925
460.00	2.2654	75.014	7.1442	75.709	7.2103	8.7814	0.8363	.9171	.37516
480.00	2.2239	79.429	7.5647	80.163	7.6346	9.2546	0.8814	.9160	.39104
500.00	2.1842	83.926	7.9930	84.701	8.0668	9.7342	0.9271	.9149	.40687
520.00	2.1471	88.502	8.4287	89.318	8.5065	1.0220	0.9733	.9140	.42260
540.00	2.1122	93.156	8.8720	94.014	8.9537	1.0711	1.0201	.9130	.43838
560.00	2.0795	97.885	9.3224	98.786	9.4082	1.1209	1.0675	.9121	.45462
580.00	2.0487	102.69	9.7797	103.63	9.8696	1.1711	1.1153	.9113	.46888
600.00	2.0196	107.55	10.244	108.55	10.338	1.2219	1.1637	.9105	.48395
620.00	1.9922	112.50	10.714	113.53	10.813	1.2732	1.2125	.9097	.49881
640.00	1.9662	117.48	11.189	118.56	11.291	1.3249	1.2618	.9090	.51344
660.00	1.9417	122.55	11.672	123.67	11.778	1.3771	1.3115	.9082	.52783
680.00	1.9184	127.68	12.160	128.85	12.272	1.4298	1.3617	.9075	.54197
700.00	1.8964	132.88	12.655	134.02	12.771	1.4828	1.4122	.9068	.55586
720.00	1.8754	138.13	13.156	139.40	13.276	1.5363	1.4632	.9062	.56949
740.00	1.8554	143.44	13.661	144.76	13.786	1.5902	1.5145	.9055	.58286
760.00	1.8365	148.81	14.173	150.17	14.302	1.6444	1.5661	.9049	.59595
780.00	1.8184	154.21	14.689	155.64	14.823	1.6991	1.6182	.9043	.60884
800.00	1.8011	159.71	15.211	161.17	15.349	1.7540	1.6705	.9037	.62142
820.00	1.7847	165.24	15.737	166.74	15.880	1.8094	1.7232	.9031	.63374
840.00	1.7690	170.82	16.268	172.37	16.416	1.8650	1.7762	.9025	.64578
860.00	1.7539	176.44	16.804	178.05	16.957	1.9210	1.8295	.9019	.65754
880.00	1.7395	182.11	17.344	183.77	17.502	1.9772	1.8831	.9013	.66903

SILVER

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	GH/CM2	MEV/CH	GH/CM2	CH	GH/CM2	CH	GH/CM2	PERCENT		
500.00	1.7258	18.121	187.83	17.889	169.54	18.051	2.0338	.19369	1.073	.68023
510.00	1.7126	17.982	193.60	18.438	195.36	18.605	2.0906	.19911	1.070	.69116
520.00	1.7000	17.849	199.41	18.991	201.22	19.163	2.1477	.20454	1.067	.70182
530.00	1.6878	17.722	205.26	19.548	207.12	19.726	2.2051	.21001	1.065	.71219
540.00	1.6762	17.600	211.15	20.109	213.06	20.292	2.2627	.21550	1.062	.72229
550.00	1.6650	17.483	217.08	20.674	219.05	20.862	2.3206	.22101	1.059	.73212
560.00	1.6543	17.370	223.05	21.243	225.07	21.435	2.3787	.22655	1.057	.74168
570.00	1.6439	17.261	229.06	21.815	231.13	22.013	2.4371	.23210	1.054	.75097
580.00	1.6340	17.157	235.11	22.391	237.23	22.594	2.4956	.23768	1.052	.76000
590.00	1.6244	17.057	241.19	22.970	243.37	23.178	2.5544	.24328	1.050	.76876
600.00	1.6152	16.960	247.31	23.553	249.54	23.766	2.6134	.24890	1.047	.77726
620.00	1.5978	16.777	259.65	24.728	261.99	24.951	2.7320	.26019	1.043	.79352
640.00	1.5817	16.607	272.11	25.916	274.57	26.149	2.8514	.27156	1.038	.80878
660.00	1.5666	16.449	284.71	27.115	287.27	27.359	2.9715	.28300	1.034	.82310
680.00	1.5526	16.302	297.42	28.325	300.09	28.580	3.0922	.29449	1.030	.83651
700.00	1.5394	16.164	310.24	29.547	313.03	29.812	3.2136	.30605	1.027	.84905
720.00	1.5272	16.036	323.17	30.778	326.07	31.054	3.3355	.31767	1.023	.86075
740.00	1.5157	15.915	336.26	32.026	339.29	32.313	3.4581	.32934	1.019	.87166
760.00	1.5050	15.802	349.40	33.277	352.53	33.575	3.5811	.34106	1.016	.88182
780.00	1.4949	15.697	362.63	34.536	365.87	34.845	3.7047	.35283	1.013	.89126
800.00	1.4855	15.597	375.93	35.803	379.29	36.123	3.8287	.36464	1.009	.90004
820.00	1.4766	15.504	389.32	37.079	392.80	37.409	3.9532	.37650	1.006	.90817
840.00	1.4682	15.416	402.79	38.361	406.39	38.703	4.0781	.38839	1.004	.91571
860.00	1.4604	15.334	416.34	39.651	420.05	40.004	4.2035	.40033	1.001	.92269
880.00	1.4530	15.256	429.96	40.948	433.78	41.312	4.3292	.41230	.9980	.92915
900.00	1.4460	15.183	443.64	42.252	447.58	42.627	4.4552	.42431	.9954	.93511
920.00	1.4394	15.114	457.40	43.562	461.46	43.948	4.5817	.43635	.9929	.94061
940.00	1.4332	15.049	471.25	44.881	475.42	45.279	4.7084	.44842	.9904	.94568
960.00	1.4274	14.988	485.21	46.211	489.50	46.619	4.8355	.46052	.9878	.95034
1000.00	1.4166	14.875	513.40	48.895	517.92	49.326	5.0905	.48481	.9829	.95854

THE ELECTRON DENSITY OF SILVER IS 2.525E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.012 BEV, AND THE MINIMUM ENERGY LOSS IS 1.3304 MEV/GH/CM2

STRONTIUM

ADJUSTED IONIZATION POTENTIAL 378.1
 ATOMIC WEIGHT 87.620
 ATOMS/MOLECULE 1
 ATOMIC NUMBER 38
 ELEMENT SR

DENSITY = 2.6000 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS MEV/GM-CM2	PROTON RANGE MG/CM2 MM	PROTON PATH LENGTH MG/CM2 MM	PATH LENGTH STRAGGLING MM PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	278.91	.64868	.66877	.03065	3.003	0.
.15	243.88	.33908	.86033	.03426	2.471	0.
.20	217.16	1.2336	1.0775	.03968	2.222	0.
.30	180.31	1.5531	1.5849	.05423	2.006	0.
.40	157.05	2.1193	2.1810	.07175	1.912	0.
.50	141.48	2.8001	2.8531	.09061	1.856	0.
.60	130.11	3.5257	3.5908	.11069	1.814	0.
.70	120.76	4.3197	4.3887	.13118	1.779	0.
.80	113.69	5.1510	5.2426	.15218	1.747	0.
.90	109.78	6.0442	6.1498	.17373	1.718	0.
1.00	99.873	6.9979	7.1182	.19656	1.690	0.
1.20	51.065	9.0663	9.2175	.24657	1.641	0.
1.40	83.937	11.324	11.507	.30010	1.598	0.
1.60	78.069	13.763	13.981	.35653	1.560	0.
1.80	73.133	16.376	16.630	.41548	1.523	0.
2.00	68.887	19.159	19.349	.47674	1.494	0.
2.20	65.156	22.106	22.435	.54027	1.465	0.
2.40	61.904	25.218	25.586	.60603	1.439	0.
2.60	58.990	28.488	28.897	.67395	1.415	0.
2.80	56.452	31.912	32.363	.74376	1.393	0.
3.00	54.150	35.488	35.982	.81542	1.373	0.
3.20	52.054	39.213	39.751	.8893	1.354	0.
3.40	50.138	43.084	43.667	.96430	1.336	0.
3.60	48.380	47.101	47.731	1.0415	1.319	0.
3.80	46.760	51.257	51.936	1.1205	1.304	0.
4.00	45.260	55.557	56.282	1.2013	1.289	0.
4.20	43.866	59.956	60.774	1.2840	1.276	0.
4.40	42.566	64.373	65.399	1.3684	1.263	0.
4.60	41.353	69.292	70.169	1.4546	1.250	0.
4.80	40.225	74.144	75.074	1.5425	1.239	0.

STRONTIUM

PROCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CH	GM/CH2	CM	GM/CM2	CH	GM/CM2	CH		
5.00	39.148	101.78	.07913	.03043	.08011	.03081	.00163	.00063	2.037	.00001
5.50	36.786	95.645	.09217	.03588	.09329	.03588	.00186	.00072	1.997	.00001
6.00	34.727	90.291	.10603	.04078	.10729	.04127	.00210	.00081	1.962	.00002
6.50	32.913	85.573	.12067	.04641	.12208	.04696	.00236	.00091	1.930	.00003
7.00	31.311	81.408	.13609	.05234	.13767	.05295	.00262	.00101	1.901	.00004
7.50	29.876	77.677	.15228	.05857	.15402	.05924	.00289	.00111	1.875	.00006
8.00	28.582	74.313	.16924	.06509	.17114	.06582	.00317	.00122	1.851	.00009
8.50	27.408	71.261	.18694	.07190	.18901	.07270	.00346	.00133	1.831	.00012
9.00	26.338	68.478	.20537	.07899	.20762	.07985	.00376	.00145	1.812	.00016
9.50	25.354	65.921	.22454	.08636	.22697	.08730	.00408	.00157	1.795	.00020
10.00	24.453	63.578	.24443	.09401	.24705	.09502	.00440	.00169	1.780	.00025
11.00	22.851	59.413	.28638	.11015	.28940	.11131	.00507	.00195	1.753	.00037
12.00	21.469	55.819	.33114	.12736	.33457	.12868	.00579	.00223	1.730	.00051
13.00	20.264	52.685	.37868	.14565	.38254	.14713	.00654	.00251	1.709	.00068
14.00	19.203	49.927	.42895	.16498	.43326	.16664	.00732	.00282	1.690	.00088
15.00	18.260	47.477	.48190	.18535	.48669	.18719	.00814	.00313	1.673	.00110
16.00	17.417	45.284	.53750	.20673	.54278	.20876	.00899	.00346	1.657	.00166
17.00	16.656	43.306	.59572	.22912	.60151	.23135	.00988	.00380	1.642	.00226
18.00	15.967	41.514	.65654	.25252	.66285	.25494	.01080	.00415	1.629	.00408
19.00	15.340	39.884	.71991	.27689	.72677	.27933	.01175	.00452	1.616	.00621
20.00	14.762	38.380	.78579	.30223	.79322	.30508	.01273	.00490	1.604	.00837
22.00	13.759	35.775	.92507	.35579	.93368	.35911	.01478	.00568	1.583	.01273
24.00	12.900	33.541	1.0740	.41309	1.0839	.41688	.01695	.00652	1.564	.01716
26.00	12.155	31.602	1.2325	.47405	1.2437	.47835	.01923	.00740	1.546	.02017
28.00	11.501	29.903	1.4004	.53860	1.4129	.54344	.02162	.00831	1.530	.02162
30.00	10.923	28.401	1.5774	.60671	1.5915	.61210	.02412	.00928	1.515	.02315
32.00	10.408	27.062	1.7635	.67827	1.7790	.68425	.02672	.01028	1.502	.02475
34.00	9.9462	25.860	1.9586	.75330	1.9757	.75989	.02943	.01132	1.489	.02640
36.00	9.5291	24.776	2.1625	.83171	2.1812	.83893	.03223	.01240	1.478	.02811
38.00	9.1506	23.792	2.3749	.91344	2.3954	.92132	.03514	.01352	1.467	.02986
40.00	8.8055	22.894	2.5961	.99849	2.6183	1.0070	.03815	.01467	1.457	.03167
45.00	8.0623	20.962	3.1855	1.2352	3.2124	1.2356	.04607	.01772	1.434	.03638
50.00	7.4522	19.376	3.8262	1.4716	3.8581	1.4839	.05457	.02099	1.414	.04133
55.00	6.9417	18.049	4.5165	1.7371	4.5538	1.7515	.06362	.02447	1.397	.04654
60.00	6.5080	16.921	5.2552	2.0212	5.2983	2.0378	.07319	.02815	1.381	.05200
65.00	6.1346	15.950	6.0409	2.3234	6.0900	2.3423	.08328	.03203	1.368	.05771
70.00	5.8127	15.113	6.8722	2.6432	6.9277	2.6645	.09383	.03609	1.354	.06362
75.00	5.5266	14.369	7.7479	2.9799	7.8101	2.9939	.10486	.04033	1.343	.06973
80.00	5.2731	13.710	8.6676	3.3338	8.7371	3.3604	.11634	.04475	1.332	.07601
90.00	4.8434	12.1593	10.634	4.0099	10.716	4.1223	.14063	.05409	1.312	.08902

STRONTIUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CM ²	MEV/CM	GM/CM ²	CM	GM/CM ²	CM	GM/CM ²	CM		
100.00	4.4931	11.682	12.764	4.9091	12.864	4.9477	.16659	.06407	1.295	.10251
110.00	4.2017	10.924	15.050	5.7884	15.167	5.8335	.19410	.07466	1.280	.11647
120.00	3.9554	10.284	17.486	6.7254	17.622	6.7775	.22310	.08581	1.266	.13092
130.00	3.7443	9.7351	20.067	7.7300	20.222	7.7775	.25348	.09749	1.254	.14574
140.00	3.5613	9.2595	22.786	8.7640	22.961	8.8313	.28519	.10969	1.242	.16091
150.00	3.4008	8.8421	25.639	9.8613	25.836	9.9368	.31815	.12236	1.231	.17630
160.00	3.2596	8.4749	28.622	11.038	28.840	11.092	.35231	.13550	1.222	.19194
170.00	3.1340	8.1483	31.729	12.203	31.970	12.296	.38759	.14907	1.212	.20784
180.00	3.0217	7.8563	34.955	13.444	35.220	13.546	.42396	.16306	1.204	.22396
190.00	2.9206	7.5934	38.298	14.730	38.588	14.841	.46134	.17744	1.196	.24024
200.00	2.8291	7.3556	41.752	16.059	42.068	16.180	.49969	.19219	1.188	.25663
210.00	2.7459	7.1394	45.315	17.429	45.656	17.560	.53897	.20730	1.181	.27307
220.00	2.6700	6.9420	48.981	18.839	49.350	18.981	.57914	.22275	1.174	.28952
230.00	2.6005	6.7612	52.749	20.288	53.145	20.440	.62016	.23852	1.167	.30592
240.00	2.5365	6.5949	56.611	21.773	57.035	21.937	.66198	.25461	1.161	.32226
250.00	2.4775	6.4415	60.571	23.296	61.024	23.471	.70458	.27099	1.155	.33849
260.00	2.4229	6.2995	64.623	24.855	65.106	25.041	.74791	.28766	1.149	.35466
270.00	2.3722	6.1678	68.764	26.448	69.278	26.645	.79196	.30460	1.143	.37080
280.00	2.3251	6.0453	72.992	28.074	73.536	28.283	.83668	.32180	1.138	.38689
290.00	2.2812	5.9312	77.302	29.732	77.878	29.953	.88205	.33925	1.133	.40290
300.00	2.2402	5.8245	81.694	31.421	82.302	31.654	.92805	.35694	1.128	.41882
310.00	2.2018	5.7246	86.164	33.140	86.804	33.386	.97464	.37486	1.123	.43461
320.00	2.1657	5.6309	90.710	34.889	91.384	35.148	1.0218	.39300	1.118	.45026
330.00	2.1319	5.5429	95.331	36.666	96.038	36.938	1.0695	.41135	1.114	.46576
340.00	2.1000	5.4601	100.02	38.470	100.76	38.755	1.1178	.42991	1.109	.48108
350.00	2.0700	5.3820	104.78	40.302	105.56	40.600	1.1665	.44866	1.105	.49621
360.00	2.0416	5.3083	109.61	42.159	110.42	42.471	1.2158	.46760	1.101	.51113
370.00	2.0148	5.2386	114.51	44.042	115.35	44.367	1.2655	.48672	1.097	.52580
380.00	1.9895	5.1726	119.47	45.949	120.35	46.288	1.3156	.50601	1.093	.54021
390.00	1.9654	5.1101	124.49	47.880	125.41	48.233	1.3662	.52547	1.089	.55436
400.00	1.9426	5.0508	129.57	49.834	130.52	50.202	1.4172	.54509	1.086	.56824
410.00	1.9210	4.9945	134.71	51.811	135.70	52.192	1.4686	.56486	1.082	.58184
420.00	1.9003	4.9409	139.90	53.809	140.93	54.205	1.5204	.58478	1.079	.59518
430.00	1.8807	4.8899	145.16	55.829	146.22	56.240	1.5726	.60485	1.075	.60824
440.00	1.8620	4.8413	150.46	57.870	151.57	58.295	1.6251	.62505	1.072	.62103
450.00	1.8442	4.7950	155.82	59.930	156.96	60.371	1.6780	.64539	1.069	.63353
460.00	1.8272	4.7508	161.23	62.010	162.41	62.466	1.7312	.66585	1.066	.64574
470.00	1.8110	4.7085	166.69	64.110	167.91	64.580	1.7848	.68644	1.063	.65767
480.00	1.7954	4.6682	172.19	66.227	173.45	66.713	1.8386	.70715	1.060	.66931
490.00	1.7806	4.6295	177.74	68.363	179.05	68.864	1.8927	.72798	1.057	.68066

STRONTIUM

REGION ENERGY MEV	ENERGY LOSS MEV/GM/CM2	HEV/CH	PROTON RANGE GM/CM2	CH	PROTON PATH LENGTH GM/CM2	CH	PROTON PATH LENGTH CM	PATH LENGTH STRAGGLING GM/CM2	CH	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	1.7664	4.5925	183.34	70.516	184.68	71.033	1.9472	.74891	1.054	.7270	.69172	
510.00	1.7527	4.5571	188.98	72.686	190.37	73.218	2.0619	.76996	1.052	.7266	.70250	
520.00	1.7397	4.5231	194.67	74.873	196.09	75.421	2.0569	.79111	1.049	.7261	.71298	
530.00	1.7271	4.4905	200.40	77.076	201.86	77.640	2.1121	.81235	1.046	.7257	.72319	
540.00	1.7151	4.4593	206.17	79.295	207.67	79.874	2.1676	.83370	1.044	.7253	.73311	
550.00	1.7035	4.4292	211.98	81.529	213.52	82.124	2.2234	.85514	1.041	.7248	.74275	
560.00	1.6924	4.4004	217.82	83.778	219.41	84.389	2.2793	.87667	1.039	.7244	.75211	
570.00	1.6818	4.3726	223.71	86.041	225.34	86.669	2.3355	.89829	1.036	.7239	.76121	
580.00	1.6715	4.3459	229.63	88.319	231.30	88.963	2.3920	.91999	1.034	.7235	.77003	
590.00	1.6616	4.3202	235.59	90.610	237.30	91.270	2.4486	.94178	1.032	.7231	.77858	
600.00	1.6521	4.2955	241.58	92.915	243.34	93.592	2.5055	.96364	1.030	.7227	.78688	
620.00	1.6341	4.2487	253.67	97.554	255.51	98.273	2.6198	1.0076	1.029	.7218	.80270	
640.00	1.6174	4.2052	265.88	102.26	267.81	103.00	2.7348	1.0519	1.021	.7209	.81753	
660.00	1.6018	4.1646	278.22	107.01	280.24	107.78	2.8506	1.0964	1.017	.7201	.83141	
680.00	1.5873	4.1269	290.67	111.80	292.78	112.61	2.9670	1.1412	1.013	.7192	.84438	
700.00	1.5737	4.0916	303.24	116.63	305.43	117.47	3.0841	1.1862	1.010	.7184	.85648	
720.00	1.5610	4.0586	315.91	121.50	318.20	122.38	3.2017	1.2314	1.006	.7175	.86775	
740.00	1.5491	4.0277	328.68	126.42	331.06	127.33	3.3200	1.2769	1.003	.7167	.87824	
760.00	1.5380	3.9988	341.55	131.37	344.01	132.31	3.4387	1.3226	.9996	.7158	.88799	
780.00	1.5276	3.9717	354.51	136.35	357.06	137.33	3.5580	1.3684	.9965	.7149	.89704	
800.00	1.5178	3.9462	367.55	141.37	370.20	142.38	3.6777	1.4145	.9934	.7141	.90543	
820.00	1.5086	3.9223	380.66	146.42	383.42	147.47	3.7979	1.4607	.9905	.7132	.91320	
840.00	1.4999	3.8997	393.89	151.49	396.71	152.58	3.9185	1.5071	.9877	.7123	.92038	
860.00	1.4917	3.8785	407.19	156.61	410.11	157.73	4.0395	1.5537	.9850	.7115	.92702	
880.00	1.4841	3.8586	420.55	161.75	423.56	162.91	4.1609	1.6004	.9824	.7106	.93316	
900.00	1.4768	3.8398	433.97	166.91	437.07	168.11	4.2827	1.6472	.9799	.7097	.93881	
920.00	1.4700	3.8220	447.47	172.10	450.66	173.33	4.4048	1.6942	.9774	.7087	.94402	
940.00	1.4636	3.8053	461.03	177.32	464.31	178.58	4.5273	1.7413	.9751	.7077	.94882	
960.00	1.4575	3.7894	474.66	182.56	478.04	183.86	4.6501	1.7885	.9727	.7065	.95323	
1000.00	1.4463	3.7604	502.25	193.17	505.80	194.54	4.8966	1.8833	.9681	.7032	.96098	

THE ELECTRON DENSITY OF STRONTIUM IS 2.613E ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.046 BEV, AND THE MINIMUM ENERGY LOSS IS 1.3606 MEV/GM/CM2

TANTALUM

ELEMENT TA
 ATOMIC NUMBER 73
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 180.95
 ADJUSTED IONIZATION POTENTIAL 720.0

DENSITY = 16.600 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE MG/CM2	PROTON PATH LENGTH MM	MG/CM2	MG/CM2	PATH LENGTH STRAGGLING PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	122.46	1.1631	.00070	1.2240	.06170	.00004	4.977	0.
.15	124.37	1.5632	.00094	1.6292	.07590	.00005	4.046	0.
.20	122.62	1.9576	.00118	2.0340	.08974	.00005	3.759	0.
.30	112.67	2.7779	.00167	2.8820	.11747	.00007	3.610	0.
.40	99.944	3.6871	.00222	3.8237	.14.33	.00009	3.574	0.
.50	88.954	4.7122	.00284	4.8858	.18194	.00011	3.554	0.
.60	81.387	5.8492	.00352	6.0436	.21955	.00013	3.536	0.
.70	76.110	7.0770	.00426	7.3349	.25847	.00016	3.510	0.
.80	69.167	8.4028	.00506	8.7070	.29969	.00018	2.493	0.
.90	69.555	9.7952	.00590	10.147	.34059	.00021	3.460	0.
1.00	69.942	11.184	.00674	11.582	.37599	.00023	3.440	0.
1.20	64.454	14.072	.00832	14.564	.44680	.00027	3.375	0.
1.40	59.981	17.198	.01056	17.786	.52499	.00032	3.304	0.
1.60	56.022	20.555	.01238	21.242	.60885	.00037	3.233	0.
1.80	52.706	24.137	.01454	24.926	.69741	.00042	3.164	0.
2.00	50.229	27.925	.01682	28.818	.78966	.00048	3.100	0.
2.20	47.614	31.917	.01923	32.917	.88415	.00053	3.039	0.
2.40	45.309	36.119	.02176	37.229	.98256	.00059	2.982	0.
2.60	43.260	40.526	.02441	41.749	1.0846	.00065	2.930	0.
2.80	41.427	45.137	.02719	46.476	1.1900	.00072	2.881	0.
3.00	39.771	49.944	.03009	51.402	1.2985	.00078	2.835	0.
3.20	38.263	54.946	.03310	56.525	1.4101	.00085	2.793	0.
3.40	36.883	60.142	.03623	61.846	1.5247	.00092	2.755	0.
3.60	35.585	65.533	.03948	67.363	1.6423	.00099	2.718	0.
3.80	34.450	71.116	.04284	73.077	1.7628	.00106	2.683	0.
4.00	33.396	76.888	.04632	78.981	1.8857	.00114	2.651	0.
4.20	32.415	82.828	.04990	85.057	2.0111	.00121	2.621	0.
4.40	31.499	88.965	.05359	91.332	2.1388	.00129	2.592	0.
4.60	30.642	95.254	.05738	97.762	2.2690	.00137	2.565	0.
4.80	29.839	101.73	.06128	104.38	2.4016	.00145	2.540	0.

TANTALUM

PROTON ENERGY MEV	ENERGY LOSS MEV/CH2	MEV/CH	PROTON RANGE GM/CH2	CH	PROTON PATH LENGTH GM/CH2	CH	PATH LENGTH STRAGGLING GM/CH2	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	29.084	482.80	1.0837	0.0653	1.1117	0.0670	0.0015	2.282	2.325	0.
5.50	27.383	454.56	1.2573	0.0757	1.2050	0.0777	0.0017	2.239	2.461	0.
6.00	25.902	429.98	1.4411	0.0868	1.4768	0.0890	0.0020	2.205	2.412	0.
6.50	24.601	408.37	1.6354	0.0985	1.6751	0.1009	0.0022	2.175	2.369	0.00032
7.00	23.442	389.14	1.8395	0.1108	1.8834	0.1135	0.0024	2.149	2.330	0.00005
7.50	22.422	372.20	2.0553	0.1237	2.1015	0.1266	0.0027	2.126	2.294	0.00009
8.00	21.501	356.92	2.2766	0.1371	2.3293	0.1403	0.0030	2.104	2.262	0.00011
8.50	20.666	343.06	2.5092	0.1512	2.5665	0.1546	0.0032	2.083	2.233	0.00012
9.00	19.902	330.33	2.7510	0.1657	2.8131	0.1695	0.0035	2.064	2.206	0.00012
9.50	19.207	318.83	3.0021	0.1808	3.0690	0.1849	0.0038	2.046	2.181	0.00012
10.00	18.566	308.20	3.2619	0.1965	3.3338	0.2008	0.0041	2.028	2.157	0.00013
11.00	17.423	289.22	3.8079	0.2294	3.8902	0.2343	0.0047	1.996	2.116	0.00015
12.00	15.435	272.81	4.3884	0.2644	4.4815	0.2700	0.0053	1.967	2.079	0.00018
13.00	15.569	258.41	5.0025	0.3014	5.1070	0.3077	0.0060	1.940	2.046	0.00024
14.00	14.802	245.72	5.6496	0.3403	5.7660	0.3473	0.0067	1.915	2.017	0.00030
15.00	14.119	234.30	6.3293	0.3813	6.4579	0.3890	0.0074	1.892	1.991	0.00040
16.00	13.506	224.20	7.0410	0.4242	7.1823	0.4327	0.0081	1.871	1.967	0.00051
17.00	12.952	215.00	7.7842	0.4689	7.9386	0.4782	0.0089	1.851	1.945	0.00065
18.00	12.448	206.64	8.5585	0.5156	8.7265	0.5257	0.0096	1.832	1.925	0.00081
19.00	11.988	199.01	9.3632	0.5640	9.5452	0.5752	0.0104	1.815	1.907	0.00099
20.00	11.566	192.00	1.0198	0.6144	1.0395	0.6262	0.0113	1.799	1.890	0.00120
22.00	10.828	179.50	1.1957	0.7203	1.2184	0.7340	0.0130	1.769	1.859	0.00168
24.00	10.172	168.86	1.3833	0.8333	1.4092	0.8489	0.0148	1.742	1.832	0.00224
26.00	9.6394	160.01	1.5821	0.9531	1.6112	0.9706	0.0167	1.717	1.808	0.00322
28.00	9.1478	151.85	1.7917	1.0793	1.8243	1.0990	0.0186	1.695	1.787	0.00462
30.00	8.7113	144.61	2.0121	1.2121	2.0483	1.2339	0.0207	1.675	1.768	0.00607
32.00	8.3193	138.10	2.2434	1.3514	2.2834	1.3755	0.0228	1.656	1.751	0.00757
34.00	7.9694	132.29	2.4853	1.4972	2.5292	1.5236	0.0250	1.639	1.735	0.00913
36.00	7.6523	127.03	2.7373	1.6490	2.7852	1.6778	0.0272	1.624	1.721	0.01074
38.00	7.3630	122.23	2.9994	1.8069	3.0515	1.8383	0.0296	1.610	1.707	0.01240
40.00	7.0990	117.84	3.2721	1.9712	3.3286	2.0052	0.0320	1.597	1.695	0.01411
45.00	6.5268	108.35	3.9958	2.4071	4.0635	2.4479	0.0384	1.569	1.668	0.01855
50.00	6.0536	100.49	4.7798	2.9276	4.8597	2.9276	0.0452	1.545	1.645	0.02324
55.00	5.6553	93.878	5.6222	3.3869	5.7152	3.4429	0.0525	1.524	1.626	0.02817
60.00	5.3154	88.236	6.5208	3.9282	6.6274	3.9924	0.0601	1.505	1.609	0.03334
65.00	5.0217	83.360	7.4730	4.5016	7.5941	4.5748	0.0681	1.488	1.595	0.03875
70.00	4.7648	79.096	8.4801	5.1085	8.6164	5.1904	0.0765	1.473	1.582	0.04436
75.00	4.5380	75.331	9.5398	5.7469	9.6921	5.8386	0.0852	1.459	1.569	0.05017
80.00	4.3359	71.975	10.651	6.4161	10.820	6.5178	0.0942	1.446	1.560	0.05615
90.00	3.9956	66.326	13.019	7.8427	13.223	7.9655	0.1133	1.423	1.542	0.06857

TANTALUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CH	GM/CH2	CM	GM/CH2	CM	GM/CH2	PERCENT		
100.00	3.7164	61.692	15.578	93843	15.820	95298	.22181	.01336	1.402	.08150
110.00	3.4833	57.822	18.319	1.1035	18.601	1.1205	.25737	.01550	1.384	.09493
120.00	3.2854	54.538	21.231	1.2790	21.556	1.2985	.29471	.01775	1.367	.10853
130.00	3.1155	51.717	24.314	1.4647	24.683	1.4869	.33371	.02010	1.352	.12326
140.00	2.9678	49.265	27.556	1.6600	27.972	1.6851	.37430	.02255	1.338	.13800
150.00	2.8383	47.116	30.954	1.8647	31.419	1.8927	.41639	.02508	1.325	.15304
160.00	2.7238	45.215	34.500	2.0783	35.016	2.1094	.45990	.02771	1.313	.16837
170.00	2.6219	43.525	38.190	2.3006	38.759	2.3349	.50476	.03041	1.302	.18401
180.00	2.5305	42.006	42.018	2.5312	42.642	2.5688	.55090	.03319	1.292	.19990
190.00	2.4482	40.639	45.977	2.7697	46.658	2.8107	.59825	.03604	1.282	.21599
200.00	2.3758	39.439	50.088	3.0161	50.808	3.0607	.64676	.03896	1.273	.23223
210.00	2.3078	38.309	54.277	3.2697	55.077	3.3179	.69624	.04194	1.266	.24855
220.00	2.2456	37.277	58.612	3.5308	59.499	3.5827	.74679	.04499	1.252	.26490
230.00	2.1886	36.331	63.051	3.7983	63.976	3.8540	.79835	.04809	1.240	.28124
240.00	2.1361	35.460	67.615	4.0732	68.605	4.1328	.85088	.05126	1.230	.29753
250.00	2.0877	34.656	72.287	4.3546	73.343	4.4183	.90433	.05448	1.223	.31375
260.00	2.0439	33.912	77.064	4.6424	78.188	4.7101	.95866	.05775	1.226	.32987
270.00	2.0013	33.221	81.943	4.9363	83.136	5.0082	1.01338	.06107	1.219	.34585
280.00	1.9626	32.579	86.905	5.2353	88.169	5.3114	1.0698	.06445	1.213	.36167
290.00	1.9265	31.980	91.979	5.5409	93.315	5.6214	1.1265	.06786	1.207	.37731
300.00	1.8918	31.405	97.144	5.8521	98.553	5.9370	1.1840	.07133	1.201	.39276
310.00	1.8602	30.880	102.41	6.1691	103.89	6.2584	1.2423	.07484	1.196	.40807
320.00	1.8306	30.388	107.75	6.4909	109.31	6.5848	1.3012	.07839	1.190	.42327
330.00	1.8028	29.926	113.18	6.8179	114.81	6.9164	1.3608	.08197	1.185	.43836
340.00	1.7765	29.491	118.69	7.1497	120.40	7.2530	1.4210	.08560	1.180	.45330
350.00	1.7518	29.081	124.27	7.4864	126.07	7.5944	1.4817	.08926	1.175	.46809
360.00	1.7285	28.693	129.98	7.8304	131.86	7.9432	1.5431	.09296	1.170	.48272
370.00	1.7065	28.327	135.70	8.1745	137.65	8.2921	1.6050	.09668	1.166	.49719
380.00	1.6856	27.980	141.50	8.5239	143.53	8.6465	1.6674	.10044	1.162	.51149
390.00	1.6658	27.652	147.38	8.8784	149.50	9.0060	1.7303	.10423	1.157	.52560
400.00	1.6470	27.340	153.33	9.2370	155.54	9.3696	1.7936	.10805	1.153	.53951
410.00	1.6292	27.044	159.35	9.5996	161.64	9.7373	1.8575	.11190	1.149	.55320
420.00	1.6122	26.762	165.44	9.9661	167.81	10.109	1.9218	.11577	1.145	.56684
430.00	1.5960	26.494	171.58	10.336	174.04	10.484	1.9865	.11967	1.141	.57984
440.00	1.5807	26.239	177.79	10.710	180.34	10.864	2.0516	.12359	1.138	.59278
450.00	1.5660	25.996	184.06	11.088	186.68	11.246	2.1172	.12754	1.134	.60546
460.00	1.5520	25.763	190.38	11.449	193.10	11.633	2.1831	.13151	1.131	.61788
470.00	1.5386	25.541	196.76	11.853	199.57	12.023	2.2493	.13550	1.127	.63003
480.00	1.5258	25.329	203.20	12.241	206.10	12.416	2.3160	.13952	1.124	.64191
490.00	1.5136	25.126	209.69	12.632	212.68	12.812	2.3829	.14355	1.120	.65353

TANTALUM

PROTON ENERGY MEV	ENERGY LOSS HEV/CM	PROTON RANGE GM/CH2	PROTON PATH LENGTH CH	PROTON PATH LENGTH GM/CH2	PATH LENGTH STRAGGLING CH	GM/CH2	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	1.5019	216.25	13.027	219.34	14.760	2.4502	1.406	.66488
510.00	1.4907	222.84	13.424	226.02	15.168	2.5178	1.405	.67595
520.00	1.4799	229.48	13.824	232.75	15.577	2.5858	1.405	.68676
530.00	1.4696	236.17	14.227	239.53	15.988	2.6540	1.404	.69729
540.00	1.4598	242.90	14.633	246.36	16.400	2.7225	1.403	.70756
550.00	1.4503	249.68	15.041	253.23	16.815	2.7912	1.402	.71756
560.00	1.4411	256.50	15.452	260.15	17.231	2.8603	1.401	.72730
570.00	1.4324	263.37	15.865	267.11	17.648	2.9296	1.401	.73677
580.00	1.4239	270.27	16.281	274.11	18.067	2.9991	1.400	.74599
590.00	1.4158	277.22	16.700	281.15	18.487	3.0689	1.399	.75494
600.00	1.4080	284.20	17.121	288.23	18.909	3.1389	1.398	.76365
620.00	1.3932	298.28	17.969	302.51	19.756	3.2795	1.397	.78031
640.00	1.3795	312.51	18.826	316.94	20.609	3.4210	1.395	.79600
660.00	1.3667	326.88	19.692	331.50	21.466	3.5633	1.394	.81075
680.00	1.3548	341.38	20.565	346.20	22.327	3.7063	1.393	.82460
700.00	1.3437	356.00	21.446	361.02	23.193	3.8500	1.391	.83758
720.00	1.3333	370.73	22.333	375.96	24.063	3.9944	1.390	.84973
740.00	1.3236	385.62	23.230	391.05	24.936	4.1393	1.388	.86109
760.00	1.3146	400.72	24.140	406.35	25.812	4.2849	1.386	.87170
780.00	1.3061	415.78	25.047	421.62	26.692	4.4309	1.385	.88159
800.00	1.2981	430.94	25.960	436.99	27.575	4.5775	1.384	.89080
820.00	1.2906	446.20	26.879	452.45	28.461	4.7245	1.382	.89937
840.00	1.2835	461.54	27.804	468.00	29.350	4.8720	1.381	.90734
860.00	1.2769	476.96	28.733	483.63	30.241	5.0200	1.379	.91473
880.00	1.2707	492.47	29.667	499.35	31.134	5.1683	1.378	.92159
900.00	1.2649	508.05	30.606	515.14	32.030	5.3170	1.376	.92795
920.00	1.2593	523.72	31.549	531.02	32.928	5.4661	1.375	.93383
940.00	1.2541	539.46	32.497	546.96	33.829	5.6156	1.373	.93927
960.00	1.2492	555.28	33.451	563.00	34.731	5.7653	1.370	.94430
1000.00	1.2403	587.31	35.380	595.43	35.641	6.0658	1.364	.95318

THE ELECTRON DENSITY OF TANTALUM IS 2.431E 23 ELECTRONS PER GRAM
 THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 1.937 BEV, AND THE MINIMUM ENERGY LOSS IS 1.1754 MEV/GM/CM2

THORIUM

ATOMIC NUMBER 90
 ELEMENT TH
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 232.04
 ADJUSTED IONIZATION POTENTIAL 888.8

DENSITY = 11.500 GM/CM3

PRCTON ENERGY MEV	ENERGY LOSS HEV/GM/CM2	MEV/CH	PROTON RANGE HG/CH2	MM	PROTON PATH LENGTH HG/CH2	MM	PROTON PATH LENGTH MM	HG/CH2	PATH LENGTH STRAGGLING MM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	120.09	1381.1	1.4063	.00122	1.4937	.00130	.07748	.00007	5.187	5.852	0.	
.15	125.62	1444.6	1.8080	.00157	1.9008	.00165	.08969	.00008	4.719	4.835	0.	
.20	124.24	1428.8	2.1993	.00191	2.3009	.00200	1.0019	.00009	4.354	4.413	0.	
.30	111.50	1282.3	3.0188	.00263	3.1473	.00274	1.2136	.00011	3.856	4.082	0.	
.40	98.322	1130.7	3.9420	.00343	4.1039	.00357	1.4674	.00013	3.576	3.946	0.	
.50	88.969	1023.1	4.9743	.00433	5.1747	.00450	1.7890	.00016	3.457	3.873	0.	
.60	81.407	936.17	6.1074	.00531	6.3503	.00552	2.1573	.00019	3.397	3.825	0.	
.70	75.931	873.21	7.3334	.00638	7.6220	.00663	2.5548	.00022	3.352	3.786	0.	
.80	69.938	804.29	8.6569	.00753	8.9943	.00782	2.9819	.00026	3.315	3.751	0.	
.90	66.006	759.07	10.076	.00876	10.465	.00910	3.4358	.00030	3.283	3.719	0.	
1.00	62.065	713.75	11.584	.01007	12.028	.01046	3.9081	.00034	3.249	3.690	0.	
1.20	56.498	649.73	14.849	.01291	15.409	.01340	4.8984	.00043	3.179	3.635	0.	
1.40	52.088	599.02	18.416	.01601	19.100	.01661	5.9280	.00052	3.104	3.584	0.	
1.60	48.500	557.75	22.268	.01936	23.084	.02007	6.9940	.00061	3.030	3.536	0.	
1.80	45.510	523.37	26.391	.02295	27.346	.02378	8.0940	.00070	2.960	3.491	0.	
2.00	42.967	494.12	30.771	.02676	31.870	.02771	9.2303	.00080	2.896	3.449	0.	
2.20	40.759	468.73	35.401	.03078	36.650	.03187	1.0430	.00091	2.846	3.408	0.	
2.40	38.939	446.64	40.275	.03502	41.680	.03624	1.1687	.00102	2.804	3.370	0.	
2.60	37.133	427.03	45.383	.03946	46.949	.04082	1.2994	.00113	2.768	3.334	0.	
2.80	35.604	409.45	50.720	.04410	52.450	.04561	1.4344	.00125	2.735	3.300	0.	
3.00	34.225	393.58	56.280	.04894	58.181	.05059	1.5735	.00137	2.705	3.267	0.	
3.20	32.972	379.17	62.060	.05397	64.136	.05577	1.7163	.00149	2.676	3.236	0.	
3.40	31.831	366.06	68.056	.05918	70.310	.06114	1.8625	.00162	2.649	3.207	0.	
3.60	30.787	354.05	74.264	.06458	76.702	.06670	2.0120	.00175	2.623	3.179	0.	
3.80	29.827	343.01	80.677	.07015	83.303	.07244	2.1645	.00188	2.598	3.152	0.	
4.00	28.978	333.24	87.293	.07591	90.110	.07836	2.3199	.00202	2.575	3.127	0.	
4.20	28.150	323.73	94.105	.08183	97.118	.08445	2.4776	.00215	2.551	3.103	0.	
4.40	27.378	314.95	101.10	.08792	104.32	.09071	2.6382	.00229	2.529	3.079	0.	
4.60	26.655	306.53	108.30	.09417	111.72	.09714	2.8015	.00244	2.509	3.057	0.	
4.80	25.979	298.76	115.70	.10061	119.33	.10376	2.9675	.00258	2.487	3.036	0.	

THORIUM

FRACON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	25.310	.12330	.12713	.00314	3.015	0.
5.50	23.916	.14308	.14745	.00357	2.967	0.
6.00	22.691	.16399	.16892	.00402	2.924	0.
6.50	21.605	.18599	.19152	.00448	2.884	0.
7.00	20.634	.20908	.21520	.00495	2.847	0.
7.50	19.762	.23322	.23997	.00544	2.813	0.
8.00	18.973	.25842	.26581	.00594	2.781	0.
8.50	18.255	.28463	.29268	.00646	2.751	0.
9.00	17.599	.31184	.32057	.00699	2.724	0.
9.50	16.996	.34006	.34949	.00753	2.698	0.
10.00	16.440	.36928	.37942	.00809	2.673	0.
11.00	15.445	.43062	.44225	.00927	2.629	.00001
12.00	14.597	.49570	.50887	.01050	2.589	.00002
13.00	13.850	.56443	.57922	.01178	2.553	.00004
14.00	13.191	.63679	.65326	.01312	2.520	.00008
15.00	12.601	.71261	.73081	.01450	2.491	.00014
16.00	12.066	.79194	.81194	.01592	2.463	.00021
17.00	11.590	.87472	.89658	.01740	2.438	.00030
18.00	11.156	.96073	.98450	.01891	2.414	.00042
19.00	10.758	1.0501	1.0758	.02047	2.393	.00055
20.00	10.391	1.1426	1.1704	.02207	2.372	.00071
22.00	9.7415	1.3374	1.3694	.02539	2.335	.00109
24.00	9.2211	1.5441	1.5805	.02885	2.303	.00155
26.00	8.7238	1.7626	1.8036	.03243	2.273	.00217
28.00	8.2852	1.9931	2.0389	.03617	2.247	.00285
30.00	7.8965	2.2355	2.2864	.04005	2.223	.00358
32.00	7.5488	2.4898	2.5458	.04409	2.201	.00437
34.00	7.2355	2.7549	2.8163	.04826	2.181	.00528
36.00	6.9515	3.0310	3.0980	.05256	2.162	.00631
38.00	6.6930	3.3191	3.3919	.05701	2.145	.00745
40.00	6.4541	3.6172	3.6959	.06158	2.130	.00871
45.00	5.9453	4.4098	4.5042	.07356	2.095	.01260
50.00	5.5237	5.2665	5.3775	.08627	2.065	.01760
55.00	5.1791	6.1843	6.3130	.09961	2.040	.02222
60.00	4.8736	7.1613	7.3088	.11368	2.017	.02706
65.00	4.6088	8.1966	8.3637	.12848	1.998	.03215
70.00	4.3774	9.2891	9.4767	.14394	1.980	.03746
75.00	4.1730	10.437	10.647	.16006	1.965	.04298
80.00	3.9911	11.642	11.873	.17679	1.951	.04869
90.00	3.6810	14.207	14.486	.21203	1.927	.06582

THORIUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CH	GM/CH2	CM	GM/CH2	CH	GM/CH2	CH		
100.00	3.4267	39.407	16.974	1.4763	17.303	1.5047	.24949	.02170	1.907	.07959
110.00	3.2136	35.956	19.935	1.7334	20.319	1.7668	.28903	.02513	1.890	.09287
120.00	3.0330	34.880	23.070	2.0061	23.511	2.0444	.33053	.02874	1.876	.10667
130.00	2.8774	33.091	26.397	2.2954	26.898	2.3390	.37387	.03251	1.864	.12091
140.00	2.7429	31.544	29.894	2.5994	30.456	2.6485	.41892	.03643	1.853	.13552
150.00	2.6248	30.185	33.556	2.9179	34.186	2.9727	.46559	.04049	1.843	.15044
160.00	2.5202	28.982	37.375	3.2500	38.074	3.3108	.51378	.04468	1.835	.16561
170.00	2.4270	27.911	41.337	3.5945	42.106	3.6614	.56342	.04899	1.826	.18100
180.00	2.3435	26.950	45.455	3.9526	46.298	4.0259	.61444	.05343	1.820	.19656
190.00	2.2681	26.083	49.717	4.3232	50.635	4.4030	.66677	.05798	1.814	.21324
200.00	2.1998	25.298	54.116	4.7058	55.113	4.7924	.72035	.06264	1.808	.22799
210.00	2.1377	24.583	58.646	5.0996	59.723	5.1933	.77511	.06740	1.803	.24384
220.00	2.0800	23.930	63.305	5.5048	64.465	5.6056	.83099	.07226	1.799	.25978
230.00	2.0207	23.330	68.087	5.9206	69.331	6.0287	.88796	.07721	1.794	.27579
240.00	1.9629	22.804	72.988	6.3468	74.319	6.4625	.94593	.08225	1.791	.29183
250.00	1.9384	22.292	77.996	6.7822	79.415	6.9056	1.0047	.08737	1.787	.30786
260.00	1.8572	21.818	83.123	7.2281	84.632	7.3593	1.0644	.09256	1.784	.32384
270.00	1.8590	21.378	88.361	7.6836	89.963	7.8229	1.1251	.09783	1.781	.33974
280.00	1.8234	20.969	93.680	8.1461	95.376	8.2936	1.1866	.10318	1.778	.35552
290.00	1.7902	20.587	99.123	8.6194	100.91	8.7752	1.2469	.10860	1.775	.37118
300.00	1.7592	20.230	104.65	9.1002	106.54	9.2644	1.3121	.11409	1.772	.38668
310.00	1.7301	19.896	110.29	9.5903	112.28	9.7631	1.3759	.11965	1.770	.40203
320.00	1.7028	19.583	116.02	10.088	118.11	10.270	1.4405	.12526	1.768	.41725
330.00	1.6772	19.288	121.84	10.594	124.03	10.785	1.5058	.13094	1.765	.43230
340.00	1.6531	19.010	127.74	11.108	130.03	11.307	1.5718	.13668	1.763	.44738
350.00	1.6303	18.749	133.73	11.629	136.13	11.837	1.6384	.14247	1.761	.46167
360.00	1.6077	18.489	139.77	12.154	142.27	12.371	1.7056	.14832	1.760	.47638
370.00	1.5874	18.256	145.93	12.690	148.54	12.917	1.7736	.15422	1.758	.49070
380.00	1.5682	18.035	152.16	13.231	154.88	13.468	1.8420	.16018	1.757	.50483
390.00	1.5500	17.825	158.46	13.779	161.29	14.025	1.9110	.16618	1.755	.51874
400.00	1.5327	17.626	164.83	14.333	167.77	14.589	1.9806	.17222	1.753	.53243
410.00	1.5163	17.438	171.28	14.894	174.33	15.159	2.0506	.17831	1.752	.54590
420.00	1.5007	17.258	177.79	15.460	180.96	15.735	2.1211	.18444	1.751	.55915
430.00	1.4858	17.087	184.37	16.032	187.65	16.318	2.1920	.19061	1.749	.57218
440.00	1.4717	16.924	191.12	16.619	194.51	16.914	2.2634	.19681	1.747	.58497
450.00	1.4581	16.769	197.83	17.202	201.34	17.508	2.3352	.20306	1.746	.59752
460.00	1.4453	16.621	204.60	17.791	208.23	18.107	2.4074	.20934	1.745	.60983
470.00	1.4330	16.479	211.43	18.385	215.18	18.711	2.4799	.21565	1.744	.62189
480.00	1.4212	16.344	218.32	18.954	222.19	19.321	2.5529	.22199	1.742	.63370
490.00	1.4100	16.214	225.26	19.588	229.25	19.935	2.6262	.22837	1.741	.64527

THORIUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/GM/CM2	MEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	PERCENT		
500.00	1.3992	16.091	232.26	20.196	236.37	20.554	2.6999	.23477	1.142	.65657
510.00	1.3889	15.972	239.31	20.810	243.54	21.178	2.7739	.24121	1.139	.66763
520.00	1.3790	15.858	246.41	21.427	250.77	21.806	2.8482	.24767	1.136	.67843
530.00	1.3695	15.749	253.57	22.049	258.05	22.439	2.9228	.25416	1.133	.68897
540.00	1.3604	15.645	260.77	22.675	265.37	23.076	2.9978	.26067	1.130	.69926
550.00	1.3517	15.544	268.02	23.306	272.75	23.717	3.0730	.26722	1.127	.70930
560.00	1.3433	15.448	275.31	23.940	280.17	24.363	3.1485	.27378	1.124	.71908
570.00	1.3352	15.355	282.65	24.579	287.64	25.012	3.2242	.28037	1.121	.72861
580.00	1.3275	15.266	290.04	25.221	295.15	25.665	3.3002	.28698	1.118	.73789
590.00	1.3200	15.180	297.46	25.866	302.70	26.322	3.3765	.29361	1.115	.74693
600.00	1.3128	15.097	304.93	26.516	310.30	26.983	3.4530	.30026	1.113	.75572
620.00	1.2992	14.941	319.99	27.825	325.61	28.314	3.6067	.31363	1.108	.77258
640.00	1.2866	14.796	335.20	29.147	341.08	29.660	3.7613	.32707	1.103	.78849
660.00	1.2749	14.661	350.55	30.482	356.70	31.017	3.9167	.34058	1.098	.80350
680.00	1.2640	14.536	365.04	31.830	372.46	32.388	4.0729	.35416	1.094	.81761
700.00	1.2538	14.418	381.66	33.188	388.35	33.769	4.2297	.36780	1.089	.83088
720.00	1.2443	14.309	397.42	34.558	404.37	35.163	4.3873	.38150	1.085	.84332
740.00	1.2354	14.207	413.28	35.937	420.50	36.566	4.5454	.39525	1.081	.85498
760.00	1.2270	14.111	429.25	37.326	436.75	37.978	4.7042	.40906	1.077	.86589
780.00	1.2193	14.021	445.42	38.732	453.19	39.408	4.8635	.42291	1.073	.87609
800.00	1.2119	13.937	461.60	40.139	469.64	40.839	5.0233	.43681	1.070	.88560
820.00	1.2051	13.859	477.88	41.555	486.20	42.278	5.1836	.45075	1.066	.89447
840.00	1.1987	13.785	494.27	42.980	502.86	43.727	5.3443	.46473	1.063	.90273
860.00	1.1926	13.715	510.73	44.411	519.60	45.182	5.5055	.47874	1.060	.91042
880.00	1.1869	13.650	527.16	45.840	536.31	46.636	5.6672	.49280	1.057	.91755
900.00	1.1816	13.588	543.79	47.286	553.22	48.106	5.8292	.50688	1.054	.92418
920.00	1.1765	13.530	560.48	48.737	570.18	49.581	5.9915	.52100	1.051	.93032
940.00	1.1718	13.476	577.25	50.195	587.23	51.063	6.1543	.53515	1.048	.93601
960.00	1.1673	13.424	594.10	51.661	604.35	52.553	6.3173	.54933	1.045	.94127
1000.00	1.1592	13.330	628.39	54.643	639.22	55.584	6.6444	.57777	1.039	.95057

THE ELECTRON DENSITY OF THORIUM IS 2.337E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 1.900 BEV, AND THE MINIMUM ENERGY LOSS IS 1.1025 MEV/GM/CM2

TIN

ATOMS/ MOLECULE 1
 ATOMIC WEIGHT 118.69
 ADJUSTED IONIZATION POTENTIAL 483.0

DENSITY = 7.2980 GM/CM3

PHOTON ENERGY MEV	ENERGY LOSS GM/CM2	PROTON RANGE MG/CM2	PROTON PATH LENGTH MM		PATH LENGTH STRAGGLING MM		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
			MG/CM2	MM	MG/CM2	MM		
.10	247.80	1808.4	.82723	.00113	.04103	.00006	3.713	0.
.15	224.06	1635.2	1.0379	.00142	.04485	.00006	3.115	0.
.20	203.28	1483.5	1.2687	.00174	.04939	.00007	2.811	0.
.30	169.56	1238.2	1.7986	.00246	.06088	.00008	2.515	0.
.40	145.09	1058.9	2.4249	.00332	.07724	.00011	2.372	0.
.50	127.69	931.88	3.1464	.00431	.09847	.00013	2.288	0.
.60	115.61	843.72	3.9543	.00542	.12275	.00017	2.231	0.
.70	106.97	780.67	4.8367	.00663	.14868	.00020	2.189	0.
.80	99.919	729.21	5.7854	.00793	.17557	.00024	2.154	0.
.90	94.257	687.89	6.7950	.00931	.20321	.00028	2.123	0.
1.00	88.591	646.54	7.8687	.01078	.23182	.00032	2.096	0.
1.20	75.386	587.24	10.195	.01397	.29171	.00040	2.047	0.
1.40	65.924	539.50	12.744	.01746	.35424	.00049	2.004	0.
1.60	58.640	500.94	15.506	.02125	.41942	.00057	1.965	0.
1.80	52.959	468.96	18.468	.02531	.48690	.00067	1.930	0.
2.00	48.510	441.60	21.621	.02963	.55665	.00076	1.898	0.
2.20	44.356	417.85	24.963	.03421	.63068	.00086	1.868	0.
2.40	40.439	397.30	28.489	.03904	.70824	.00097	1.841	0.
2.60	36.745	379.09	32.191	.04411	.78902	.00108	1.816	0.
2.80	33.266	362.83	36.064	.04942	.87270	.00120	1.792	0.
3.00	30.000	348.19	40.107	.05496	.95907	.00131	1.770	0.
3.20	26.924	334.92	44.317	.06072	1.0480	.00144	1.750	0.
3.40	24.024	322.82	48.687	.06671	1.1392	.00156	1.730	0.
3.60	21.273	311.72	53.221	.07293	1.2328	.00169	1.712	0.
3.80	18.661	301.50	57.911	.07935	1.3286	.00182	1.695	0.
4.00	16.176	292.04	62.757	.08599	1.4266	.00195	1.678	0.
4.20	13.800	283.26	67.759	.09285	1.5267	.00209	1.663	0.
4.40	11.512	275.08	72.912	.09991	1.6288	.00223	1.648	0.
4.60	9.395	267.43	78.216	.10717	1.7330	.00237	1.634	0.
4.80	7.435	260.28	83.672	.11465	1.8392	.00252	1.621	0.

TIN

PRCTON ENERGY MEV	ENERGY LOSS MEV/GH/CH2	MEV/CH	PROTON RANGE GH/CH2	CH	PROTON PATH LENGTH GH/CH2	CH	GM/CM2	PROTON PATH LENGTH STRAGGLING CM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	34.740	253.53	.08927	.01223	.09073	.01243	.00195	.00027	2.146	1.608	0.
5.50	32.739	238.93	.10390	.01424	.10557	.01447	.00223	.00030	2.108	1.579	0.
6.00	30.926	225.70	.11941	.01636	.12130	.01662	.00251	.00034	2.073	1.553	0.
6.50	29.332	214.07	.13580	.01861	.13791	.01890	.00282	.00039	2.042	1.529	.00001
7.00	27.916	203.73	.15304	.02097	.15538	.02129	.00313	.00043	2.013	1.507	.00001
7.50	26.650	194.49	.17114	.02345	.17372	.02380	.00345	.00047	1.987	1.487	.00002
8.00	25.503	186.12	.19007	.02604	.19290	.02643	.00379	.00052	1.962	1.469	.00003
8.50	24.490	178.73	.20983	.02875	.21292	.02918	.00413	.00057	1.940	1.452	.00004
9.00	23.566	171.98	.23038	.03157	.23374	.03203	.00448	.00061	1.919	1.436	.00006
9.50	22.719	165.80	.25172	.03449	.25535	.03499	.00485	.00066	1.899	1.422	.00008
10.00	21.938	160.11	.27382	.03752	.27773	.03806	.00522	.00072	1.880	1.408	.00011
11.00	20.548	149.94	.32038	.04390	.32487	.04452	.00600	.00082	1.846	1.384	.00018
12.00	19.342	141.16	.36995	.05069	.37506	.05139	.00681	.00093	1.816	1.362	.00028
13.00	18.299	133.54	.42250	.05789	.42824	.05868	.00766	.00105	1.789	1.342	.00040
14.00	17.376	126.81	.47793	.06549	.48435	.06637	.00855	.00117	1.765	1.325	.00055
15.00	16.553	120.80	.53622	.07347	.54333	.07445	.00947	.00130	1.743	1.309	.00072
16.00	15.815	115.42	.59731	.08185	.60514	.08292	.01043	.00145	1.724	1.294	.00092
17.00	15.148	110.55	.66119	.09060	.66977	.09177	.01143	.00157	1.707	1.281	.00114
18.00	14.542	106.13	.72783	.09973	.73718	.10101	.01247	.00171	1.691	1.269	.00138
19.00	13.988	102.09	.79715	.10923	.80730	.11062	.01354	.00186	1.677	1.257	.00165
20.00	13.481	98.381	.86918	.11910	.88016	.12060	.01465	.00201	1.664	1.247	.00193
22.00	12.581	91.815	1.0211	.13992	1.0338	.14166	.01696	.00232	1.640	1.228	.00313
24.00	11.808	86.175	1.1835	.16217	1.1980	.16416	.01940	.00266	1.619	1.211	.00911
26.00	11.137	81.274	1.3561	.18582	1.3726	.18808	.02197	.00301	1.601	1.197	.01185
28.00	10.547	76.971	1.5388	.21085	1.5572	.21337	.02466	.00338	1.584	1.184	.01327
30.00	10.026	73.168	1.7312	.23722	1.7518	.24004	.02748	.00376	1.568	1.172	.01476
32.00	9.5605	69.773	1.9334	.26492	1.9561	.26804	.03041	.00417	1.554	1.161	.01630
34.00	9.1420	66.718	2.1452	.29394	2.1702	.29737	.03345	.00458	1.541	1.152	.01790
36.00	8.7653	63.969	2.3664	.32425	2.3937	.32800	.03660	.00502	1.529	1.143	.01955
38.00	8.4213	61.458	2.5968	.35582	2.6266	.35990	.03987	.00546	1.518	1.135	.02125
40.00	8.1104	59.190	2.8363	.38865	2.8687	.39308	.04324	.00592	1.507	1.127	.02300
45.00	7.4388	54.288	3.4742	.47604	3.5132	.48139	.05210	.00714	1.483	1.111	.02755
50.00	6.8858	50.253	4.1662	.57089	4.2125	.57721	.06158	.00844	1.463	1.098	.03234
55.00	6.4217	46.866	4.9111	.67293	4.9650	.68032	.07165	.00982	1.443	1.086	.03738
60.00	6.0265	43.982	5.7073	.78203	5.7693	.79054	.08229	.01128	1.426	1.076	.04267
65.00	5.6856	41.494	6.5534	.89797	6.6241	.90765	.09347	.01281	1.411	1.067	.04819
70.00	5.3884	39.325	7.4481	1.0206	7.5279	1.0315	.10519	.01441	1.397	1.059	.05393
75.00	5.1269	37.416	8.3902	1.1497	8.4794	1.1619	.11741	.01609	1.385	1.053	.05986
80.00	4.8949	35.723	9.3789	1.2851	9.4781	1.2987	.13012	.01783	1.373	1.047	.06596
90.00	4.5012	32.850	11.491	1.5745	11.611	1.5910	.15696	.02151	1.352	1.036	.07862

TIN

PRCTON ENERGY MEV	ENERGY LOSS HEV/GM/CM2	PROYON RANGE GM/CM2	PROYON PATH LENGTH GM/CM2	PROYON STRAGGLING PERCENT	PATH LENGTH STRAGGLING GM/CM2	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	4.1796	13.776	13.919	1.9072	.18558	1.027	.09178
110.00	3.9117	16.227	16.394	2.2464	.21588	1.020	.10544
120.00	3.6849	18.837	19.030	2.6075	.24777	1.014	.11960
130.00	3.4928	21.599	21.820	2.9898	.28114	1.009	.13419
140.00	3.3239	24.508	24.756	3.3922	.31588	1.004	.14912
150.00	3.1758	27.556	27.834	3.8140	.35196	.999	.16433
160.00	3.0451	30.743	31.053	4.2550	.38933	.996	.17982
170.00	2.9290	34.058	34.400	4.7136	.42791	.993	.19557
180.00	2.8250	37.503	37.879	5.1903	.46764	.990	.21153
190.00	2.7313	41.071	41.481	5.6838	.50846	.987	.22756
200.00	2.6465	44.754	45.200	6.1934	.55033	.985	.24390
210.00	2.5695	48.553	49.035	6.7189	.59320	.983	.26019
220.00	2.4985	52.463	52.982	7.2599	.63702	.981	.27645
230.00	2.4340	56.481	57.040	7.8158	.68177	.979	.29266
240.00	2.3747	60.598	61.197	8.3854	.72738	.976	.30878
250.00	2.3200	64.819	65.458	8.9692	.77382	.974	.32477
260.00	2.2693	69.139	69.820	9.5669	.82104	.973	.34071
270.00	2.2223	73.550	74.273	10.177	.86902	.972	.35667
280.00	2.1786	78.052	78.818	10.800	.91773	.970	.37261
290.00	2.1379	82.642	83.452	11.435	.96712	.969	.38851
300.00	2.0998	87.313	88.168	12.081	1.0172	.969	.40435
310.00	2.0642	92.071	92.972	12.739	1.0679	.968	.42008
320.00	2.0307	96.914	97.861	13.409	1.1192	.967	.43555
330.00	1.9993	101.83	102.82	14.089	1.1710	.966	.45104
340.00	1.9697	106.82	107.86	14.700	1.2235	.965	.46624
350.00	1.9418	111.89	112.98	15.481	1.2765	.965	.48124
360.00	1.9155	117.02	118.16	16.191	1.3299	.964	.49603
370.00	1.8906	122.23	123.42	16.911	1.3839	.963	.51060
380.00	1.8671	127.50	128.74	17.640	1.4384	.962	.52495
390.00	1.8447	132.84	134.13	18.379	1.4933	.961	.53907
400.00	1.8235	138.24	139.58	19.126	1.5487	.961	.55294
410.00	1.8034	143.70	145.09	19.881	1.6045	.960	.56656
420.00	1.7845	149.22	150.67	20.645	1.6607	.959	.57994
430.00	1.7660	154.80	156.30	21.417	1.7173	.959	.59306
440.00	1.7487	160.44	161.99	22.197	1.7743	.958	.60593
450.00	1.7321	166.13	167.74	22.984	1.8316	.957	.61853
460.00	1.7163	171.88	173.54	23.779	1.8893	.957	.63086
470.00	1.7012	177.62	179.33	24.573	1.9473	.956	.64292
480.00	1.6868	183.47	185.24	25.382	2.0057	.956	.65471
490.00	1.6730	189.36	191.19	26.197	2.0644	.955	.66622

TIN

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2	PROTON RANGE CM	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	GM/CM2	PATH LENGTH STRAGGLING CM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	1.6598	12.113	26.761	197.19	27.019	2.1233	.29095	1.977	.9549	.67746
510.00	1.6471	12.021	27.582	203.23	27.848	2.1826	.29907	1.074	.9343	.68843
520.00	1.6350	11.932	28.409	209.32	28.682	2.2422	.30723	1.071	.9537	.69912
530.00	1.6234	11.847	29.242	215.46	29.523	2.3020	.31543	1.068	.9532	.70954
540.00	1.6122	11.766	30.081	221.64	30.370	2.3621	.32366	1.066	.9526	.71968
550.00	1.6015	11.688	30.925	227.86	31.222	2.4225	.33193	1.063	.9521	.72955
560.00	1.5912	11.612	31.775	234.12	32.081	2.4831	.34024	1.061	.9515	.73916
570.00	1.5813	11.540	32.631	240.43	32.944	2.5439	.34857	1.058	.9510	.74849
580.00	1.5717	11.470	33.492	246.77	33.813	2.6050	.35694	1.056	.9505	.75757
590.00	1.5625	11.403	34.358	253.15	34.687	2.6663	.36534	1.053	.9499	.76638
600.00	1.5537	11.339	35.228	259.56	35.566	2.7278	.37377	1.051	.9494	.77494
620.00	1.5370	11.217	36.935	272.50	37.339	2.8514	.39071	1.046	.9484	.79130
640.00	1.5215	11.104	38.772	285.67	39.143	2.9759	.40776	1.042	.9474	.80667
660.00	1.5070	10.998	40.665	298.87	40.953	3.1010	.42492	1.038	.9464	.82110
680.00	1.4935	10.900	42.615	309.25	42.779	3.2269	.44216	1.034	.9454	.83462
700.00	1.4810	10.808	44.621	325.65	44.622	3.3534	.45950	1.030	.9443	.84727
720.00	1.4692	10.722	46.681	339.22	46.481	3.4806	.47692	1.026	.9433	.85908
740.00	1.4582	10.642	48.897	352.86	48.353	3.6083	.49442	1.023	.9422	.87010
760.00	1.4475	10.567	49.766	366.64	50.239	3.7366	.51200	1.019	.9412	.88036
780.00	1.4382	10.496	51.648	380.51	52.138	3.8654	.52965	1.016	.9402	.88991
800.00	1.4292	10.430	53.542	394.46	54.050	3.9947	.54736	1.013	.9392	.89877
820.00	1.4207	10.368	55.448	408.49	55.973	4.1244	.56514	1.010	.9381	.90701
840.00	1.4126	10.309	57.366	422.61	57.908	4.2546	.58298	1.007	.9371	.91464
860.00	1.4051	10.254	59.293	436.81	59.854	4.3852	.60088	1.004	.9360	.92170
880.00	1.3980	10.203	61.231	451.09	61.809	4.5162	.61883	1.001	.9349	.92823
900.00	1.3913	10.154	63.179	465.43	63.775	4.6476	.63683	.9986	.9339	.93427
920.00	1.3850	10.108	65.151	479.95	65.765	4.7793	.65488	.9958	.9324	.93984
940.00	1.3791	10.065	67.120	494.45	67.751	4.9114	.67298	.9933	.9311	.94498
960.00	1.3735	10.024	69.106	509.08	69.736	5.0438	.69112	.9908	.9309	.94971
1000.00	1.3632	9.9485	73.113	538.57	73.797	5.3096	.72754	.9859	.9260	.95802

THE ELECTRON DENSITY OF TIN IS 2.530E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.005 BEV, AND THE MINIMUM ENERGY LOSS IS 1.2861 MEV/GM/CM2

TITANIUM

ADJUSTED
IONIZATION
POTENTIAL
227.2

ATOMIC
WEIGHT
47.900

ATOMS/
MOLECULE
1

ATOMIC
NUMBER
22

ELEMENT
Ti

DENSITY = 4.5400 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE MG/CM2 MM	PROTON PATH LENGTH MG/CM2 MM	MG/CM2	PATH LENGTH STRAGGLING MM PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	447.51	.00090	.41494	.01743	.09004	4.201	1.967
.15	403.75	.00115	.52252	.01919	.00004	3.603	1.606
.20	367.00	.00144	.66237	.02124	.00005	3.207	1.417
.30	305.67	.00209	.94961	.02689	.00006	2.797	1.212
.40	258.00	.00287	1.3181	.03492	.00008	2.649	1.098
.50	224.58	.00378	1.7346	.04490	.00010	2.588	1.024
.60	201.78	.00481	2.2051	.05616	.00012	2.547	.9718
.70	182.49	.00595	2.7261	.06840	.00015	2.509	.9329
.80	168.11	.00720	3.3000	.08172	.00018	2.476	.9023
.90	154.73	.00856	3.9194	.09575	.00021	2.443	.8775
1.00	141.35	.01004	4.5958	.11116	.00024	2.419	.8567
1.20	126.43	.01331	6.0941	.14452	.00032	2.371	.8245
1.40	114.96	.01695	7.7553	.17952	.00040	2.315	.8003
1.60	105.86	.02092	9.4963	.21613	.00048	2.258	.7810
1.80	98.345	.02521	11.534	.25434	.00056	2.205	.7646
2.00	92.006	.02981	13.637	.29435	.00065	2.157	.7505
2.20	86.542	.03472	15.879	.33558	.00074	2.113	.7381
2.40	81.773	.03992	18.258	.37876	.00083	2.075	.7269
2.60	77.563	.04542	20.771	.42413	.00093	2.042	.7160
2.80	73.814	.05121	23.415	.47162	.00104	2.014	.7076
3.00	70.452	.05728	26.188	.52115	.00115	1.990	.6991
3.20	67.415	.06363	29.091	.57262	.00126	1.968	.6912
3.40	64.669	.07027	32.121	.62596	.00138	1.949	.6839
3.60	62.160	.07718	35.278	.68110	.00150	1.931	.6772
3.80	59.882	.08436	38.556	.73798	.00163	1.914	.6708
4.00	57.782	.09180	41.956	.79655	.00175	1.899	.6649
4.20	55.845	.09951	45.478	.85675	.00189	1.884	.6593
4.40	54.048	.10748	49.119	.91858	.00202	1.870	.6541
4.60	52.374	.11572	52.878	.98200	.00216	1.857	.6491
4.80	50.808	.12421	56.756	1.0470	.00231	1.845	.6444

TITANIUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CM	GM/CH2	CM	GM/CH2	CM	GM/CH2	CM	PERCENT	PERCENT	
5.00	49.342	224.01	.06036	.01330	.06075	.01338	.00111	.00025	1.833	.6399	.00006
5.50	46.098	209.28	.07079	.01559	.07124	.01569	.00129	.00028	1.806	.6297	.00009
6.00	43.280	196.49	.08194	.01805	.08246	.01816	.00147	.00032	1.782	.6206	.00012
6.50	40.863	185.52	.09377	.02065	.09435	.02078	.00166	.00037	1.760	.6125	.00016
7.00	38.727	175.82	.10627	.02341	.10692	.02355	.00186	.00041	1.739	.6051	.00021
7.50	36.827	167.20	.11945	.02631	.12017	.02647	.00207	.00046	1.721	.5984	.00027
8.00	35.126	159.47	.13327	.02935	.13407	.02953	.00228	.00050	1.703	.5923	.00034
8.50	33.593	152.51	.14776	.03255	.14863	.03274	.00251	.00055	1.687	.5867	.00041
9.00	32.202	146.20	.16289	.03588	.16384	.03609	.00274	.00060	1.672	.5815	.00049
9.50	30.933	140.44	.17865	.03935	.17969	.03958	.00298	.00066	1.658	.5767	.00058
10.00	29.772	135.16	.19504	.04296	.19616	.04321	.00323	.00071	1.645	.5722	.00068
11.00	27.718	125.84	.22970	.05059	.23100	.05088	.00375	.00083	1.622	.5641	.00090
12.00	25.950	117.85	.26681	.05877	.26831	.05910	.00429	.00095	1.601	.5570	.00126
13.00	24.430	110.91	.30634	.06748	.30804	.06783	.00487	.00107	1.582	.5506	.00168
14.00	23.092	104.84	.34825	.07671	.35016	.07713	.00548	.00121	1.565	.5430	.00211
15.00	21.909	99.425	.39250	.08645	.39463	.08692	.00611	.00135	1.549	.5398	.00265
16.00	20.854	94.677	.43907	.09671	.44143	.09723	.00678	.00149	1.535	.5331	.00331
17.00	19.908	90.381	.48793	.10747	.49053	.10805	.00747	.00164	1.522	.5271	.00410
18.00	19.053	86.503	.53903	.11873	.54189	.11936	.00818	.00180	1.510	.5270	.00507
19.00	18.278	82.992	.59237	.13048	.59549	.13116	.00893	.00197	1.499	.5234	.00613
20.00	17.571	79.771	.64792	.14271	.65131	.14346	.00969	.00214	1.489	.5200	.00727
22.00	16.326	74.122	.76553	.16852	.76948	.16949	.01131	.00249	1.470	.5140	.00881
24.00	15.265	69.304	.89169	.19641	.89525	.19741	.01302	.00287	1.453	.5080	.01062
26.00	14.350	65.150	1.0263	.22605	1.0315	.22719	.01483	.00327	1.438	.5042	.01277
28.00	13.552	61.524	1.1691	.25751	1.1750	.25880	.01673	.00359	1.424	.5001	.01508
30.00	12.848	58.329	1.3200	.29075	1.3266	.29220	.01873	.00413	1.412	.4964	.01755
32.00	12.223	55.491	1.4789	.32575	1.4862	.32736	.02081	.00458	1.400	.4930	.02010
34.00	11.663	52.952	1.6457	.36249	1.6538	.36427	.02299	.00506	1.390	.4900	.02270
36.00	11.160	50.655	1.8203	.40094	1.8292	.40290	.02525	.00556	1.380	.4872	.02547
38.00	10.704	48.595	2.0024	.44107	2.0122	.44322	.02759	.00606	1.371	.4847	.02833
40.00	10.289	46.711	2.1922	.48286	2.2028	.48520	.03002	.00661	1.363	.4823	.03123
45.00	8.3976	42.665	2.6990	.59449	2.7119	.59734	.03634	.00803	1.344	.4772	.03502
50.00	8.6685	39.355	3.2510	.71609	3.2665	.71949	.04335	.00955	1.327	.4728	.03943
55.00	8.0603	36.594	3.8473	.84736	3.8651	.85135	.05074	.01118	1.313	.4691	.04411
60.00	7.5441	34.250	4.4858	.98806	4.5068	.99268	.05857	.01290	1.300	.4659	.04906
65.00	7.1015	32.241	5.1663	1.1379	5.1903	1.1432	.06685	.01472	1.288	.4631	.05423
70.00	6.7170	30.495	5.8874	1.2968	5.9146	1.3028	.07554	.01664	1.277	.4607	.05961
75.00	6.3793	28.962	6.6481	1.4643	6.6787	1.4711	.08464	.01864	1.267	.4585	.06518
80.00	6.0807	27.606	7.4477	1.6405	7.4819	1.6480	.09414	.02074	1.258	.4565	.07189
90.00	5.5757	25.314	9.1597	2.0176	9.2014	2.0267	.11426	.02517	1.242	.4531	.08170

TITANIUM

PROTON ENERGY MEV	ENERGY LOSS MEV/CH	PROTON RANGE GH/CH	PROTON PATH LENGTH CH	PROTON PATH LENGTH STRAGGLING CH	GH/CM2	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC INTERACTION		
100.00	5.1647	23.448	11.067	2.4376	13582	.02992	1.227	.4502	.12585
110.00	4.3234	21.898	13.072	2.8793	15873	.03496	1.214	.4476	.14043
120.00	4.5354	20.591	15.211	3.3505	18293	.04029	1.203	.4458	.15532
130.00	4.2889	19.472	17.480	3.8502	20832	.04589	1.192	.4440	.17185
140.00	4.0757	18.503	19.873	4.3774	23488	.05174	1.182	.4424	.18891
150.00	3.8892	17.657	22.386	4.9308	26252	.05782	1.173	.4410	.20185
160.00	3.7249	16.911	25.014	5.5097	29119	.06414	1.164	.4398	.21942
170.00	3.5789	16.248	27.754	6.1132	32085	.07067	1.156	.4387	.23603
180.00	3.4484	15.656	30.601	6.7404	35245	.07741	1.148	.4377	.25282
190.00	3.3310	15.123	33.553	7.3904	38293	.08435	1.141	.4367	.26973
200.00	3.2249	14.641	36.604	8.0626	41528	.09147	1.134	.4359	.28671
210.00	3.1285	14.203	39.753	8.7562	44843	.09877	1.128	.4351	.30372
220.00	3.0405	13.804	42.996	9.4705	48236	.10625	1.122	.4344	.32073
230.00	2.9600	13.438	46.330	10.205	51703	.11388	1.116	.4337	.33770
240.00	2.8860	13.102	49.752	10.959	55242	.12168	1.110	.4331	.35459
250.00	2.8177	12.792	53.259	11.731	58848	.12962	1.105	.4325	.37137
260.00	2.7545	12.506	56.849	12.522	62519	.13771	1.100	.4320	.38804
270.00	2.6960	12.240	60.519	13.330	66252	.14593	1.095	.4314	.40464
280.00	2.6415	11.993	64.267	14.156	70046	.15429	1.090	.4309	.42112
290.00	2.5908	11.762	68.090	14.998	73896	.16277	1.085	.4305	.43746
300.00	2.5434	11.547	71.986	15.856	77802	.17137	1.081	.4300	.45364
310.00	2.4991	11.346	75.953	16.730	81760	.18009	1.076	.4296	.46982
320.00	2.4575	11.157	79.988	17.619	85769	.18892	1.072	.4292	.48538
330.00	2.4184	10.979	84.090	18.523	89826	.19785	1.068	.4288	.50090
340.00	2.3816	10.813	88.257	19.442	93930	.20689	1.064	.4284	.51617
350.00	2.3470	10.655	92.487	20.378	98079	.21603	1.060	.4280	.53116
360.00	2.3142	10.507	96.779	21.317	10227	.22527	1.057	.4276	.54593
370.00	2.2833	10.366	101.13	22.275	10651	.23459	1.053	.4273	.56050
380.00	2.2541	10.233	105.54	23.246	11078	.24401	1.050	.4269	.57485
390.00	2.2263	10.107	110.00	24.229	11509	.25351	1.046	.4266	.58899
400.00	2.2000	9.9880	114.52	25.225	11944	.26309	1.043	.4262	.60288
410.00	2.1750	9.8745	119.09	26.232	12383	.27275	1.040	.4259	.61650
420.00	2.1512	9.7666	123.72	27.250	12825	.28248	1.037	.4256	.62979
430.00	2.1286	9.6639	128.39	28.279	13270	.29229	1.034	.4252	.64276
440.00	2.1071	9.5661	133.11	29.320	13719	.30217	1.031	.4249	.65541
450.00	2.0865	9.4728	137.88	30.370	14170	.31212	1.028	.4246	.66773
460.00	2.0669	9.3837	142.70	31.431	14625	.32213	1.025	.4243	.67922
470.00	2.0482	9.2986	147.56	32.501	15082	.33221	1.022	.4240	.69139
480.00	2.0302	9.2173	152.46	33.582	15543	.34235	1.019	.4237	.70373
490.00	2.0131	9.1394	157.41	34.671	16006	.35255	1.017	.4234	.71775

TITANIUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLYING SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/GM/CM2	MEV/CH	GM/CM2	CH	GM/CM2	CH	GM/CM2	PERCENT		
500.00	1.9967	9.0649	161.71	35.618	162.39	35.770	1.6471	.36281	1.014	.72445
510.00	1.9810	8.9935	166.72	36.721	167.42	36.877	1.6940	.37312	1.012	.73483
520.00	1.9659	8.9251	171.76	37.833	172.49	37.994	1.7410	.38348	1.009	.74490
530.00	1.9514	8.8594	176.85	38.953	177.60	39.118	1.7883	.39390	1.007	.75466
540.00	1.9375	8.7964	181.97	40.081	182.74	40.251	1.8358	.40437	1.005	.76411
550.00	1.9242	8.7358	187.13	41.217	187.92	41.392	1.8836	.41488	1.002	.77327
560.00	1.9114	8.6776	192.32	42.361	193.13	42.540	1.9315	.42545	1.000	.78212
570.00	1.8990	8.6217	197.55	43.512	198.38	43.696	1.9797	.43605	.9979	.79069
580.00	1.8872	8.5678	202.81	44.671	203.66	44.860	2.0281	.44671	.9958	.79897
590.00	1.8758	8.5160	208.10	45.837	208.98	46.031	2.0766	.45740	.9937	.80698
600.00	1.8648	8.4661	213.43	47.010	214.33	47.208	2.1254	.46814	.9916	.81471
620.00	1.8440	8.3716	224.17	49.376	225.11	49.584	2.2234	.48974	.9877	.82938
640.00	1.8246	8.2838	235.03	51.768	236.02	51.986	2.3221	.51148	.9839	.84303
660.00	1.8066	8.2020	246.00	54.185	247.03	54.413	2.4215	.53337	.9802	.85571
680.00	1.7898	8.1257	257.08	56.625	258.16	56.863	2.5215	.55540	.9767	.86748
700.00	1.7741	8.0543	268.26	59.087	269.38	59.335	2.6221	.57755	.9734	.87839
720.00	1.7594	7.9876	279.53	61.571	280.70	61.829	2.7232	.59983	.9701	.88848
740.00	1.7456	7.9252	290.90	64.075	292.11	64.342	2.8249	.62222	.9670	.89701
760.00	1.7327	7.8666	302.35	66.598	303.62	66.876	2.9270	.64471	.9640	.90642
786.00	1.7206	7.8116	313.89	69.139	315.20	69.427	3.0296	.66731	.9612	.91437
800.00	1.7092	7.7599	325.51	71.698	326.86	71.996	3.1326	.69001	.9584	.92168
820.00	1.6985	7.7113	337.20	74.273	338.60	74.582	3.2361	.71280	.9557	.92842
840.00	1.6885	7.6656	348.97	76.865	350.41	77.184	3.3400	.73568	.9532	.93461
860.00	1.6790	7.6225	360.80	79.471	362.29	79.801	3.4443	.75865	.9507	.94030
880.00	1.6700	7.5819	372.70	82.093	374.24	82.432	3.5489	.78169	.9483	.94553
900.00	1.6616	7.5436	384.67	84.728	386.25	85.078	3.6539	.80482	.9460	.95032
920.00	1.6536	7.5074	396.69	87.378	398.33	87.738	3.7592	.82801	.9437	.95471
940.00	1.6461	7.4732	408.78	90.041	410.47	90.411	3.8648	.85128	.9416	.95973
960.00	1.6390	7.4409	420.94	92.718	422.67	93.099	3.9707	.87461	.9394	.96241
1000.00	1.6259	7.3815	445.53	98.135	447.35	98.536	4.1835	.92148	.9352	.96885

THE ELECTRON DENSITY OF TITANIUM IS 2.767E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.129 BEV, AND THE MINIMUM ENERGY LOSS IS 1.5206 MEV/GM/CM2

TUNGSTEN

ELEMENT NUMBER 74
 ATOMIC NUMBER 74
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 183.85
 ADJUSTED IONIZATION POTENTIAL 731.8

DENSITY = 19.300 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS MEV/GM	PROTON RANGE MG/CM2	PROTON PATH LENGTH MH	PROTON PATH LENGTH HG/CM2	PROTON PATH LENGTH MH	HG/CM2	PATH LENGTH STRAGGLING MH	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	119.53	2307.0	.00061	1.2399	.00064	.06261	.00003	5.029	0.
.15	123.03	2374.5	.00082	1.6522	.00086	.07733	.00004	4.086	0.
.20	121.96	2353.9	.00103	2.0603	.00107	.09117	.00005	3.798	0.
.30	112.28	2167.1	.00145	2.9117	.00151	.11874	.00006	3.648	0.
.40	99.622	1922.7	.00193	3.8567	.00200	.14882	.00008	3.610	0.
.50	88.808	1714.0	.00246	4.9214	.00255	.18302	.00009	3.589	0.
.60	81.304	1569.2	.00305	6.1006	.00316	.22045	.00011	3.569	0.
.70	75.924	1465.3	.00369	7.3739	.00382	.25929	.00013	3.548	0.
.80	69.306	1337.6	.00437	8.7473	.00453	.30036	.00016	3.524	0.
.90	68.852	1328.8	.00510	10.194	.00528	.34155	.00018	3.498	0.
1.00	68.396	1320.1	.00583	11.652	.00604	.37843	.00020	3.470	0.
1.20	63.217	1220.1	.00736	14.696	.00761	.45188	.00023	3.405	0.
1.40	58.827	1135.4	.00900	17.978	.00932	.53235	.00028	3.336	0.
1.60	55.116	1063.7	.01077	21.494	.01114	.61834	.00032	3.267	0.
1.80	51.919	1002.0	.01266	25.236	.01308	.70884	.00037	3.200	0.
2.00	49.127	948.14	.01465	29.197	.01513	.80333	.00042	3.137	0.
2.20	46.664	900.61	.01676	33.375	.01725	.90147	.00047	3.078	0.
2.40	44.475	858.36	.01898	37.767	.01957	1.0031	.00052	3.023	0.
2.60	42.517	820.58	.02130	42.369	.02195	1.1079	.00057	2.971	0.
2.80	40.755	786.58	.02373	47.174	.02444	1.2158	.00063	2.924	0.
3.00	39.443	761.26	.02626	52.181	.02704	1.3265	.00069	2.879	0.
3.20	37.955	732.53	.02886	57.329	.02970	1.4381	.00075	2.838	0.
3.40	36.592	706.23	.03159	62.728	.03250	1.5528	.00080	2.799	0.
3.60	35.339	682.04	.03440	68.283	.03538	1.6706	.00087	2.763	0.
3.80	34.191	659.89	.03731	74.024	.03835	1.7913	.00093	2.730	0.
4.00	33.105	638.93	.04031	79.963	.04143	1.9151	.00099	2.697	0.
4.20	32.138	620.26	.04343	86.126	.04462	2.0414	.00106	2.667	0.
4.40	31.234	602.81	.04662	92.417	.04788	2.1702	.00112	2.637	0.
4.60	30.388	586.48	.04991	98.913	.05125	2.3015	.00119	2.610	0.
4.80	29.594	571.16	.05330	105.59	.05471	2.4351	.00126	2.585	0.

TUNGSTEN

PRCTON ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE GH/CM2	PROTON PATH LENGTH GH/CM2	PROTON PATH LENGTH CH	PROTON PATH LENGTH GH/CM2	PROTON PATH LENGTH CH	PATH LENGTH STRAGGLING CM	PATH LENGTH PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	28.848	.10958	.11246	.00583	.00257	.00013	2.286	2.560	0.	
5.50	27.105	.12704	.13030	.00675	.00292	.00015	2.243	2.504	0.	
6.00	25.700	.14558	.14924	.00773	.00329	.00017	2.207	2.455	0.	
6.50	24.410	.16515	.16923	.00877	.00368	.00019	2.176	2.411	.00002	
7.00	23.268	.18569	.19020	.00986	.00409	.00021	2.150	2.371	.00005	
7.50	22.242	.20725	.21221	.01100	.00451	.00023	2.126	2.335	.00007	
8.00	21.331	.22974	.23515	.01218	.00495	.00026	2.104	2.302	.00009	
8.50	20.504	.25321	.25910	.01342	.00540	.00028	2.084	2.272	.00010	
9.00	19.750	.27757	.28394	.01471	.00586	.00030	2.065	2.245	.00010	
9.50	19.057	.30283	.30970	.01605	.00634	.00033	2.047	2.219	.00010	
10.00	18.423	.32904	.33643	.01743	.00683	.00035	2.029	2.195	.00011	
11.00	17.292	.38401	.39245	.02033	.00784	.00041	1.998	2.152	.00013	
12.00	16.312	.44248	.45204	.02342	.00890	.00046	1.969	2.115	.00016	
13.00	15.454	.50433	.51505	.02669	.01000	.00052	1.942	2.081	.00021	
14.00	14.695	.56951	.58143	.03013	.01115	.00058	1.917	2.051	.00028	
15.00	14.018	.63796	.65115	.03374	.01234	.00064	1.895	2.025	.00037	
16.00	13.410	.70964	.72412	.03752	.01357	.00070	1.873	2.000	.00048	
17.00	12.861	.78446	.80029	.04147	.01483	.00077	1.854	1.978	.00062	
18.00	12.362	.86239	.87960	.04558	.01614	.00084	1.835	1.957	.00077	
19.00	11.906	.94341	.96205	.04985	.01749	.00091	1.818	1.938	.00095	
20.00	11.488	1.0275	1.0476	.05428	.01887	.00098	1.802	1.921	.00116	
22.00	10.746	1.12045	1.2277	.06361	.02176	.00113	1.772	1.889	.00163	
24.00	10.109	1.2393	1.4197	.07356	.02478	.00128	1.745	1.862	.00219	
26.00	9.5759	1.3936	1.6234	.08411	.02794	.00145	1.721	1.837	.00316	
28.00	9.0882	1.5842	1.8376	.09521	.03122	.00162	1.699	1.816	.00456	
30.00	8.6552	1.80266	2.0636	.10692	.03463	.00179	1.676	1.796	.00601	
32.00	8.2681	2.02591	2.3000	.11917	.03817	.00198	1.660	1.779	.00751	
34.00	7.9184	2.25022	2.5471	.13196	.04184	.00217	1.643	1.763	.00907	
36.00	7.6030	2.47562	2.8053	.14535	.04564	.00236	1.627	1.748	.01068	
38.00	7.3166	3.0199	3.0732	.15923	.04957	.00257	1.613	1.735	.01234	
40.00	7.0547	3.2938	3.3515	.17365	.05362	.00278	1.600	1.722	.01405	
45.00	6.4871	4.0222	4.0915	.21199	.06430	.00333	1.572	1.694	.01849	
50.00	6.0176	4.8108	4.8926	.25350	.07570	.00392	1.547	1.671	.02318	
55.00	5.6222	5.6580	5.7530	.29808	.08779	.00455	1.526	1.651	.02810	
60.00	5.2847	6.5617	6.6707	.34563	.10055	.00521	1.507	1.634	.03328	
65.00	4.9930	7.5186	7.6423	.39595	.11393	.00590	1.491	1.620	.03868	
70.00	4.7380	8.5312	8.6705	.44925	.12792	.00663	1.475	1.606	.04429	
75.00	4.5127	9.5970	9.7525	.50531	.14250	.00738	1.461	1.594	.05009	
80.00	4.3130	10.713	10.886	.56404	.15765	.00817	1.448	1.584	.05606	
90.00	3.9734	13.074	13.303	.68925	.18957	.00982	1.425	1.566	.06848	

TUNGSTEN

PROTON ENERGY MEV	ENERGY LOSS MEV/CH	PROTON RANGE GM/CH2	PROTON PATH LENGTH GM/CH2	GM/CH2	PROTON PATH LENGTH CM	GM/CH2	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	3.6962	71.337	15.567	81174	15.913	.82452	.22349	.01158	1.404
110.00	3.4645	66.864	18.422	95451	18.710	.96942	.25930	.01344	1.386
120.00	3.2679	63.071	21.352	11063	21.684	1.1235	.29690	.01538	1.369
130.00	3.0990	59.811	24.428	12667	24.825	1.2863	.33617	.01742	1.354
140.00	2.9523	56.979	27.707	14356	28.132	1.4576	.37704	.01954	1.340
150.00	2.8236	54.495	31.122	16125	31.597	1.6371	.41941	.02173	1.327
160.00	2.7098	52.298	34.685	17972	35.212	1.8245	.46321	.02400	1.315
170.00	2.6084	50.342	38.393	19893	38.974	2.0194	.50837	.02634	1.304
180.00	2.5176	48.590	42.241	21886	42.878	2.2216	.55481	.02875	1.486
190.00	2.4357	47.010	46.221	23949	46.916	2.4309	.60248	.03122	1.284
200.00	2.3616	45.579	50.329	26077	51.083	2.6468	.65131	.03375	1.275
210.00	2.2963	44.318	54.559	28269	55.375	2.8692	.70114	.03633	1.266
220.00	2.2344	43.125	58.915	30526	59.794	3.0981	.75200	.03896	1.258
230.00	2.1777	42.030	63.387	32843	64.330	3.3332	.80389	.04165	1.250
240.00	2.1256	41.024	67.960	35212	68.970	3.5736	.85675	.04439	1.242
250.00	2.0774	40.095	72.655	37645	73.732	3.8203	.91054	.04718	1.235
260.00	2.0329	39.234	77.455	40132	78.601	4.0726	.96520	.05001	1.228
270.00	1.9915	38.436	82.357	42672	83.574	4.3303	1.0207	.05289	1.221
280.00	1.9530	37.693	87.358	45263	88.647	4.5931	1.0770	.05580	1.215
290.00	1.9173	37.000	92.439	47896	93.801	4.8602	1.1341	.05876	1.209
300.00	1.8836	36.353	97.529	50585	99.066	5.1330	1.1919	.06176	1.203
310.00	1.8512	35.729	102.91	53321	104.42	5.4105	1.2506	.06480	1.198
320.00	1.8217	35.160	108.28	56105	109.87	5.6929	1.3099	.06787	1.192
330.00	1.7941	34.625	113.74	58931	115.40	5.9795	1.3698	.07097	1.187
340.00	1.7680	34.122	119.27	61798	121.02	6.2704	1.4303	.07411	1.182
350.00	1.7434	33.648	124.89	64708	126.71	6.5655	1.4915	.07728	1.177
360.00	1.7202	33.200	130.62	67681	132.53	6.8671	1.5532	.08048	1.172
370.00	1.6983	32.777	136.39	70670	138.39	7.1703	1.6155	.08370	1.167
380.00	1.6775	32.376	142.20	73680	144.28	7.4756	1.6782	.08696	1.163
390.00	1.6578	31.996	148.10	76736	150.26	7.7855	1.7415	.09023	1.159
400.00	1.6392	31.636	154.08	79834	156.33	8.0998	1.8053	.09354	1.155
410.00	1.6214	31.294	160.13	82967	162.46	8.4175	1.8695	.09687	1.151
420.00	1.6046	30.968	165.24	86133	168.65	8.7386	1.9342	.10022	1.147
430.00	1.5885	30.658	172.41	89332	174.92	9.0631	1.9993	.10359	1.143
440.00	1.5732	30.363	178.65	92563	181.24	9.3908	2.0648	.10699	1.139
450.00	1.5586	30.081	184.94	95824	187.63	9.7216	2.1308	.11040	1.136
460.00	1.5447	29.813	191.29	99116	194.07	10.059	2.1971	.11384	1.132
470.00	1.5314	29.556	197.70	10244	200.57	10.392	2.2637	.11729	1.129
480.00	1.5187	29.311	204.17	10579	207.13	10.732	2.3308	.12076	1.125
490.00	1.5065	29.076	210.68	10916	213.74	11.074	2.3981	.12426	1.122

TUNGSTEN

PROCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CH	GH/CH2	CM	GH/CH2	CM	GH/CH2	PERCENT		
500.00	1.4949	28.851	217.25	11.257	220.40	11.420	2.4658	.12776	1.427	.66456
510.00	1.4837	28.636	223.90	11.601	227.14	11.769	2.5338	.13129	1.426	.67563
520.00	1.4730	28.430	230.57	11.947	233.90	12.119	2.6022	.13483	1.425	.68644
530.00	1.4628	28.232	237.29	12.295	240.71	12.472	2.6708	.13838	1.424	.69697
540.00	1.4530	28.042	244.05	12.645	247.57	12.828	2.7397	.14195	1.423	.70724
550.00	1.4435	27.860	250.86	12.998	254.48	13.185	2.8089	.14554	1.422	.71724
560.00	1.4344	27.685	257.71	13.353	261.43	13.545	2.8783	.14913	1.422	.72698
570.00	1.4257	27.516	264.61	13.710	268.42	13.908	2.9480	.15275	1.421	.73645
580.00	1.4173	27.355	271.54	14.070	275.45	14.272	3.0179	.15637	1.420	.74567
590.00	1.4093	27.199	278.52	14.431	282.53	14.639	3.0881	.16001	1.419	.75463
600.00	1.4015	27.049	285.54	14.795	289.64	15.008	3.1585	.16365	1.418	.76333
620.00	1.3868	26.765	299.68	15.528	303.99	15.751	3.3000	.17099	1.417	.77999
640.00	1.3732	26.502	313.97	16.268	318.48	16.502	3.4423	.17836	1.415	.79568
660.00	1.3605	26.257	328.40	17.016	333.11	17.260	3.5854	.18577	1.414	.81044
680.00	1.3486	26.029	342.96	17.770	347.88	18.025	3.7293	.19323	1.413	.82429
700.00	1.3376	25.816	357.65	18.531	362.77	18.796	3.8738	.20072	1.411	.83727
720.00	1.3273	25.616	372.49	19.300	377.82	19.576	4.0190	.20824	1.410	.84943
740.00	1.3176	25.430	387.54	20.080	393.07	20.366	4.1648	.21579	1.407	.86079
760.00	1.3086	25.256	402.57	20.859	408.31	21.156	4.3111	.22337	1.406	.87140
780.00	1.3001	25.093	417.70	21.643	423.65	21.951	4.4580	.23099	1.404	.88130
800.00	1.2922	24.940	432.93	22.431	439.09	22.751	4.6054	.23862	1.404	.89052
820.00	1.2848	24.796	448.25	23.225	454.62	23.556	4.7533	.24629	1.402	.89910
840.00	1.2778	24.661	463.65	24.024	470.24	24.365	4.9016	.25397	1.401	.90707
860.00	1.2712	24.534	479.15	24.826	485.95	25.179	5.0504	.26168	1.399	.91447
880.00	1.2650	24.415	494.72	25.633	501.73	25.997	5.1996	.26941	1.398	.92134
900.00	1.2592	24.302	510.37	26.444	517.60	26.818	5.3491	.27716	1.396	.92770
920.00	1.2537	24.197	526.10	27.259	533.54	27.645	5.4991	.28493	1.395	.93359
940.00	1.2485	24.097	541.81	28.078	549.56	28.475	5.6493	.29271	1.392	.93904
960.00	1.2437	24.003	557.80	28.902	565.67	29.302	5.7999	.30051	1.390	.94407
1000.00	1.2348	23.831	589.97	30.568	598.24	30.997	6.1021	.31617	1.384	.95297

THE ELECTRON DENSITY OF TUNGSTEN IS 2.425E 23 ELECTRONS PER GRAM
 THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 1.934 BEV, AND THE MINIMUM ENERGY LOSS IS 1.1695 MEV/GM/CM2

URANIUM

ADJUSTED
IONIZATION
POTENTIAL
90a.0

ATOMIC
WEIGHT
238.03

ATOMIC
NUMBER
92

ELEMENT
U

ATOMS/
MOLECULE
1

DENSITY = 18.700 GM/CM³

PRCTCN ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		MG/CM ²		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/ GM/CM ²	MEV/CM	MG/CM ²	MM	MG/CM ²	MM	MM	PERCENT	MM	PERCENT		
.10	120.02	2244.5	1.4366	.00077	1.5254	.00082	.07936	.00004	5.202	5.952	0.	
.15	125.55	2347.8	1.8375	.00098	1.9327	.00103	.09064	.00005	4.690	4.928	0.	
.20	124.17	2322.0	2.2282	.00119	2.3331	.00125	.10079	.00005	4.320	4.496	0.	
.30	111.44	2083.9	3.0483	.00163	3.1800	.00170	.12173	.00007	3.828	4.141	0.	
.40	98.267	1837.6	3.9719	.00212	4.1371	.00221	.14658	.00008	3.543	3.993	0.	
.50	88.919	1662.8	5.0047	.00268	5.2085	.00279	.17735	.00009	3.405	3.913	0.	
.60	81.361	1521.4	6.1383	.00328	6.3847	.00341	.21352	.00011	3.344	3.860	0.	
.70	75.888	1419.1	7.3648	.00394	7.6572	.00409	.25303	.00014	3.305	3.819	0.	
.80	69.899	1307.1	8.6887	.00465	9.0302	.00483	.29577	.00016	3.275	3.782	0.	
.90	65.969	1233.6	10.106	.00541	10.502	.00562	.34134	.00018	3.250	3.750	0.	
1.00	62.030	1160.0	11.617	.00621	12.066	.00645	.38884	.00021	3.223	3.719	0.	
1.20	56.354	1053.8	14.867	.00796	15.454	.00826	.48895	.00026	3.164	3.663	0.	
1.40	51.883	970.21	18.464	.00987	19.156	.01024	.59347	.00032	3.098	3.613	0.	
1.60	48.243	902.15	22.333	.01194	23.159	.01238	.70204	.00038	3.031	3.566	0.	
1.80	45.215	845.53	26.479	.01416	27.446	.01468	.81435	.00044	2.967	3.521	0.	
2.00	42.649	797.54	30.888	.01652	32.002	.01711	.93016	.00050	2.907	3.480	0.	
2.20	40.437	756.17	35.552	.01901	36.819	.01969	1.0503	.00056	2.853	3.440	0.	
2.40	38.497	719.89	40.466	.02164	41.891	.02240	1.1769	.00063	2.809	3.403	0.	
2.60	36.792	688.01	45.618	.02439	47.208	.02524	1.3091	.00070	2.773	3.368	0.	
2.80	35.271	659.56	51.001	.02727	52.761	.02821	1.4461	.00077	2.741	3.335	0.	
3.00	33.899	633.91	56.612	.03027	58.546	.03131	1.5873	.00085	2.711	3.303	0.	
3.20	32.654	610.63	62.445	.03339	64.558	.03452	1.7325	.00093	2.684	3.273	0.	
3.40	31.516	589.36	68.495	.03663	70.792	.03786	1.8814	.00101	2.658	3.245	0.	
3.60	30.476	569.91	74.764	.03998	77.249	.04131	2.0337	.00109	2.633	3.218	0.	
3.80	29.519	552.01	81.240	.04344	83.919	.04488	2.1893	.00117	2.609	3.192	0.	
4.00	28.635	535.47	87.922	.04702	90.798	.04856	2.3480	.00126	2.586	3.167	0.	
4.20	27.816	520.15	94.809	.05070	97.886	.05235	2.5096	.00134	2.564	3.143	0.	
4.40	27.054	505.91	101.90	.05449	105.18	.05624	2.6741	.00143	2.542	3.121	0.	
4.60	26.343	492.61	109.18	.05838	112.67	.06025	2.8414	.00152	2.522	3.099	0.	
4.80	25.707	480.73	116.45	.06236	120.35	.06436	3.0108	.00161	2.502	3.078	0.	

URANIUM

PRCTON ENERGY HEV	ENERGY LOSS MEV/CM	PROTON RANGE CM	PROTON PATH LENGTH CM	GM/CM2	PROTON PATH LENGTH CM	GM/CM2	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	25.078	468.95	.12430	.00665	.12822	.00686	.00318	3.059	0.
5.50	23.657	442.39	.14429	.00772	.14877	.00796	.00362	3.032	0.
6.00	22.411	419.09	.16546	.00885	.17052	.00912	.00408	2.969	0.
6.50	21.345	399.16	.18773	.01004	.19339	.01034	.00455	2.930	0.
7.00	20.391	381.32	.21106	.01129	.21735	.01162	.00504	2.894	0.
7.50	19.533	365.26	.23549	.01259	.24243	.01296	.00554	2.860	0.
8.00	18.756	350.73	.26093	.01395	.26853	.01436	.00605	2.829	0.
8.50	18.049	337.52	.28745	.01537	.29573	.01581	.00658	2.800	0.
9.00	17.403	325.44	.31497	.01684	.32395	.01732	.00712	2.773	0.
9.50	16.810	314.34	.34349	.01837	.35319	.01889	.00767	2.747	0.
10.00	16.262	304.10	.37297	.01995	.38341	.02050	.00824	2.723	0.
11.00	15.284	285.81	.43493	.02326	.44690	.02390	.00942	2.679	.00001
12.00	14.433	269.90	.50075	.02678	.51433	.02750	.01067	2.640	.00002
13.00	13.699	256.18	.57023	.03049	.58547	.03131	.01198	2.604	.00004
14.00	13.046	243.96	.64329	.03440	.66027	.03531	.01333	2.571	.00007
15.00	12.465	233.09	.71992	.03850	.73869	.03950	.01474	2.541	.00012
16.00	11.942	223.31	.80005	.04278	.82068	.04389	.01619	2.514	.00019
17.00	11.463	214.36	.88363	.04725	.90619	.04846	.01768	2.489	.00028
18.00	11.035	206.36	.97057	.05190	.99510	.05321	.01922	2.465	.00039
19.00	10.643	199.03	1.0608	.05673	1.0874	.05815	.02081	2.443	.00052
20.00	10.283	192.29	1.1544	.06173	1.1830	.06326	.02243	2.423	.00067
22.00	9.6402	180.27	1.3510	.07225	1.3840	.07401	.02581	2.386	.00104
24.00	9.0868	169.92	1.5602	.08343	1.5978	.08545	.02933	2.353	.00150
26.00	8.6418	161.60	1.7818	.09528	1.8241	.09755	.03301	2.323	.00241
28.00	8.2087	153.50	2.0138	.10769	2.0611	.11022	.03679	2.297	.00379
30.00	7.8235	146.30	2.2592	.12081	2.3117	.12362	.04073	2.273	.00522
32.00	7.4796	139.87	2.5150	.13449	2.5730	.13759	.04481	2.251	.00671
34.00	7.1698	134.07	2.7822	.14878	2.8457	.15218	.04903	2.230	.00824
36.00	6.8890	128.82	3.0608	.16368	3.1301	.16738	.05340	2.212	.00983
38.00	6.6331	124.04	3.3515	.17922	3.4267	.18324	.05790	2.195	.01147
40.00	6.3991	119.66	3.6519	.19529	3.7332	.19964	.06253	2.178	.01314
45.00	5.8919	110.18	4.4515	.23805	4.5489	.24326	.07467	2.142	.01753
50.00	5.4751	102.38	5.3155	.28425	5.4302	.29039	.08756	2.113	.02214
55.00	5.1347	96.018	6.2407	.33373	6.3737	.34084	.10109	2.087	.02699
60.00	4.8324	90.366	7.2258	.38641	7.3781	.39455	.11531	2.064	.03267
65.00	4.5702	85.462	8.2689	.44219	8.4414	.45141	.13025	2.044	.03738
70.00	4.3412	81.180	9.3708	.50111	9.5646	.51147	.14588	2.026	.04290
75.00	4.1389	77.397	10.530	.56310	10.746	.57465	.16217	2.010	.04860
80.00	3.9588	74.029	11.741	.62786	11.980	.64065	.17908	1.996	.05448
90.00	3.6518	68.288	14.326	.76608	14.614	.78148	.21470	1.971	.06672

URANIUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	NEV/CM	GM/CH2	CM	GM/CH2	CM	GM/CH2	PERCENT		
100.00	3.3998	63.576	17.115	91523	17.455	93344	.25256	.01351	1.447	.07948
110.00	3.1890	59.634	20.097	1.0747	20.493	1.0959	.29251	.01564	1.427	.09275
120.00	3.0098	56.282	23.256	1.2436	23.711	1.2680	.33444	.01788	1.410	.10655
130.00	2.8553	53.394	26.605	1.4227	27.122	1.4504	.37823	.02023	1.395	.12079
140.00	2.7220	50.902	30.126	1.6110	30.708	1.6421	.42376	.02266	1.380	.13540
150.00	2.6050	48.713	33.815	1.8083	34.465	1.8431	.47091	.02518	1.366	.15032
160.00	2.5013	46.775	37.663	2.0141	38.383	2.0526	.51960	.02779	1.354	.16550
170.00	2.4090	45.048	41.663	2.2280	42.457	2.2704	.56975	.03047	1.342	.18088
180.00	2.3262	43.500	45.800	2.4492	46.666	2.4956	.62129	.03322	1.331	.19640
190.00	2.2515	42.103	50.041	2.6787	51.038	2.7293	.67415	.03605	1.321	.21203
200.00	2.1838	40.836	54.518	2.9154	55.545	2.9703	.72826	.03894	1.311	.22772
210.00	2.1221	39.584	59.082	3.1594	60.192	3.2180	.78357	.04190	1.302	.24350
220.00	2.0658	38.630	63.772	3.4103	64.968	3.4742	.84001	.04492	1.293	.25940
230.00	2.0141	37.663	68.586	3.6677	69.868	3.7363	.89753	.04800	1.285	.27541
240.00	1.9665	36.774	73.521	3.9316	74.893	4.0050	.95609	.05113	1.277	.29147
250.00	1.9247	35.991	78.562	4.2012	80.024	4.2794	1.0155	.05430	1.269	.30755
260.00	1.8838	35.227	83.725	4.4773	85.281	4.5605	1.0758	.05753	1.261	.32358
270.00	1.8459	34.518	88.997	4.7592	90.648	4.8475	1.1370	.06080	1.254	.33951
280.00	1.8106	33.858	94.375	5.0468	96.122	5.1402	1.1991	.06412	1.247	.35531
290.00	1.7776	33.242	99.831	5.3385	101.68	5.4372	1.2620	.06749	1.241	.37097
300.00	1.7469	32.666	105.41	5.6368	107.35	5.7409	1.3257	.07089	1.235	.38646
310.00	1.7180	32.127	111.08	5.9402	113.13	6.0497	1.3902	.07434	1.229	.40178
320.00	1.6910	31.621	116.85	6.2486	119.00	6.3636	1.4554	.07783	1.223	.41695
330.00	1.6655	31.146	122.69	6.5611	124.95	6.6817	1.5213	.08135	1.218	.43195
340.00	1.6416	30.698	128.64	6.8790	131.00	7.0053	1.5879	.08491	1.212	.44677
350.00	1.6190	30.276	134.66	7.2013	137.13	7.3334	1.6551	.08851	1.207	.46139
360.00	1.5977	29.878	140.74	7.5263	143.32	7.6642	1.7229	.09213	1.202	.47583
370.00	1.5765	29.480	146.93	7.8573	149.62	8.0011	1.7914	.09580	1.197	.49009
380.00	1.5574	29.124	153.21	8.1933	156.01	8.3431	1.8605	.09949	1.193	.50417
390.00	1.5393	28.786	159.56	8.5324	162.47	8.6853	1.9302	.10322	1.188	.51805
400.00	1.5222	28.465	165.97	8.8755	169.00	9.0375	2.0003	.10697	1.184	.53173
410.00	1.5059	28.161	172.46	9.2222	175.60	9.3904	2.0710	.11075	1.179	.54519
420.00	1.4904	27.871	179.01	9.5726	182.27	9.7472	2.1421	.11455	1.175	.55843
430.00	1.4757	27.595	185.63	9.9269	189.01	10.108	2.2137	.11838	1.171	.57145
440.00	1.4616	27.333	192.32	10.284	195.82	10.472	2.2857	.12223	1.167	.58424
450.00	1.4483	27.082	199.18	10.651	202.80	10.845	2.3582	.12611	1.163	.59679
460.00	1.4355	26.843	205.99	11.016	209.74	11.216	2.4310	.13000	1.159	.60910
470.00	1.4232	26.614	212.87	11.383	216.73	11.590	2.5043	.13392	1.155	.62116
480.00	1.4116	26.396	219.80	11.754	223.79	11.967	2.5779	.13786	1.152	.63298
490.00	1.4004	26.188	226.79	12.128	230.90	12.348	2.6519	.14181	1.148	.64455

URANIUM

PRCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/	MEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	PERCENT		
500.00	1.3897	25.988	233.83	12.504	239.07	12.731	2.7262	.14579	1.779	.65586
510.00	1.3795	25.797	240.93	12.884	245.29	13.127	2.8009	.14978	1.778	.66593
520.00	1.3697	25.613	248.08	13.266	252.57	13.506	2.8759	.15379	1.777	.67774
530.00	1.3603	25.437	255.28	13.651	259.89	13.898	2.9512	.15782	1.776	.68829
540.00	1.3513	25.269	262.52	14.039	267.27	14.292	3.0268	.16186	1.775	.69860
550.00	1.3426	25.107	269.82	14.429	274.69	14.689	3.1027	.16592	1.774	.70865
560.00	1.3343	24.951	277.16	14.821	282.16	15.089	3.1788	.16999	1.773	.71845
570.00	1.3263	24.801	284.55	15.217	289.68	15.491	3.2553	.17408	1.772	.72799
580.00	1.3186	24.658	291.98	15.614	297.24	15.895	3.3320	.17818	1.771	.73729
590.00	1.3112	24.519	299.45	16.014	304.85	16.302	3.4087	.18229	1.770	.74635
600.00	1.3041	24.386	306.97	16.416	312.50	16.711	3.4861	.18642	1.769	.75516
620.00	1.2906	24.134	322.12	17.226	327.92	17.536	3.6412	.19471	1.768	.77205
640.00	1.2781	23.900	337.42	18.044	343.49	18.368	3.7971	.20305	1.766	.78801
660.00	1.2665	23.683	352.88	18.870	359.21	19.209	3.9538	.21144	1.764	.80305
680.00	1.2556	23.480	368.48	19.705	375.08	20.058	4.1114	.21986	1.762	.81721
700.00	1.2455	23.291	384.19	20.545	391.08	20.913	4.2696	.22832	1.760	.83051
720.00	1.2361	23.115	400.04	21.392	407.20	21.775	4.4285	.23682	1.759	.84300
740.00	1.2272	22.949	415.00	22.246	423.44	22.644	4.5880	.24535	1.757	.85469
760.00	1.2189	22.794	432.07	23.105	439.79	23.518	4.7482	.25391	1.755	.86564
780.00	1.2112	22.649	448.25	23.971	456.25	24.398	4.9089	.26251	1.753	.87587
800.00	1.2039	22.513	464.54	24.842	472.82	25.284	5.0701	.27113	1.751	.88542
820.00	1.1971	22.385	480.92	25.718	489.48	26.175	5.2318	.27978	1.749	.89432
840.00	1.1906	22.265	497.40	26.599	506.25	27.072	5.3941	.28845	1.748	.90261
860.00	1.1846	22.152	513.96	27.485	523.09	27.973	5.5567	.29715	1.746	.91033
880.00	1.1789	22.046	530.61	28.375	540.03	28.878	5.7198	.30587	1.744	.91749
900.00	1.1736	21.946	547.34	29.269	557.04	29.788	5.8833	.31462	1.742	.92414
920.00	1.1685	21.851	564.13	30.167	574.12	30.701	6.0472	.32338	1.740	.93031
940.00	1.1638	21.763	581.00	31.070	591.28	31.619	6.2115	.33216	1.738	.93602
960.00	1.1593	21.679	597.94	31.975	608.52	32.541	6.3761	.34097	1.740	.94129
1000.00	1.1511	21.525	632.50	33.824	643.65	34.420	6.7063	.35863	1.732	.95061

THE ELECTRON DENSITY OF URANIUM IS 2.329E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 1.896 BEV, AND THE MINIMUM ENERGY LOSS IS 1.0919 MEV/GM/CM2

VANADIUM

ELEMENT NUMBER 23
 ATOMIC NUMBER 23
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 50.942
 ADJUSTED IONIZATION POTENTIAL 235.6

DENSITY = 6.0000 GM/CM³

PROTON ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE MG/CM ²	PROTON PATH LENGTH MM	MG/CM ²	PROTON RANGE MM	PROTON PATH LENGTH MM	MG/CM ²	MG/CM ²	PROTON PATH LENGTH MM	MULTIPLY SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	424.18	2545.1	.00070	.43081	.00072	.00003	.01823	.00003	4.232	2.036	0.
.15	387.55	2325.3	.00091	.55488	.00092	.00003	.02018	.00003	3.642	1.661	0.
.20	354.49	2126.9	.00113	.67983	.00115	.00004	.02239	.00004	3.250	1.467	0.
.30	298.33	1790.0	.00164	.98425	.00166	.00005	.02802	.00005	2.811	1.259	0.
.40	254.19	1525.1	.00224	1.3450	.00227	.00006	.03597	.00006	2.644	1.142	0.
.50	220.57	1323.4	.00294	1.7645	.00297	.00008	.04595	.00008	2.576	1.065	0.
.60	195.97	1175.8	.00374	2.2425	.00378	.00010	.05758	.00010	2.542	1.010	0.
.70	178.89	1073.3	.00462	2.7735	.00467	.00012	.07034	.00012	2.511	.9691	0.
.80	167.81	1005.9	.00558	3.3475	.00563	.00014	.08353	.00014	2.472	.9371	0.
.90	152.61	915.63	.00661	3.9670	.00667	.00016	.09751	.00016	2.436	.9110	0.
1.00	137.39	824.75	.00775	4.6527	.00782	.00019	.11348	.00019	2.418	.8886	0.
1.20	122.88	737.29	.01030	6.1822	.01039	.00025	.14869	.00025	2.385	.8541	0.
1.40	111.67	670.04	.01313	7.8794	.01324	.00031	.18547	.00031	2.334	.8289	0.
1.60	102.75	616.48	.01623	9.7362	.01636	.00037	.22391	.00037	2.281	.8090	0.
1.80	95.442	572.65	.01957	11.744	.01973	.00044	.26398	.00044	2.230	.7923	0.
2.00	89.283	535.70	.02316	13.896	.02334	.00051	.30569	.00051	2.183	.7781	0.
2.20	83.997	503.98	.02698	16.190	.02719	.00058	.34903	.00058	2.139	.7654	0.
2.40	79.351	476.34	.03104	18.624	.03128	.00066	.39401	.00066	2.100	.7542	0.
2.60	75.330	451.98	.03532	21.194	.03539	.00073	.44069	.00073	2.064	.7440	0.
2.80	71.714	430.29	.03983	23.898	.04013	.00082	.48952	.00082	2.033	.7348	0.
3.00	68.470	410.82	.04456	26.735	.04488	.00090	.54050	.00090	2.007	.7261	0.
3.20	65.540	393.24	.04950	29.702	.04986	.00099	.59352	.00099	1.984	.7183	0.
3.40	62.875	377.25	.05466	32.798	.05505	.00108	.64850	.00108	1.963	.7109	.00001
3.60	60.451	362.71	.06004	36.023	.06046	.00118	.70540	.00118	1.944	.7041	.00001
3.80	58.232	349.39	.06562	39.373	.06608	.00127	.76412	.00127	1.927	.6976	.00001
4.00	56.193	337.16	.07141	42.848	.07191	.00137	.82462	.00137	1.911	.6916	.00002
4.20	54.313	325.88	.07741	46.447	.07795	.00148	.88685	.00148	1.896	.6860	.00002
4.40	52.572	315.43	.08361	50.167	.08418	.00158	.95076	.00158	1.882	.6806	.00003
4.60	50.955	305.73	.09001	54.008	.09063	.00169	1.0163	.00169	1.869	.6755	.00003
4.80	49.446	296.68	.09662	57.969	.09727	.00181	1.0835	.00181	1.857	.6708	.00004

VANADIUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	HEV/CH	GM/CH2	CM	GM/CH2	CM	GM/CH2	PERCENT		
5.00	48.034	288.20	.06205	.01034	.06246	.01041	.00115	.00019	1.845	.00005
5.50	44.858	269.15	.07276	.01213	.07324	.01221	.00133	.00022	1.817	.00008
6.00	42.131	252.79	.08240	.01403	.08375	.01413	.00152	.00025	1.793	.00011
6.50	39.748	238.49	.09636	.01606	.09698	.01616	.00172	.00029	1.771	.00015
7.00	37.685	226.11	.10921	.01820	.10990	.01832	.00192	.00032	1.751	.00020
7.50	35.844	215.07	.12274	.02046	.12351	.02059	.00214	.00036	1.732	.00025
8.00	34.195	205.17	.13695	.02282	.13780	.02297	.00236	.00039	1.714	.00031
8.50	32.708	196.25	.15182	.02530	.15276	.02546	.00259	.00043	1.698	.00038
9.00	31.359	188.15	.16734	.02789	.16836	.02806	.00283	.00047	1.683	.00046
9.50	30.129	180.77	.18353	.03059	.18464	.03077	.00308	.00051	1.669	.00054
10.00	29.002	174.01	.20036	.03339	.20156	.03359	.00334	.00056	1.656	.00064
11.00	27.009	162.06	.23592	.03932	.23731	.03955	.00387	.00065	1.632	.00085
12.00	25.300	151.80	.27399	.04566	.27559	.04593	.00444	.00074	1.612	.00118
13.00	23.815	142.89	.31454	.05242	.31635	.05273	.00504	.00084	1.592	.00327
14.00	22.514	135.09	.35751	.05959	.35956	.05993	.00566	.00094	1.574	.00584
15.00	21.353	129.18	.40289	.06715	.40518	.06753	.00632	.00105	1.559	.00843
16.00	20.337	122.02	.45064	.07511	.45317	.07553	.00700	.00117	1.544	.01104
17.00	19.416	116.50	.50071	.08345	.50350	.08392	.00771	.00128	1.531	.01367
18.00	18.585	111.51	.55310	.09218	.55616	.09269	.00845	.00141	1.519	.01632
19.00	17.830	106.98	.60778	.10130	.61112	.10185	.00921	.00154	1.508	.01899
20.00	17.141	102.85	.66470	.11078	.66833	.11139	.01000	.00167	1.497	.02168
22.00	15.930	95.579	.78523	.13067	.78946	.13158	.01167	.00194	1.478	.02712
24.00	14.897	89.383	.91449	.15242	.91938	.15323	.01343	.00224	1.461	.03263
26.00	14.006	84.034	1.0523	.17539	1.0579	.17632	.01529	.00255	1.445	.03622
28.00	13.227	79.360	1.1986	.19977	1.2049	.20082	.01725	.00287	1.432	.03781
30.00	12.541	75.247	1.3532	.22554	1.3603	.22671	.01930	.00322	1.419	.03947
32.00	11.932	71.592	1.5160	.25267	1.5238	.25397	.02145	.00357	1.407	.04120
34.00	11.387	68.322	1.6868	.28113	1.6955	.28258	.02368	.00395	1.397	.04300
36.00	10.896	65.378	1.8695	.31092	1.8751	.31251	.02601	.00433	1.387	.04485
38.00	10.452	62.711	2.0521	.34202	2.0625	.34376	.02842	.00474	1.378	.04676
40.00	10.047	60.284	2.2464	.37440	2.2573	.37629	.03091	.00515	1.369	.04872
45.00	9.1785	55.071	2.7652	.46067	2.7791	.46318	.03752	.00625	1.350	.05384
50.00	8.4675	50.805	3.3303	.55505	3.3468	.55780	.04462	.00744	1.333	.05923
55.00	7.8743	47.246	3.9403	.65671	3.9596	.65994	.05220	.00870	1.318	.06488
60.00	7.3714	44.229	4.5939	.76565	4.6164	.76939	.06025	.01004	1.305	.07079
65.00	6.9328	41.633	5.2902	.88170	5.3159	.88598	.06875	.01146	1.293	.07693
70.00	6.5634	39.380	6.0281	1.0047	6.0572	1.0095	.07768	.01295	1.282	.08328
75.00	6.2342	37.405	6.8064	1.1344	6.8391	1.1398	.08702	.01450	1.272	.08981
80.00	5.9428	35.657	7.6244	1.2707	7.6609	1.2768	.09677	.01613	1.263	.09649
90.00	5.4499	32.701	9.3757	1.5626	9.4203	1.5700	.11742	.01957	1.247	.11022

VANADIUM

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH	MEV/CH	GM/CH ²	CM	GM/CH ²	CM	GM/CH ²	PERCENT		
100.00	5.0487	30.292	11.275	1.6792	11.329	1.8881	1.3955	0.2326	1.232	.12430
110.00	4.7155	28.293	13.317	2.2195	13.380	2.2300	1.6306	0.2718	1.219	.13881
120.00	4.4342	26.605	15.496	2.5826	15.568	2.5947	1.8787	0.3131	1.207	.15384
130.00	4.1936	25.161	17.806	2.9676	17.888	2.9814	2.1393	0.3566	1.196	.16931
140.00	3.9853	23.912	20.242	3.3737	20.336	3.3893	2.4116	0.4019	1.186	.18514
150.00	3.8032	22.819	22.800	3.8000	22.905	3.8176	2.6950	0.4492	1.177	.20124
160.00	3.6427	21.856	25.476	4.2460	25.593	4.2655	2.9891	0.4982	1.166	.21759
170.00	3.5001	21.000	28.265	4.7108	28.395	4.7324	3.2932	0.5489	1.160	.23419
180.00	3.3726	20.235	31.163	5.1939	31.306	5.2177	3.6069	0.6011	1.152	.25096
190.00	3.2579	19.547	34.167	5.6945	34.324	5.7206	3.9297	0.6549	1.145	.26786
200.00	3.1542	18.925	37.274	6.2123	37.444	6.2406	4.2612	0.7102	1.138	.28484
210.00	3.0600	18.360	40.479	6.7464	40.663	6.7772	4.6011	0.7668	1.132	.30184
220.00	2.9741	17.844	43.779	7.2966	43.979	7.3296	4.9489	0.8248	1.125	.31884
230.00	2.8954	17.372	47.173	7.8621	47.387	7.8978	5.3043	0.8840	1.119	.33580
240.00	2.8230	16.938	50.655	8.4426	50.885	8.4899	5.6669	0.9445	1.114	.35268
250.00	2.7563	16.538	54.225	9.0375	54.471	9.0784	6.0365	1.0061	1.108	.36944
260.00	2.6946	16.168	57.878	9.6464	58.140	9.6901	6.4128	1.0688	1.103	.38610
270.00	2.6374	15.824	61.614	10.269	61.892	10.318	6.7954	1.1326	1.098	.40269
280.00	2.5842	15.505	65.428	10.905	65.723	10.934	7.1841	1.1973	1.093	.41916
290.00	2.5346	15.208	69.318	11.553	69.631	11.605	7.5787	1.2631	1.088	.43550
300.00	2.4883	14.930	73.283	12.214	73.613	12.269	7.9768	1.3298	1.084	.45167
310.00	2.4450	14.670	77.319	12.887	77.668	12.945	8.3841	1.3974	1.080	.46766
320.00	2.4043	14.426	81.426	13.571	81.792	13.632	8.7952	1.4659	1.075	.48341
330.00	2.3661	14.197	85.601	14.267	85.985	14.331	9.2139	1.5351	1.071	.49893
340.00	2.3302	13.981	89.841	14.974	90.244	15.041	9.6314	1.6052	1.067	.51419
350.00	2.2963	13.778	94.145	15.691	94.568	15.761	1.0056	1.6761	1.063	.52918
360.00	2.2643	13.586	98.512	16.419	98.953	16.492	1.0486	1.7477	1.060	.54394
370.00	2.2341	13.405	102.94	17.156	103.40	17.233	1.0920	1.8200	1.056	.55851
380.00	2.2055	13.233	107.42	17.904	107.90	17.964	1.1358	1.8929	1.053	.57287
390.00	2.1784	13.070	111.97	18.661	112.47	18.745	1.1799	1.9666	1.049	.58702
400.00	2.1527	12.916	116.56	19.427	117.09	19.514	1.2245	2.0408	1.046	.60093
410.00	2.1283	12.770	121.22	20.203	121.76	20.293	1.2694	2.1157	1.043	.61456
420.00	2.1050	12.630	125.92	20.987	126.48	21.080	1.3147	2.1912	1.039	.62787
430.00	2.0829	12.498	130.68	21.779	131.26	21.876	1.3603	2.2672	1.036	.64086
440.00	2.0619	12.371	135.48	22.580	136.08	22.681	1.4063	2.3438	1.033	.65353
450.00	2.0418	12.251	140.33	23.389	140.96	23.493	1.4525	2.4209	1.030	.66587
460.00	2.0226	12.136	145.23	24.206	145.88	24.313	1.4991	2.4985	1.028	.67789
470.00	2.0043	12.026	150.18	25.030	150.85	25.141	1.5460	2.5766	1.025	.68958
480.00	1.9868	11.921	155.17	25.861	155.86	25.976	1.5931	2.6552	1.022	.70095
490.00	1.9700	11.820	160.20	26.700	160.91	26.819	1.6405	2.7342	1.020	.71199

VANADIUM

PROCTON ENERGY MEV	ENERGY LOSS MEV/ GH/CM2	PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
		GH/CM2	CM	GH/CM2	CM	GH/CM2	CM		
500.00	1.9540	165.28	27.546	166.01	27.668	1.6882	.28137	1.017	.72272
510.00	1.9386	170.39	28.399	171.15	28.525	1.7362	.28936	1.014	.73313
520.00	1.9239	175.55	29.258	176.33	29.388	1.7844	.29739	1.012	.74322
530.00	1.9097	180.74	30.124	181.54	30.257	1.8328	.30546	1.010	.75301
540.00	1.8962	185.98	30.996	186.80	31.133	1.8815	.31358	1.007	.76249
550.00	1.8831	191.24	31.874	192.09	32.015	1.9304	.32173	1.005	.77168
560.00	1.8706	196.55	32.758	197.42	32.903	1.9795	.32991	1.003	.78055
570.00	1.8586	201.89	33.648	202.78	33.797	2.0288	.33813	1.000	.78916
580.00	1.8470	207.26	34.544	208.18	34.696	2.0783	.34639	.9983	.79747
590.00	1.8358	212.67	35.445	213.61	35.602	2.1280	.35467	.9962	.80551
600.00	1.8251	218.11	36.352	219.07	36.512	2.1780	.36299	.9942	.81327
620.00	1.8047	229.09	38.181	230.09	38.349	2.2784	.37973	.9902	.82800
640.00	1.7858	240.18	40.030	241.23	40.206	2.3795	.39658	.9864	.84171
650.00	1.7682	251.29	41.898	252.45	42.082	2.4812	.41354	.9827	.85446
680.00	1.7518	262.70	43.784	263.85	43.976	2.5836	.43060	.9792	.86629
700.00	1.7365	274.12	45.687	275.32	45.887	2.6866	.44776	.9758	.87726
720.00	1.7221	285.64	47.607	286.89	47.815	2.7901	.46502	.9725	.88741
740.00	1.7087	297.25	49.542	298.55	49.758	2.8942	.48237	.9694	.89680
760.00	1.6960	308.95	51.492	310.30	51.716	2.9988	.49979	.9664	.90547
780.00	1.6842	320.74	53.456	322.13	53.689	3.1038	.51730	.9635	.91346
800.00	1.6731	332.60	55.434	334.05	55.675	3.2093	.53489	.9607	.92063
820.00	1.6626	344.55	57.424	346.04	57.673	3.3152	.55254	.9581	.92762
840.00	1.6528	356.56	59.427	358.11	59.685	3.4216	.57026	.9555	.93386
860.00	1.6435	368.65	61.442	370.24	61.707	3.5283	.58805	.9530	.93960
880.00	1.6348	380.81	63.468	382.45	63.742	3.6354	.60590	.9504	.94486
900.00	1.6265	393.03	65.504	394.72	65.787	3.7429	.62381	.9482	.94976
920.00	1.6188	405.31	67.552	407.05	67.843	3.8507	.64178	.9460	.95413
940.00	1.6114	417.66	69.610	419.45	69.909	3.9588	.65980	.9438	.95819
960.00	1.6045	430.08	71.679	431.92	71.987	4.0673	.67788	.9417	.96190
980.00	1.5977	442.56	73.766	444.44	74.076	4.1763	.69600	.9396	.96533
1000.00	1.5917	455.19	75.866	457.14	76.189	4.2850	.71417	.9374	.96842

THE ELECTRON DENSITY OF VANADIUM IS 2.720E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.123 BEV, AND THE MINIMUM ENERGY LOSS IS 1.4993 MEV/GM/CM2

XENON

ELEMENT NUMBER 54
 ATOMIC NUMBER 54
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 131.30
 ADJUSTED IONIZATION POTENTIAL 535.4

DENSITY = 5.8960 MG/CM3

FRCTON ENERGY MEV	ENERGY LOSS HEV/GM/CM2	PROTON RANGE MG/CM2	PROTON RANGE METER	PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
				MG/CM2	METER	MG/CM2	METER PERCENT		
.10	229.89	.45564	.00078	.47850	.00081	.02311	.00004	3.941	0.
.15	207.56	.68677	.00116	.70730	.00120	.03066	.00005	2.903	0.
.20	190.99	.93403	.00158	.95837	.00163	.03849	.00007	2.540	0.
.30	163.39	1.4897	.00253	1.5249	.00259	.05493	.00009	2.309	0.
.40	142.31	2.1334	.00362	2.1823	.00370	.07312	.00012	2.240	0.
.50	127.31	2.8616	.00485	2.9262	.00496	.09413	.00016	2.206	0.
.60	114.89	3.6715	.00623	3.7534	.00637	.11845	.00020	2.183	0.
.70	106.04	4.5585	.00773	4.6593	.00790	.14496	.00025	2.163	0.
.80	97.994	5.5194	.00936	5.6403	.00957	.17318	.00029	2.144	0.
.90	89.374	6.5656	.01114	6.7082	.01138	.20406	.00035	2.125	0.
1.00	80.751	7.7188	.01309	7.8851	.01337	.23916	.00041	2.108	0.
1.20	74.067	10.254	.01739	10.472	.01776	.31354	.00053	2.080	0.
1.40	68.466	13.009	.02206	13.282	.02253	.38766	.00066	2.056	0.
1.60	63.750	15.982	.02711	16.314	.02767	.46308	.00079	2.033	0.
1.80	59.746	19.166	.03251	19.559	.03317	.54041	.00092	2.010	0.
2.00	56.301	22.550	.03825	23.007	.03902	.61989	.00105	1.988	0.
2.20	53.297	26.134	.04433	26.658	.04521	.70169	.00119	1.966	0.
2.40	50.656	29.917	.05074	30.511	.05175	.78589	.00133	1.945	0.
2.60	48.375	33.887	.05748	34.553	.05860	.87358	.00148	1.925	0.
2.80	46.331	38.039	.06452	38.778	.06577	.96484	.00164	1.906	0.
3.00	44.485	42.369	.07186	43.185	.07324	1.0593	.00180	1.887	0.
3.20	42.812	46.875	.07950	47.768	.08102	1.1568	.00196	1.870	0.
3.40	41.274	51.555	.08744	52.528	.08909	1.2571	.00213	1.853	0.
3.60	39.886	56.406	.09567	57.461	.09745	1.3600	.00231	1.837	0.
3.80	38.606	61.416	.10417	62.555	.10610	1.4653	.00249	1.821	0.
4.00	37.421	66.592	.11295	67.818	.11502	1.5730	.00267	1.807	0.
4.20	36.321	71.931	.12200	73.244	.12423	1.6829	.00285	1.792	0.
4.40	35.296	77.427	.13132	78.829	.13370	1.7951	.00304	1.779	0.
4.60	34.338	83.082	.14091	84.575	.14345	1.9093	.00324	1.765	0.
4.80	33.439	88.893	.15077	90.479	.15346	2.0257	.00344	1.753	0.

XENON

PROCTON ENERGY MEV	ENERGY LOSS HEV/CH2	KEV/CH	PROTON RANGE GN/CH2	METER	PROTON PATH LENGTH GN/CH2	METER	PATH LENGTH STRAGGLING GN/CM2	METER PERCENT	MULTIPLYING SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	32.594	192.18	.09486	1.6088	.09654	1.6373	.00214	0.0364	1.741	0.
5.50	30.687	180.93	.11043	1.8730	.11235	1.9056	.00245	0.0415	1.713	0.
6.00	29.024	171.12	.12694	2.1530	.12912	2.1899	.00277	0.0469	1.687	0.
6.50	27.558	162.48	.14336	2.4485	.14681	2.4899	.00310	0.0525	1.663	0.
7.00	26.255	154.80	.16268	2.7592	.16540	2.8053	.00344	0.0583	1.641	.00001
7.50	25.089	147.93	.18189	3.0850	.18489	3.1358	.00379	0.0643	1.621	.00001
8.00	24.036	141.72	.20196	3.4254	.20525	3.4812	.00415	0.0704	1.603	.00002
8.50	23.084	136.10	.22290	3.7805	.22649	3.8414	.00453	0.0768	1.585	.00003
9.00	22.214	130.97	.24467	4.1498	.24857	4.2160	.00491	0.0833	1.569	.00004
9.50	21.416	126.27	.26728	4.5332	.27150	4.6048	.00531	0.0901	1.554	.00006
10.00	20.653	121.95	.29071	4.9307	.29526	5.0078	.00572	0.0970	1.540	.00009
11.00	19.379	114.26	.34002	5.7669	.34524	5.8555	.00656	0.1113	1.514	.00015
12.00	18.302	107.91	.39248	6.6567	.39842	6.7574	.00744	0.1262	1.491	.00023
13.00	17.322	102.13	.44790	7.5967	.45458	7.7100	.00836	0.1418	1.470	.00033
14.00	16.454	97.012	.50636	8.5882	.51382	8.7147	.00931	0.1580	1.451	.00047
15.00	15.682	92.464	.56786	9.6313	.57612	9.7714	.01030	0.1748	1.434	.00062
16.00	14.987	88.364	.63232	1.0725	.64142	1.0879	.01133	0.1922	1.418	.00080
17.00	14.364	84.688	.69961	1.1866	.70957	1.2035	.01239	0.2102	1.404	.00101
18.00	13.796	81.339	.76974	1.3055	.78059	1.3239	.01350	0.2289	1.390	.00124
19.00	13.279	78.1290	.84273	1.4293	.85451	1.4493	.01464	0.2482	1.378	.00149
20.00	12.804	75.1491	.91852	1.5579	.93124	1.5795	.01581	0.2682	1.366	.00176
22.00	11.961	70.522	1.0783	1.8288	1.0930	1.8538	.01827	0.3099	1.346	.00433
24.00	11.235	66.243	1.2488	2.1181	1.2656	2.1465	.02087	0.3540	1.327	.00825
26.00	10.604	62.519	1.4299	2.4253	1.4489	2.4575	.02361	0.4004	1.311	.01095
28.00	10.048	59.245	1.6215	2.7501	1.6428	2.7863	.02647	0.4489	1.296	.01238
30.00	9.5561	56.343	1.8232	3.0923	1.8469	3.1325	.02946	0.4996	1.283	.01387
32.00	9.1168	53.752	2.0351	3.4516	2.0613	3.4961	.03257	0.5524	1.271	.01541
34.00	8.7219	51.425	2.2568	3.8278	2.2057	3.8766	.03580	0.6072	1.261	.01701
36.00	8.3651	49.320	2.4883	4.2204	2.5198	4.2738	.03915	0.6639	1.251	.01866
38.00	8.0396	47.401	2.7296	4.6296	2.7639	4.6870	.04261	0.7227	1.241	.02036
40.00	7.7428	45.651	2.9803	5.0548	3.0175	5.1179	.04618	0.7833	1.233	.02211
45.00	7.1028	41.878	3.6477	6.1868	3.6926	6.2628	.05560	0.9429	1.215	.02666
50.00	6.5790	38.790	4.3716	7.4146	4.4247	7.5046	.06565	1.1135	1.199	.03146
55.00	6.1388	36.194	5.1504	8.7355	5.2122	8.8403	.07632	1.2945	1.186	.03650
60.00	5.7637	33.983	5.9821	10.146	6.0532	10.267	.08758	1.4855	1.175	.04179
65.00	5.4398	32.073	6.8660	11.645	6.9469	11.782	.09942	1.6862	1.165	.04732
70.00	5.1572	30.407	7.8002	13.230	7.8914	13.384	.11180	1.8962	1.156	.05307
75.00	4.9084	28.940	8.7836	14.898	8.8856	15.071	.12471	2.1152	1.148	.05900
80.00	4.6876	27.638	9.8151	16.647	9.9284	16.839	.13814	2.3429	1.141	.06512
90.00	4.3126	25.427	12.018	20.383	12.155	20.616	.16647	2.8234	1.129	.07781

XENON

PROTON ENERGY MEV	ENERGY LOSS HEV/ GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH METER	PATH LENGTH STRAGGLING GM/CM2	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	4.0060	14.400	14.564	24.701	.19666	.33354	1.350	.09101
110.00	3.7504	16.955	17.145	29.080	.22860	.38772	1.333	.10472
120.00	3.5340	19.674	19.894	33.742	.26220	.44470	1.318	.11895
130.00	3.3454	22.552	22.803	38.675	.29735	.50433	1.304	.13361
140.00	3.1873	25.583	25.865	43.869	.33398	.56646	1.291	.14864
150.00	3.0462	28.760	29.076	49.315	.37201	.63095	1.279	.16396
160.00	2.9236	32.076	32.427	54.998	.41129	.69757	1.268	.17955
170.00	2.8124	35.525	35.913	60.911	.45183	.76633	1.258	.19540
180.00	2.7129	39.111	39.536	67.056	.49358	.83714	1.248	.21145
190.00	2.6233	42.823	43.288	73.419	.53647	.90989	1.239	.22767
200.00	2.5422	46.652	47.157	79.982	.58046	.98449	1.231	.24400
210.00	2.4685	50.605	51.151	86.756	.62548	1.0608	1.223	.26038
220.00	2.4012	54.671	55.261	93.726	.67148	1.1389	1.215	.27674
230.00	2.3394	58.849	59.482	100.89	.71843	1.2185	1.208	.29304
240.00	2.2826	63.130	63.808	108.22	.76628	1.2997	1.201	.30925
250.00	2.2296	67.520	68.243	115.75	.81502	1.3823	1.194	.32535
260.00	2.1811	72.008	72.778	123.44	.86459	1.4664	1.188	.34139
270.00	2.1362	76.591	77.409	131.29	.91495	1.5518	1.182	.35744
280.00	2.0943	81.270	82.137	139.31	.96605	1.6385	1.176	.37345
290.00	2.0553	86.046	86.963	147.50	1.0179	1.7264	1.170	.38942
300.00	2.0188	90.905	91.873	155.82	1.0704	1.8154	1.165	.40531
310.00	1.9847	95.845	96.864	164.29	1.1236	1.9056	1.160	.42107
320.00	1.9527	100.87	101.94	172.90	1.1774	1.9969	1.155	.43664
330.00	1.9226	105.90	107.11	181.66	1.2318	2.0891	1.150	.45201
340.00	1.8943	111.17	112.35	190.54	1.2867	2.1824	1.145	.46716
350.00	1.8676	116.43	117.66	199.56	1.3423	2.2766	1.141	.48208
360.00	1.8424	121.76	123.05	208.71	1.3984	2.3717	1.136	.49679
370.00	1.8185	127.18	128.52	217.99	1.4550	2.4677	1.132	.51130
380.00	1.7960	132.66	134.06	227.37	1.5121	2.5645	1.128	.52560
390.00	1.7746	138.20	139.66	236.87	1.5696	2.6622	1.124	.53968
400.00	1.7543	143.81	145.33	246.48	1.6276	2.7606	1.120	.55353
410.00	1.7350	149.48	151.06	256.21	1.6861	2.8597	1.116	.56713
420.00	1.7167	155.22	156.85	266.03	1.7450	2.9596	1.112	.58050
430.00	1.6992	161.01	162.71	275.97	1.8043	3.0602	1.109	.59361
440.00	1.6826	166.87	168.62	286.00	1.8640	3.1614	1.105	.60646
450.00	1.6668	172.78	174.59	296.12	1.9240	3.2633	1.102	.61905
460.00	1.6516	178.74	180.62	306.34	1.9845	3.3658	1.099	.63138
470.00	1.6372	184.76	186.70	316.65	2.0452	3.4688	1.095	.64343
480.00	1.6234	190.83	192.83	327.05	2.1063	3.5725	1.092	.65522
490.00	1.6102	196.95	199.02	337.54	2.1678	3.6767	1.089	.66673

XENON

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/GM/CM2	KEY/CH	GM/CM2	METER	GM/CM2	METER	GM/CM2	METER PERCENT		
500.00	1.5975	9.4189	203.12	344.51	205.25	348.12	2.2295	3.7815	1.037	.67797
510.00	1.5854	9.3474	209.34	355.06	211.54	358.78	2.2916	3.8867	1.036	.68893
520.00	1.5738	9.2789	215.61	365.69	217.87	369.52	2.3540	3.9925	1.035	.69962
530.00	1.5626	9.2132	221.92	376.33	224.24	380.33	2.4166	4.0987	1.035	.71004
540.00	1.5519	9.1501	228.28	387.18	230.66	391.22	2.4795	4.2054	1.034	.72019
550.00	1.5416	9.0895	234.68	398.04	237.14	402.20	2.5427	4.3126	1.034	.73006
560.00	1.5318	9.0313	241.13	408.96	243.64	413.23	2.6061	4.4201	1.033	.73967
570.00	1.5223	8.9754	247.61	419.96	250.19	424.34	2.6698	4.5281	1.032	.74901
580.00	1.5132	8.9216	254.13	431.02	256.78	435.52	2.7337	4.6366	1.032	.75809
590.00	1.5044	8.8698	260.69	442.15	263.41	446.76	2.7979	4.7453	1.031	.76691
600.00	1.4959	8.8199	267.29	453.34	270.07	458.06	2.8622	4.8545	1.031	.77547
620.00	1.4799	8.7257	280.60	475.91	283.52	480.86	2.9916	5.0740	1.030	.79184
640.00	1.4651	8.6380	294.04	498.71	297.10	503.90	3.1218	5.2948	1.028	.80723
660.00	1.4512	8.5565	307.62	521.75	310.81	527.16	3.2528	5.5169	1.027	.82167
680.00	1.4383	8.4804	321.33	544.99	324.66	550.64	3.3844	5.7452	1.026	.83520
700.00	1.4263	8.4095	335.15	568.44	338.63	574.33	3.5168	5.9647	1.025	.84785
720.00	1.4151	8.3432	349.09	592.08	352.79	598.21	3.6497	6.1902	1.024	.85967
740.00	1.4045	8.2811	363.14	615.91	366.89	622.27	3.7833	6.4167	1.023	.87070
760.00	1.3947	8.2230	377.29	639.90	381.18	646.51	3.9174	6.6442	1.022	.88096
780.00	1.3854	8.1685	391.53	664.06	395.57	670.91	4.0521	6.8726	1.021	.89051
800.00	1.3768	8.1174	405.87	688.38	410.05	695.47	4.1873	7.1019	1.021	.89938
820.00	1.3686	8.0694	420.30	712.85	424.62	720.18	4.3229	7.3320	1.018	.90761
840.00	1.3610	8.0242	434.81	737.46	439.28	745.04	4.4590	7.5628	1.017	.91524
860.00	1.3538	7.9818	449.43	762.26	454.04	770.09	4.5955	7.7943	1.016	.92230
880.00	1.3470	7.9418	464.19	787.30	468.95	795.37	4.7325	8.0266	1.015	.92883
900.00	1.3406	7.9042	478.94	812.31	483.84	820.63	4.8698	8.2594	1.013	.93486
920.00	1.3346	7.8687	493.83	837.57	498.85	846.14	5.0074	8.4930	1.014	.94042
940.00	1.3289	7.8353	508.73	862.85	513.93	871.67	5.1455	8.7271	1.012	.94555
960.00	1.3236	7.8037	523.64	888.13	528.96	897.18	5.2838	8.9617	1.009	.95026
1000.00	1.3137	7.7458	553.96	939.56	559.58	949.09	5.5615	9.4327	1.005	.95854

THE ELECTRON DENSITY OF XENON IS 2.478E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 1.985 BEV, AND THE MINIMUM ENERGY LOSS IS 1.2409 MEV/GM/CM2

ZINC

ELEMENT NUMBER 30
 ZN
 ATOMIC NUMBER 30
 ATOMS/MOLECULE 1
 ATOMIC WEIGHT 65.370
 ADJUSTED IONIZATION POTENTIAL 330.9

DENSITY = 7.1330 GR/CM3

PROTON ENERGY MEV	ENERGY LOSS MEV/CM2	PROTON RANGE MG/CM2	PROTON PATH LENGTH MG/CM2	PROTON PATH LENGTH MM	HQ/CM2	PATH LENGTH STRAGGLING MM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION		
.10	235.94	1683.0	.52830	.00074	.54185	.00076	.02394	.00003	4.418	2.501	0.
.15	230.53	1644.4	.74123	.00104	.75624	.00106	.03193	.00004	4.222	1.985	0.
.20	218.84	1561.0	.96089	.00135	.97881	.00137	.03677	.00005	3.961	1.831	0.
.30	194.08	1384.4	1.4391	.00202	1.4644	.00205	.05197	.00007	3.549	1.728	0.
.40	175.37	1250.9	1.9737	.00277	2.0073	.00281	.06551	.00009	3.264	1.678	0.
.50	160.34	1143.7	2.5613	.00359	2.6039	.00365	.09497	.00013	3.054	1.635	0.
.60	146.93	1048.1	3.2038	.00449	3.2357	.00456	.11211	.00016	2.917	1.595	0.
.70	137.32	979.50	3.8997	.00547	3.9613	.00555	.12990	.00018	2.830	1.557	0.
.80	129.69	925.08	4.6375	.00650	4.7091	.00660	.14810	.00021	2.758	1.521	0.
.90	124.33	886.87	5.4143	.00759	5.4961	.00771	.16644	.00023	2.634	1.488	0.
1.00	118.97	848.62	6.2266	.00873	6.3187	.00886	.20521	.00029	2.537	1.457	0.
1.20	107.48	766.67	7.9767	.01118	8.0900	.01134	.24712	.00035	2.462	1.400	0.
1.40	98.353	701.55	9.9021	.01388	10.038	.01407	.29182	.00041	2.401	1.349	0.
1.60	90.824	647.85	11.997	.01682	12.156	.01704	.33908	.00048	2.348	1.305	0.
1.80	84.564	603.19	14.257	.01999	14.440	.02024	.38862	.00054	2.302	1.267	0.
2.00	79.387	566.27	16.673	.02338	16.882	.02367	.44020	.00062	2.260	1.232	0.
2.20	74.905	534.30	19.243	.02698	19.477	.02731	.49376	.00069	2.222	1.202	0.
2.40	70.977	506.28	21.960	.03079	22.221	.03115	.54925	.00077	2.187	1.175	0.
2.60	67.505	481.51	24.823	.03480	25.112	.03521	.60660	.00085	2.155	1.151	0.
2.80	64.411	459.45	27.827	.03901	28.145	.03946	.66579	.00093	2.126	1.129	0.
3.00	61.659	439.81	30.973	.04342	31.321	.04391	.72672	.00102	2.099	1.109	0.
3.20	59.169	422.06	34.252	.04802	34.630	.04855	.78937	.00111	2.073	1.091	0.
3.40	56.905	405.90	37.669	.05281	38.078	.05338	.85370	.00120	2.049	1.074	0.
3.60	54.834	391.13	41.220	.05779	41.661	.05841	.91971	.00129	2.027	1.059	0.
3.80	52.930	377.55	44.901	.06295	45.375	.06361	.98737	.00138	2.006	1.045	0.
4.00	51.174	365.02	48.708	.06829	49.215	.06900	1.0567	.00148	1.987	1.031	0.
4.20	49.547	353.42	52.648	.07381	53.190	.07457	1.1276	.00158	1.968	1.019	0.
4.40	48.034	342.63	56.712	.07951	57.289	.08032	1.2002	.00168	1.951	1.007	.00001
4.60	46.623	332.56	60.903	.08538	61.516	.08624	1.2749	.00179	1.935	.9966	.00001
4.80	45.303	323.15	65.220	.09143	65.870	.09235				.9864	.00001

ZINC

PROTON ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE CM	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	GM/CM2	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	44.066	0.0977	0.07034	0.0986	0.0135	0.0019	1.921	0.0002
5.50	41.282	0.1140	0.08208	0.1151	0.0155	0.0022	1.890	0.0003
6.00	38.669	0.1313	0.09368	0.1326	0.0176	0.0025	1.863	0.0005
6.50	36.755	0.1497	0.10681	0.1511	0.0198	0.0028	1.840	0.0007
7.00	34.888	0.1692	0.12177	0.1707	0.0222	0.0031	1.819	0.0010
7.50	33.224	0.1896	0.13646	0.1913	0.0246	0.0034	1.801	0.0013
8.00	31.735	0.2110	0.15186	0.2129	0.0271	0.0038	1.784	0.0018
8.50	30.390	0.2334	0.16797	0.2355	0.0297	0.0042	1.768	0.0023
9.00	29.188	0.2568	0.18476	0.2599	0.0324	0.0045	1.753	0.0028
9.50	28.067	0.2811	0.20223	0.2835	0.0352	0.0049	1.739	0.0035
10.00	27.037	0.3064	0.22039	0.3090	0.0380	0.0053	1.726	0.0042
11.00	25.216	0.3597	0.25871	0.3627	0.0440	0.0062	1.702	0.0058
12.00	23.652	0.4167	0.29968	0.4201	0.0504	0.0071	1.681	0.0077
13.00	22.309	0.4773	0.34323	0.4812	0.0570	0.0080	1.661	0.0099
14.00	21.127	0.5415	0.38932	0.5458	0.0640	0.0090	1.643	0.0124
15.00	20.078	0.6091	0.43790	0.6139	0.0712	0.0100	1.627	0.0152
16.00	19.141	0.6802	0.48891	0.6855	0.0788	0.0110	1.612	0.0179
17.00	18.296	0.7545	0.54235	0.7603	0.0867	0.0122	1.598	0.0214
18.00	17.532	0.8323	0.59822	0.8387	0.0948	0.0133	1.585	0.0250
19.00	16.836	0.9134	0.65643	0.9203	0.1032	0.0145	1.573	0.0288
20.00	16.201	0.9977	0.71699	1.0052	0.1119	0.0157	1.561	0.0328
22.00	15.079	1.1761	0.84508	1.1847	0.1302	0.0183	1.540	0.0413
24.00	14.120	1.3670	0.98222	1.3770	0.1495	0.0210	1.522	0.0505
26.00	13.291	1.5705	1.1283	1.5818	0.1698	0.0238	1.505	0.0603
28.00	12.565	1.7961	1.2831	1.7988	0.1912	0.0268	1.493	0.0710
30.00	11.925	2.0138	1.4466	2.0280	0.2136	0.0299	1.477	0.0833
32.00	11.355	2.2533	1.6185	2.2691	0.2369	0.0332	1.464	0.0972
34.00	10.845	2.5044	1.7988	2.5218	0.2612	0.0366	1.452	0.1128
36.00	10.385	2.7669	1.9873	2.7860	0.2865	0.0402	1.442	0.1299
38.00	9.9684	3.0409	2.1839	3.0617	0.3126	0.0438	1.431	0.1486
40.00	9.5886	3.3259	2.3885	3.3486	0.3397	0.0476	1.422	0.1689
45.00	8.7717	4.0863	2.9344	4.1138	0.4111	0.0576	1.401	0.2130
50.00	8.1015	4.9135	3.5281	4.9462	0.4877	0.0684	1.382	0.2687
55.00	7.5421	5.8054	4.1683	5.8436	0.5695	0.0798	1.366	0.3361
60.00	7.0571	6.7602	4.8536	6.8044	0.6561	0.0920	1.352	0.4163
65.00	6.6585	7.7764	5.5829	7.8269	0.7473	0.1048	1.339	0.5099
70.00	6.3030	8.8522	6.3551	8.9094	0.8430	0.1182	1.327	0.6189
75.00	5.9908	9.9865	7.1691	1.0051	0.9431	0.1322	1.316	0.7458
80.00	5.7143	1.1178	8.0240	1.1249	1.0475	0.1468	1.305	0.8875
85.00	5.4743	1.3726	8.8527	1.3813	1.1682	0.1628	1.297	1.0456
90.00	5.2457		9.7908					

ZINC

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CM2	MEV/CH	GM/CM2	CH	GM/CM2	CH	GM/CM2	CH	PERCENT	PERCENT	
100.00	4.8639	34.695	11.761	1.6487	11.834	1.6591	.15043	.02109	1.271	.6241	.11385
110.00	4.5465	32.430	13.876	1.9453	13.963	1.9575	.17549	.02460	1.257	.6203	.12861
120.00	4.2784	30.518	16.131	2.2615	16.231	2.2755	.20190	.02831	1.244	.6170	.14383
130.00	4.0489	28.881	18.521	2.5965	18.635	2.6125	.22961	.03219	1.232	.6141	.15942
140.00	3.8500	27.462	21.040	2.9496	21.169	2.9678	.25853	.03624	1.221	.6116	.17530
150.00	3.6760	26.221	23.683	3.3202	23.828	3.3406	.28861	.04046	1.211	.6094	.19137
160.00	3.5225	25.126	26.447	3.7076	26.608	3.7303	.31978	.04483	1.202	.6074	.20767
170.00	3.3861	24.153	29.326	4.1113	29.505	4.1364	.35201	.04935	1.193	.6057	.22422
180.00	3.2640	23.282	32.317	4.5306	32.513	4.5581	.38522	.05401	1.185	.6041	.24097
190.00	3.1542	22.499	35.416	4.9650	35.630	4.9951	.41939	.05880	1.177	.6027	.25787
200.00	3.0549	21.790	38.619	5.4141	38.853	5.4469	.45445	.06371	1.170	.6013	.27487
210.00	2.9646	21.146	41.923	5.8773	42.176	5.9128	.49038	.06875	1.163	.6001	.29194
220.00	2.8822	20.559	45.325	6.3542	45.598	6.3925	.52713	.07390	1.156	.5990	.30906
230.00	2.8067	20.020	48.020	6.8443	49.114	6.8655	.56467	.07916	1.150	.5980	.32620
240.00	2.7373	19.525	52.408	7.3472	52.722	7.3913	.60295	.08453	1.144	.5970	.34332
250.00	2.6733	19.068	56.083	7.8625	56.420	7.9097	.64196	.09000	1.138	.5962	.36038
260.00	2.6140	18.646	59.845	8.3898	60.203	8.4401	.68165	.09556	1.132	.5953	.37734
270.00	2.5591	18.254	63.629	8.9287	64.070	8.9821	.72199	.10122	1.127	.5945	.39416
280.00	2.5080	17.890	67.613	9.4789	68.017	9.5356	.76297	.10696	1.122	.5938	.41071
290.00	2.4604	17.550	71.616	10.040	72.043	10.100	.80455	.11279	1.117	.5931	.42728
300.00	2.4159	17.233	75.694	10.612	76.145	10.675	.84671	.11870	1.112	.5924	.44353
310.00	2.3743	16.936	79.845	11.194	80.320	11.250	.88942	.12469	1.107	.5918	.45958
320.00	2.3352	16.657	84.068	11.786	84.568	11.856	.93267	.13075	1.103	.5912	.47545
330.00	2.2985	16.395	88.359	12.387	88.884	12.461	.97643	.13689	1.099	.5906	.49110
340.00	2.2640	16.149	92.718	12.998	93.268	13.076	1.0207	.14309	1.094	.5900	.50653
350.00	2.2314	15.917	97.141	13.619	97.717	13.699	1.0654	.14936	1.090	.5895	.52172
360.00	2.2007	15.698	101.63	14.248	102.23	14.332	1.1106	.15570	1.086	.5890	.53667
370.00	2.1717	15.491	106.18	14.885	106.80	14.973	1.1562	.16209	1.083	.5885	.55135
380.00	2.1442	15.294	110.78	15.531	111.44	15.623	1.2022	.16854	1.079	.5880	.56577
390.00	2.1181	15.109	115.45	16.185	116.13	16.281	1.2487	.17505	1.075	.5875	.57991
400.00	2.0934	14.932	120.17	16.847	120.88	16.947	1.2955	.18162	1.072	.5870	.59377
410.00	2.0699	14.765	124.95	17.517	125.68	17.620	1.3427	.18823	1.069	.5866	.60733
420.00	2.0476	14.605	129.78	18.194	130.54	18.301	1.3902	.19490	1.065	.5861	.62060
430.00	2.0263	14.454	134.66	18.878	135.45	18.989	1.4381	.20162	1.062	.5857	.63355
440.00	2.0061	14.309	139.59	19.570	140.41	19.685	1.4864	.20838	1.059	.5852	.64620
450.00	1.9868	14.172	144.57	20.268	145.42	20.387	1.5349	.21519	1.056	.5848	.65854
460.00	1.9684	14.040	149.60	20.973	150.48	21.096	1.5838	.22204	1.053	.5844	.67056
470.00	1.9508	13.915	154.67	21.684	155.58	21.811	1.6330	.22893	1.050	.5840	.68228
480.00	1.9339	13.795	159.79	22.402	160.73	22.533	1.6825	.23587	1.047	.5836	.69368
490.00	1.9178	13.680	164.95	23.126	165.92	23.261	1.7322	.24284	1.044	.5832	.70477

ZINC

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/GM/CM2	HEV/GM	GM/CM2	CM	GM/CM2	CM	GM/CM2	CM	PERCENT	PERCENT	
500.00	1.9024	13.570	170.16	23.855	171.16	23.995	1.7822	.24986	1.041	.5828	.71555
510.00	1.8876	13.465	175.41	24.591	176.43	24.735	1.8325	.25690	1.039	.5824	.72603
520.00	1.8735	13.364	180.69	25.332	181.75	25.480	1.8830	.26399	1.036	.5820	.73620
530.00	1.8599	13.267	186.02	26.079	187.11	26.231	1.9338	.27111	1.034	.5816	.74607
540.00	1.8469	13.174	191.39	26.831	192.50	26.988	1.9848	.27825	1.031	.5812	.75565
550.00	1.8343	13.084	196.79	27.588	197.94	27.750	2.0361	.28544	1.029	.5808	.76493
560.00	1.8223	12.999	202.23	28.351	203.41	28.516	2.0875	.29266	1.026	.5804	.77393
570.00	1.8107	12.916	207.70	29.118	208.91	29.288	2.1392	.29990	1.024	.5800	.78264
580.00	1.7996	12.837	213.21	29.891	214.45	30.065	2.1911	.30717	1.022	.5796	.79107
590.00	1.7889	12.760	218.75	30.667	220.03	30.846	2.2432	.31448	1.019	.5793	.79922
600.00	1.7786	12.687	224.33	31.449	225.63	31.632	2.2954	.32181	1.017	.5789	.80711
620.00	1.7591	12.547	235.57	33.025	236.94	33.217	2.4006	.33654	1.013	.5781	.82210
640.00	1.7409	12.418	246.93	34.619	248.37	34.820	2.5064	.35138	1.009	.5774	.83609
660.00	1.7240	12.298	258.42	36.228	259.91	36.438	2.6129	.36631	1.005	.5766	.84912
680.00	1.7083	12.185	270.00	37.853	271.57	38.072	2.7200	.38132	1.002	.5758	.86123
700.00	1.6936	12.080	281.70	39.492	283.33	39.721	2.8277	.39643	.9980	.5751	.87248
720.00	1.6798	11.982	293.49	41.145	295.19	41.383	2.9360	.41160	.9946	.5743	.88291
740.00	1.6669	11.890	305.38	42.812	307.14	43.059	3.0448	.42686	.9913	.5736	.89258
760.00	1.6549	11.804	317.35	44.491	319.18	44.747	3.1541	.44219	.9882	.5728	.90152
780.00	1.6435	11.723	329.41	46.182	331.31	46.447	3.2638	.45757	.9851	.5720	.90978
800.00	1.6329	11.647	341.56	47.884	343.52	48.159	3.3741	.47302	.9822	.5713	.91740
820.00	1.6229	11.576	353.78	49.597	355.81	49.882	3.4847	.48854	.9794	.5705	.92443
840.00	1.6135	11.509	366.07	51.320	368.17	51.615	3.5958	.50410	.9767	.5697	.93091
860.00	1.6046	11.446	378.43	53.054	380.60	53.357	3.7072	.51973	.9740	.5690	.93687
880.00	1.5963	11.386	390.87	54.797	393.10	55.110	3.8190	.53540	.9715	.5682	.94235
900.00	1.5884	11.330	403.36	56.549	405.67	56.872	3.9312	.55113	.9691	.5674	.94738
920.00	1.5810	11.277	415.93	58.310	418.30	58.643	4.0437	.56690	.9667	.5665	.95200
940.00	1.5740	11.227	428.56	60.081	430.99	60.422	4.1565	.58272	.9644	.5656	.95624
960.00	1.5674	11.180	441.25	61.860	443.75	62.212	4.2696	.59858	.9622	.5646	.96012
1000.00	1.5552	11.093	466.94	65.462	469.58	65.832	4.4968	.63042	.9576	.5619	.96692

THE ELECTRON DENSITY OF ZINC IS 2.765E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.068 BEV, AND THE MINIMUM ENERGY LOSS IS 1.4608 MEV/GM/CM2

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TABULATIONS (COMPOUNDS AND MIXTURES)

ALPHABETIC LIST OF MATERIALS

AIR
BONE
BRASS
CALCIUM FLUORIDE
CARBON DIOXIDE
EMULSION (G-5)
EMULSION (NTA)
GLASS (PYREX)
LEXAN
LITHIUM FLUORIDE
LUCITE
METHANE
MUSCLE
NYLON
POLYETHYLENE
POLYSTYRENE
SARAN
SCINTILLATOR (ANTHRACENE)
SCINTILLATOR (CS-1)
SCINTILLATOR (NAI)
SCINTILLATOR (PILOT B)
SCINTILLATOR (STILBENE)
SCINTILLATOR (TOLUENE)
SILVER BROMIDE
SILVER CHLORIDE
STEEL (STAINLESS)
TEFLON
WATER

AIR

ELEMENT	ATOMIC NUMBER	ATOMS/MOLECULE	PERCENT BY WEIGHT	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL
O	8	5.3205	74.5287	14.007	86.70
N	7	1.4312	22.9009	15.999	88.50
A	18	.06434	2.5704	39.948	205.0

DENSITY = 1.2900 MG/CM3

PROTON ENERGY MEV	ENERGY LOSS MEV/CM2	PROTON RANGE MG/CM2	PROTON PATH LENGTH MG/CM2	PROTON PATH LENGTH METER	MG/CM2	PATH LENGTH STRAGGLING METER	PERCENT SCATTERING	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	729.86	14200	.14321	.00111	.00505	.00004	3.526	.8442	0.
.15	665.21	21364	.21494	.00167	.00659	.00005	3.068	.6051	0.
.20	586.10	29347	.29496	.00229	.00819	.00006	2.776	.5056	0.
.30	467.53	48479	.48682	.00377	.01230	.00010	2.527	.4157	0.
.40	393.12	71799	.72068	.00559	.01749	.00014	2.427	.3737	0.
.50	339.23	99161	.99508	.00771	.02351	.00018	2.362	.3489	0.
.60	303.23	13033	1.3077	.01014	.03015	.00023	2.306	.3321	0.
.70	274.11	16491	1.6544	.01282	.03722	.00029	2.250	.3198	0.
.80	251.42	20290	2.0353	.01578	.04476	.00035	2.199	.3101	0.
.90	236.08	24301	2.4455	.01896	.05259	.00041	2.150	.3022	0.
1.00	220.72	28752	2.8837	.02235	.06066	.00047	2.104	.2954	0.
1.20	194.58	38398	3.8507	.02985	.07812	.00061	2.029	.2843	0.
1.40	174.68	49240	4.9376	.03828	.09723	.00075	1.969	.2754	0.
1.60	158.95	61233	6.1398	.04760	.11788	.00091	1.920	.2681	.00001
1.80	146.15	74340	7.4535	.05778	.14002	.00109	1.879	.2619	.00002
2.00	135.50	88531	8.8759	.06881	.16358	.00127	1.843	.2566	.00003
2.20	126.48	10378	10.404	.08065	.18850	.00146	1.812	.2520	.00004
2.40	118.72	12008	12.038	.09331	.21475	.00166	1.784	.2479	.00006
2.60	111.95	13740	13.773	.10677	.24230	.00188	1.759	.2443	.00008
2.80	106.01	15572	15.610	.12101	.27111	.00210	1.737	.2410	.00010
3.00	100.72	17504	17.546	.13602	.30116	.00233	1.716	.2380	.00012
3.20	95.998	19554	19.581	.15179	.33244	.00258	1.698	.2354	.00015
3.40	91.740	21662	21.713	.16831	.36493	.00283	1.681	.2329	.00018
3.60	87.884	23886	23.941	.18559	.39861	.00309	1.665	.2306	.00021
3.80	84.372	26204	26.264	.20360	.43345	.00336	1.650	.2285	.00024
4.00	81.158	28616	28.681	.22234	.46946	.00364	1.637	.2266	.00028
4.20	78.203	31122	31.192	.24180	.50661	.00393	1.624	.2248	.00032
4.40	75.478	33721	33.796	.26198	.54489	.00422	1.612	.2231	.00036
4.60	72.955	36411	36.492	.28288	.58430	.00453	1.601	.2215	.00040
4.80	70.611	39192	39.279	.30449	.62482	.00484	1.591	.2200	.00044

AIR

PRCTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH METER	GM/CM2	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	68.429	0.4206	0.4216	0.32679	0.0067	0.0517	1.581	0.0049
5.50	63.572	0.4964	0.4974	0.38560	0.0078	0.0601	1.559	0.0062
6.00	59.361	0.5777	0.5789	0.44880	0.0089	0.0691	1.539	0.0077
6.50	55.777	0.6645	0.6659	0.51619	0.0101	0.0786	1.522	0.0205
7.00	52.638	0.7566	0.7582	0.58773	0.0114	0.0885	1.506	0.0434
7.50	49.852	0.8540	0.8558	0.66340	0.0128	0.0990	1.492	0.0683
8.00	47.384	0.9566	0.9587	0.74319	0.0142	0.1100	1.480	0.0932
8.50	45.171	1.0647	1.0666	0.82699	0.0157	0.1214	1.468	0.1180
9.00	43.173	1.1777	1.1801	0.91482	0.0172	0.1333	1.457	0.1429
9.50	41.361	1.2955	1.2984	1.0065	0.0188	0.1457	1.447	0.1677
10.00	39.709	1.4190	1.4219	1.1022	0.0204	0.1585	1.438	0.1925
11.00	36.804	1.6803	1.6836	1.3051	0.0239	0.1855	1.421	0.2423
12.00	34.331	1.9613	1.9651	1.5204	0.0276	0.2142	1.406	0.2924
13.00	32.198	2.2617	2.2661	1.7567	0.0316	0.2447	1.393	0.3425
14.00	30.338	2.5813	2.5863	2.0049	0.0357	0.2769	1.381	0.3927
15.00	28.701	2.9197	2.9253	2.2677	0.0401	0.3108	1.370	0.4430
16.00	27.247	3.2768	3.2830	2.5450	0.0447	0.3463	1.361	0.4933
17.00	25.948	3.6524	3.6592	2.8366	0.0495	0.3834	1.352	0.5436
18.00	24.779	4.0462	4.0537	3.1424	0.0545	0.4221	1.343	0.5941
19.00	23.721	4.4581	4.4663	3.4622	0.0597	0.4624	1.336	0.6446
20.00	22.759	4.8878	4.8968	3.7960	0.0650	0.5043	1.328	0.6952
22.00	21.073	5.8003	5.8108	4.5045	0.0764	0.5925	1.315	0.7965
24.00	19.644	6.7823	6.7945	5.2671	0.0886	0.6867	1.304	0.8980
26.00	18.415	7.8327	7.8467	6.0827	0.1015	0.7867	1.293	0.9594
28.00	17.347	8.9504	8.9663	6.9506	0.1151	0.8924	1.284	0.9797
30.00	16.409	1.0134	1.0152	7.8700	0.1295	1.0036	1.275	1.0007
32.00	15.579	1.1384	1.1404	8.8401	0.1445	1.1203	1.267	1.0225
34.00	14.838	1.2697	1.2720	9.8602	0.1603	1.2423	1.260	1.0449
36.00	14.173	1.4075	1.4099	10.930	0.1767	1.3696	1.253	1.0680
38.00	13.572	1.5515	1.5542	12.048	0.1938	1.5019	1.247	1.0916
40.00	13.027	1.7017	1.7046	13.214	0.2115	1.6394	1.241	1.1157
45.00	11.860	2.1038	2.1074	16.337	0.2586	2.0046	1.227	1.1777
50.00	10.909	2.5431	2.5475	19.748	0.3095	2.3995	1.215	1.2418
55.00	10.120	3.0186	3.0237	23.440	0.3642	2.8231	1.204	1.3082
60.00	9.4526	3.5294	3.5353	27.406	0.4224	3.2743	1.195	1.3773
65.00	8.8813	4.0746	4.0814	31.639	0.4840	3.7522	1.186	1.4489
70.00	8.3861	4.6533	4.6610	36.132	0.5490	4.2559	1.178	1.5225
75.00	7.9528	5.2648	5.2736	40.880	0.6172	4.7845	1.170	1.5978
80.00	7.5701	5.9085	5.9182	45.878	0.6885	5.3372	1.163	1.6745
90.00	6.9248	7.2892	7.3012	56.598	0.8401	6.5123	1.151	1.8305

AIR

PROTON ENERGY MEV	ENERGY LOSS MEV/CH2	PROTON RANGE GM/CH2	PROTON PATH LENGTH GM/CH2	PROTON PATH LENGTH METER	GM/CM2	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	6.4013	8.7904	8.8047	68.254	.10031	.77757	1.139	.19884
110.00	5.9677	10.407	10.424	80.806	.11768	.91225	1.129	.21488
120.00	5.6027	12.135	12.155	94.222	.13607	1.0548	1.120	.23129
130.00	5.2910	13.970	13.992	108.29	.15543	1.2049	1.111	.24794
140.00	5.0217	15.908	15.933	123.51	.17570	1.3620	1.103	.26473
150.00	4.7866	17.945	17.974	139.33	.19684	1.5259	1.095	.28145
160.00	4.5797	20.078	20.111	155.90	.21881	1.6962	1.088	.29846
170.00	4.3961	22.304	22.340	173.18	.24158	1.8727	1.081	.31550
180.00	4.2321	24.620	24.659	191.16	.26509	2.0549	1.075	.33261
190.00	4.0848	27.022	27.065	209.80	.28932	2.2428	1.069	.34972
200.00	3.9517	29.508	29.554	229.10	.31423	2.4359	1.063	.36679
210.00	3.8309	32.074	32.125	249.03	.33980	2.6341	1.058	.38386
220.00	3.7208	34.719	34.774	269.57	.36600	2.8372	1.053	.40098
230.00	3.6200	37.440	37.499	290.69	.39280	3.0450	1.047	.41809
240.00	3.5274	40.235	40.298	312.39	.42017	3.2571	1.043	.43515
250.00	3.4420	43.101	43.169	334.64	.44809	3.4736	1.038	.45214
260.00	3.3631	46.036	46.108	357.43	.47654	3.6941	1.034	.46898
270.00	3.2900	49.115	49.195	380.73	.50550	3.9186	1.029	.48560
280.00	3.2220	52.105	52.187	404.55	.53494	4.1468	1.025	.50199
290.00	3.1587	55.1235	55.321	428.85	.56484	4.3786	1.021	.51812
300.00	3.0995	58.126	58.518	453.63	.59520	4.6139	1.017	.53396
310.00	3.0442	61.177	61.774	478.86	.62598	4.8526	1.013	.54950
320.00	2.9923	64.286	65.087	504.55	.65718	5.0944	1.010	.56470
330.00	2.9436	67.440	68.457	530.67	.68878	5.3394	1.006	.57955
340.00	2.8977	71.769	71.881	557.22	.72076	5.5873	1.003	.59404
350.00	2.8545	75.241	75.558	584.17	.75311	5.8381	.9994	.60817
360.00	2.8137	78.765	78.887	611.53	.78582	6.0916	.9961	.62205
370.00	2.7752	82.338	82.466	639.27	.81886	6.3478	.9930	.63577
380.00	2.7387	85.960	86.093	667.39	.85224	6.6065	.9899	.64931
390.00	2.7042	89.629	89.768	695.88	.88594	6.8677	.9869	.66265
400.00	2.6714	93.345	93.489	724.72	.91994	7.1313	.9840	.67578
410.00	2.6402	97.105	97.254	753.91	.95424	7.3972	.9812	.68901
420.00	2.6106	100.91	101.06	783.44	.98883	7.6653	.9784	.70107
430.00	2.5824	104.75	104.92	813.30	1.0237	7.9356	.9757	.71316
440.00	2.5555	108.64	108.81	843.47	1.0588	8.2079	.9731	.72487
450.00	2.5299	112.57	112.74	873.96	1.0942	8.4822	.9705	.73622
460.00	2.5055	116.53	116.71	904.75	1.1298	8.7584	.9681	.74721
470.00	2.4821	120.54	120.72	935.84	1.1657	9.0366	.9656	.75783
480.00	2.4598	124.56	124.77	967.21	1.2018	9.3165	.9632	.76810
490.00	2.4384	128.66	128.85	998.86	1.2382	9.5982	.9609	.77802

AIR

PROTON ENERGY MEV	ENERGY LOSS MEV/GH/CM2	PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
		GH/CM2	METER	GH/CM2	METER	GH/CM2	METER PERCENT		
500.00	2.4179	3.1191	1029.2	132.97	1030.0	1.2747	9.8816	.9586	.78759
510.00	2.3983	3.0938	1061.4	137.12	1063.0	1.3115	10.167	.9564	.79681
520.00	2.3795	3.0696	1093.8	141.31	1095.4	1.3485	10.453	.9543	.80571
530.00	2.3615	3.0463	1126.4	145.53	1128.1	1.3856	10.741	.9521	.81428
540.00	2.3441	3.0239	1159.3	149.78	1161.1	1.4230	11.031	.9501	.82253
550.00	2.3275	3.0025	1192.5	154.06	1194.3	1.4605	11.322	.9480	.83046
560.00	2.3115	2.9818	1225.8	158.37	1227.7	1.4983	11.615	.9460	.83809
570.00	2.2961	2.9620	1259.4	162.71	1261.3	1.5362	11.903	.9441	.84543
580.00	2.2813	2.9429	1293.3	167.08	1295.2	1.5743	12.294	.9422	.85247
590.00	2.2670	2.9245	1327.3	171.48	1329.3	1.6125	12.500	.9404	.85924
600.00	2.2533	2.9067	1361.5	175.90	1363.6	1.6509	12.798	.9385	.86573
620.00	2.2273	2.8732	1430.7	184.83	1432.8	1.7282	13.397	.9350	.87793
640.00	2.2031	2.8420	1500.5	193.86	1502.8	1.8061	14.001	.9315	.88914
660.00	2.1805	2.8128	1571.2	202.99	1573.6	1.8845	14.609	.9284	.89941
680.00	2.1594	2.7857	1642.5	212.21	1645.0	1.9635	15.221	.9253	.90882
700.00	2.1397	2.7603	1714.6	221.51	1717.1	2.0429	15.837	.9223	.91742
720.00	2.1213	2.7365	1787.2	230.90	1789.9	2.1229	16.456	.9194	.92527
740.00	2.1040	2.7142	1860.5	240.37	1863.3	2.2033	17.080	.9166	.93243
760.00	2.0878	2.6933	1934.4	249.91	1937.3	2.2841	17.706	.9140	.93895
780.00	2.0726	2.6736	2008.8	259.52	2011.8	2.3653	18.336	.9114	.94488
800.00	2.0582	2.6551	2083.8	269.21	2086.9	2.4469	18.969	.9089	.95027
820.00	2.0447	2.6377	2159.3	278.96	2162.5	2.5290	19.604	.9066	.95516
840.00	2.0320	2.6213	2235.2	288.77	2238.5	2.6113	20.243	.9043	.95959
860.00	2.0200	2.6058	2311.7	298.64	2315.1	2.6940	20.884	.9021	.96361
880.00	2.0087	2.5912	2388.5	308.58	2392.1	2.7771	21.528	.9000	.96724
900.00	1.9980	2.5774	2465.9	318.56	2469.5	2.8604	22.174	.8979	.97053
920.00	1.9879	2.5644	2543.6	328.61	2547.3	2.9440	22.822	.8959	.97350
940.00	1.9783	2.5520	2621.8	338.70	2625.6	3.0280	23.473	.8940	.97618
960.00	1.9693	2.5404	2700.4	348.86	2704.3	3.1122	24.126	.8921	.97861
1000.00	1.9526	2.5188	2859.3	369.38	2863.4	3.2814	25.436	.8884	.98278

THE ELECTRON DENSITY OF AIR IS 3.004E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.272 BEV, AND THE MINIMUM ENERGY LOSS IS 1.8083 MEV/GH/CM2

THE EFFECTIVE IONIZATION POTENTIAL IS 88.96 ELECTRON VOLTS

BONE (HUMAN)

PROTON ENERGY MEV	ENERGY LOSS MEV/GM	ATOMIC NUMBER	ELEMENT	ATOMS/MOLECULE	PERCENT BY WEIGHT	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL	PROTON RANGE MG/CM2	PROTON PATH LENGTH MM	MG/CM2	PROTON PATH LENGTH MM	MG/CM2	PATH LENGTH STRAGGLING MM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	828.49	1	H	6.3492	6.3998	1.0080	18.30	.14257	.00077	.14361	.00078	.06898	.00037	2.616	.3032	0.
.15	738.23	6	C	2.3147	27.8025	12.011	77.30	.20639	.00112	.20751	.00112	.08812	.00048	2.491	.2937	0.
.20	649.13	7	N	.19275	2.6998	14.007	99.50	.27639	.00130	.27969	.00151	.10803	.00059	2.394	.2863	0.
.30	520.28	8	O	2.5625	40.9982	15.999	98.50	.45060	.00234	.45239	.00245	.13128	.00071	2.315	.2802	.00001
.40	434.25	12	Mg	.0822	.1998	24.312	156.5	.63104	.00357	.63346	.00359	.15512	.00084	2.249	.2750	.00001
.50	376.14	15	P	.22598	6.9997	30.974	175.9	.90825	.00491	.91150	.00493	.18041	.00098	2.194	.2706	.00002
.60	335.44	16	S	.00424	.2001	32.064	182.6	1.1895	.00643	1.1935	.00645	.20722	.00112	2.147	.2667	.00003
.70	301.83	20	CA	.36677	14.7001	40.080	211.3	1.5026	.00812	1.5075	.00815	.23547	.00127	2.107	.2632	.00004
.80	275.38							1.8489	.00999	1.8547	.01003	.26511	.00143	2.072	.2601	.00005
.90	253.22							2.1239	.01202	2.1308	.01206	.29511	.00160	2.040	.2573	.00007
1.00	237.04							2.6287	.01421	2.6367	.01425	.32842	.00178	2.012	.2548	.00009
1.20	208.89							3.5270	.01906	3.5374	.01912	.36202	.00196	1.986	.2524	.00011
1.40	187.46							4.5388	.02452	4.5498	.02459	.39687	.00215	1.962	.2503	.00013
1.60	170.49							5.6546	.03057	5.6704	.03065	.43297	.00234	1.941	.2483	.00015
1.80	156.68							6.8767	.03717	6.8957	.03727	.47028	.00254	1.921	.2464	.00018
2.00	145.17							8.2204	.04433	8.2227	.04445	.50880	.00275	1.902	.2447	.00020
2.20	135.44							9.6241	.05202	9.6498	.05216	.54855	.00297	1.885	.2431	.00023
2.40	127.06							11.146	.06025	11.175	.06041	.58947	.00319	1.869	.2416	.00026
2.60	119.77							12.764	.06900	12.797	.06918	.63157	.00341	1.854	.2402	.00029
2.80	113.35							14.477	.07826	14.515	.07846	.67478	.00365	1.839	.2385	.00033
3.00	107.66							16.284	.08802	16.325	.08825	.72842	.00382	1.824	.2368	.00036
3.20	102.58							18.183	.09829	18.229	.09854	.78202	.00401	1.809	.2352	.00039
3.40	97.999							20.174	.10905	20.225	.10932	.83687	.00419	1.794	.2337	.00042
3.60	93.854							22.256	.12030	22.311	.12060	.89297	.00437	1.779	.2322	.00045
3.80	90.078							24.426	.13203	24.487	.13236	.95028	.00455	1.764	.2307	.00048
4.00	86.625							26.686	.14425	26.751	.14460	.10143	.00473	1.749	.2292	.00051
4.20	83.409							29.034	.15694	29.105	.15732	.11175	.00491	1.734	.2277	.00054
4.40	80.483							31.471	.17011	31.547	.17052	.12175	.00509	1.719	.2262	.00057
4.60	77.790							33.992	.18374	34.074	.18418	.13175	.00527	1.704	.2247	.00060
4.80	75.289							36.601	.19784	36.689	.19832	.14175	.00545	1.689	.2232	.00063

DENSITY = 1.8500 GM/CM3

BONE

PROTON ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE CM	PROTON PATH LENGTH GM/CM ²	PROTON PATH LENGTH CM	GM/CM ²	PATH LENGTH STRAGGLING PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	72.960	.02124	.03939	.02129	.00072	.00039	1.826	.00036
5.50	67.773	.02508	.04650	.02514	.00083	.00045	1.795	.00046
6.00	63.336	.02920	.05414	.02927	.00096	.00052	1.768	.00108
6.50	59.496	.03359	.06215	.03367	.00109	.00059	1.744	.00198
7.00	56.137	.03826	.07095	.03835	.00122	.00066	1.722	.00340
7.50	53.148	.04320	.08010	.04330	.00135	.00074	1.703	.00516
8.00	50.512	.04841	.08976	.04852	.00151	.00082	1.685	.00595
8.50	48.148	.05388	.09990	.05400	.00167	.00090	1.659	.00875
9.00	46.018	.05961	.11052	.05974	.00183	.00099	1.654	.01056
9.50	44.084	.06560	.12163	.06575	.00199	.00108	1.640	.01237
10.00	42.320	.07185	.13321	.07200	.00217	.00117	1.627	.01419
11.00	39.221	.08510	.15777	.08528	.00253	.00137	1.604	.01790
12.00	36.584	.09935	.18419	.09956	.00292	.00158	1.584	.02164
13.00	34.309	.11458	.21243	.11483	.00333	.00180	1.566	.02565
14.00	32.327	.13079	.24248	.13107	.00376	.00203	1.550	.02967
15.00	30.581	.14795	.27429	.14827	.00421	.00228	1.536	.03370
16.00	29.032	.16607	.30786	.16641	.00469	.00253	1.522	.03773
17.00	27.648	.18511	.34317	.18550	.00518	.00280	1.510	.04179
18.00	26.402	.20509	.38020	.20551	.00570	.00308	1.499	.04585
19.00	25.275	.22595	.41892	.22644	.00624	.00337	1.489	.04992
20.00	24.250	.24777	.45932	.24828	.00679	.00367	1.479	.05401
22.00	22.454	.29405	.54510	.29465	.00797	.00431	1.462	.06221
24.00	20.931	.34386	.63743	.34455	.00922	.00498	1.446	.07044
26.00	19.622	.39713	.73617	.39793	.01055	.00570	1.433	.07547
28.00	18.484	.45382	.84124	.45473	.01195	.00646	1.420	.07717
30.00	17.485	.51387	.95255	.51489	.01342	.00726	1.409	.07895
32.00	16.600	.57724	1.0700	.57837	.01497	.00809	1.399	.08078
34.00	15.811	.64386	1.1935	.64513	.01658	.00896	1.389	.08267
36.00	15.102	.71371	1.3230	.71511	.01825	.00987	1.380	.08462
38.00	14.462	.78675	1.4583	.78828	.02001	.01082	1.372	.08661
40.00	13.881	.86292	1.5995	.86460	.02183	.01180	1.365	.08865
45.00	12.638	1.0669	1.9775	1.0689	.02664	.01440	1.347	.09391
50.00	11.625	1.2897	2.3905	1.2921	.03185	.01721	1.332	.09935
55.00	10.784	1.5308	2.8374	1.5337	.03742	.02023	1.319	.10501
60.00	10.073	1.7899	3.3175	1.7932	.04336	.02344	1.307	.11092
65.00	9.4641	2.0663	3.8277	2.0702	.04964	.02683	1.296	.11706
70.00	8.9365	2.3577	4.3739	2.3643	.05625	.03041	1.286	.12340
75.00	8.4749	2.6700	4.9487	2.6750	.06319	.03416	1.277	.12990
80.00	8.0671	3.0964	5.5433	3.0920	.07044	.03808	1.268	.13555
90.00	7.3794	3.6966	6.8514	3.7035	.08585	.04641	1.253	.15017

BONE

PROTON ENERGY MEV	ENERGY LOSS HEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	GM/CM2	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	6.8214	8.2471	8.2633	4.4661	1.0240	.05535	1.239	.16466
110.00	6.3594	9.7839	9.7839	5.2875	1.2004	.06489	1.227	.17629
120.00	5.9703	11.385	11.406	6.1634	1.3869	.07497	1.216	.19293
130.00	5.6381	13.107	13.131	7.0976	1.5832	.08558	1.206	.20791
140.00	5.3511	14.925	14.952	8.0822	1.7887	.09660	1.196	.22311
150.00	5.1004	16.836	16.867	9.1173	2.0028	.10826	1.187	.23846
160.00	4.8798	18.838	18.872	10.201	2.2253	.12029	1.179	.25396
170.00	4.6841	20.927	20.965	11.332	2.4557	.13274	1.171	.26963
180.00	4.5093	23.109	23.141	12.509	2.6937	.14561	1.164	.28541
190.00	4.3522	25.353	25.399	13.704	2.9389	.15886	1.157	.30123
200.00	4.2102	27.686	27.736	14.992	3.1909	.17248	1.150	.31707
210.00	4.0814	30.094	30.148	16.296	3.4495	.18646	1.144	.33289
220.00	3.9640	32.577	32.635	17.641	3.7143	.20077	1.138	.34871
230.00	3.8564	35.130	35.193	19.023	3.9852	.21542	1.132	.36447
240.00	3.7577	37.753	37.820	20.444	4.2618	.23037	1.127	.38014
250.00	3.6666	40.443	40.515	21.900	4.5439	.24562	1.122	.39570
260.00	3.5825	43.197	43.274	23.392	4.8313	.26115	1.116	.41116
270.00	3.5044	46.015	46.097	24.917	5.1238	.27696	1.112	.42650
280.00	3.4319	48.894	48.982	26.476	5.4211	.29303	1.107	.44173
290.00	3.3643	51.832	51.924	28.067	5.7231	.30936	1.102	.45680
300.00	3.3012	54.828	54.925	29.689	6.0295	.32592	1.098	.47170
310.00	3.2421	57.879	57.982	31.342	6.3403	.34272	1.093	.48652
320.00	3.1868	60.985	61.093	33.023	6.6552	.35974	1.089	.50119
330.00	3.1347	64.144	64.257	34.734	6.9741	.37698	1.085	.51571
340.00	3.0858	67.354	67.473	36.472	7.2958	.39442	1.081	.53006
350.00	3.0397	70.613	70.735	38.237	7.6231	.41205	1.078	.54422
360.00	2.9961	73.921	74.052	40.026	7.9531	.42990	1.074	.55823
370.00	2.9550	77.277	77.413	41.845	8.2864	.44791	1.070	.57215
380.00	2.9160	80.678	80.820	43.687	8.6230	.46611	1.067	.58595
390.00	2.8791	84.123	84.272	45.552	8.9629	.48448	1.064	.59960
400.00	2.8440	87.612	87.766	47.441	9.3057	.50301	1.060	.61310
410.00	2.8108	91.143	91.303	49.333	9.6515	.52171	1.057	.62636
420.00	2.7791	94.715	94.882	51.287	1.0000	.54055	1.054	.63932
430.00	2.7490	98.327	98.500	53.243	1.0352	.55755	1.051	.65197
440.00	2.7203	101.98	102.16	55.210	1.0706	.57869	1.048	.66430
450.00	2.6929	105.67	105.85	57.217	1.1062	.59797	1.045	.67632
460.00	2.6667	109.39	109.58	59.234	1.1422	.61738	1.042	.68803
470.00	2.6417	113.15	113.35	61.271	1.1783	.63692	1.040	.69941
480.00	2.6178	116.95	117.15	63.326	1.2147	.65659	1.037	.71049
490.00	2.5950	120.78	120.99	65.400	1.2513	.67638	1.034	.72125

BONE

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM ²	PROTON RANGE GM/CM ²	PROTON PATH LENGTH GM/CM ²	PROTON PATH LENGTH CM	BATH LENGTH STRAGGLING GM/CM ²	BATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	2.5731	124.64	124.86	67.492	1.2861	.69629	1.032	.73170
510.00	2.5521	128.54	128.76	69.602	1.3252	.71631	1.029	.74185
520.00	2.5320	132.47	132.70	71.728	1.3624	.73644	1.027	.75171
530.00	2.5126	136.42	136.66	73.874	1.3999	.75668	1.024	.76127
540.00	2.4941	140.41	140.66	76.031	1.4375	.77702	1.022	.77055
550.00	2.4762	144.43	144.68	78.206	1.4753	.79747	1.020	.77954
560.00	2.4591	148.48	148.73	80.396	1.5133	.81801	1.017	.78825
570.00	2.4426	152.55	152.81	82.602	1.5515	.83864	1.015	.79668
580.00	2.4267	156.65	156.92	84.822	1.5898	.85937	1.013	.80484
590.00	2.4114	160.78	161.05	87.057	1.6283	.88018	1.011	.81273
600.00	2.3967	164.93	165.21	89.305	1.6670	.90108	1.009	.82036
620.00	2.3688	173.31	173.61	93.843	1.7443	.94314	1.005	.83485
640.00	2.3428	181.79	182.10	98.432	1.8232	.98551	1.001	.84837
660.00	2.3185	190.35	190.68	103.07	1.9021	1.0282	.9974	.86096
680.00	2.2960	199.01	199.35	107.76	1.9816	1.0711	.9940	.87266
700.00	2.2748	207.74	208.10	112.49	2.0616	1.1144	.9907	.88351
720.00	2.2550	216.56	216.93	117.26	2.1420	1.1579	.9874	.89356
740.00	2.2364	225.45	225.84	122.08	2.2229	1.2016	.9843	.90285
760.00	2.2182	234.42	234.82	126.93	2.3043	1.2455	.9813	.91142
780.00	2.2025	243.45	243.87	131.82	2.3860	1.2897	.9784	.91930
800.00	2.1870	252.55	252.98	136.75	2.4681	1.3341	.9756	.92654
820.00	2.1725	261.71	262.16	141.71	2.5506	1.3787	.9729	.93317
840.00	2.1588	270.93	271.39	146.70	2.6335	1.4235	.9704	.93925
860.00	2.1458	280.21	280.69	151.72	2.7166	1.4685	.9679	.94481
880.00	2.1336	289.55	290.04	156.78	2.8002	1.5136	.9653	.94990
900.00	2.1220	298.93	299.44	161.86	2.8840	1.5589	.9631	.95455
920.00	2.1110	308.38	308.90	166.97	2.9681	1.6044	.9609	.95878
940.00	2.1007	317.87	318.40	172.11	3.0525	1.6500	.9587	.96265
960.00	2.0908	327.42	327.97	177.28	3.1372	1.6958	.9566	.96618
1000.00	2.0727	346.72	347.30	187.73	3.3074	1.7878	.9523	.97233

THE ELECTRON DENSITY OF BONE IS 3.194E 23 ELECTRONS PER GRAM
 THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.278 BEV, AND THE MINIMUM ENERGY LOSS IS 1.9021 MEV/GM/CM²
 THE EFFECTIVE IONIZATION POTENTIAL IS 87.35 ELECTRON VOLTS

BRASS

PROTON ENERGY MEV	ELEMENT		ATOMIC NUMBER	ATOMS/MOLECULE	PERCENT BY WEIGHT	ATOMIC HEIGHT MG/CH2	ADJUSTED IONIZATION POTENTIAL	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	CU	ZN							
.10	225.91	1917.7	.53270	.00063	.00064	.02641	.00003	2.500	0.
.15	225.14	1911.2	.75286	.00089	.00090	.03497	.00004	1.979	0.
.20	217.43	1645.8	.97582	.00115	.00117	.04197	.00005	1.831	0.
.30	195.67	1661.1	1.4531	.00171	.00174	.05517	.00006	1.734	0.
.40	177.18	1504.1	1.9825	.00234	.00238	.05898	.00008	1.683	0.
.50	162.43	1378.9	2.5635	.00302	.00307	.08355	.00010	1.640	0.
.60	149.72	1270.9	3.1959	.00376	.00383	.09972	.00012	1.598	0.
.70	139.49	1184.2	3.8788	.00457	.00464	.11728	.00014	1.559	0.
.80	131.21	1113.9	4.6077	.00543	.00551	.13580	.00016	1.522	0.
.90	124.99	1061.1	5.3781	.00634	.00643	.15496	.00018	1.488	0.
1.00	118.77	1008.2	6.1869	.00729	.00740	.17460	.00021	1.455	0.
1.20	107.10	909.18	7.9437	.00936	.00949	.21617	.00025	1.397	0.
1.40	97.826	830.45	9.8778	.01164	.01179	.26064	.00031	1.347	0.
1.60	90.281	766.40	11.985	.01412	.01430	.30790	.00036	1.303	0.
1.80	84.107	713.98	14.258	.01680	.01701	.35780	.00042	1.265	0.
2.00	78.905	669.83	16.689	.01966	.01990	.41004	.00048	1.231	0.
2.20	74.409	631.66	19.273	.02270	.02298	.46444	.00055	1.202	0.
2.40	70.490	598.39	22.009	.02593	.02624	.52087	.00061	1.175	0.
2.60	67.029	569.01	24.991	.02932	.02966	.57924	.00068	1.152	0.
2.80	63.961	542.96	27.917	.03289	.03326	.63948	.00075	1.130	0.
3.00	61.250	519.95	31.086	.03662	.03703	.70153	.00083	1.111	0.
3.20	58.765	498.85	34.387	.04051	.04096	.76529	.00090	1.093	0.
3.40	56.504	479.67	37.829	.04456	.04503	.83080	.00098	1.077	0.
3.60	54.438	462.13	41.404	.04877	.04930	.89806	.00106	1.062	0.
3.80	52.540	446.01	45.110	.05314	.05370	.96702	.00114	1.048	0.
4.00	50.789	431.15	48.946	.05766	.05826	1.0377	.00122	1.033	0.
4.20	49.167	417.38	52.917	.06234	.06298	1.1100	.00131	1.023	.00001
4.40	47.659	404.58	57.011	.06716	.06784	1.1843	.00140	1.012	.00001
4.60	46.253	392.64	61.236	.07214	.07286	1.2604	.00148	1.001	.00001
4.80	44.939	381.48	65.586	.07736	.07803	1.3385	.00158	.9912	.00001

DENSITY = 8.4890 GM/CM3.

BRASS

PROTON ENERGY MEV.	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PATH LENGTH STRAGGLING GM/CM2	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	43.706	0.7006	0.0834	0.0017	2.005	.00002
5.50	40.936	0.8179	0.0973	0.0019	1.970	.00003
6.00	38.536	0.9421	0.1121	0.0022	1.940	.00005
6.50	36.435	1.0753	0.1278	0.0028	1.913	.00007
7.00	34.582	1.2150	0.1444	0.0032	1.889	.00010
7.50	32.933	1.3621	0.1619	0.0030	1.868	.00014
8.00	31.456	1.5163	0.1802	0.0033	1.848	.00018
8.50	30.120	1.6775	0.1994	0.0036	1.830	.00023
9.00	28.911	1.8457	0.2174	0.0040	1.813	.00029
9.50	27.798	2.0207	0.2360	0.0043	1.798	.00036
10.00	26.777	2.2027	0.2595	0.0047	1.783	.00043
11.00	24.975	2.5867	0.3073	0.0054	1.756	.00059
12.00	23.441	2.9972	0.3560	0.0062	1.732	.00079
13.00	22.108	3.4335	0.4078	0.0070	1.711	.00112
14.00	20.936	3.8952	0.4625	0.0078	1.691	.00149
15.00	19.896	4.3819	0.5203	0.0087	1.672	.00223
16.00	18.967	4.8933	0.5810	0.0096	1.655	.00451
17.00	18.130	5.4288	0.6445	0.0097	1.640	.00683
18.00	17.372	5.9885	0.7109	0.0081	1.625	.00917
19.00	16.682	6.5720	0.7801	0.0126	1.612	.01353
20.00	16.052	7.1768	0.8521	0.0136	1.600	.01390
22.00	14.941	8.4626	1.0043	0.0158	1.577	.01871
24.00	13.991	9.8374	1.1674	0.0182	1.556	.02359
26.00	13.169	1.1302	1.3411	0.0206	1.538	.02884
28.00	12.451	1.2254	1.5251	0.0232	1.522	.02841
30.00	11.817	1.4492	1.7194	0.0259	1.507	.03004
32.00	11.252	1.6216	1.9239	0.0287	1.493	.03174
34.00	10.747	1.8024	2.1382	0.0317	1.480	.03350
36.00	10.291	1.9913	2.3622	0.0347	1.469	.03532
38.00	9.8791	2.1885	2.5960	0.0378	1.458	.03719
40.00	9.5026	2.3936	2.8392	0.0411	1.447	.03911
45.00	8.6935	2.9408	3.4880	0.0497	1.425	.04413
50.00	8.0297	3.5361	4.1937	0.0589	1.405	.04942
55.00	7.4754	4.1779	4.9545	0.0687	1.387	.05496
60.00	7.0048	4.8649	5.7309	0.0791	1.372	.06079
65.00	6.6002	5.5961	6.5922	0.0901	1.358	.06686
70.00	6.2479	6.3702	7.5041	0.1016	1.345	.07316
75.00	5.9385	7.1864	8.4655	0.1136	1.334	.07967
80.00	5.6832	8.0530	9.4864	0.1264	1.324	.08640
90.00	5.0923	9.9148	1.1754	0.1543	1.313	.10051

BRASS

INCIDENT ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	HEV/CM2	HEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	PERCENT		
100.00	4.7313	40.164	11.944	1.4070	12.019	1.4159	.15613	.01839	1.299	.11910
110.00	4.4306	37.611	14.101	1.6611	14.190	1.9716	.18253	.04150	1.223	.13014
120.00	4.1755	35.446	16.401	1.9320	16.504	2.2442	.21018	.02476	1.274	.14561
130.00	3.9560	33.583	18.843	2.2196	18.961	2.5336	.23905	.02816	1.261	.16144
140.00	3.7656	31.968	21.431	2.5246	21.565	2.8504	.26908	.03170	1.245	.17753
150.00	3.5989	30.551	24.126	2.8421	24.277	3.1936	.30022	.03537	1.237	.19379
160.00	3.4514	29.299	26.942	3.1738	27.110	3.5407	.33244	.03916	1.226	.21027
170.00	3.3201	28.184	29.871	3.5108	30.057	3.9012	.36567	.04308	1.217	.22699
180.00	3.2024	27.189	32.913	3.8771	33.118	4.2767	.39988	.04711	1.207	.24389
190.00	3.0964	26.285	36.081	4.2503	36.305	4.6617	.43502	.05124	1.198	.26093
200.00	3.0004	25.470	39.329	4.6330	39.573	5.0547	.47105	.05547	1.190	.27805
210.00	2.9130	24.729	42.692	5.0291	42.956	5.4688	.50793	.05983	1.182	.29524
220.00	2.8332	24.051	46.140	5.4353	46.424	5.8968	.54562	.06427	1.175	.31247
230.00	2.7768	23.521	49.662	5.8501	49.968	6.3338	.58372	.06876	1.168	.32966
240.00	2.7027	22.943	53.270	6.2792	53.598	6.7800	.62255	.07354	1.162	.34681
250.00	2.6400	22.411	57.007	6.7193	57.358	7.2442	.66213	.07800	1.154	.36391
260.00	2.5818	21.917	60.800	7.1622	61.174	7.7263	.70242	.08275	1.148	.38089
270.00	2.5279	21.460	64.705	7.6222	65.103	8.2222	.74339	.08757	1.142	.39773
280.00	2.4778	21.034	68.678	8.0982	69.100	8.7399	.78502	.09247	1.136	.41439
290.00	2.4310	20.637	72.728	8.5974	73.175	9.2800	.82726	.09745	1.131	.43085
300.00	2.3873	20.266	76.865	9.1147	77.337	9.8433	.87009	.10250	1.125	.44709
310.00	2.3464	19.919	81.076	9.6507	81.573	10.4303	.91350	.10761	1.120	.46312
320.00	2.3080	19.593	85.345	10.2050	85.839	11.0422	.95745	.11279	1.115	.47895
330.00	2.2705	19.275	89.657	10.762	90.206	11.6766	1.0020	.11804	1.111	.49458
340.00	2.2366	18.987	93.998	11.333	94.574	12.3336	1.0472	.12336	1.107	.50998
350.00	2.2046	18.715	98.437	11.906	99.039	13.0167	1.0929	.12874	1.103	.52514
360.00	2.1744	18.459	102.98	12.491	103.61	13.718	1.1390	.13418	1.099	.54035
370.00	2.1459	18.216	107.59	13.075	108.25	14.4352	1.1856	.13966	1.095	.55470
380.00	2.1189	17.987	112.25	13.663	112.94	15.1663	1.2326	.14520	1.091	.56908
390.00	2.0932	17.770	116.97	14.259	117.68	15.9103	1.2800	.15078	1.088	.58318
400.00	2.0689	17.563	121.78	14.864	122.52	16.6693	1.3277	.15641	1.084	.59699
410.00	2.0459	17.367	126.61	15.478	127.37	17.4433	1.3759	.16208	1.080	.61051
420.00	2.0239	17.181	131.49	16.101	132.28	18.2322	1.4244	.16779	1.077	.62372
430.00	2.0030	17.003	136.42	16.732	137.25	19.0358	1.4733	.17355	1.073	.63663
440.00	1.9831	16.834	141.41	17.371	142.26	19.8543	1.5225	.17935	1.070	.64923
450.00	1.9641	16.673	146.44	18.016	147.32	20.6878	1.5720	.18518	1.067	.66151
460.00	1.9460	16.519	151.52	18.667	152.44	21.5363	1.6218	.19105	1.064	.67348
470.00	1.9286	16.372	156.65	19.324	157.59	22.3998	1.6720	.19696	1.061	.68514
480.00	1.9121	16.232	161.88	19.988	162.66	23.2783	1.7224	.20290	1.059	.69649
490.00	1.8962	16.097	166.90	20.660	167.91	24.1718	1.7731	.20887	1.056	.70752

BRASS

PROCTON ENERGY MEV	ENERGY LOSS MEV/CH2	PROTON RANGE GM/CH2	PROTON PATH LENGTH CM	PROTON PATH LENGTH GM/CH2	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	1.8811	172.15	20.279	173.19	1.8241	.6006	.71824
510.00	1.8665	177.45	20.904	178.32	1.8753	.5979	.72866
520.00	1.8526	182.79	21.533	183.89	1.9268	.5975	.73877
530.00	1.8392	188.17	22.166	189.30	1.9786	.5971	.74859
540.00	1.8264	193.59	22.804	194.75	2.0305	.5966	.75810
550.00	1.8141	199.04	23.447	200.23	2.0827	.5962	.76732
560.00	1.8022	204.53	24.093	205.75	2.1352	.5958	.77626
570.00	1.7908	210.05	24.744	211.31	2.1878	.5953	.78491
580.00	1.7799	215.61	25.399	216.90	2.2407	.5949	.79328
590.00	1.7693	221.21	26.059	222.54	2.2937	.5945	.80138
600.00	1.7592	226.84	26.721	228.20	2.3470	.5963	.80921
620.00	1.7400	238.18	28.098	239.61	2.4540	.5971	.82408
640.00	1.7221	249.07	29.446	251.46	2.5618	.5948	.83796
660.00	1.7054	261.56	30.812	263.12	2.6702	.5841	.85087
680.00	1.6899	273.27	32.191	274.90	2.7793	.5935	.86288
700.00	1.6754	285.08	33.582	286.78	2.8889	.5928	.87403
720.00	1.6619	296.99	34.985	298.76	2.9992	.5920	.88433
740.00	1.6492	308.89	36.398	310.82	3.1099	.5914	.89393
760.00	1.6373	321.07	37.822	322.98	3.2212	.5906	.90278
780.00	1.6262	333.24	39.256	335.22	3.3329	.5901	.91095
800.00	1.6157	345.50	40.700	347.55	3.4451	.5897	.91849
820.00	1.6058	357.83	42.152	359.95	3.5577	.5893	.92545
840.00	1.5966	370.24	43.614	372.43	3.6707	.5890	.93185
860.00	1.5879	382.73	45.085	384.99	3.7841	.5889	.93774
880.00	1.5796	395.26	46.562	397.60	3.8978	.5888	.94316
900.00	1.5719	407.89	48.050	410.31	4.0119	.5887	.94813
920.00	1.5646	420.60	49.547	423.09	4.1264	.5888	.95269
940.00	1.5577	433.37	51.050	435.94	4.2412	.5896	.95688
960.00	1.5512	446.20	52.552	448.85	4.3562	.5907	.96071
1000.00	1.5392	472.19	55.023	475.01	4.5872	.5950	.96742

THE ELECTRON DENSITY OF BRASS IS 2.743E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.067 BEV, AND THE MINIMUM ENERGY LOSS IS 1.4440 MEV/GM/CH2

THE EFFECTIVE IONIZATION POTENTIAL IS 332.45 ELECTRON VOLTS

CALCIUM FLUORIDE

ATOMIC NUMBER 20
 ELEMENT CA
 ATOMS/MOLECULE 1
 PERCENT BY HEIGHT 51.3341
 ATOMIC HEIGHT 40.080
 ADJUSTED IONIZATION POTENTIAL 211.3
 18.998
 120.7

DENSITY = 3.1800 GM/CM3

PROTON ENERGY HEV	ENERGY LOSS HEV/CM	PROTON RANGE MG/CM2	PROTON PATH LENGTH MM		MG/CM2	ATOMS/MOLECULE	PERCENT BY HEIGHT		ATOMIC HEIGHT	ADJUSTED IONIZATION POTENTIAL		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
			MG/CM2	MM			MG/CM2	MM		MG/CM2	MM		
.10	545.50	1234.7	.26685	.00085	.27238	.00086	.01249	.00004	4.585	1.294	0.		
.15	484.83	1541.8	.36579	.00115	.36955	.00116	.01406	.00004	3.804	1.016	0.		
.20	432.60	1385.2	.47406	.00149	.47839	.00150	.01601	.00005	3.347	.872	0.		
.30	357.12	1135.6	.72871	.00229	.73230	.00230	.02133	.00007	2.913	.7839	0.		
.40	300.07	954.21	1.0314	.00324	1.0387	.00327	.02850	.00009	2.744	.7019	0.		
.50	253.82	838.95	1.3861	.00436	1.3953	.00439	.03719	.00012	2.665	.6637	0.		
.60	219.28	767.26	1.7809	.00560	1.7923	.00564	.04645	.00015	2.592	.6367	0.		
.70	190.97	699.51	2.2120	.00695	2.2257	.00700	.05627	.00018	2.528	.6161	0.		
.80	168.55	637.70	2.6876	.00845	2.7039	.00850	.06756	.00021	2.499	.6001	0.		
.90	147.45	596.09	3.2003	.01006	3.2192	.01012	.07917	.00025	2.439	.5859	0.		
1.00	127.33	554.38	3.7509	.01180	3.7745	.01186	.09078	.00029	2.408	.5726	0.		
1.20	104.94	492.72	4.9044	.01541	4.9219	.01570	.11531	.00036	2.310	.5502	0.		
1.40	90.18	445.76	6.3172	.01987	6.3311	.01997	.14169	.00045	2.231	.5325	0.		
1.60	78.39	408.27	7.8034	.02454	7.8240	.02467	.16978	.00053	2.164	.5181	0.		
1.80	68.68	377.41	9.4182	.02982	9.4461	.02977	.19951	.00063	2.108	.5059	.00001		
2.00	60.52	351.45	11.158	.03509	11.213	.03526	.23096	.00073	2.060	.4954	.00001		
2.20	53.54	329.25	13.020	.04094	13.084	.04114	.26432	.00083	2.020	.4863	.00002		
2.40	47.492	310.02	15.004	.04718	15.076	.04741	.29951	.00094	1.987	.4782	.00002		
2.60	42.196	293.18	17.106	.05379	17.186	.05405	.33644	.00106	1.958	.4710	.00003		
2.80	37.524	278.32	19.324	.06077	19.414	.06105	.37502	.00118	1.931	.4645	.00004		
3.00	33.365	265.10	21.656	.06810	21.756	.06841	.41519	.00131	1.908	.4586	.00005		
3.20	29.636	253.24	24.101	.07579	24.211	.07614	.45688	.00144	1.887	.4532	.00006		
3.40	26.269	242.54	26.658	.08383	26.778	.08421	.50006	.00157	1.867	.4482	.00008		
3.60	23.297	232.80	29.325	.09222	29.456	.09263	.54469	.00171	1.849	.4437	.00009		
3.80	20.506	223.89	32.100	.10094	32.242	.10139	.59077	.00186	1.832	.4394	.00011		
4.00	17.833	215.71	34.983	.11001	35.136	.11049	.63826	.00201	1.817	.4355	.00013		
4.20	15.469	208.19	37.974	.11942	38.139	.11993	.68715	.00216	1.802	.4318	.00014		
4.40	13.254	201.15	41.049	.12915	41.246	.12970	.73740	.00232	1.788	.4284	.00017		
4.60	11.250	194.77	44.270	.13921	44.459	.13981	.78906	.00248	1.775	.4252	.00019		
4.80	9.383	188.84	47.576	.14961	47.777	.15024	.84197	.00265	1.762	.4222	.00021		

CALCIUM FLUORIDE

PRCTON ENERGY HEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	HEV/CH2	HEV/CH	GM/CH2	CM	GM/CH2	CH	GM/CH2	CH		
5.00	57.641	133.30	.05098	.01603	.05119	.01610	.00090	.00028	1.750	.00024
5.50	53.736	170.68	.05994	.01885	.06019	.01893	.00104	.00033	1.723	.00031
6.00	50.377	150.20	.06952	.02186	.06980	.02195	.00119	.00037	1.655	.00039
6.50	47.456	150.91	.07971	.02507	.08003	.02517	.00134	.00042	1.677	.00049
7.00	44.889	142.75	.09051	.02846	.09087	.02858	.00151	.00047	1.657	.00060
7.50	42.633	135.51	.10191	.03205	.10231	.03217	.00168	.00053	1.639	.00160
8.00	40.580	129.04	.11389	.03581	.11433	.03595	.00185	.00058	1.622	.00278
8.50	38.751	123.23	.12646	.03977	.12695	.03992	.00204	.00064	1.607	.00396
9.00	37.097	117.97	.13960	.04390	.14014	.04407	.00223	.00070	1.593	.00515
9.50	35.576	113.13	.15332	.04821	.15390	.04840	.00243	.00076	1.580	.00634
10.00	34.204	108.77	.16760	.05270	.16824	.05290	.00264	.00083	1.568	.00794
11.00	31.785	101.06	.19786	.06222	.19860	.06245	.00307	.00097	1.546	.00995
12.00	29.718	94.503	.23030	.07242	.23115	.07269	.00353	.00111	1.527	.01245
13.00	27.929	88.814	.26492	.08331	.26588	.08361	.00401	.00126	1.510	.01608
14.00	26.365	83.839	.30166	.09486	.30275	.09521	.00452	.00142	1.494	.01972
15.00	24.984	79.449	.34051	.10708	.34173	.10746	.00506	.00159	1.481	.02338
16.00	23.755	75.542	.38143	.11995	.38279	.12037	.00562	.00177	1.465	.02705
17.00	22.655	72.042	.42441	.13346	.42591	.13393	.00620	.00195	1.452	.03074
18.00	21.663	68.887	.46942	.14762	.47107	.14813	.00681	.00214	1.445	.03444
19.00	20.763	66.025	.51643	.16240	.51823	.16297	.00744	.00234	1.435	.03815
20.00	19.943	63.419	.56542	.17781	.56739	.17842	.00809	.00254	1.426	.04188
22.00	18.504	58.843	.66928	.21047	.67158	.21119	.00946	.00298	1.409	.04938
24.00	17.280	54.950	.78085	.24555	.78351	.24639	.01092	.00343	1.394	.05694
26.00	16.225	51.595	.89965	.28301	.90302	.28397	.01247	.00392	1.380	.06167
28.00	15.306	48.672	1.0264	.32282	1.03300	.32390	.01409	.00443	1.368	.06747
30.00	14.497	46.100	1.1605	.36493	1.16443	.36614	.01580	.00497	1.357	.07335
32.00	13.780	43.819	1.3016	.40930	1.3059	.41066	.01759	.00553	1.347	.07929
34.00	13.139	41.781	1.4498	.45591	1.4546	.45741	.01946	.00612	1.338	.08530
36.00	12.562	39.948	1.6050	.50473	1.6103	.50636	.02140	.00673	1.329	.09137
38.00	12.041	38.290	1.7672	.55573	1.7730	.55754	.02342	.00737	1.321	.09750
40.00	11.567	36.782	1.9362	.60866	1.9425	.61084	.02552	.00802	1.314	.07532
45.00	10.550	33.550	2.3880	.75094	2.3957	.75336	.03107	.00977	1.297	.08131
50.00	9.7198	30.909	2.8808	.90590	2.8899	.90879	.03705	.01165	1.282	.08716
55.00	9.0290	28.712	3.4133	1.0734	3.4241	1.0768	.04345	.01366	1.269	.09350
60.00	8.4442	26.853	3.9846	1.2530	3.9971	1.2570	.05026	.01580	1.257	.09970
65.00	7.9424	25.257	4.5937	1.4445	4.6081	1.4491	.05745	.01807	1.247	.10635
70.00	7.5070	23.872	5.2396	1.6477	5.2559	1.6528	.06502	.02045	1.237	.11322
75.00	7.1258	22.660	5.9214	1.8621	5.9398	1.8679	.07295	.02294	1.228	.12027
80.00	6.7883	21.587	6.6385	2.0876	6.6590	2.0940	.08123	.02554	1.220	.12748
90.00	6.2183	19.774	8.1751	2.5708	8.2002	2.5787	.09861	.03107	1.203	.14238

CALCIUM FLUORIDE

PROTON ENERGY HEV	ENERGY LOSS HEV/CM2	HEV/CH	PROTON RANGE GM/CM2	CH	PROTON PATH LENGTH GM/CM2	CH	GM/CM2	PATH LENGTH STRAGGLING GM/CM2	CH	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	5.7550	18.301	9.8434	3.0954	9.8735	3.1049	1.1766	.03700	1.192		.3043	.15742
110.00	5.3707	17.079	11.638	3.6599	11.674	3.6710	1.3773	.04331	1.180		.3030	.17293
120.00	5.0468	16.049	13.958	4.2625	13.996	4.2754	1.5894	.04998	1.169		.3018	.16890
130.00	4.7698	15.166	15.988	4.9019	15.635	4.9167	1.8123	.05699	1.159		.3007	.20921
140.00	4.5304	14.407	17.734	5.5768	17.787	5.5935	2.0454	.06432	1.150		.2997	.22177
150.00	4.3212	13.741	19.989	6.2857	20.048	6.3045	2.2884	.07176	1.141		.2988	.23869
160.00	4.1368	13.155	22.348	7.0276	22.415	7.0486	2.5406	.07989	1.132		.2974	.25536
170.00	3.9732	12.635	24.808	7.8012	24.882	7.8245	2.8016	.08810	1.126		.2974	.27240
180.00	3.8270	12.170	27.366	8.6055	27.447	8.6312	3.0710	.09657	1.119		.2967	.28954
190.00	3.6955	11.752	30.016	9.4395	30.107	9.4678	3.3484	.10530	1.112		.2961	.30672
200.00	3.5767	11.374	32.761	10.302	32.858	10.333	3.6335	.11426	1.106		.2956	.32389
210.00	3.4688	11.031	35.592	11.193	35.698	11.226	3.9259	.12345	1.100		.2951	.34104
220.00	3.3704	10.718	38.509	12.110	38.623	12.146	4.2252	.13287	1.094		.2946	.35815
230.00	3.2803	10.431	41.508	13.053	41.631	13.091	4.5312	.14249	1.088		.2942	.37518
240.00	3.1975	10.168	44.588	14.021	44.719	14.063	4.8436	.15231	1.082		.2938	.39211
250.00	3.1212	9.9253	47.744	15.014	47.885	15.058	5.1621	.16233	1.076		.2934	.40888
260.00	3.0506	9.7009	50.976	16.030	51.126	16.077	5.4865	.17253	1.070		.2930	.42552
270.00	2.9851	9.4927	54.281	17.065	54.440	17.120	5.8164	.18291	1.063		.2927	.44204
280.00	2.9243	9.2993	57.656	18.151	57.825	18.184	6.1519	.19345	1.064		.2924	.45840
290.00	2.8676	9.1190	61.100	19.214	61.279	19.270	6.4923	.20416	1.059		.2920	.47458
300.00	2.8147	8.9506	64.610	20.318	64.799	20.377	6.8377	.21502	1.055		.2917	.49057
310.00	2.7651	8.7930	68.184	21.442	68.384	21.504	7.1880	.22604	1.051		.2914	.50634
320.00	2.7186	8.6453	71.822	22.585	72.031	22.651	7.5427	.23719	1.047		.2911	.52189
330.00	2.6750	8.5065	75.520	23.748	75.740	23.818	7.9019	.24849	1.043		.2909	.53720
340.00	2.6339	8.3759	79.276	24.930	79.507	25.002	8.2653	.25992	1.040		.2906	.55225
350.00	2.5952	8.2528	83.091	26.129	83.333	26.205	8.6328	.27147	1.036		.2903	.56703
360.00	2.5587	8.1367	86.966	27.346	87.213	27.426	9.0042	.28315	1.032		.2901	.58158
370.00	2.5242	8.0269	90.884	28.580	91.148	28.663	9.3793	.29495	1.029		.2898	.59591
380.00	2.4915	7.9229	94.861	29.830	95.136	29.917	9.7581	.30686	1.026		.2896	.61001
390.00	2.4605	7.8245	98.888	31.097	99.175	31.187	1.0140	.31888	1.022		.2893	.62386
400.00	2.4311	7.7310	102.97	32.379	103.26	32.473	1.0526	.33101	1.019		.2891	.63747
410.00	2.4032	7.6423	107.09	33.676	107.40	33.774	1.0915	.34323	1.016		.2888	.65076
420.00	2.3767	7.5579	111.26	34.989	111.59	35.090	1.1307	.35556	1.013		.2886	.66371
430.00	2.3514	7.4774	115.48	36.315	115.82	36.420	1.1702	.36798	1.010		.2884	.67631
440.00	2.3274	7.4011	119.74	37.656	120.09	37.764	1.2100	.38050	1.008		.2881	.68855
450.00	2.3044	7.3281	124.05	39.010	124.41	39.122	1.2501	.39310	1.005		.2879	.70045
460.00	2.2825	7.2584	128.40	40.377	128.77	40.494	1.2904	.40579	1.002		.2877	.71199
470.00	2.2616	7.1919	132.70	41.757	133.17	41.878	1.3314	.41856	.9995		.2875	.72319
480.00	2.2416	7.1282	137.22	43.150	137.61	43.274	1.3719	.43141	.9969		.2872	.73403
490.00	2.2224	7.0674	141.69	44.555	142.09	44.683	1.4130	.44434	.9944		.2870	.74455

CALCIUM FLUORIDE

PROTON ENERGY MEV	ENERGY LOSS MEV/CM2	PROTON RANGE CH	PROTON PATH LENGTH GH/CM2	PROTON PATH LENGTH CH	PATH LENGTH STRAGGLING CH	GH/CM2	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	2.2041	146.19	45.972	146.61	46.104	1.4543	.9920	.2868	.75473
510.00	2.1866	150.73	47.400	151.17	47.537	1.4959	.9896	.2866	.76458
520.00	2.1697	155.31	48.840	155.76	48.980	1.5377	.9873	.2864	.77410
530.00	2.1536	159.93	50.251	160.38	50.435	1.5797	.9850	.2861	.78330
540.00	2.1380	164.57	51.752	165.04	51.901	1.6220	.9827	.2859	.79218
550.00	2.1231	169.25	53.224	169.74	53.377	1.6644	.9806	.2857	.80076
560.00	2.1088	173.97	54.706	174.46	54.863	1.7070	.9784	.2855	.80904
570.00	2.0950	178.71	56.198	179.22	56.359	1.7498	.9764	.2853	.81702
580.00	2.0818	183.49	57.700	184.01	57.865	1.7928	.9743	.2851	.82471
590.00	2.0690	188.29	59.211	188.83	59.380	1.8360	.9723	.2848	.83212
600.00	2.0567	193.13	60.731	193.68	60.904	1.8794	.9704	.2846	.83926
620.00	2.0335	202.88	63.798	203.46	63.980	1.9666	.9656	.2842	.85274
640.00	2.0119	212.74	66.899	213.35	67.090	2.0544	.9629	.2838	.86521
660.00	1.9917	222.70	70.033	223.34	70.232	2.1428	.9595	.2833	.87673
680.00	1.9729	232.77	73.197	233.43	73.405	2.2318	.9552	.2829	.88735
700.00	1.9553	242.92	76.391	243.61	76.607	2.3214	.9529	.2824	.89714
720.00	1.9389	253.17	79.612	253.89	79.837	2.4114	.9498	.2820	.90614
740.00	1.9235	263.50	82.860	264.24	83.094	2.5019	.9468	.2816	.91442
760.00	1.9090	273.91	86.134	274.68	86.377	2.5929	.9440	.2811	.92201
780.00	1.8954	284.39	89.431	285.19	89.683	2.6843	.9412	.2807	.92898
800.00	1.8827	294.95	92.752	295.78	93.013	2.7762	.9386	.2802	.93536
820.00	1.8707	305.58	96.095	306.44	96.364	2.8684	.9360	.2798	.94119
840.00	1.8594	316.28	99.459	317.16	99.737	2.9610	.9336	.2794	.94653
860.00	1.8487	327.04	102.84	327.95	103.13	3.0539	.9312	.2789	.95141
880.00	1.8387	337.86	106.25	338.81	106.54	3.1472	.9289	.2785	.95582
900.00	1.8292	348.74	109.67	349.72	109.97	3.2409	.9267	.2780	.95992
920.00	1.8202	359.68	113.11	360.68	113.42	3.3348	.9246	.2775	.96363
940.00	1.8117	370.68	116.57	371.71	116.89	3.4290	.9225	.2770	.96700
960.00	1.8037	381.74	120.04	382.80	120.38	3.5236	.9203	.2765	.97007
1000.00	1.7890	404.11	127.08	405.22	127.43	3.7135	.9164	.2750	.97543

THE ELECTRON DENSITY OF CALCIUM FLUORIDE IS 2.932E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.183 BEV, AND THE MINIMUM ENERGY LOSS IS 1.6605 MEV/CM2

THE EFFECTIVE IONIZATION POTENTIAL IS 162.07 ELECTRON VOLTS

CARBON DIOXIDE

ATOMS/
MOLECULE
1
2

PERCENT
BY WEIGHT
27.2919
72.7081

ATOMIC
NUMBER
6
8

ELEMENT
C
O

ADJUSTED
IONIZATION
POTENTIAL
77.30
81.50

ATOMIC
WEIGHT
12.011
15.999

DENSITY = 1.9634 MG/CM3

PROTON ENERGY MEV	ENERGY LOSS MEV/ GM/CM2	PROTON RANGE MG/CM2	PROTON RANGE METER	PROTON PATH LENGTH MG/CM2	PROTON PATH LENGTH METER	MG/CM2	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	668.66	1.6436	.00084	1.6576	.00084	.00371	.00003	3.444	.6491
.15	633.36	2.4107	.00123	2.4259	.00124	.00742	.00004	3.060	.6238
.20	568.70	3.2412	.00165	3.2585	.00166	.00905	.00005	2.776	.5291
.30	466.74	5.1809	.00264	5.2038	.00265	.01283	.00007	2.466	.4395
.40	393.47	7.7254	.00383	7.7437	.00384	.01766	.00009	2.341	.3943
.50	343.65	1.0232	.00521	1.0270	.00523	.02331	.00012	2.270	.3662
.60	308.47	1.3299	.00677	1.3345	.00680	.02951	.00015	2.211	.3466
.70	277.94	1.6703	.00851	1.6759	.00854	.03621	.00018	2.161	.3318
.80	256.35	2.0440	.01041	2.0506	.01044	.04339	.00022	2.116	.3201
.90	237.77	2.4477	.01247	2.4553	.01251	.05093	.00026	2.074	.3106
1.00	219.17	2.8647	.01469	2.8934	.01474	.05901	.00030	2.040	.3025
1.20	193.32	3.8558	.01964	3.8670	.01970	.07673	.00039	1.964	.2894
1.40	173.62	4.9467	.02519	4.9606	.02527	.09602	.00049	1.936	.2895
1.60	158.01	6.1534	.03134	6.1701	.03143	.11682	.00059	1.893	.2715
1.80	145.20	7.4718	.03806	7.4917	.03816	.13905	.00071	1.856	.2648
2.00	134.71	8.8993	.04533	8.9224	.04544	.16268	.00083	1.823	.2593
2.20	125.75	10.433	.05314	10.460	.05327	.18766	.00096	1.794	.2544
2.40	118.03	12.072	.06149	12.102	.06164	.21395	.00109	1.768	.2502
2.60	111.32	13.814	.07036	13.848	.07053	.24152	.00123	1.744	.2464
2.80	105.41	15.657	.07974	15.695	.07994	.27036	.00138	1.723	.2431
3.00	100.16	17.600	.08967	17.642	.08985	.30043	.00153	1.703	.2400
3.20	95.472	19.641	.10064	19.688	.10028	.33172	.00169	1.625	.2373
3.40	91.246	21.780	.11093	21.832	.11119	.36421	.00185	1.663	.2348
3.60	87.417	24.016	.12232	24.072	.12260	.39789	.00203	1.653	.2325
3.80	83.929	26.347	.13419	26.407	.13450	.43274	.00220	1.639	.2303
4.00	80.737	28.771	.14654	28.837	.14687	.46875	.00239	1.625	.2283
4.20	77.759	31.292	.15937	31.363	.15974	.50594	.00258	1.613	.2265
4.40	75.059	33.905	.17268	33.982	.17307	.54428	.00277	1.602	.2248
4.60	72.558	36.609	.18646	36.691	.18687	.58373	.00297	1.591	.2231
4.80	70.236	39.406	.20070	39.494	.20115	.62428	.00316	1.581	.2216

CARBON DIOXIDE

PRCTCN ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	KEV/GM	GH/CH2	METER	GH/CH2	METER	GH/CH2	METER PERCENT		
5.00	68.072	133.65	.04229	.21541	.04239	.21588	.00067	.00339	1.571	.00049
5.50	63.294	124.19	.04990	.25417	.05001	.25472	.00077	.00395	1.549	.00062
6.00	59.132	116.10	.05807	.29575	.05819	.29639	.00089	.00453	1.530	.00130
6.50	55.561	109.09	.06678	.34012	.06692	.34084	.00101	.00516	1.513	.00225
7.00	52.435	102.95	.07603	.38723	.07619	.38804	.00114	.00581	1.498	.00411
7.50	49.633	97.450	.08582	.43708	.08600	.43799	.00128	.00650	1.484	.00664
8.00	47.181	92.636	.09613	.48942	.09633	.49063	.00142	.00722	1.472	.00916
8.50	44.982	88.318	.10696	.54478	.10718	.54589	.00157	.00797	1.460	.01168
9.00	42.927	84.420	.11832	.60261	.11856	.60383	.00172	.00875	1.450	.01420
9.50	41.195	80.883	.13018	.66304	.13044	.66437	.00188	.00957	1.440	.01671
10.00	39.553	77.658	.14255	.72604	.14284	.72749	.00204	.01041	1.431	.01923
11.00	36.664	71.987	.16878	.85964	.16912	.86133	.00239	.01218	1.415	.02425
12.00	34.204	67.137	.19699	1.0033	.19737	1.0053	.00276	.01408	1.400	.02926
13.00	32.082	62.991	.22714	1.1568	.22758	1.1591	.00316	.01608	1.387	.03432
14.00	30.232	59.358	.25921	1.3202	.25970	1.3227	.00357	.01820	1.376	.03935
15.00	28.602	56.158	.29316	1.4931	.29372	1.4961	.00401	.02042	1.365	.04440
16.00	27.156	53.319	.32899	1.6756	.32961	1.6788	.00447	.02276	1.356	.04944
17.00	25.863	50.779	.36667	1.8675	.36736	1.8710	.00495	.02520	1.347	.05450
18.00	24.699	48.495	.40619	2.0688	.40694	2.0726	.00545	.02775	1.339	.05956
19.00	23.646	46.427	.44750	2.2792	.44833	2.2834	.00597	.03049	1.331	.06463
20.00	22.698	44.546	.49061	2.4988	.49152	2.5034	.00651	.03312	1.324	.06970
22.00	21.009	41.250	.58213	2.9649	.58320	2.9703	.00765	.03895	1.311	.07986
24.00	19.386	38.455	.68063	3.4666	.68187	3.4729	.00886	.04515	1.300	.09005
26.00	18.362	36.052	.78598	4.0031	.78739	4.0103	.01016	.05172	1.290	.09621
28.00	17.298	33.822	.89807	4.5740	.89967	4.5822	.01152	.05857	1.280	.09823
30.00	16.363	32.128	1.0168	5.1787	1.0186	5.1879	.01296	.06599	1.272	.10035
32.00	15.536	30.504	1.1421	5.8168	1.1441	5.8271	.01446	.07367	1.264	.10251
34.00	14.798	29.053	1.2738	6.4876	1.2760	6.4991	.01604	.08169	1.257	.10475
36.00	14.135	27.754	1.4119	7.1910	1.4144	7.2036	.01758	.09006	1.250	.10705
38.00	13.537	26.578	1.5563	7.9264	1.5590	7.9402	.01939	.09877	1.244	.10940
40.00	12.993	25.511	1.7069	8.6933	1.7098	8.7085	.02117	.10781	1.238	.11181
45.00	11.830	23.228	2.1100	10.747	2.1137	10.765	.02588	.13183	1.221	.11717
50.00	10.883	21.368	2.5504	12.990	2.5548	13.011	.03099	.15782	1.213	.12336
55.00	10.096	19.823	3.0270	15.417	3.0322	15.443	.03646	.18568	1.202	.13096
60.00	9.4310	18.517	3.5390	18.025	3.5450	18.055	.04228	.21536	1.193	.13786
65.00	8.8614	17.399	4.0854	20.807	4.0922	20.842	.04846	.24600	1.184	.14501
70.00	8.3677	16.429	4.6654	23.762	4.6732	23.801	.05496	.27993	1.176	.15237
75.00	7.9356	15.581	5.2783	26.883	5.2871	26.928	.06179	.31471	1.169	.15992
80.00	7.5541	14.832	5.9233	30.168	5.9331	30.218	.06893	.35107	1.161	.16763
90.00	6.9106	13.568	7.3069	37.215	7.3190	37.277	.08411	.42837	1.146	.18337

CARBON DIOXIDE

PROTON ENERGY NEV	ENERGY LOSS HEV/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH METER	GM/CM2	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	6.3885	8.8111	8.8253	44.950	.10043	.51148	1.138	.19938
110.00	5.9561	10.431	10.440	53.214	.11782	.60008	1.128	.21570
120.00	5.5920	12.162	12.182	61.944	.13623	.69326	1.118	.23244
130.00	5.2611	14.001	14.023	71.307	.15561	.79256	1.110	.24946
140.00	5.0125	15.846	15.968	81.327	.17591	.89593	1.102	.26667
150.00	4.7780	17.983	18.012	91.738	.19702	1.0037	1.094	.28396
160.00	4.5716	20.120	20.152	102.64	.21907	1.1158	1.087	.30133
170.00	4.3895	22.350	22.386	114.01	.24186	1.2318	1.080	.31879
180.00	4.2240	24.669	24.709	125.85	.26540	1.3517	1.074	.33628
190.00	4.0775	27.075	27.119	138.12	.28965	1.4753	1.068	.35372
200.00	3.9452	29.565	29.612	150.82	.31460	1.6023	1.062	.37108
210.00	3.8246	32.136	32.187	163.67	.34020	1.7327	1.057	.38832
220.00	3.7148	34.786	34.841	177.45	.36642	1.8662	1.052	.40546
230.00	3.6142	37.511	37.570	191.35	.39325	2.0029	1.047	.42244
240.00	3.5218	40.310	40.374	205.63	.42065	2.1424	1.042	.43923
250.00	3.4366	43.180	43.249	220.27	.44860	2.2848	1.037	.45581
260.00	3.3579	46.120	46.193	235.27	.47708	2.4298	1.033	.47218
270.00	3.2849	49.127	49.204	250.60	.50606	2.5775	1.029	.48836
280.00	3.2171	52.198	52.280	266.27	.53553	2.7276	1.024	.50433
290.00	3.1539	55.333	55.420	282.26	.56547	2.8800	1.020	.52007
300.00	3.0949	58.529	58.621	298.57	.59596	3.0348	1.016	.53556
310.00	3.0397	61.785	61.882	315.17	.62667	3.1917	1.013	.55081
320.00	2.9879	65.098	65.200	332.07	.65790	3.3508	1.009	.56594
330.00	2.9393	68.468	68.575	349.26	.68953	3.5119	1.006	.58063
340.00	2.8936	71.892	72.004	366.73	.72154	3.6749	1.002	.59516
350.00	2.8505	75.369	75.486	384.46	.75392	3.8399	.9988	.60943
360.00	2.8098	78.897	79.020	402.46	.78666	4.0066	.9955	.62347
370.00	2.7713	82.475	82.604	420.71	.81974	4.1751	.9924	.63733
380.00	2.7349	86.102	86.236	439.21	.85315	4.3452	.9893	.65099
390.00	2.7004	89.777	89.916	457.96	.88687	4.5170	.9863	.66444
400.00	2.6677	93.497	93.642	476.20	.92091	4.6903	.9834	.67765
410.00	2.6366	97.262	97.413	495.37	.95524	4.8652	.9806	.69054
420.00	2.6071	101.07	101.23	515.57	.98986	5.0415	.9779	.70305
430.00	2.5789	104.92	105.08	534.38	1.0247	5.2192	.9751	.71517
440.00	2.5521	108.81	108.98	554.21	1.0599	5.3983	.9726	.72691
450.00	2.5266	112.75	112.92	574.24	1.0953	5.5787	.9700	.73827
460.00	2.5022	116.72	116.90	594.46	1.1310	5.7603	.9675	.74925
470.00	2.4789	120.73	120.91	614.88	1.1669	5.9432	.9651	.75986
480.00	2.4566	124.77	124.96	636.47	1.2030	6.1273	.9627	.77010
490.00	2.4353	128.86	129.05	657.29	1.2394	6.3125	.9604	.77998

CARBON DIOXIDE

PRCTON ENERGY MEV	ENERGY LOSS MEV/GH/CM2	PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
		GM/CM2	METER	GM/CM2	METER	GM/CM2	METER PERCENT		
500.00	2.4148	132.97	677.26	133.18	678.29	1.2760	6.4989	.9501	.78951
510.00	2.3993	137.13	698.40	137.34	699.47	1.3128	6.6863	.9559	.79869
520.00	2.3765	141.31	719.72	141.53	720.82	1.3498	6.8748	.9537	.80754
530.00	2.3585	145.53	741.20	145.75	742.33	1.3870	7.0643	.9516	.81605
540.00	2.3412	149.70	762.84	150.01	764.01	1.4244	7.2547	.9496	.82423
550.00	2.3246	154.06	784.64	154.29	785.84	1.4620	7.4461	.9475	.83210
560.00	2.3086	158.37	806.60	158.61	807.83	1.4997	7.6385	.9456	.83966
570.00	2.2933	162.71	828.70	162.96	829.96	1.5377	7.8317	.9436	.84693
580.00	2.2785	167.08	850.95	167.33	852.24	1.5758	8.0258	.9417	.85390
590.00	2.2643	171.47	873.34	171.73	874.67	1.6141	8.2208	.9399	.86059
600.00	2.2506	175.90	895.87	176.16	897.23	1.6525	8.4165	.9381	.86701
620.00	2.2246	184.82	941.33	185.10	942.76	1.7299	8.8104	.9345	.87905
640.00	2.2005	193.85	987.31	194.14	988.80	1.8078	9.2073	.9312	.89010
660.00	2.1780	202.97	1033.8	203.28	1035.3	1.8863	9.6071	.9279	.90023
680.00	2.1569	212.19	1080.7	212.51	1082.3	1.9653	10.010	.9248	.90949
700.00	2.1373	221.49	1128.1	221.82	1129.8	2.0448	10.415	.9218	.91796
720.00	2.1189	230.87	1175.9	231.22	1177.6	2.1248	10.822	.9190	.92568
740.00	2.1017	240.34	1224.1	240.70	1225.9	2.2053	11.232	.9162	.93272
760.00	2.0855	249.80	1272.7	250.25	1274.6	2.2862	11.644	.9135	.93913
780.00	2.0703	259.49	1321.6	259.88	1323.6	2.3674	12.058	.9110	.94496
800.00	2.0560	269.17	1370.9	269.57	1373.0	2.4491	12.474	.9085	.95026
820.00	2.0425	278.92	1420.6	279.33	1422.7	2.5312	12.892	.9062	.95507
840.00	2.0298	288.73	1470.5	289.16	1472.7	2.6136	13.312	.9039	.95943
860.00	2.0179	298.60	1520.8	299.04	1523.1	2.6964	13.733	.9017	.96339
880.00	2.0066	308.53	1571.4	308.98	1573.7	2.7795	14.156	.8995	.96697
900.00	1.9959	318.51	1622.2	318.98	1624.6	2.8629	14.581	.8975	.97021
920.00	1.9858	328.55	1673.4	329.04	1675.8	2.9466	15.007	.8955	.97315
940.00	1.9763	338.65	1724.8	339.14	1727.3	3.0306	15.432	.8936	.97580
960.00	1.9673	348.79	1776.5	349.31	1779.1	3.1148	15.864	.8917	.97820
1000.00	1.9506	369.32	1881.0	369.85	1883.7	3.2842	16.727	.8880	.98234

THE ELECTRON DENSITY OF CARBON DIOXIDE IS 3.012E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.267 BEV, AND THE MINIMUM ENERGY LOSS IS 1.8072 MEV/GH/CM2

THE EFFECTIVE IONIZATION POTENTIAL IS 92.20 ELECTRON VOLTS

EMULSION (ILFORD G-5 AT 58 PERCENT HUMIDITY)

PROTON ENERGY MEV	ENERGY LOSS HEV/CM	ELEMENT	ATOMIC NUMBER	ATOMS/MOLECULE	PERCENT BY WEIGHT	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
							MG/CM ²	MM		
.10	381.64	AG	47	1.0000	47.4730	107.87	.00008	8.060	1.789	0.
.15	338.87	BC	35	.99404	34.9580	79.909	.00009	6.663	1.429	0.
.20	301.62	I	53	.00561	.72373	126.90	.00010	5.829	1.296	0.
.30	247.88	U	6	1.3691	1.3952	12.011	.00014	4.919	1.209	0.
.40	212.50	H	1	3.1452	6.5057	1.0080	.06702	4.501	1.185	0.
.50	187.98	O	8	.92394	3.9334	15.999	.08447	4.244	1.173	0.
.60	169.95	N	7	.51365	1.829	14.007	.10338	4.053	1.165	0.
.70	155.44	S	16	.01296	.1829	32.064	.12358	3.903	1.157	0.
.80	143.89						.14498	3.780	1.149	0.
.90	135.12						.16709	3.671	1.140	0.
1.00	126.35						.19989	3.571	1.130	0.
1.20	113.47						.23776	3.401	1.112	0.
1.40	103.41						.28808	3.259	1.094	0.
1.60	95.385						.34954	3.137	1.078	0.
1.80	88.680						.39539	3.034	1.062	0.
2.00	83.003						.45332	2.950	1.048	.00001
2.20	78.126						.51399	2.880	1.035	.00001
2.40	73.881						.57714	2.818	1.022	.00002
2.60	70.148						.64260	2.762	1.011	.00002
2.80	66.833						.71022	2.712	1.000	.00003
3.00	63.864						.77993	2.667	.9904	.00003
3.20	61.185						.85164	2.625	.9810	.00004
3.40	58.754						.92531	2.586	.9722	.00005
3.60	56.542						1.0009	2.550	.9641	.00006
3.80	54.510						1.0783	2.516	.9563	.00007
4.00	52.653						1.1576	2.484	.9490	.00008
4.20	50.924						1.2385	2.455	.9421	.00009
4.40	49.334						1.3212	2.427	.9354	.00010
4.60	47.853						1.4056	2.400	.9292	.00011
4.80	46.472						1.4917	2.375	.9232	.00012

DENSITY = 3.8278 GM/CM³

EMULSION (G-5)

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM ²	PROTON RANGE GM/CM ²	PROTON RANGE CM	PROTON PATH LENGTH GM/CM ²	PROTON PATH LENGTH CM	GM/CM ²	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	45.181	0.6656	0.1733	0.6717	0.1755	0.0158	0.0041	9.176	0.0014
5.50	42.277	0.7991	0.2351	0.7862	0.2054	0.0181	0.0047	9.046	0.0017
6.00	39.775	0.9082	0.2351	0.9082	0.2373	0.0204	0.0053	8.929	0.0042
6.50	37.590	1.0284	0.2687	1.0376	0.2711	0.0229	0.0060	8.823	0.0082
7.00	35.672	1.1639	0.3041	1.1742	0.3067	0.0255	0.0067	8.727	0.0137
7.50	33.959	1.3065	0.3413	1.3179	0.3443	0.0281	0.0073	8.640	0.0200
8.00	32.426	1.4560	0.3804	1.4686	0.3837	0.0309	0.0081	8.559	0.0263
8.50	31.041	1.6124	0.4212	1.6262	0.4248	0.0337	0.0088	8.484	0.0327
9.00	29.783	1.7757	0.4639	1.7908	0.4676	0.0367	0.0096	8.416	0.0391
9.50	28.636	1.9456	0.5083	1.9620	0.5126	0.0397	0.0104	8.352	0.0455
10.00	27.583	2.1222	0.5544	2.1400	0.5591	0.0428	0.0112	8.292	0.0519
11.00	25.728	2.4950	0.6518	2.5156	0.6572	0.0493	0.0129	8.185	0.0649
12.00	24.133	2.8936	0.7529	2.9172	0.7621	0.0561	0.0147	8.087	0.0781
13.00	22.747	3.3174	0.8667	3.3442	0.8737	0.0633	0.0165	8.002	0.0914
14.00	21.528	3.7662	0.9839	3.7963	0.9918	0.0708	0.0185	7.925	0.1049
15.00	20.447	4.2395	1.1076	4.2731	1.1163	0.0787	0.0206	7.855	0.1186
16.00	19.493	4.7369	1.2375	4.7741	1.2472	0.0868	0.0227	7.792	0.1332
17.00	18.623	5.2581	1.3737	5.2991	1.3844	0.0953	0.0249	7.735	0.1482
18.00	17.840	5.8032	1.5161	5.8481	1.5278	0.1041	0.0272	7.682	0.1646
19.00	17.127	6.3711	1.6644	6.4201	1.6772	0.1132	0.0296	7.633	0.1819
20.00	16.476	6.9624	1.8189	7.0156	1.8328	0.1226	0.0320	7.586	0.2003
22.00	15.329	8.2129	2.2456	8.2750	2.1618	0.1423	0.0372	7.505	0.2752
24.00	14.348	9.5529	2.4987	9.6244	2.5143	0.1631	0.0426	7.434	0.3307
26.00	13.501	1.0982	2.8691	1.1064	2.8994	0.1850	0.0483	7.368	0.3666
28.00	12.760	1.2496	3.2646	1.2588	3.2887	0.2080	0.0543	7.312	0.3819
30.00	12.105	1.4095	3.6823	1.4198	3.7093	0.2320	0.0606	7.261	0.3979
32.00	11.522	1.5777	4.1217	1.5892	4.1516	0.2570	0.0672	7.215	0.4145
34.00	11.003	1.7542	4.5828	1.7669	4.6160	0.2831	0.0740	7.174	0.4316
36.00	10.535	1.9388	5.0650	1.9527	5.1014	0.3101	0.0810	7.136	0.4493
38.00	10.110	2.1314	5.5681	2.1466	5.6079	0.3381	0.0883	7.101	0.4674
40.00	9.7240	2.3317	6.0916	2.3485	6.1349	0.3670	0.0959	7.069	0.4861
45.00	8.8940	3.1485	7.4805	3.1667	7.5413	0.4431	0.1158	6.999	0.5344
50.00	8.2122	3.4482	9.0064	3.4723	9.0713	0.5248	0.1371	6.940	0.5850
55.00	7.6420	4.0756	1.0647	4.1039	1.0721	0.6116	0.1598	6.889	0.6380
60.00	7.1592	4.7476	1.2403	4.7803	1.2489	0.7035	0.1838	6.846	0.6935
65.00	6.7435	5.4629	1.4272	5.4969	1.4369	0.8003	0.2091	6.809	0.7513
70.00	6.3818	6.2205	1.6251	6.2630	1.6362	0.9018	0.2356	6.775	0.8112
75.00	6.0654	7.0192	1.8338	7.0469	1.8462	1.0078	0.2633	6.746	0.8730
80.00	5.7834	7.8564	2.0530	7.9116	2.0669	1.1182	0.2921	6.720	0.9354
90.00	5.3077	9.6538	2.5220	9.7187	2.5390	1.3515	0.3551	6.675	1.0672

EMULSION (G-5)

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CH2	PROTON RANGE GM/CH2	PROTON RANGE CH	PROTON PATH LENGTH GM/CH2	PROTON PATH LENGTH CH	PATH LENGTH STRAGGLING GM/CH2	PATH LENGTH STRAGGLING CH	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	4.9201	11.600	3.0305	11.678	3.0507	.16007	.04182	1.371	.12022
110.00	4.5980	13.691	3.5766	13.782	3.6004	.18649	.04872	1.353	.13415
120.00	4.3270	16.920	4.1589	16.025	4.1865	.21430	.05598	1.337	.14855
130.00	4.0925	18.281	4.7760	18.462	4.8075	.24344	.06360	1.323	.16332
140.00	3.8908	20.773	5.4269	20.910	5.4626	.27388	.07155	1.310	.17839
150.00	3.7144	23.388	6.1099	23.541	6.1500	.30552	.07982	1.298	.19368
160.00	3.5588	26.121	6.8240	26.292	6.8687	.33829	.08838	1.287	.20920
170.00	3.4205	28.971	7.5685	29.160	7.6180	.37214	.09722	1.276	.22495
180.00	3.2968	31.930	8.3416	32.138	8.3960	.40702	.10633	1.266	.24088
190.00	3.1855	34.997	9.1428	35.225	9.2023	.44288	.11570	1.257	.25695
200.00	3.0863	38.167	9.9711	38.415	10.036	.47966	.12531	1.249	.27309
210.00	2.9947	41.435	10.825	41.705	10.895	.51728	.13514	1.240	.28926
220.00	2.9111	44.803	11.705	45.094	11.781	.55576	.14519	1.232	.30543
230.00	2.8346	48.259	12.608	48.572	12.689	.59506	.15546	1.225	.32155
240.00	2.7642	51.812	13.536	52.147	13.623	.63513	.16593	1.218	.33760
250.00	2.6993	55.431	14.486	55.809	14.586	.67595	.17659	1.211	.35353
260.00	2.6392	59.175	15.459	59.557	15.559	.71747	.18744	1.205	.36940
270.00	2.5835	62.982	16.454	63.388	16.560	.75968	.19846	1.198	.38522
280.00	2.5317	66.867	17.469	67.298	17.581	.80254	.20966	1.193	.40097
290.00	2.4834	70.831	18.504	71.288	18.624	.84603	.22102	1.187	.41663
300.00	2.4383	74.872	19.560	75.354	19.686	.89011	.23254	1.181	.43218
310.00	2.3961	78.984	20.634	79.492	20.767	.93477	.24420	1.175	.44762
320.00	2.3565	83.167	21.727	83.702	21.867	.97997	.25602	1.171	.46292
330.00	2.3193	87.419	22.838	87.980	22.985	1.0257	.26796	1.166	.47806
340.00	2.2843	91.737	23.966	92.326	24.120	1.0720	.28004	1.161	.49302
350.00	2.2513	96.120	25.111	96.737	25.272	1.1187	.29225	1.156	.50779
360.00	2.2201	100.57	26.273	101.21	26.441	1.1659	.30458	1.152	.52237
370.00	2.1907	105.07	27.449	105.74	27.625	1.2135	.31703	1.148	.53676
380.00	2.1628	109.63	28.642	110.34	28.825	1.2616	.32959	1.143	.55095
390.00	2.1364	114.26	29.849	114.99	30.040	1.3101	.34226	1.139	.56491
400.00	2.1113	118.94	31.072	119.70	31.271	1.3590	.35504	1.135	.57865
410.00	2.0875	123.67	32.305	124.46	32.515	1.4083	.36791	1.132	.59214
420.00	2.0648	128.46	33.560	129.28	33.774	1.4579	.38088	1.128	.60536
430.00	2.0433	133.30	34.824	134.15	35.046	1.5080	.39395	1.124	.61829
440.00	2.0227	138.19	36.101	139.07	36.331	1.5583	.40710	1.121	.63095
450.00	2.0032	143.12	37.391	144.04	37.629	1.6090	.42035	1.117	.64331
460.00	1.9845	148.11	38.693	149.05	38.940	1.6600	.43367	1.114	.65539
470.00	1.9666	153.14	40.007	154.12	40.262	1.7113	.44708	1.110	.66718
480.00	1.9495	158.22	41.332	159.22	41.597	1.7629	.46056	1.107	.67868
490.00	1.9332	163.33	42.671	164.38	42.942	1.8149	.47413	1.104	.68988

EMULSION (G-5)

PROTON ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
		GM/CM ²	CM	GM/CM ²	CM	GM/CM ²	PERCENT		
500.00	1.9175	7.3400	168.50	44.019	169.57	44.299	1.8670	1.101	.70080
510.00	1.9026	7.2826	173.70	45.379	174.81	45.667	1.9195	1.098	.71142
520.00	1.8882	7.2276	178.94	46.748	180.08	47.046	1.9722	1.095	.72177
530.00	1.8744	7.1748	184.23	48.129	185.40	48.433	2.0252	1.092	.73183
540.00	1.8612	7.1242	189.55	49.519	190.75	49.833	2.0784	1.090	.74160
550.00	1.8485	7.0755	194.91	50.919	196.14	51.242	2.1318	1.087	.75110
560.00	1.8362	7.0287	200.30	52.328	201.57	52.660	2.1855	1.084	.76032
570.00	1.8245	6.9838	205.73	53.746	207.04	54.088	2.2394	1.082	.76928
580.00	1.8132	6.9405	211.20	55.174	212.53	55.524	2.2935	1.079	.77796
590.00	1.8023	6.8988	216.69	56.610	218.07	56.969	2.3478	1.077	.78638
600.00	1.7918	6.8587	222.22	58.055	223.63	58.423	2.4023	1.074	.79454
620.00	1.7720	6.7828	233.38	60.970	234.86	61.356	2.5119	1.070	.81010
640.00	1.7536	6.7123	244.66	63.916	246.20	64.320	2.6222	1.065	.82467
660.00	1.7364	6.6465	256.05	66.892	257.67	67.314	2.7332	1.061	.83830
680.00	1.7204	6.5852	267.55	69.897	269.24	70.338	2.8448	1.057	.85103
700.00	1.7054	6.5279	279.14	72.929	280.92	73.388	2.9570	1.053	.86289
720.00	1.6914	6.4743	290.86	75.986	292.69	76.465	3.0698	1.049	.87393
740.00	1.6783	6.4240	302.67	79.073	304.58	79.570	3.1832	1.045	.88419
760.00	1.6659	6.3769	314.57	82.179	316.54	82.694	3.2971	1.042	.89372
780.00	1.6544	6.3327	326.54	85.308	328.59	85.843	3.4114	1.038	.90254
800.00	1.6435	6.2911	338.60	88.457	340.72	89.012	3.5262	1.035	.91069
820.00	1.6333	6.2520	350.73	91.628	352.93	92.202	3.6414	1.032	.91823
840.00	1.6237	6.2152	362.94	94.819	365.22	95.411	3.7571	1.029	.92519
860.00	1.6146	6.1805	375.22	98.026	377.57	98.639	3.8732	1.026	.93160
880.00	1.6061	6.1478	387.57	101.25	390.00	101.89	3.9896	1.023	.93751
900.00	1.5980	6.1169	399.98	104.49	402.48	105.15	4.1064	1.020	.94295
920.00	1.5904	6.0878	412.46	107.75	415.03	108.43	4.2235	1.018	.94795
940.00	1.5832	6.0602	425.04	111.04	427.69	111.73	4.3410	1.015	.95253
960.00	1.5764	6.0342	437.66	114.34	440.38	115.05	4.4587	1.012	.95674
1000.00	1.5639	5.9863	463.15	121.00	466.02	121.75	4.6951	1.008	.96412

THE ELECTRON DENSITY OF EMULSION (G-5) IS 2.730E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.092 BEV, AND THE MINIMUM ENERGY LOSS IS 1.4622 MEV/GR/CM²

THE EFFECTIVE IONIZATION POTENTIAL IS 286.60 ELECTRON VOLTS

EMULSION (KODAK NTA AT 50 PERCENT HUMIDITY)

ELEMENT	ATOMIC NUMBER	ATOMS/MOLECULE	PERCENT BY WEIGHT	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL
AG	47	1.0000	42.3000	107.87	465.0
BR	35	.97013	30.4000	79.909	348.5
I	53	.02813	1.4000	126.90	525.5
C	6	1.9533	9.2000	12.011	77.30
H	1	4.0479	1.6000	1.0380	18.30
O	8	1.9605	12.3000	15.999	98.50
N	7	.50978	2.8000	14.007	99.50

DENSITY = 3.0570 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE MG/CM2	PROTON PATH LENGTH MM	MG/CM2	PATH LENGTH STRAGGLING MM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	422.95	.32512	.00106	.33020	.02997	1.538	0.
.15	378.16	.44982	.00147	.45516	.03360	1.215	0.
.20	336.34	.58873	.00193	.59528	.03807	1.100	0.
.30	275.53	.91544	.00299	.92493	.04930	1.027	0.
.40	235.16	1.3057	.00427	1.3189	.06381	1.006	0.
.50	207.25	1.7551	.00574	1.7728	.08444	.9926	0.
.60	186.91	2.2590	.00739	2.2815	.09843	.9894	0.
.70	170.43	2.8139	.00920	2.8419	.11780	.9830	0.
.80	157.52	3.4189	.01118	3.4526	.13827	.9762	0.
.90	147.50	4.0683	.01331	4.1081	.15944	.9691	0.
1.00	137.48	4.7643	.01558	4.8106	.18131	.9614	0.
1.20	123.03	6.2907	.02058	6.3508	.22725	.9461	0.
1.40	111.81	7.9836	.02612	8.0587	.27553	.9320	0.
1.60	102.87	9.8357	.03217	9.9269	.32587	.9188	0.
1.80	95.448	11.839	.03873	11.947	.37850	.9064	.00001
2.00	89.181	13.990	.04576	14.116	.43407	.8952	.00001
2.20	83.14	16.285	.05327	16.430	.49227	.8846	.00002
2.40	79.15	18.722	.06124	18.887	.55285	.8750	.00002
2.60	75.065	21.297	.06967	21.483	.61567	.8659	.00003
2.80	71.439	24.007	.07853	24.215	.68060	.8575	.00004
3.00	68.198	26.852	.08784	27.082	.74754	.8497	.00005
3.20	65.278	29.826	.09757	30.079	.81643	.8423	.00006
3.40	62.633	32.931	.10772	33.209	.88722	.8354	.00007
3.60	60.229	36.164	.11830	36.466	.95986	.8290	.00008
3.80	58.023	39.522	.12928	39.850	1.0343	.8229	.00009
4.00	56.006	43.004	.14067	43.358	1.1105	.8171	.00011
4.20	54.130	46.611	.15247	46.992	1.1883	.8117	.00012
4.40	52.407	50.339	.16467	50.748	1.2679	.8065	.00014
4.60	50.805	54.186	.17723	54.623	1.3491	.8015	.00015
4.80	49.312	58.154	.19023	58.621	1.4319	.7959	.00017

EMULSION (NTA)

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/GM/CM2	MEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	PERCENT		
5.00	47.916	143.48	.06224	.02036	.06274	.02052	.00152	.00050	.7924	.00019
5.50	44.785	136.91	.07296	.02387	.07354	.02406	.00173	.00057	.7822	.00024
6.00	42.089	129.67	.08440	.02761	.08505	.02782	.00196	.00064	.7730	.00055
6.50	39.739	121.48	.09655	.03158	.09723	.03183	.00220	.00072	.7647	.00104
7.00	37.677	115.18	.10939	.03578	.11022	.03605	.00245	.00080	.7571	.00176
7.50	35.836	109.55	.12290	.04020	.12383	.04051	.00270	.00088	.7502	.00269
8.00	34.194	104.53	.13709	.04485	.13812	.04518	.00297	.00097	.7438	.00359
8.50	32.712	99.00	.15194	.04970	.15307	.05007	.00324	.00106	.7379	.00449
9.00	31.367	95.890	.16745	.05478	.16859	.05518	.00353	.00115	.7325	.00539
9.50	30.143	92.146	.18361	.06006	.18495	.06050	.00382	.00125	.7275	.00629
10.00	29.019	88.712	.20041	.06556	.20186	.06603	.00412	.00135	.7228	.00719
11.00	27.042	82.667	.23589	.07716	.23758	.07772	.00475	.00155	.7142	.00701
13.00	25.344	77.476	.27386	.08958	.27581	.09022	.00540	.00177	.7067	.01084
13.00	23.871	72.973	.31427	.10280	.31648	.10353	.00610	.00199	.6999	.01268
14.00	22.577	69.017	.35709	.11681	.35958	.11763	.00682	.00223	.6938	.01454
15.00	21.430	65.512	.40227	.13159	.40506	.13250	.00758	.00246	.6883	.01642
16.00	20.418	62.417	.44979	.14713	.45288	.14815	.00837	.00274	.6833	.01854
17.00	19.497	59.603	.49960	.16343	.50302	.16453	.00919	.00301	.6788	.02085
18.00	18.668	57.069	.55172	.18048	.55546	.18170	.01004	.00328	.6747	.02329
19.00	17.915	54.767	.60605	.19825	.61014	.19959	.01092	.00357	.6708	.02588
20.00	17.228	52.665	.66243	.21676	.66708	.21821	.01182	.00387	.6671	.02857
22.00	16.017	48.963	.78237	.25593	.78757	.25763	.01372	.00449	.6607	.03466
24.00	14.983	45.803	.91076	.29793	.91677	.29989	.01574	.00515	.6551	.04081
26.00	14.090	43.075	1.0478	.34274	1.0546	.34499	.01785	.00584	.6499	.04472
28.00	13.310	40.690	1.1930	.39225	1.2007	.39278	.02008	.00657	.6455	.04831
30.00	12.622	38.587	1.3464	.44044	1.3551	.44328	.02240	.00733	.6414	.04796
32.00	12.010	36.715	1.5079	.49325	1.5175	.49641	.02483	.00812	.6378	.04968
34.00	11.465	35.047	1.6774	.54870	1.6881	.55220	.02735	.00895	.6346	.05145
36.00	10.973	33.544	1.8547	.60669	1.8665	.61055	.02996	.00980	.6316	.05327
38.00	10.528	32.183	2.0397	.66723	2.0526	.67145	.03267	.01069	.6289	.05514
40.00	10.122	30.943	2.2323	.73023	2.2464	.73483	.03547	.01160	.6263	.05706
45.00	9.2520	28.283	2.7466	.89245	2.7637	.90406	.04285	.01402	.6208	.06204
50.00	8.5382	26.101	3.3064	1.0816	3.3269	1.0883	.05076	.01660	.6151	.06723
55.00	7.9423	24.250	3.9104	1.2791	3.9344	1.2870	.05910	.01936	.6121	.07266
60.00	7.4370	22.735	4.5576	1.4909	4.5855	1.5000	.06810	.02228	.6087	.07834
65.00	7.0026	21.407	5.2468	1.7163	5.2788	1.7268	.07748	.02535	.6058	.08426
70.00	6.6250	20.253	5.9770	1.9592	6.0137	1.9670	.08733	.02857	.6032	.09039
75.00	6.2937	19.240	6.7471	2.2071	6.7876	2.2204	.09761	.03193	.6008	.09669
80.00	6.0005	18.343	7.5263	2.4718	7.6018	2.4867	.10832	.03543	.5988	.10315
90.00	5.5044	16.827	9.2884	3.0384	9.3440	3.0565	.13097	.04284	.5953	.11648

EMULSION (NTA)

PROTON ENERGY HEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CH	GM/CH2	CM	GM/CH2	CM	GM/CH2	CM	PERCENT	PERCENT	
100.00	5.1004	15.592	11.167	3.6528	11.233	3.6746	.15517	.05076	1.381	.5924	.13021
116.00	4.7649	14.566	13.185	4.3130	13.263	4.3386	.18033	.05915	1.343	.5899	.14434
120.00	4.8226	13.703	15.336	5.0173	15.428	5.0469	.20784	.06799	1.347	.5879	.15893
130.00	4.2388	12.958	17.619	5.7837	17.723	5.7976	.23615	.07725	1.352	.5861	.17389
140.00	4.0289	12.316	20.027	6.5511	20.145	6.5897	.26573	.08692	1.319	.5845	.18913
150.00	3.8455	11.756	22.554	7.3778	22.686	7.4210	.29647	.09698	1.307	.5832	.20457
160.00	3.6835	11.261	25.196	8.2421	25.343	8.2903	.32832	.10740	1.295	.5820	.22022
176.00	3.5399	10.821	27.951	9.1434	28.115	9.1968	.36123	.11816	1.285	.5809	.23609
180.00	3.4113	10.428	30.813	10.079	30.993	10.138	.39514	.12926	1.275	.5800	.25213
190.00	3.2956	10.075	33.779	11.050	33.976	11.114	.43000	.14066	1.266	.5792	.26828
200.00	3.1923	9.7509	36.846	12.053	37.060	12.123	.46577	.15236	1.257	.5785	.28449
210.00	3.0972	9.4661	40.008	13.087	40.241	13.164	.50236	.16433	1.248	.5778	.30071
220.00	3.0104	9.2027	43.266	14.153	43.518	14.235	.53978	.17657	1.240	.5771	.31693
230.00	2.9309	8.9597	46.611	15.247	46.881	15.336	.57800	.18907	1.233	.5767	.33309
240.00	2.8578	8.7363	50.049	16.372	50.339	16.467	.61698	.20183	1.226	.5761	.34916
250.00	2.7904	8.5302	53.571	17.524	53.881	17.626	.65669	.21481	1.219	.5757	.36512
260.00	2.7282	8.3356	57.176	18.705	57.507	18.812	.69709	.22803	1.212	.5752	.38100
270.00	2.6702	8.1629	60.861	19.909	61.213	20.024	.73816	.24146	1.206	.5748	.39682
280.00	2.6165	7.9985	64.623	21.139	64.997	21.262	.77986	.25511	1.200	.5744	.41255
290.00	2.5663	7.8453	68.462	22.395	68.857	22.524	.82217	.26895	1.194	.5741	.42818
300.00	2.5195	7.7022	72.374	23.675	72.792	23.812	.86507	.28298	1.188	.5737	.44366
310.00	2.4757	7.5682	76.356	24.977	76.797	25.122	.90853	.29720	1.183	.5734	.45907
320.00	2.4346	7.4426	80.407	26.303	80.871	26.454	.95252	.31159	1.178	.5731	.47430
330.00	2.3960	7.3246	84.525	27.650	85.012	27.809	.99703	.32615	1.173	.5728	.48937
340.00	2.3597	7.2135	88.700	29.018	89.219	29.195	1.0420	.34087	1.168	.5725	.50425
350.00	2.3254	7.1088	92.954	30.407	93.469	30.582	1.0875	.35575	1.163	.5719	.51894
360.00	2.2931	7.0100	97.261	31.816	97.820	31.999	1.1335	.37078	1.159	.5716	.53344
370.00	2.2625	6.9165	101.62	33.243	102.21	33.434	1.1798	.38595	1.154	.5714	.54775
380.00	2.2336	6.8281	106.05	34.690	106.66	34.889	1.2267	.40126	1.150	.5711	.56187
390.00	2.2062	6.7443	110.53	36.155	111.16	36.363	1.2739	.41670	1.146	.5709	.57578
400.00	2.1802	6.6646	115.06	37.639	115.72	37.855	1.3215	.43228	1.142	.5706	.58947
410.00	2.1555	6.5892	119.65	39.139	120.34	39.354	1.3694	.44797	1.138	.5703	.60391
420.00	2.1320	6.5174	124.29	40.657	125.00	40.890	1.4178	.46379	1.134	.5701	.61806
430.00	2.1096	6.4490	128.98	42.191	129.72	42.433	1.4665	.47972	1.131	.5699	.63293
440.00	2.0883	6.3839	133.72	43.741	134.48	43.992	1.5155	.49575	1.127	.5696	.64750
450.00	2.0680	6.3217	138.50	45.307	139.28	45.566	1.5649	.51190	1.123	.5694	.66150
460.00	2.0486	6.2624	143.33	46.887	144.15	47.155	1.6146	.52815	1.120	.5691	.67575
470.00	2.0300	6.2058	148.21	48.482	149.06	48.760	1.6645	.54450	1.117	.5689	.68980
480.00	2.0123	6.1516	153.13	50.092	154.01	50.378	1.7148	.56094	1.113	.5686	.70380
490.00	1.9953	6.0998	158.09	51.715	159.00	52.011	1.7653	.57747	1.110	.5684	.71780

EMULSION (NTA)

PRCTGN ENERGY HEV	ENERGY LOSS HEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	1.9791	163.10	164.03	.59410	1.107	.71067
510.00	1.9636	168.14	169.10	.61081	1.104	.72116
520.00	1.9486	173.23	174.22	.62760	1.101	.73135
530.00	1.9343	178.35	179.37	.64448	1.098	.74126
540.00	1.9206	183.51	184.56	.66143	1.096	.75089
550.00	1.9074	188.70	189.74	.67846	1.093	.76023
560.00	1.8947	193.94	195.04	.69556	1.090	.76929
570.00	1.8825	199.20	200.34	.71273	1.088	.77808
580.00	1.8708	204.50	205.67	.72997	1.085	.78660
590.00	1.8595	209.83	211.03	.74727	1.083	.79484
600.00	1.8486	215.20	216.42	.76464	1.080	.80293
620.00	1.8280	226.02	227.30	.79956	1.075	.81804
640.00	1.8089	236.95	238.30	.83471	1.071	.83226
660.00	1.7910	248.01	249.41	.87009	1.066	.84553
680.00	1.7744	259.17	260.63	.90567	1.062	.85791
700.00	1.7588	270.42	271.96	.94144	1.058	.86942
720.00	1.7443	281.78	283.37	.97740	1.054	.88012
740.00	1.7307	293.24	294.90	1.0135	1.051	.89004
760.00	1.7179	304.78	306.50	1.0498	1.047	.89923
780.00	1.7059	316.40	318.18	1.0863	1.044	.90773
800.00	1.6946	328.10	329.95	1.1229	1.040	.91558
820.00	1.6840	339.88	341.79	1.1596	1.037	.92282
840.00	1.6740	351.73	353.70	1.1965	1.034	.92945
860.00	1.6646	363.65	365.69	1.2335	1.031	.93562
880.00	1.6557	375.63	377.74	1.2706	1.028	.94126
900.00	1.6474	387.67	389.85	1.3078	1.026	.94645
920.00	1.6394	399.79	402.03	1.3452	1.023	.95120
940.00	1.6319	412.00	414.30	1.3826	1.020	.95556
960.00	1.6248	424.25	426.61	1.4202	1.018	.95956
1000.00	1.6118	446.99	451.49	1.4956	1.013	.96655

THE ELECTRON DENSITY OF EMULSION (NTA) IS 2.775E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.115 BEV, AND THE MINIMUM ENERGY LOSS IS 1.5031 MEV/GM/CM2

THE EFFECTIVE IONIZATION POTENTIAL IS 248.55 ELECTRON VOLTS

GLASS (AVERAGE COMPOSITION AND DENSITY OF PYREX)

ELEMENT	ATOMIC NUMBER	ATOMS/MOLECULE	PERCENT BY WEIGHT	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL	PROTON ENERGY MEV/CH	ENERGY LOSS GH/CM2	PROTON RANGE MH	PROTON PATH LENGTH MH	PROTON MG/CM2	PROTON PATH LENGTH MH	MG/CM2	PATH LENGTH STRAGGLING MH	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
SI	14	1.0000	20.0470	28.086	170.0	577.50	1443.7	.00073	.18355	.00073	.00744	.00003	4.054	.9503	0.	
O	8	6.1949	70.7450	15.999	98.50	554.54	1366.4	.00108	.27189	.00109	.00985	.00004	3.624	.6989	0.	
NA	11	.12401	5.9580	10.811	67.10	502.48	1256.2	.00146	.36655	.00147	.01218	.00005	3.323	.6016	0.	
K	19	.00176	2.0350	39.102	293.8	419.14	1047.8	.00233	.58486	.00234	.01716	.00007	2.935	.5141	0.	
CA	20	.00259	.0740	40.080	211.3	357.95	894.89	.00336	.84367	.00337	.02269	.00009	2.713	.4697	0.	
AL	13	.02835	.5460	26.981	163.0	315.49	788.72	.00455	1.1419	.00457	.02929	.00012	2.565	.4411	0.	
FE	26	.01370	.5460	55.847	273.0	284.71	711.78	.00588	1.4759	.00590	.03621	.00014	2.454	.4203	0.	
						257.47	643.67	.00735	1.8651	.00738	.04368	.00017	2.367	.4042	0.	
						238.66	596.65	.00896	2.2485	.00899	.05165	.00021	2.297	.3910	0.	
						222.59	556.49	.01069	2.6821	.01073	.05993	.00024	2.234	.3800	0.	
						206.51	516.27	.01255	3.1486	.01259	.06866	.00027	2.181	.3703	0.	
						182.62	456.54	.01666	4.1804	.01672	.08775	.00031	2.099	.3543	0.	
						164.26	410.64	.02128	5.3373	.02135	.10876	.00044	2.038	.3420	0.	
						149.73	374.31	.02637	6.6145	.02646	.13148	.00053	1.988	.3319	.00001	
						137.81	344.52	.03193	8.0092	.03204	.15584	.00062	1.946	.3235	.00001	
						127.88	319.70	.03794	9.5163	.03807	.18172	.00073	1.910	.3164	.00002	
						115.46	298.64	.04440	11.135	.04454	.20907	.00084	1.878	.3102	.00003	
						112.21	280.52	.05130	12.864	.05146	.23786	.00095	1.849	.3048	.00005	
						105.88	264.70	.05862	14.700	.05880	.26804	.00107	1.823	.3000	.00006	
						100.29	250.73	.06637	16.642	.06657	.29958	.00120	1.800	.2957	.00008	
						95.348	238.37	.07453	18.687	.07475	.33246	.00133	1.779	.2919	.00010	
						90.926	227.32	.08330	20.836	.08334	.36665	.00147	1.760	.2884	.00012	
						86.941	217.35	.09208	23.026	.09234	.40212	.00161	1.742	.2852	.00015	
						83.335	208.34	.10146	25.437	.10175	.43884	.00176	1.725	.2823	.00017	
						80.042	200.11	.11123	27.886	.11155	.47680	.00191	1.718	.2796	.00020	
						77.028	192.57	.12140	30.434	.12173	.51600	.00206	1.715	.2771	.00023	
						74.256	185.64	.13195	33.079	.13231	.55641	.00223	1.712	.2748	.00026	
						71.698	179.24	.14289	35.820	.14328	.59802	.00239	1.708	.2726	.00030	
						69.329	173.32	.15421	38.657	.15433	.64682	.00256	1.706	.2706	.00033	
						67.327	167.82	.16591	41.590	.16636	.68479	.00274	1.704	.2687	.00037	

DENSITY = 2.5000 GM/CM3

GLASS (PYREX)

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	GM/CM2	PATH LENGTH STRAGGLING CM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	65.076	162.69	0.4462	0.01785	0.0073	0.0029	1.636	.2669	.00044
5.50	60.509	151.27	0.5259	0.2104	0.0085	0.0034	1.612	.2628	.00075
6.00	56.600	141.50	0.6114	0.2446	0.0097	0.0039	1.591	.2593	.00107
6.50	53.211	133.03	0.7026	0.2810	0.0110	0.0044	1.572	.2561	.00141
7.00	50.243	125.61	0.7993	0.3197	0.0124	0.0050	1.555	.2533	.00209
7.50	47.594	118.98	0.9016	0.3506	0.0139	0.0056	1.540	.2508	.00365
8.00	45.263	113.16	1.0094	0.4037	0.0154	0.0062	1.524	.2485	.00674
8.50	43.171	107.93	1.1224	0.4490	0.0170	0.0068	1.513	.2464	.00839
9.00	41.282	103.21	1.2409	0.4964	0.0186	0.0075	1.501	.2445	.01102
9.50	39.567	98.918	1.3647	0.5459	0.0203	0.0081	1.490	.2427	.01320
10.00	38.002	95.006	1.4937	0.5975	0.0221	0.0088	1.480	.2410	.01548
11.00	35.250	88.124	1.7671	0.7069	0.0258	0.0103	1.462	.2381	.02003
12.00	32.904	82.259	2.0610	0.8244	0.0298	0.0119	1.445	.2355	.02459
13.00	30.878	77.196	2.3749	0.9499	0.0340	0.0136	1.431	.2333	.02917
14.00	29.111	72.777	2.7023	1.0809	0.0384	0.0154	1.418	.2312	.03375
15.00	27.553	68.883	3.0618	1.2247	0.0431	0.0172	1.406	.2294	.03834
16.00	26.170	65.425	3.4343	1.3737	0.0479	0.0192	1.395	.2277	.04295
17.00	24.933	62.332	3.8260	1.5304	0.0530	0.0212	1.386	.2262	.04734
18.00	23.819	59.547	4.2365	1.6946	0.0583	0.0233	1.376	.2249	.05219
19.00	22.810	57.025	4.6656	1.8662	0.0638	0.0255	1.368	.2236	.05682
20.00	21.822	54.730	5.1132	2.0453	0.0695	0.0278	1.360	.2224	.06146
22.00	20.283	50.707	6.0631	2.2252	0.0816	0.0326	1.346	.2203	.07077
24.00	18.916	47.289	7.0849	2.4140	0.0945	0.0378	1.333	.2185	.08012
26.00	17.741	44.353	8.1773	2.6109	0.1081	0.0432	1.322	.2168	.08983
28.00	16.719	41.798	9.3392	2.8276	0.1225	0.0490	1.312	.2154	.08979
30.00	15.821	39.554	1.0569	3.0678	0.1376	0.0551	1.302	.2141	.08982
32.00	15.026	37.568	1.1867	3.3311	0.1535	0.0614	1.294	.2129	.09193
34.00	14.316	35.791	1.3231	3.6224	0.1701	0.0680	1.286	.2119	.09410
36.00	13.679	34.197	1.4661	3.9443	0.1874	0.0750	1.278	.2109	.09633
38.00	13.103	32.756	1.6155	4.3021	0.2054	0.0822	1.271	.2100	.09862
40.00	12.579	31.448	1.7713	4.6953	0.2241	0.0896	1.265	.2091	.10096
45.00	11.459	28.647	2.1884	5.7534	0.2736	0.1094	1.250	.2073	.10697
50.00	10.546	26.364	2.6437	6.6575	0.3272	0.1309	1.238	.2058	.11319
55.00	9.7863	24.458	3.1363	7.4545	0.3846	0.1538	1.226	.2044	.11965
60.00	9.1445	22.861	3.6652	8.1661	0.4457	0.1783	1.218	.2033	.12640
65.00	8.5946	21.487	4.2295	8.8118	0.5103	0.2041	1.210	.2023	.13340
70.00	8.1178	20.295	4.8285	9.5114	0.5784	0.2314	1.208	.2014	.14063
75.00	7.7004	19.251	5.4611	10.2615	0.6499	0.2600	1.150	.2005	.14805
80.00	7.3317	18.329	6.1146	11.0507	0.7246	0.2898	1.103	.1996	.15562
90.00	6.7095	16.774	7.5545	13.0218	0.8833	0.3533	1.169	.1984	.17114

GLASS (PYREX)

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
		GM/CM2	CM	GM/CM2	CH	GM/CM2	CH		
100.00	6.2046	9.0880	3.6392	9.1060	3.6424	.10538	.04215	1.157	.16699
110.00	5.7862	10.755	4.3021	10.776	4.3105	.12352	.04942	1.146	.20315
120.00	5.4338	12.536	5.0146	12.561	5.0244	.14277	.05711	1.137	.21974
130.00	5.1328	14.427	5.7710	14.456	5.7822	.16299	.06520	1.127	.23664
140.00	4.8726	16.424	6.5697	16.456	6.5825	.18416	.07366	1.119	.25372
150.00	4.6455	18.523	7.4092	18.559	7.4236	.20623	.08249	1.111	.27089
160.00	4.4455	20.720	8.2831	20.760	8.3041	.23116	.09166	1.104	.28815
170.00	4.2681	23.012	9.2049	23.057	9.2227	.25291	.10116	1.097	.30552
180.00	4.1096	25.396	10.158	25.443	10.178	.27743	.11097	1.090	.32293
190.00	3.9671	27.869	11.148	27.922	11.167	.30270	.12108	1.084	.34031
200.00	3.8384	30.427	12.171	30.486	12.194	.32867	.13147	1.076	.35762
210.00	3.7215	33.069	13.227	33.132	13.253	.35532	.14213	1.072	.37483
220.00	3.6150	35.790	14.316	35.859	14.344	.38262	.15305	1.067	.39194
230.00	3.5175	38.590	15.436	38.664	15.465	.41054	.16422	1.062	.40892
240.00	3.4279	41.465	16.586	41.544	16.618	.43905	.17562	1.057	.42572
250.00	3.3453	44.432	17.765	44.497	17.799	.46813	.18725	1.052	.44231
260.00	3.2690	47.432	18.973	47.522	19.009	.49775	.19910	1.047	.45872
270.00	3.1982	50.519	20.208	50.615	20.246	.52790	.21116	1.043	.47497
280.00	3.1324	53.673	21.469	53.775	21.510	.55855	.22342	1.038	.49104
290.00	3.0711	56.891	22.757	56.999	22.800	.58967	.23567	1.035	.50689
300.00	3.0138	60.173	24.069	60.286	24.115	.62126	.24851	1.031	.52252
310.00	2.9603	63.515	25.406	63.635	25.454	.65330	.26132	1.027	.53792
320.00	2.9100	66.916	26.766	67.042	26.817	.68576	.27430	1.023	.55312
330.00	2.8620	70.374	28.150	70.507	28.203	.71863	.28745	1.019	.56808
340.00	2.8185	73.888	29.555	74.028	29.611	.75189	.30076	1.016	.58281
350.00	2.7767	77.457	30.983	77.602	31.041	.78553	.31421	1.012	.59728
360.00	2.7372	81.078	32.431	81.230	32.492	.81954	.32782	1.009	.61151
370.00	2.6999	84.750	33.900	84.909	33.963	.85390	.34156	1.006	.62554
380.00	2.6645	88.471	35.389	88.637	35.455	.88861	.35544	1.003	.63935
390.00	2.6311	92.241	36.897	92.414	36.966	.92364	.36945	.9995	.65292
400.00	2.5993	96.056	38.423	96.238	38.495	.95898	.38359	.9965	.66624
410.00	2.5692	99.921	39.968	100.11	40.043	.99463	.39785	.9934	.67924
420.00	2.5405	103.805	41.531	104.02	41.609	1.0306	.41223	.9907	.69186
430.00	2.5132	107.78	43.112	107.98	43.192	1.0668	.42672	.9880	.70411
440.00	2.4871	111.77	44.709	111.98	44.792	1.1033	.44132	.9853	.71598
450.00	2.4623	115.81	46.322	116.02	46.409	1.1401	.45603	.9826	.72748
460.00	2.4386	119.88	47.952	120.10	48.041	1.1771	.47084	.9801	.73862
470.00	2.4160	123.99	49.589	124.22	49.689	1.2144	.48575	.9776	.74939
480.00	2.3944	128.14	51.257	128.38	51.352	1.2519	.50076	.9751	.75979
490.00	2.3736	132.33	52.933	132.57	53.030	1.2896	.51586	.9728	.76989

GLASS (PYREX)

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	PATH LENGTH STRAGGLING GM/CM2	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	2.3538	136.55	136.81	54.722	1.3276	.1551	.77955
510.00	2.3348	140.81	141.07	56.429	1.3658	.1849	.78892
520.00	2.3166	145.19	145.46	58.149	1.4042	.1848	.79794
530.00	2.2991	149.43	149.70	59.882	1.4428	.1846	.80664
540.00	2.2823	153.73	154.07	61.628	1.4816	.1844	.81502
550.00	2.2661	158.18	158.47	63.387	1.5206	.1843	.82308
560.00	2.2505	162.60	162.90	65.158	1.5598	.1841	.83084
570.00	2.2357	167.05	167.35	66.942	1.5992	.1839	.83830
580.00	2.2213	171.53	171.84	68.737	1.6387	.1838	.84547
590.00	2.2075	176.03	176.36	70.543	1.6784	.1836	.85236
600.00	2.1942	180.57	180.90	72.360	1.7183	.1834	.85898
620.00	2.1689	189.72	190.07	76.028	1.7586	.1831	.87143
640.00	2.1454	198.98	199.31	79.737	1.8794	.1828	.88287
660.00	2.1235	208.33	208.71	83.485	1.9609	.1825	.89339
680.00	2.1031	217.78	218.18	87.271	2.0429	.1821	.90304
700.00	2.0840	227.32	227.73	91.092	2.1254	.1818	.91187
720.00	2.0661	236.94	237.37	94.948	2.2084	.1815	.91996
740.00	2.0493	246.64	247.09	98.836	2.2918	.1812	.92735
760.00	2.0335	256.42	256.89	102.76	2.3758	.1808	.93409
780.00	2.0187	266.28	266.76	106.70	2.4601	.1805	.94025
800.00	2.0048	276.20	276.70	110.68	2.5449	.1802	.94585
820.00	1.9916	286.20	286.71	114.69	2.6300	.1799	.95096
840.00	1.9793	296.26	296.79	118.72	2.7156	.1795	.95560
860.00	1.9676	306.37	306.92	122.77	2.8014	.1792	.95982
880.00	1.9566	316.55	317.12	126.85	2.8877	.1789	.96365
900.00	1.9462	326.79	327.37	130.95	2.9742	.1785	.96713
920.00	1.9363	337.08	337.68	135.07	3.0611	.1782	.97029
940.00	1.9270	347.43	348.05	139.22	3.1493	.1778	.97315
960.00	1.9182	357.84	358.47	143.39	3.2357	.1774	.97575
1000.00	1.9018	378.88	379.55	151.82	3.4115	.1764	.98025

THE ELECTRON DENSITY OF GLASS (PYREX) IS 2.993E 23 ELECTRONS PER GR4H

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.243 BEV, AND THE MINIMUM ENERGY LOSS IS 1.7414 MEV/GM/CM2

THE EFFECTIVE IONIZATION POTENTIAL IS 109. ELECTRON VOLTS

LEXAN

ADJUSTED IONIZATION POTENTIAL
 77.30
 18.30
 98.50

ATOMS/MOLECULE
 16
 19
 3.

PERCENT BY WEIGHT
 74.1063
 7.3850
 18.5087

ATOMIC NUMBER
 6
 1
 8

ELEMENT
 C
 H
 O

DENSITY = 1.2000 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		ATOMIC WEIGHT		ADJUSTED IONIZATION POTENTIAL		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CM	HEV/CM	MG/CM2	MM	MG/CM2	MM	MG/CM2	MM	MG/CM2	MM		
.10	979.93	1175.5	.12472	.00104	.12546	.00105	.60522	.00004	4.158	.5920	0.	
.15	852.40	1022.9	.17933	.00149	.18012	.00150	.8642	.00005	3.563	.4488	0.	
.20	743.84	892.60	.24197	.00202	.24287	.00202	.10780	.00007	3.212	.3722	0.	
.30	589.55	707.46	.39330	.00328	.39451	.00329	.01123	.00009	2.846	.3079	0.	
.40	489.41	587.29	.57973	.00483	.58134	.00484	.01555	.00013	2.674	.2773	0.	
.50	421.51	505.81	.79994	.00667	.80202	.00668	.02059	.00017	2.567	.2591	0.	
.60	373.03	447.64	1.0520	.00877	1.0546	.00879	.02616	.00022	2.480	.2449	0.	
.70	335.76	402.93	1.3339	.01112	1.3371	.01114	.03119	.00027	2.408	.2380	0.	
.80	305.26	366.32	1.6456	.01371	1.6494	.01375	.03872	.00032	2.347	.2310	0.	
.90	282.62	339.14	1.9851	.01654	1.9896	.01658	.04563	.00038	2.294	.2255	0.	
1.00	259.95	311.94	2.3534	.01961	2.3586	.01965	.05302	.00044	2.248	.2207	0.	
1.20	228.52	274.22	3.1741	.02645	3.1809	.02651	.06915	.00058	2.174	.2132	0.	
1.40	204.67	245.61	4.0968	.03416	4.1073	.03423	.08666	.00072	2.110	.2075	0.	
1.60	185.85	223.02	5.1241	.04270	5.1345	.04279	.10550	.00088	2.055	.2029	.00001	
1.80	170.55	204.66	6.12469	.05206	6.2594	.05216	.12565	.00105	2.007	.1989	.00002	
2.00	157.84	189.40	7.14646	.06221	7.4792	.06233	.14706	.00123	1.966	.1956	.00003	
2.20	147.07	176.49	8.7755	.07313	8.7925	.07327	.16971	.00141	1.930	.1927	.00004	
2.40	137.82	165.39	10.179	.08482	10.198	.08499	.19359	.00161	1.898	.1900	.00006	
2.60	129.78	155.74	11.673	.09727	11.695	.09745	.21866	.00182	1.870	.1877	.00007	
2.80	122.72	147.26	13.255	.11046	13.280	.11067	.24491	.00204	1.844	.1856	.00010	
3.00	116.46	135.73	14.926	.12438	14.953	.12461	.27232	.00227	1.821	.1837	.00012	
3.20	110.86	133.03	16.684	.13903	16.714	.13929	.30088	.00251	1.800	.1820	.00015	
3.40	105.83	127.00	18.528	.15440	18.561	.15468	.33058	.00275	1.781	.1804	.00017	
3.60	101.28	121.54	20.457	.17048	20.494	.17078	.36139	.00301	1.763	.1789	.00021	
3.80	97.140	116.57	22.471	.18726	22.511	.18759	.39331	.00326	1.747	.1775	.00024	
4.00	93.356	112.03	24.568	.20473	24.611	.20509	.42632	.00355	1.732	.1762	.00027	
4.20	89.764	107.72	26.751	.22292	26.798	.22331	.46054	.00384	1.719	.1750	.00031	
4.40	86.581	103.90	29.017	.24181	29.068	.24223	.49585	.00413	1.706	.1739	.00035	
4.60	83.636	100.36	31.351	.26135	31.416	.26180	.53220	.00443	1.694	.1728	.00039	
4.80	80.904	97.084	33.792	.28160	33.850	.28208	.56958	.00475	1.683	.1718	.00044	

LEXAN

REACTION ENERGY MEV	ENERGY LOSS MEV/CM2	ENERGY LOSS MEV/CM	PROTON RANGE GM/CM2	PROTON RANGE CM	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	CM ² /CM2	PATH LENGTH STRAGGLING PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	78.360	94.031	.03630	.03025	.03636	.03030	.00061	.00051	1.672	.00048
5.50	72.705	87.246	.04292	.03577	.04299	.03597	.00071	.00059	1.648	.00061
6.00	67.877	81.452	.05003	.04169	.05011	.04176	.00082	.00068	1.627	.00201
6.50	63.702	76.442	.05772	.04802	.05772	.04810	.00093	.00077	1.608	.00400
7.00	60.052	72.063	.06570	.05475	.06581	.05484	.00105	.00087	1.591	.00619
7.50	56.823	68.180	.07425	.06188	.07437	.06198	.00117	.00098	1.576	.00852
8.00	53.963	64.756	.08327	.06939	.08341	.06950	.00130	.00109	1.563	.01085
8.50	51.401	61.682	.09275	.07729	.09290	.07742	.00150	.00120	1.550	.01318
9.00	49.093	58.911	.10269	.08558	.10286	.08572	.00170	.00132	1.539	.01551
9.50	47.001	56.401	.11309	.09424	.11327	.09439	.00173	.00144	1.528	.01784
10.00	45.095	54.115	.12394	.10326	.12413	.10345	.00188	.00157	1.518	.02017
11.00	41.751	50.101	.14697	.12248	.14720	.12267	.00221	.00184	1.501	.02482
12.00	38.908	46.690	.17176	.14314	.17203	.14336	.00255	.00213	1.475	.02948
13.00	36.465	43.752	.19829	.16524	.19859	.16549	.00292	.00243	1.471	.03415
14.00	34.328	41.194	.22653	.18878	.22688	.18906	.00331	.00276	1.459	.03882
15.00	32.454	38.945	.25646	.21372	.25684	.21404	.00372	.00310	1.447	.04350
16.00	30.792	36.950	.28806	.24005	.28849	.24041	.00415	.00346	1.437	.04819
17.00	29.307	35.169	.32132	.26776	.32179	.26816	.00459	.00383	1.428	.05288
18.00	27.973	33.567	.35620	.29684	.35673	.29736	.00506	.00422	1.419	.05759
19.00	26.766	32.119	.39271	.32725	.39328	.32774	.00555	.00462	1.411	.06230
20.00	25.669	30.803	.43081	.35901	.43145	.35954	.00605	.00505	1.403	.06701
22.00	23.749	28.499	.51177	.42648	.51252	.42710	.00712	.00593	1.390	.07646
24.00	22.123	26.547	.59897	.49914	.59984	.49986	.00826	.00688	1.377	.08593
26.00	20.726	24.872	.69230	.57692	.69329	.57775	.00947	.00789	1.366	.09163
28.00	19.513	23.416	.79167	.65972	.79280	.66066	.01075	.00896	1.356	.09342
30.00	18.449	22.139	.89698	.74749	.89826	.74853	.01210	.01009	1.347	.09529
32.00	17.508	21.009	1.0082	.84033	1.0096	.84132	.01352	.01126	1.339	.09722
34.00	16.668	20.002	1.1251	.93760	1.1267	.93892	.01500	.01250	1.331	.09921
36.00	15.915	19.098	1.2478	1.0398	1.2495	1.0413	.01654	.01379	1.324	.10125
38.00	15.235	18.282	1.3761	1.1467	1.3780	1.1483	.01815	.01513	1.317	.10335
40.00	14.618	17.542	1.5100	1.2583	1.5121	1.2600	.01982	.01652	1.311	.10548
45.00	13.299	15.959	1.8686	1.5571	1.8711	1.5593	.02426	.02022	1.296	.11097
50.00	12.226	14.671	2.2606	1.8833	2.2637	1.8864	.02906	.02422	1.284	.11663
55.00	11.335	13.602	2.6851	2.2376	2.6888	2.2407	.03422	.02851	1.273	.12249
60.00	10.583	12.699	3.1414	2.6178	3.1457	2.6214	.03971	.03309	1.262	.12861
65.00	9.9387	11.920	3.6286	3.0238	3.6335	3.0279	.04553	.03794	1.253	.13495
70.00	9.3810	11.257	4.1460	3.4550	4.1516	3.4597	.05166	.04305	1.244	.14149
75.00	8.8931	10.672	4.6930	3.9108	4.6993	3.9161	.05810	.04842	1.236	.14818
80.00	8.4625	10.153	5.2688	4.3907	5.2758	4.3965	.06484	.05404	1.229	.15500
90.00	7.7368	9.2842	6.1507	5.4206	6.1533	5.4278	.07917	.06597	1.215	.16894

LEXAN

PROTON ENERGY HEV	ENERGY LOSS HEV/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH CH	PROTON PATH LENGTH GM/CH2	GM/CH2	PATH LENGTH STRAGGLING CH	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	7.1484	7.18491	6.5495	7.8594	0.9458	0.7882	1.203	.1315	.18308
110.00	6.6614	9.2976	7.7582	9.3098	1.1101	0.9251	1.192	.1309	.19752
120.00	6.2516	9.0846	9.0504	10.860	1.2862	1.0701	1.182	.1304	.21237
130.00	5.9018	7.0822	10.423	12.508	1.4674	1.2228	1.173	.1299	.22755
140.00	5.5997	6.7196	11.873	14.248	1.6593	1.3827	1.165	.1295	.24295
150.00	5.3361	6.4034	13.399	16.078	1.8555	1.5496	1.157	.1291	.25848
160.00	5.1042	6.1250	14.977	17.995	2.0676	1.7230	1.149	.1287	.27415
170.00	4.8984	5.8781	16.642	19.996	2.2832	1.9027	1.142	.1284	.28998
180.00	4.7147	5.6576	18.374	22.077	2.5080	2.0883	1.135	.1281	.30590
190.00	4.5496	5.4596	20.172	24.237	2.7356	2.2796	1.129	.1279	.32186
200.00	4.4006	5.2807	22.032	26.472	2.9717	2.4764	1.123	.1276	.33781
210.00	4.2653	5.1183	23.984	28.781	3.2141	2.6784	1.117	.1273	.35373
220.00	4.1417	4.9700	25.934	31.161	3.4624	2.8854	1.111	.1271	.36961
230.00	4.0288	4.8345	28.008	33.609	3.7165	3.0971	1.106	.1269	.38541
240.00	3.9251	4.7101	30.103	36.124	3.9761	3.3134	1.101	.1267	.40108
250.00	3.8295	4.5954	32.253	38.704	4.2408	3.5340	1.096	.1265	.41662
260.00	3.7411	4.4893	34.412	41.343	4.5107	3.7589	1.091	.1263	.43200
270.00	3.6592	4.3910	36.682	44.049	4.7853	3.9878	1.086	.1261	.44723
280.00	3.5830	4.2996	38.960	46.811	5.0646	4.2205	1.082	.1259	.46229
290.00	3.5121	4.2145	41.307	49.630	5.3483	4.4569	1.078	.1258	.47716
300.00	3.4459	4.1350	43.699	52.505	5.6363	4.6969	1.073	.1256	.49182
310.00	3.3839	4.0606	46.137	55.434	5.9284	4.9404	1.069	.1254	.50637
320.00	3.3257	3.9909	48.619	58.342	6.2245	5.1871	1.066	.1253	.52040
330.00	3.2711	3.9254	51.142	61.448	6.5244	5.4370	1.062	.1251	.53508
340.00	3.2198	3.8637	53.707	64.448	6.8279	5.6899	1.058	.1250	.54921
350.00	3.1714	3.8056	56.312	67.659	7.1350	5.9458	1.055	.1248	.56316
360.00	3.1257	3.7508	58.956	70.835	7.4454	6.2045	1.051	.1247	.57699
370.00	3.0825	3.6990	61.637	74.057	7.7591	6.4660	1.048	.1245	.59075
380.00	3.0416	3.6499	64.356	77.323	8.0760	6.7300	1.044	.1244	.60442
390.00	3.0028	3.6034	67.110	80.632	8.3960	6.9966	1.041	.1242	.61799
400.00	2.9661	3.5593	69.899	83.983	8.7188	7.2657	1.038	.1241	.63142
410.00	2.9311	3.5174	72.722	87.374	9.0445	7.5371	1.035	.1240	.64462
420.00	2.8979	3.4775	75.578	90.805	9.3729	7.8108	1.032	.1238	.65750
430.00	2.8663	3.4396	78.466	94.275	9.7040	8.0867	1.029	.1237	.67005
440.00	2.8362	3.4034	81.385	97.783	1.0038	8.3647	1.027	.1236	.68227
450.00	2.8074	3.3689	84.339	101.333	1.0374	8.6448	1.024	.1234	.69416
460.00	2.7800	3.3360	87.315	104.91	1.0712	8.9269	1.021	.1233	.70572
470.00	2.7538	3.3045	90.323	108.52	1.1053	9.2109	1.019	.1232	.71695
480.00	2.7287	3.2744	93.359	112.17	1.1396	9.4969	1.016	.1230	.72786
490.00	2.7047	3.2456	96.423	115.85	1.1741	9.7844	1.013	.1229	.73844

LEXAN

PROTON ENERGY PEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING GM/CM2	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION	
		GM/CM2	CM	GM/CM2	CM				
500.00	2.6817	3.2180	99.514	119.56	99.636	1.2089	1.0074	1.011	.74870
510.00	2.6597	3.1916	102.63	123.31	102.76	1.2438	1.0365	1.009	.75865
520.00	2.6385	3.1662	105.77	127.08	105.90	1.2789	1.0658	1.006	.76829
530.00	2.6182	3.1419	108.94	130.89	109.07	1.3142	1.0952	1.004	.77763
540.00	2.5988	3.1185	112.13	134.72	112.27	1.3498	1.1248	1.002	.78668
550.00	2.5800	3.0961	115.35	138.41	115.49	1.3854	1.1545	.9997	.79543
560.00	2.5620	3.0745	118.58	142.30	118.73	1.4213	1.1844	.9976	.80389
570.00	2.5447	3.0537	121.84	146.39	121.99	1.4573	1.2144	.9955	.81207
580.00	2.5281	3.0337	125.12	150.33	125.28	1.4935	1.2446	.9935	.81998
590.00	2.5120	3.0144	128.43	154.30	128.58	1.5299	1.2749	.9915	.82761
600.00	2.4965	2.9958	131.75	158.29	131.91	1.5664	1.3053	.9895	.83497
620.00	2.4672	2.9607	138.46	166.35	138.63	1.6398	1.3665	.9858	.84822
640.00	2.4400	2.9279	145.24	174.51	145.42	1.7139	1.4282	.9821	.86188
660.00	2.4145	2.8974	152.10	182.74	152.29	1.7884	1.4904	.9787	.87390
680.00	2.3907	2.8689	159.03	191.07	159.22	1.8635	1.5529	.9753	.88503
700.00	2.3685	2.8422	166.03	199.47	166.33	1.9391	1.6159	.9721	.89531
720.00	2.3477	2.8172	173.09	207.96	173.30	2.0151	1.6793	.9690	.90479
740.00	2.3281	2.7937	180.21	216.51	180.43	2.0916	1.7430	.9660	.91353
760.00	2.3090	2.7717	187.39	225.14	187.61	2.1685	1.8070	.9632	.92153
780.00	2.2925	2.7510	194.63	233.83	194.86	2.2457	1.8714	.9604	.92887
800.00	2.2762	2.7315	201.91	242.59	202.15	2.3234	1.9362	.9578	.93557
820.00	2.2609	2.7131	209.25	251.40	209.50	2.4014	2.0012	.9552	.94169
840.00	2.2465	2.6958	216.64	260.28	216.90	2.4798	2.0665	.9527	.94727
860.00	2.2328	2.6794	224.08	269.21	224.34	2.5585	2.1321	.9504	.95235
880.00	2.2199	2.6639	231.56	277.87	231.83	2.6375	2.1979	.9481	.95697
900.00	2.2078	2.6493	239.08	286.90	239.36	2.7168	2.2640	.9458	.96117
920.00	2.1962	2.6355	246.65	296.32	246.94	2.7964	2.3303	.9437	.96498
940.00	2.1853	2.6224	254.25	305.46	254.55	2.8763	2.3969	.9416	.96844
960.00	2.1750	2.6099	261.90	314.28	262.21	2.9565	2.4637	.9396	.97158
1000.00	2.1558	2.5870	277.37	332.85	277.70	3.1172	2.5980	.9355	.97700

THE ELECTRON DENSITY OF LEXAN IS 3.229E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.319 BEV, AND THE MINIMUM ENERGY LOSS IS 1.9799 MEV/GM/CM2

THE EFFECTIVE IONIZATION POTENTIAL IS 66.19 ELECTRON VOLTS

LITHIUM FLUORIDE

FRCION ENERGY MEV	ENERGY LOSS NEV/GM/CM2	ELEMENT	ATOMIC NUMBER	ATOMS/MOLECULE	PERCENT BY WEIGHT	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION	PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT		
										MG/CM2	MM	MG/CM2	MM	MG/CM2	MM	MG/CM2	MM	
.10	640.37	Li	3	1	26.7529	6.9390	38.80	.7546	0.	.18322	.00070	.00669	.00003	3.651	.00003	.00003	.7546	0.
.15	573.53	F	9	1	73.2471	18.998	120.7	.5625	0.	.26568	.00102	.00854	.00003	3.215	.00003	.00003	.5625	0.
.20	514.98							.4869	0.	.00137	.00138	.01048	.00004	2.931	.00004	.00004	.4869	0.
.30	422.62							.4186	0.	.57254	.00220	.01487	.00006	2.596	.00006	.00006	.4186	0.
.40	358.42							.3799	0.	.83023	.00319	.02017	.00008	2.430	.00008	.00008	.3799	0.
.50	314.55							.3556	0.	1.1247	.00432	.02644	.00010	2.343	.00010	.00010	.3556	0.
.60	284.02							.3382	0.	1.4639	.00561	.03326	.00013	2.272	.00013	.00013	.3382	0.
.70	261.57							.3248	0.	1.8350	.00702	.04036	.00016	2.204	.00016	.00016	.3248	0.
.80	241.59							.3138	0.	2.2286	.00857	.04772	.00018	2.142	.00018	.00018	.3138	0.
.90	224.09							.3046	0.	2.6581	.01022	.05562	.00021	2.092	.00021	.00021	.3046	0.
1.00	206.58							.2971	0.	3.1229	.01201	.06437	.00025	2.061	.00025	.00025	.2971	0.
1.20	181.83							.2849	0.	4.1570	.01598	.08394	.00032	2.019	.00032	.00032	.2849	0.
1.40	163.07							.2751	.00001	5.3205	.02046	.10525	.00040	1.978	.00040	.00040	.2751	.00001
1.60	148.24							.2671	.00001	6.6089	.02541	.12816	.00049	1.939	.00049	.00049	.2671	.00001
1.80	136.16							.2603	.00002	7.9975	.03075	.15264	.00059	1.904	.00059	.00059	.2603	.00002
2.00	126.10							.2546	.00003	9.5215	.03661	.17864	.00069	1.871	.00069	.00069	.2546	.00003
2.20	117.59							.2496	.00005	11.161	.04291	.20611	.00079	1.842	.00079	.00079	.2496	.00005
2.40	110.28							.2452	.00007	12.915	.04978	.23502	.00090	1.815	.00090	.00090	.2452	.00007
2.60	103.92							.2413	.00010	14.816	.05696	.26533	.00102	1.791	.00102	.00102	.2413	.00010
2.80	98.340							.2379	.00013	16.795	.06457	.29701	.00114	1.768	.00114	.00114	.2379	.00013
3.00	93.393							.2348	.00016	18.883	.07260	.33004	.00127	1.748	.00127	.00127	.2348	.00016
3.20	88.974							.2320	.00020	21.077	.08104	.36440	.00140	1.729	.00140	.00140	.2320	.00020
3.40	84.990							.2295	.00023	23.378	.08988	.40005	.00154	1.711	.00154	.00154	.2295	.00023
3.60	81.402							.2271	.00027	25.784	.09913	.43699	.00168	1.695	.00168	.00168	.2271	.00027
3.80	78.129							.2250	.00029	28.292	.10877	.47519	.00183	1.680	.00183	.00183	.2250	.00029
4.00	75.137							.2230	.00033	30.902	.11881	.51464	.00198	1.665	.00198	.00198	.2230	.00033
4.20	72.390							.2212	.00037	33.615	.12924	.55533	.00214	1.652	.00214	.00214	.2212	.00037
4.40	69.857							.2198	.00042	36.428	.14005	.59724	.00230	1.640	.00230	.00230	.2198	.00042
4.60	67.513							.2178	.00046	39.341	.15125	.64036	.00246	1.628	.00246	.00246	.2178	.00046
4.80	65.338							.2163	.00050	42.353	.16283	.68468	.00263	1.617	.00263	.00263	.2163	.00050

DENSITY = 2.6010 GM/CM3

LITHIUM FLUORIDE

PRCTON ENERGY HEV	ENERGY LOSS HEV/CH2	PROTON RANGE GH/CH2	PROTON PATH LENGTH CM	PROTON PATH LENGTH CM	GM/CM2	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION	
5.00	63.313	164.68	.01744	.04546	.01748	.00073	.00028	1.606	.00475
5.50	58.809	152.96	.02059	.05366	.02063	.00085	.00033	1.582	.00632
6.00	54.960	142.95	.02397	.06246	.02402	.00098	.00037	1.561	.00789
6.50	51.629	134.29	.02757	.07186	.02763	.00111	.00043	1.542	.00946
7.00	48.714	126.71	.03140	.08183	.03146	.00125	.00048	1.526	.01104
7.50	46.140	120.01	.03545	.09238	.03552	.00140	.00054	1.511	.01383
8.00	43.850	114.05	.03971	.10350	.03979	.00155	.00060	1.497	.01685
8.50	41.796	108.71	.04420	.11518	.04428	.00171	.00066	1.484	.01987
9.00	39.944	103.90	.04889	.12742	.04899	.00188	.00072	1.473	.02287
9.50	38.241	99.464	.05380	.14022	.05391	.00205	.00079	1.462	.02588
10.00	36.714	95.493	.05892	.15356	.05904	.00223	.00086	1.452	.02888
11.00	34.030	88.513	.06979	.18189	.06993	.00261	.00100	1.434	.03486
12.00	31.745	82.569	.08148	.21232	.08163	.00301	.00116	1.419	.04084
13.00	29.774	77.442	.09397	.24441	.09415	.00344	.00132	1.405	.04681
14.00	28.055	72.972	.10725	.27949	.10746	.00389	.00150	1.392	.05277
13.00	26.542	69.036	.12132	.31615	.12155	.00437	.00168	1.381	.05872
16.00	25.199	65.542	.13617	.35483	.13642	.00486	.00187	1.371	.06467
17.00	23.998	62.418	.15178	.39551	.15206	.00538	.00207	1.361	.07061
18.00	22.917	59.608	.16815	.43917	.16846	.00593	.00228	1.352	.07656
19.00	21.939	57.065	.18528	.48278	.18561	.00649	.00249	1.344	.08249
20.00	21.050	54.751	.20314	.52932	.20351	.00707	.00272	1.337	.08942
22.00	19.492	50.698	.24107	.62814	.24150	.00831	.00319	1.323	.10028
24.00	18.170	47.260	.28189	.73449	.28239	.00963	.00370	1.311	.11211
26.00	17.034	44.305	.32555	.84824	.32612	.01102	.00424	1.300	.11916
28.00	16.046	41.736	.37200	.96928	.37266	.01250	.00481	1.290	.12132
30.00	15.179	39.481	.42121	1.0975	.42195	.01406	.00540	1.281	.12355
32.00	14.411	37.484	.47314	1.2328	.47396	.01569	.00603	1.273	.12586
34.00	13.726	35.702	.52773	1.3750	.52865	.01739	.00669	1.265	.12823
36.00	13.111	34.103	.58498	1.5241	.58598	.01917	.00737	1.258	.13067
38.00	12.556	32.658	.64483	1.6801	.64593	.02102	.00808	1.251	.13315
40.00	12.052	31.347	.70724	1.8395	.70845	.02294	.00882	1.245	.13568
45.00	10.972	28.539	.87436	2.2781	.87584	.02804	.01078	1.231	.14218
50.00	10.094	26.253	1.0569	2.7537	1.0587	.03356	.01290	1.219	.14883
55.00	9.3633	24.354	1.2545	3.2684	1.2566	.03947	.01518	1.208	.15571
60.00	8.7463	22.749	1.4668	3.8214	1.4692	.04577	.01760	1.198	.16289
65.00	8.2179	21.373	1.6933	4.4115	1.6961	.05244	.02016	1.189	.17035
70.00	7.7599	20.183	1.9337	5.0379	1.9369	.05947	.02286	1.180	.17803
75.00	7.3590	19.141	2.1878	5.6995	2.1914	.06685	.02570	1.173	.18591
80.00	7.0051	18.220	2.4552	6.3965	2.4593	.07456	.02867	1.166	.19395
90.00	6.4082	16.663	3.0289	7.8910	3.0338	.09096	.03497	1.153	.21040

LITHIUM FLUORIDE

PRCTON ENERGY MEV	ENERGY LOSS MEV/CH		PROTON RANGE GM/CM2 CH		PROTON PATH LENGTH GM/CM2 CH		PATH LENGTH STRAGGLING GM/CM2 CH PERCENT		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH	CH	GM/CM2	CH	GM/CM2	CH	GM/CM2	CH PERCENT		
100.00	5.9239	15.408	9.5004	3.6526	9.5158	3.6585	.10859	.04175	1.141	.22714
110.00	5.5228	14.365	11.247	4.3243	11.266	4.3312	.12737	.04897	1.131	.24427
120.00	5.1851	13.487	13.115	5.0421	13.136	5.0502	.14726	.05662	1.121	.26192
130.00	4.8955	12.733	15.097	5.8044	15.121	5.8136	.16819	.06466	1.112	.27997
140.00	4.6462	12.085	17.192	6.6096	17.219	6.6201	.19012	.07309	1.104	.29830
150.00	4.4287	11.519	19.394	7.4563	19.425	7.4682	.21299	.08189	1.096	.31682
160.00	4.2371	11.021	21.699	8.3427	21.734	8.3559	.23675	.09102	1.089	.33544
170.00	4.0672	10.579	24.106	9.2679	24.144	9.2825	.26137	.10049	1.083	.35408
180.00	3.9154	10.184	26.608	10.230	26.650	10.246	.28680	.11027	1.076	.37266
190.00	3.7790	9.8291	29.205	11.228	29.251	11.246	.31301	.12034	1.070	.39113
200.00	3.6557	9.5086	31.892	12.261	31.942	12.281	.33996	.13070	1.064	.40941
210.00	3.5439	9.2176	34.666	13.328	34.721	13.349	.36762	.14134	1.059	.42737
220.00	3.4419	8.9523	37.526	14.427	37.584	14.450	.39596	.15223	1.054	.44486
230.00	3.3485	8.7095	40.467	15.558	40.530	15.583	.42495	.16338	1.048	.46186
240.00	3.2627	8.4864	43.489	16.720	43.557	16.746	.45456	.17476	1.044	.47833
250.00	3.1837	8.2807	46.587	17.911	46.660	17.939	.48476	.18638	1.039	.49427
260.00	3.1106	8.0905	49.760	19.131	49.838	19.161	.51554	.19821	1.034	.50981
270.00	3.0428	7.9143	53.006	20.379	53.088	20.411	.54687	.21025	1.030	.52512
280.00	2.9798	7.7505	56.322	21.654	56.409	21.688	.57873	.22250	1.026	.54016
290.00	2.9211	7.5978	59.708	22.956	59.800	22.991	.61109	.23494	1.022	.55493
300.00	2.8663	7.4552	63.158	24.282	63.256	24.320	.64393	.24757	1.018	.56939
310.00	2.8150	7.3218	66.674	25.634	66.777	25.674	.67725	.26038	1.014	.58373
320.00	2.7669	7.1967	70.252	27.010	70.360	27.051	.71101	.27336	1.011	.59810
330.00	2.7217	7.0792	73.891	28.408	74.004	28.452	.74521	.28651	1.007	.61246
340.00	2.6792	6.9686	77.588	29.830	77.708	29.876	.77983	.29982	1.004	.62679
350.00	2.6391	6.8644	81.344	31.274	81.469	31.322	.81485	.31328	1.000	.64105
360.00	2.6013	6.7660	85.155	32.739	85.285	32.789	.85025	.32689	.9969	.65517
370.00	2.5655	6.6730	89.020	34.225	89.156	34.278	.88603	.34065	.9938	.66909
380.00	2.5317	6.5850	92.938	35.732	93.080	35.786	.92217	.35454	.9907	.68279
390.00	2.4996	6.5015	96.908	37.258	97.056	37.315	.95865	.36857	.9877	.69625
400.00	2.4692	6.4224	100.93	38.803	101.08	38.863	.99547	.38273	.9848	.70946
410.00	2.4403	6.3472	105.00	40.367	105.16	40.429	1.0326	.39701	.9820	.72230
420.00	2.4128	6.2756	109.11	41.949	109.28	42.013	1.0701	.41141	.9792	.73476
430.00	2.3866	6.2075	113.27	43.549	113.44	43.616	1.1078	.42593	.9765	.74666
440.00	2.3616	6.1426	117.48	45.166	117.66	45.235	1.1459	.44056	.9739	.75818
450.00	2.3370	6.0807	121.73	46.800	121.91	46.871	1.1842	.45530	.9714	.76927
460.00	2.3151	6.0216	126.02	48.450	126.21	48.524	1.2228	.47014	.9689	.77994
470.00	2.2934	5.9652	130.35	50.116	130.55	50.193	1.2617	.48508	.9664	.79020
480.00	2.2727	5.9112	134.73	51.798	134.93	51.877	1.3008	.50013	.9641	.80066
490.00	2.2528	5.8595	139.14	53.495	139.35	53.576	1.3402	.51527	.9618	.80952

LITHIUM FLUORIDE

PRCTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2 CM	PROTON PATH LENGTH GM/CM2 CM	PATH LENGTH STRAGGLING GM/CM2 CM PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION	
500.00	2.2338	143.59	55.204	1.3798	.53050	.9595	.81859
510.00	2.2155	148.08	56.932	1.4197	.54582	.9573	.82730
520.00	2.1980	152.60	58.672	1.4598	.56123	.9551	.83563
530.00	2.1812	157.17	60.425	1.5001	.57673	.9530	.84362
540.00	2.1651	161.76	62.192	1.5406	.59230	.9509	.85126
550.00	2.1496	166.39	63.971	1.5813	.60796	.9489	.85857
560.00	2.1347	171.05	65.763	1.6222	.62369	.9470	.86555
570.00	2.1204	175.74	67.568	1.6633	.63949	.9450	.87223
580.00	2.1066	180.47	69.385	1.7046	.65537	.9431	.87861
590.00	2.0933	185.22	71.213	1.7461	.67132	.9413	.88469
600.00	2.0805	190.01	73.053	1.7878	.68734	.9395	.89050
620.00	2.0562	199.67	76.765	1.8716	.71958	.9360	.90133
640.00	2.0336	209.43	80.520	1.9561	.75207	.9326	.91116
660.00	2.0126	219.31	84.316	2.0413	.78480	.9294	.92007
680.00	1.9929	229.28	88.150	2.1270	.81776	.9263	.92815
700.00	1.9745	239.35	92.021	2.2133	.85093	.9233	.93545
720.00	1.9572	249.51	95.927	2.3001	.88431	.9205	.94205
740.00	1.9411	259.75	99.867	2.3874	.91789	.9178	.94861
760.00	1.9259	270.08	103.84	2.4753	.95166	.9151	.95337
780.00	1.9116	280.49	107.84	2.5635	.98560	.9126	.95821
800.00	1.8981	290.98	111.87	2.6523	1.0197	.9102	.96256
820.00	1.8854	301.54	115.93	2.7414	1.0540	.9078	.96647
840.00	1.8735	312.17	120.02	2.8310	1.0884	.9056	.96998
860.00	1.8622	322.86	124.13	2.9210	1.1230	.9034	.97314
880.00	1.8515	333.62	128.27	3.0113	1.1578	.9013	.97597
900.00	1.8415	344.44	132.43	3.1020	1.1926	.8993	.97851
920.00	1.8319	355.32	136.61	3.1931	1.2276	.8973	.98078
940.00	1.8229	366.26	140.82	3.2845	1.2628	.8955	.98282
960.00	1.8143	377.27	145.05	3.3762	1.2980	.8936	.98464
1000.00	1.7985	399.52	153.60	3.5605	1.3689	.8899	.98775

THE ELECTRON DENSITY OF LITHIUM FLUORIDE IS 2.787E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.272 BEV; AND THE MINIMUM ENERGY LOSS IS 1.6466 MEV/GM/CM2

THE EFFECTIVE IONIZATION POTENTIAL IS 90.88 ELECTRON VOLTS

LUCITE

ADJUSTED IONIZATION POTENTIAL
 77.30
 18.30
 98.50

ATOMS/MOLECULE
 5
 8
 2

PERCENT BY WEIGHT
 59.9848
 8.0542
 31.9610

ATOMIC NUMBER
 6
 1
 8

ELEMENT
 C
 H
 O

DENSITY = 1.2000 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS HEV/GM/CM2	ENERGY LOSS MEV/CM	PROTON RANGE MM	PROTON PATH LENGTH MG/CM2	PROTON PATH LENGTH MM	ATOMIC WEIGHT	PERCENT BY WEIGHT	ATOMS/MOLECULE	ADJUSTED IONIZATION POTENTIAL	PATH LENGTH STRAGGLING MM	MG/CM2	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	969.18	1163.0	.00102	.12342	.00103	.00528			.00004	4.276			.5983	0.
.15	850.26	1020.3	.00148	.17846	.00149	.00661			.00006	3.702			.4436	0.
.20	742.70	871.34	.00200	.24133	.00201	.00804			.00007	3.331			.3750	0.
.30	589.94	707.93	.00326	.39302	.00328	.01152			.00010	2.930			.3115	0.
.40	490.18	588.21	.00482	.57962	.00483	.01592			.00013	2.746			.2815	0.
.50	422.50	507.00	.00655	.79988	.00667	.02106			.00018	2.633			.2636	0.
.60	374.30	449.16	.00874	1.0811	.00876	.02672			.00022	2.541			.2516	0.
.70	336.84	404.21	.01108	1.3333	.01111	.03206			.00027	2.465			.2428	0.
.80	306.79	368.14	.01367	1.6444	.01370	.03948			.00033	2.401			.2359	0.
.90	284.01	340.81	.01649	1.9828	.01652	.04647			.00039	2.344			.2303	0.
1.00	261.21	313.45	.01954	2.3501	.01958	.05395			.00045	2.296			.2256	0.
1.20	229.54	275.44	.02635	3.1685	.02640	.07030			.00059	2.219			.2180	0.
1.40	205.51	246.62	.03402	4.0910	.03409	.08807			.00073	2.153			.2123	0.
1.60	186.56	223.87	.04293	5.1142	.04262	.10720			.00089	2.096			.2076	.00001
1.80	171.17	205.40	.05185	6.2439	.05196	.12735			.00106	2.047			.2036	.00002
2.00	158.33	190.06	.06196	7.4595	.06209	.14939			.00124	2.005			.2002	.00004
2.20	147.56	177.08	.07285	8.7592	.07299	.17239			.00144	1.968			.1973	.00005
2.40	138.28	165.93	.08451	10.160	.08467	.19662			.00164	1.935			.1946	.00007
2.60	130.20	156.25	.09691	11.652	.09710	.22205			.00185	1.906			.1923	.00009
2.80	123.11	147.74	.11006	13.232	.11027	.24867			.00207	1.879			.1902	.00011
3.00	116.83	140.20	.12394	14.900	.12417	.27645			.00230	1.855			.1882	.00014
3.20	111.22	133.46	.13854	16.655	.13879	.30540			.00254	1.834			.1865	.00016
3.40	106.17	127.41	.15385	18.496	.15414	.33547			.00280	1.814			.1848	.00019
3.60	101.61	121.93	.16988	20.423	.17019	.36667			.00306	1.795			.1834	.00022
3.80	97.456	116.95	.18660	22.433	.18694	.39899			.00332	1.779			.1819	.00026
4.00	93.662	112.39	.20402	24.527	.20439	.43240			.00360	1.763			.1806	.00029
4.20	90.083	108.10	.22215	26.706	.22255	.46699			.00389	1.749			.1794	.00033
4.40	86.888	104.27	.24097	28.968	.24140	.50267			.00419	1.735			.1783	.00037
4.60	83.933	100.72	.26044	31.308	.26090	.53941			.00450	1.723			.1772	.00041
4.80	81.190	97.428	.28061	33.733	.28111	.57718			.00481	1.711			.1762	

LUCITE

PRCTON ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	GM/CM2	CH	GM/CM2	CH	PERCENT	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	78.637	94.365	.03617	.03014	.03624	.03020	.00062	.00051	1.700	.1753	.00045	
5.50	72.964	87.557	.04277	.03564	.04284	.03570	.00072	.00060	1.675	.1731	.00057	
6.00	68.120	81.744	.04985	.04155	.04994	.04162	.00083	.00069	1.653	.1712	.00172	
6.50	63.932	76.718	.05742	.04785	.05752	.04793	.00094	.00078	1.633	.1694	.00335	
7.00	60.271	72.329	.06547	.05456	.06558	.05465	.00106	.00088	1.616	.1679	.00533	
7.50	57.024	68.429	.07399	.06166	.07411	.06176	.00119	.00099	1.600	.1665	.00755	
8.00	54.157	64.988	.08297	.06915	.08311	.06926	.00132	.00110	1.586	.1653	.00978	
8.50	51.588	61.906	.09242	.07702	.09257	.07714	.00146	.00121	1.573	.1641	.01201	
9.00	49.273	59.128	.10233	.08527	.10249	.08541	.00160	.00133	1.561	.1630	.01423	
9.50	47.175	56.610	.11269	.09391	.11287	.09446	.00175	.00146	1.550	.1626	.01646	
10.00	45.264	54.317	.12349	.10291	.12369	.10308	.00190	.00159	1.540	.1611	.01868	
11.00	41.909	50.291	.14644	.12203	.14667	.12223	.00223	.00186	1.521	.1595	.02314	
12.00	39.058	46.870	.17113	.14261	.17141	.14284	.00258	.00215	1.505	.1580	.02760	
13.00	36.602	43.923	.19756	.16463	.19787	.16489	.00295	.00246	1.490	.1567	.03207	
14.00	34.463	41.356	.22569	.18807	.22604	.18837	.00334	.00278	1.477	.1555	.03654	
15.00	32.582	39.099	.25550	.21291	.25589	.21324	.00375	.00313	1.466	.1545	.04102	
16.00	30.915	37.098	.28697	.23914	.28741	.23951	.00418	.00349	1.455	.1535	.04551	
17.00	29.425	35.310	.32009	.26674	.32058	.26715	.00463	.00386	1.445	.1527	.05002	
18.00	28.086	33.703	.35484	.29570	.35538	.29615	.00510	.00425	1.436	.1519	.05452	
19.00	26.875	32.250	.39119	.32599	.39178	.32649	.00559	.00456	1.428	.1511	.05904	
20.00	25.774	30.929	.42914	.35762	.42979	.35816	.00610	.00509	1.420	.1504	.06357	
22.00	23.847	28.617	.50977	.42481	.51053	.42544	.00718	.00598	1.406	.1492	.07264	
24.00	22.215	26.658	.59660	.49717	.59749	.49791	.00832	.00694	1.393	.1481	.08174	
26.00	20.813	24.976	.68954	.57462	.69056	.57546	.00954	.00795	1.382	.1472	.08723	
28.00	19.596	23.515	.78849	.65707	.78964	.65804	.01083	.00902	1.371	.1463	.08890	
30.00	18.527	22.233	.89336	.74446	.89466	.74555	.01219	.01015	1.362	.1455	.09080	
32.00	17.582	21.099	1.0041	.83672	1.0055	.83793	.01361	.01134	1.353	.1448	.09268	
34.00	16.740	20.088	1.1205	.93376	1.1221	.93511	.01510	.01258	1.345	.1442	.09462	
36.00	15.984	19.186	1.2427	1.03555	1.2444	1.0370	.01665	.01387	1.338	.1436	.09661	
38.00	15.301	18.361	1.3704	1.1420	1.3724	1.1436	.01827	.01522	1.331	.1430	.09865	
40.00	14.682	17.618	1.5037	1.2531	1.5058	1.2549	.01994	.01662	1.324	.1425	.10073	
45.00	13.357	16.029	1.8607	1.5506	1.8634	1.5528	.02440	.02034	1.310	.1414	.10508	
50.00	12.280	14.736	2.2510	1.8759	2.2542	1.8785	.02923	.02436	1.297	.1404	.11161	
55.00	11.385	13.662	2.6737	2.2281	2.6774	2.2312	.03441	.02867	1.285	.1396	.11753	
60.00	10.630	12.755	3.1279	2.6066	3.1323	2.6102	.03992	.03327	1.275	.1389	.12331	
65.00	9.9630	11.988	3.6150	3.0108	3.6180	3.0150	.04577	.03814	1.265	.1383	.12951	
70.00	9.4230	11.308	4.1281	3.4401	4.1338	3.4448	.05193	.04328	1.256	.1377	.13591	
75.00	8.9331	10.720	4.6726	3.8938	4.6790	3.8991	.05840	.04867	1.248	.1372	.14247	
80.00	8.5007	10.201	5.2458	4.3715	5.2530	4.3775	.06516	.05430	1.241	.1367	.14915	
90.00	7.7719	9.3263	6.4761	5.3967	6.4849	5.4041	.07953	.06629	1.227	.1359	.16283	

LUCITE

PROTON ENERGY HEV	ENERGY LOSS HEV/CH2	PROTON RANGE GM/CH2	PROTON PATH LENGTH CM	PROTON PATH LENGTH GM/CM2	PATH LENGTH STRAGGLING CM	PATH LENGTH STRAGGLING GM/CM2	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	7.1810	8.6172	6.5119	7.0249	6.5207	.09502	.1350	.17673
110.00	6.6919	8.0303	7.7135	9.2687	7.7239	.11152	.1346	.19094
120.00	6.2803	7.5364	8.9982	10.812	9.0102	.12899	.1340	.20356
130.00	5.9290	7.1148	10.363	12.452	10.377	.14738	.1335	.22050
140.00	5.6256	6.7507	11.805	14.184	11.820	.16664	.1331	.23566
150.00	5.3609	6.4330	13.321	16.006	13.338	.18673	.1327	.25097
160.00	5.1279	6.1535	14.909	17.914	14.928	.20761	.1324	.26641
170.00	4.9212	5.9055	16.566	19.825	16.588	.22925	.1321	.28201
180.00	4.7367	5.6840	18.290	21.977	18.314	.25160	.1318	.29771
190.00	4.5709	5.4951	20.079	24.127	20.106	.27464	.1315	.31345
200.00	4.4212	5.3054	21.931	26.352	21.960	.29833	.1312	.32919
210.00	4.2853	5.1424	23.844	28.650	23.875	.32265	.1310	.34490
220.00	4.1612	4.9934	25.815	31.018	25.849	.34757	.1307	.36058
230.00	4.0477	4.8573	27.843	33.455	27.879	.37306	.1305	.37619
240.00	3.9435	4.7322	29.926	35.959	29.965	.39909	.1303	.39169
250.00	3.8475	4.6170	32.064	38.526	32.105	.42566	.1301	.40766
260.00	3.7587	4.5105	34.252	41.156	34.297	.45272	.1299	.42409
270.00	3.6764	4.4117	36.491	43.847	36.539	.48027	.1297	.44091
280.00	3.6000	4.3200	38.779	46.596	38.830	.50829	.1295	.45827
290.00	3.5287	4.2344	41.115	49.401	41.168	.53675	.1293	.47616
300.00	3.4621	4.1546	43.496	52.263	43.552	.56564	.1292	.49457
310.00	3.3999	4.0798	45.922	55.178	45.982	.59494	.1290	.51350
320.00	3.3415	4.0098	48.392	58.145	48.454	.62463	.1289	.53287
330.00	3.2866	3.9440	50.904	61.163	50.900	.65471	.1287	.55263
340.00	3.2350	3.8820	53.456	64.230	53.525	.68515	.1285	.57284
350.00	3.1864	3.8237	56.049	67.355	56.121	.71595	.1284	.59349
360.00	3.1405	3.7684	58.680	70.506	58.755	.74709	.1282	.61462
370.00	3.0971	3.7169	61.349	73.713	61.427	.77855	.1281	.63619
380.00	3.0560	3.6672	64.054	76.963	64.136	.81033	.1279	.65826
390.00	3.0171	3.6205	66.795	80.257	66.881	.84242	.1278	.68074
400.00	2.9801	3.5762	69.571	83.592	69.660	.87479	.1277	.70369
410.00	2.9450	3.5341	72.380	86.967	72.473	.90746	.1275	.72710
420.00	2.9117	3.4940	75.223	90.389	75.319	.94039	.1274	.75096
430.00	2.8799	3.4559	78.097	93.716	78.196	.97360	.1273	.77526
440.00	2.8496	3.4195	81.003	97.027	81.106	1.0071	.1271	.79999
450.00	2.8207	3.3849	83.939	100.35	84.045	1.0408	.1270	.82516
460.00	2.7932	3.3518	86.904	104.42	87.014	1.0747	.1269	.85076
470.00	2.7668	3.3202	89.898	108.01	90.012	1.1089	.1267	.87678
480.00	2.7416	3.2899	92.920	111.65	93.038	1.1433	.1266	.90317
490.00	2.7175	3.2610	95.969	115.31	96.091	1.1779	.1265	.92995

LUCITE

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	HEV/CM	GM/CM2	GM/CM2	CM	GM/CM2	CM	GM/CM2	PERCENT		
500.00	2.6944	3.2333	118.85	99.045	119.00	99.171	1.2127	1.0160	1.263	.73922
510.00	2.6723	3.2067	122.58	102.15	122.73	102.28	1.2477	1.0398	1.262	.74928
520.00	2.6510	3.1812	126.33	105.27	126.49	105.41	1.2830	1.0691	1.261	.75905
530.00	2.6306	3.1558	130.11	108.43	130.28	108.56	1.3184	1.0988	1.260	.76852
540.00	2.6111	3.1333	133.92	111.60	134.09	111.74	1.3540	1.1285	1.259	.77770
550.00	2.5923	3.1107	137.76	114.80	137.94	114.95	1.3898	1.1581	1.257	.78660
560.00	2.5742	3.0890	141.63	118.02	141.81	118.17	1.4257	1.1881	1.256	.79521
570.00	2.5568	3.0681	145.52	121.27	145.70	121.42	1.4610	1.2182	1.255	.80355
580.00	2.5400	3.0480	149.44	124.53	149.63	124.69	1.4981	1.2484	1.253	.81161
590.00	2.5239	3.0287	153.39	127.82	153.58	127.98	1.5346	1.2788	1.252	.81940
600.00	2.5083	3.0100	157.36	131.13	157.55	131.29	1.5712	1.3093	1.251	.82693
620.00	2.4789	2.9747	165.37	137.81	165.57	137.98	1.6448	1.3707	1.248	.84222
640.00	2.4515	2.9418	173.47	144.56	173.69	144.74	1.7191	1.4326	1.246	.85453
660.00	2.4259	2.9111	181.66	151.38	181.89	151.57	1.7938	1.4949	1.243	.86681
680.00	2.4020	2.8824	189.94	158.28	190.17	158.48	1.8691	1.5576	1.241	.87840
700.00	2.3787	2.8556	198.29	165.24	198.54	165.45	1.9449	1.6207	1.239	.88904
720.00	2.3587	2.8305	206.73	172.27	206.98	172.49	2.0211	1.6842	1.236	.89887
740.00	2.3391	2.8069	215.23	179.36	215.50	179.58	2.0977	1.7481	1.234	.90795
760.00	2.3206	2.7847	223.81	186.51	224.08	186.74	2.1748	1.8123	1.231	.91631
780.00	2.3033	2.7639	232.45	193.71	232.73	193.94	2.2523	1.8769	1.229	.92398
800.00	2.2869	2.7443	241.15	200.96	241.45	201.21	2.3301	1.9418	1.226	.93100
820.00	2.2715	2.7258	249.92	208.27	250.23	208.52	2.4083	2.0069	1.224	.93742
840.00	2.2570	2.7084	258.74	215.62	259.06	215.88	2.4869	2.0724	1.222	.94329
860.00	2.2433	2.6919	267.62	223.02	267.95	223.29	2.5658	2.1381	1.219	.94864
880.00	2.2303	2.6764	276.56	230.46	276.89	230.74	2.6450	2.2041	1.217	.95352
900.00	2.2181	2.6617	285.54	237.95	285.89	238.24	2.7245	2.2704	1.214	.95797
920.00	2.2065	2.6478	294.58	245.48	294.94	245.78	2.8043	2.3369	1.212	.96202
940.00	2.1955	2.6346	303.67	253.05	304.03	253.36	2.8843	2.4036	1.209	.96569
960.00	2.1851	2.6221	312.80	260.67	313.18	260.98	2.9647	2.4706	1.206	.96904
1000.00	2.1658	2.5990	331.28	276.07	331.68	276.40	3.1262	2.6051	1.199	.97485

36

THE ELECTRON DENSITY OF LUCITE IS 3.250E 23 ELECTRONS PER GRAM
 THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.317 BEV, AND THE MINIMUM ENERGY LOSS IS 1.9877 MEV/GM/CM2
 THE EFFECTIVE IONIZATION POTENTIAL IS 67.09 ELECTRON VOLTS

METHANE

ELEMENT ATOMIC NUMBER ATOMS/MOLECULE PERCENT BY WEIGHT ADJUSTED IONIZATION POTENTIAL
 C 6 1 74.8683 77.30
 H 1 4 25.1317 18.30

DENSITY = .71573 MG/CM3

PROTON ENERGY MEV	ENERGY LOSS KEV/CM2	PROTON RANGE MG/CM2	PROTON PATH LENGTH METER	ATOMS/MOLECULE	PERCENT BY WEIGHT	ATOMIC WEIGHT	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	1490.9	1067.1	.08059	.00113	.08090	.00113	.00460	.3837	0.
.15	1245.0	891.07	.11722	.00164	.11755	.00164	.00551	.2854	0.
.20	1061.7	759.90	.16061	.00224	.16100	.00225	.00670	.2430	0.
.30	819.34	586.42	.26829	.00375	.26884	.00376	.00972	.2066	0.
.40	671.73	480.78	.40341	.00554	.40418	.00556	.01351	.1908	0.
.50	571.73	409.20	.56488	.00789	.56591	.00791	.01792	.1819	0.
.60	500.29	358.07	.75193	.01051	.75326	.01052	.02283	.1760	0.
.70	449.34	321.60	.96243	.01345	.96409	.01347	.02815	.1718	0.
.80	405.10	289.94	1.1964	.01672	1.1985	.01674	.03391	.1685	0.
.90	374.14	267.78	1.4526	.02030	1.4551	.02032	.04006	.1658	0.
1.00	343.15	245.60	1.7314	.02419	1.7342	.02423	.04661	.1634	0.
1.20	299.89	214.64	2.3553	.03291	2.3591	.03296	.06091	.1596	0.
1.40	267.30	191.31	3.0620	.04278	3.0668	.04285	.07641	.1566	0.
1.60	241.73	173.02	3.8491	.05378	3.8550	.05386	.09310	.1540	.00001
1.80	221.07	158.23	4.7143	.06587	4.7215	.06597	.11093	.1518	.00001
2.00	203.97	145.99	5.6555	.07902	5.6640	.07914	.12990	.1499	.00002
2.20	189.56	135.67	6.6716	.09321	6.6815	.09335	.14999	.1482	.00003
2.40	177.23	126.85	7.7622	.10845	7.7736	.10861	.17117	.1466	.00004
2.60	166.54	119.20	8.9255	.12471	8.9385	.12489	.19343	.1452	.00005
2.80	157.18	112.50	10.161	.14196	10.175	.14217	.21676	.1440	.00007
3.00	148.90	106.57	11.467	.16021	11.483	.16044	.24114	.1428	.00008
3.20	141.53	101.30	12.843	.17944	12.861	.17969	.26556	.1417	.00010
3.40	134.92	96.263	14.289	.19964	14.309	.19992	.29391	.1407	.00012
3.60	128.94	92.289	15.804	.22081	15.826	.22112	.32047	.1390	.00014
3.80	123.53	88.411	17.387	.24293	17.411	.24327	.34893	.1389	.00016
4.00	118.58	84.873	19.037	.26599	19.064	.26635	.37839	.1381	.00019
4.20	113.93	81.545	20.757	.29001	20.786	.29041	.40897	.1373	.00021
4.40	109.78	78.576	22.544	.31498	22.575	.31541	.44054	.1366	.00024
4.60	105.95	75.833	24.395	.34084	24.428	.34130	.47306	.1359	.00027
4.80	102.40	73.291	26.314	.36766	26.350	.36816	.50650	.1353	.00030

METHANE

FRCTON ENERGY HEV	ENERGY LOSS HEV/GH/CH	PROTON RANGE GH/CH2	PROTON PATH LENGTH GH/CH2	PATH LENGTH STRAGGLING GH/CH2	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	99.101	0.2830	0.2834	0.0054	1.347	.00033
5.50	91.782	0.3354	0.3358	0.0063	1.333	.00041
6.00	85.550	0.3918	0.3923	0.0073	1.320	.00152
6.50	80.175	0.4521	0.4527	0.0083	1.309	.00309
7.00	75.489	0.5163	0.5170	0.0093	1.299	.00467
7.50	71.361	0.5844	0.5852	0.0105	1.290	.00625
8.00	67.698	0.6563	0.6571	0.0116	1.282	.00782
8.50	64.424	0.7319	0.7328	0.0129	1.274	.00940
9.00	61.477	0.8113	0.8123	0.0142	1.267	.01098
9.50	58.810	0.8944	0.8955	0.0155	1.260	.01256
10.00	56.385	0.9811	0.9824	0.0169	1.254	.01415
11.00	52.134	1.1655	1.1670	0.0198	1.243	.01732
12.00	48.529	1.3642	1.3659	0.0229	1.233	.02051
13.00	45.429	1.5771	1.5790	0.0262	1.224	.02371
14.00	42.734	1.8039	1.8061	0.0297	1.216	.02692
15.00	40.368	2.0445	2.0470	0.0334	1.209	.03014
16.00	38.272	2.2987	2.3015	0.0372	1.203	.03337
17.00	36.402	2.5664	2.5695	0.0413	1.197	.03661
18.00	34.723	2.8475	2.8509	0.0455	1.191	.03987
19.00	33.206	3.1417	3.1454	0.0499	1.186	.04314
20.00	31.828	3.4491	3.4531	0.0545	1.181	.04641
22.00	29.419	4.1025	4.1073	0.0641	1.172	.05300
24.00	27.381	4.8069	4.8125	0.0744	1.165	.05963
26.00	25.633	5.5615	5.5679	0.0854	1.158	.06362
28.00	24.117	6.3654	6.3727	0.0969	1.152	.06486
30.00	22.788	7.2180	7.2263	0.1091	1.143	.06616
32.00	21.613	8.1186	8.1279	0.1219	1.141	.06750
34.00	20.566	9.0665	9.0768	0.1353	1.136	.06888
36.00	19.627	10.061	10.073	0.1493	1.132	.07030
38.00	18.781	11.102	11.115	0.1639	1.128	.07176
40.00	18.013	12.189	12.202	0.1790	1.124	.07324
45.00	16.372	15.101	15.118	0.2192	1.116	.07707
50.00	15.039	18.287	18.308	0.2627	1.109	.08103
55.00	13.934	21.741	21.765	0.3094	1.103	.08514
60.00	13.001	25.455	25.482	0.3592	1.097	.08944
65.00	12.203	29.422	29.455	0.4119	1.092	.09390
70.00	11.513	33.638	33.675	0.4676	1.088	.09851
75.00	10.909	38.097	38.130	0.5260	1.084	.10325
80.00	10.377	42.794	42.840	0.5871	1.080	.10808
90.00	9.4802	51.2879	51.2936	0.7171	1.074	.11799

METHANE

PRCTON ENERGY MEV	ENERGY LOSS HEV/CH2	PRCTON RANGE GH/CH2	PRCTON PATH LENGTH METER	GH/CH2	PROTON PATH LENGTH METER	GH/CH2	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	8.7538	6.3856	89.314	6.3924	89.314	.08570	1.1774	1.341	.12810
110.00	8.1530	7.5691	105.75	7.5772	105.87	.10062	1.4059	1.328	.13847
130.00	7.6477	8.8351	123.57	8.8445	123.57	.11642	1.6267	1.316	.14922
140.00	7.2167	10.181	142.24	10.191	142.39	.13306	1.8591	1.306	.16027
150.00	6.8446	11.603	162.11	11.615	162.28	.15050	2.1027	1.296	.17157
160.00	6.5201	13.099	183.01	13.113	183.21	.16869	2.3568	1.286	.18304
170.00	6.2346	14.666	204.91	14.682	205.13	.18759	2.6210	1.278	.19471
180.00	5.9814	16.320	227.78	16.320	228.01	.20719	2.8948	1.270	.20659
190.00	5.7555	18.006	251.57	18.024	251.83	.22743	3.1777	1.262	.21863
200.00	5.5525	19.773	276.27	19.794	276.56	.24830	3.4693	1.254	.23080
210.00	5.3693	21.603	301.24	21.626	302.15	.26977	3.7692	1.247	.24306
220.00	5.2030	23.494	328.25	23.518	328.59	.29181	4.0771	1.241	.25540
230.00	5.0515	25.443	355.48	25.469	355.85	.31439	4.3926	1.234	.26781
240.00	4.9128	27.448	383.50	27.477	383.90	.33749	4.7153	1.228	.28026
250.00	4.7855	29.509	412.29	29.539	412.72	.36109	5.0451	1.222	.29272
260.00	4.6682	31.623	441.83	31.655	442.28	.38517	5.3816	1.217	.30517
270.00	4.5598	33.789	472.09	33.823	472.57	.40971	5.7244	1.211	.31760
280.00	4.4593	36.004	503.04	36.041	503.56	.43469	6.0734	1.206	.33002
290.00	4.3659	38.269	534.68	38.308	535.23	.46010	6.4284	1.201	.34239
300.00	4.2789	40.580	566.98	40.622	567.56	.48591	6.7890	1.196	.35470
310.00	4.1977	42.938	599.92	42.981	600.53	.51211	7.1551	1.191	.36695
320.00	4.1217	45.340	633.48	45.386	634.12	.53868	7.5264	1.187	.37941
330.00	4.0504	47.785	667.64	47.833	668.32	.56562	7.9027	1.182	.39191
340.00	3.9835	50.272	702.39	50.323	703.10	.59290	8.2839	1.178	.40444
350.00	3.9206	52.800	737.71	52.854	738.46	.62052	8.6698	1.174	.41699
360.00	3.8613	55.368	773.59	55.424	774.37	.64846	9.0602	1.170	.42953
370.00	3.8053	57.974	810.01	58.033	810.82	.67671	9.4549	1.166	.44214
380.00	3.7524	60.618	846.95	60.679	847.80	.70526	9.8538	1.162	.45484
390.00	3.7024	63.299	884.40	63.363	885.29	.73410	10.257	1.159	.46764
400.00	3.6549	66.015	922.34	66.081	923.27	.76321	10.663	1.155	.48050
410.00	3.6099	68.765	960.77	68.834	961.74	.79260	11.074	1.151	.49342
420.00	3.5672	71.549	999.67	71.621	1000.7	.82224	11.488	1.148	.50628
430.00	3.5265	74.366	1039.0	74.441	1040.1	.85214	11.906	1.145	.51899
440.00	3.4878	77.215	1078.8	77.292	1079.9	.88227	12.327	1.141	.53156
450.00	3.4509	80.095	1119.1	80.175	1120.2	.91264	12.751	1.138	.54395
460.00	3.4158	83.004	1159.7	83.087	1160.9	.94324	13.179	1.135	.55618
470.00	3.3822	85.944	1200.8	86.030	1202.0	.97405	13.609	1.132	.56823
480.00	3.3501	88.912	1242.3	89.001	1243.5	1.0051	14.043	1.129	.58010
490.00	3.3195	91.908	1284.1	91.999	1285.4	1.0363	14.479	1.126	.59179
490.00	3.2901	94.931	1326.4	95.025	1327.7	1.0677	14.918	1.124	.60328

METHANE

PROTON ENERGY MEV	ENERGY LOSS HEV/GM/CM2	PROTON RANGE GM/CM2	PROTON RANGE METER	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH METER	GM/CM2	PATH LENGTH STRAGGLING METER PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	3.2620	97.981	1369.0	98.078	1370.3	1.0994	15.360	.0992	.61457
510.00	3.2351	101.06	1411.9	101.16	1413.3	1.1312	15.804	.0991	.62569
520.00	3.2092	104.16	1455.3	104.26	1456.7	1.1631	16.251	.0990	.63666
530.00	3.1844	107.28	1498.9	107.39	1500.4	1.1953	16.701	.0989	.64746
540.00	3.1606	110.43	1542.9	110.54	1544.4	1.2276	17.152	.0988	.65810
550.00	3.1378	113.60	1587.2	113.72	1588.8	1.2601	17.506	.0987	.66857
560.00	3.1158	116.80	1631.9	116.91	1633.5	1.2928	18.002	.0986	.67886
570.00	3.0946	120.02	1676.8	120.13	1678.5	1.3256	18.221	.0985	.68898
580.00	3.0742	123.26	1722.1	123.38	1723.9	1.3585	18.481	.0984	.69890
590.00	3.0546	126.52	1767.7	126.64	1769.4	1.3916	18.744	.0983	.70864
600.00	3.0357	129.80	1813.5	129.92	1815.3	1.4249	19.008	.0982	.71819
620.00	3.0000	136.42	1906.0	136.55	1907.9	1.4918	20.843	.0979	.73675
640.00	2.9667	143.12	1999.6	143.26	2001.5	1.5592	21.785	.0977	.75460
660.00	2.9356	149.89	2094.2	150.03	2096.2	1.6271	22.734	.0975	.77171
680.00	2.9066	156.73	2189.8	156.88	2191.9	1.6955	23.689	.0973	.78807
700.00	2.8795	163.64	2286.3	163.79	2288.5	1.7643	24.651	.0971	.80365
720.00	2.8541	170.61	2383.7	170.77	2386.0	1.8336	25.618	.0969	.81846
740.00	2.8302	177.64	2481.9	177.81	2484.3	1.9032	26.591	.0967	.83249
760.00	2.8078	184.73	2581.0	184.90	2583.4	1.9733	27.570	.0965	.84573
780.00	2.7868	191.87	2680.8	192.05	2683.3	2.0436	28.553	.0963	.85811
800.00	2.7670	199.07	2781.3	199.26	2784.0	2.1144	29.542	.0961	.86965
820.00	2.7483	206.31	2882.6	206.51	2885.3	2.1855	30.535	.0959	.88039
840.00	2.7307	213.61	2984.5	213.81	2987.3	2.2569	31.532	.0957	.89036
860.00	2.7141	220.95	3087.1	221.16	3090.0	2.3285	32.534	.0955	.89961
880.00	2.6984	228.33	3190.2	228.55	3193.3	2.4005	33.540	.0953	.90312
900.00	2.6836	235.76	3294.0	235.99	3297.2	2.4728	34.549	.0951	.91612
920.00	2.6696	243.23	3398.4	243.46	3401.6	2.5453	35.563	.0949	.92344
940.00	2.6563	250.75	3503.4	250.98	3506.7	2.6181	36.580	.0946	.93020
960.00	2.6437	258.30	3608.9	258.54	3612.3	2.6912	37.601	.0944	.93643
1000.00	2.6204	273.57	3822.3	273.83	3825.9	2.8380	39.652	.0938	.94745

THE ELECTRON DENSITY OF METHANE IS 3.755E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.378 BEV, AND THE MINIMUM ENERGY LOSS IS 2.4104 MEV/GM/CM2

THE EFFECTIVE IONIZATION POTENTIAL IS 43.44 ELECTRON VOLTS

MUSCLE (HUMAN)

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE HG/CM2	PROTON RANGE MM	ATOMS/MOLECULE	PERCENT BY WEIGHT	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL	PATH LENGTH STRAGGLING MM	PATH LENGTH PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	933.68	11642	.00116	10.119	10.1992	12.011	59.30	.00558	4.760	.6206	0.
.15	841.65	17274	.00173	1.0241	12.3007	14.007	77.30	.06729	4.201	.4538	0.
.20	737.44	23603	.00236	.24966	3.4994	15.999	99.50	.00888	3.745	.3854	0.
.30	589.15	38799	.00388	4.5562	72.6940	22.990	98.50	.01259	3.235	.3249	0.
.40	490.99	57408	.00574	.00348	.0800	30.974	150.1	.01731	3.007	.2969	0.
.50	424.15	79322	.00793	.00082	.0199	175.9	156.5	.02283	2.870	.2803	0.
.60	376.99	10431	.01043	.00646	.2001	32.064	175.9	.02887	2.760	.2689	0.
.70	339.08	13222	.01322	.01559	.4999	39.102	182.6	.03540	2.671	.2604	0.
.80	310.57	16295	.01630	.00767	.2999	40.080	203.8	.04238	2.594	.2537	0.
.90	287.46	19632	.01963	.00017	.0068		211.3	.04970	2.525	.2462	0.
1.00	264.31	23253	.02325					.05753	2.468	.2434	0.
1.20	232.00	31329	.03133					.07470	2.379	.2356	0.
1.40	207.51	40442	.04044					.09341	2.304	.2297	0.
1.60	188.22	50559	.05056					.12358	2.242	.2248	.00001
1.80	172.59	61647	.06165					.15518	2.188	.2207	.00001
2.00	159.63	73682	.07368					.18811	2.141	.2172	.00002
2.20	146.69	86644	.08664					.22336	2.100	.2141	.00003
2.40	139.31	10052	.10052					.26088	2.064	.2113	.00004
2.60	131.16	11530	.11530					.29464	2.031	.2089	.00005
2.80	124.02	13096	.13096					.32662	2.001	.2067	.00007
3.00	117.69	14749	.14749					.39179	1.974	.2046	.00009
3.20	112.04	16488	.16488					.32213	1.950	.2028	.00011
3.40	106.96	18312	.18312					.35364	1.927	.2011	.00013
3.60	102.37	20221	.20221					.39629	1.907	.1995	.00015
3.80	98.197	22212	.22212					.42006	1.887	.1981	.00017
4.00	94.382	24286	.24286					.45496	1.870	.1967	.00020
4.20	90.861	26442	.26442					.49097	1.853	.1954	.00023
4.40	87.639	28680	.28680					.52809	1.838	.1943	.00026
4.60	84.659	30998	.30998					.56628	1.823	.1931	.00029
4.80	81.894	33396	.33396					.60553	1.810	.1921	.00032

DENSITY = 1.0000 GM/CM3

MUSCLE

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CH	GM/CH2	CH	GM/CH2	CH	GM/CH2	PERCENT		
5.00	79.322	72.322	.03587	.03587	.03594	.03594	.00065	1.797	.1911	.00036
5.50	73.606	73.606	.04241	.04241	.04249	.04249	.00075	1.768	.1888	.00045
6.00	68.724	68.724	.04943	.04943	.04953	.04953	.00086	1.743	.1866	.00077
6.50	64.506	64.506	.05693	.05693	.05704	.05704	.00098	1.720	.1850	.00124
7.00	60.820	60.820	.06491	.06491	.06503	.06503	.00111	1.700	.1833	.00254
7.50	57.528	57.528	.07335	.07335	.07348	.07348	.00124	1.682	.1817	.00441
8.00	54.645	54.645	.08226	.08226	.08240	.08240	.00137	1.666	.1805	.00629
8.50	52.062	52.062	.09161	.09161	.09178	.09178	.00152	1.651	.1793	.00817
9.00	49.733	49.733	.10143	.10143	.10161	.10161	.00166	1.638	.1782	.01005
9.50	47.622	47.622	.11169	.11169	.11189	.11189	.00182	1.625	.1771	.01193
10.00	45.698	45.698	.12239	.12239	.12261	.12261	.00198	1.613	.1761	.01382
11.00	42.321	42.321	.14511	.14511	.14537	.14537	.00231	1.592	.1744	.01760
12.00	39.449	39.449	.16956	.16956	.16986	.16986	.00267	1.574	.1728	.02139
13.00	36.975	36.975	.19572	.19572	.19606	.19606	.00305	1.558	.1714	.02521
14.00	34.819	34.819	.22356	.22356	.22394	.22394	.00345	1.543	.1702	.02903
15.00	32.923	32.923	.25306	.25306	.25349	.25349	.00388	1.529	.1691	.03286
16.00	31.242	31.242	.28420	.28420	.28468	.28468	.00432	1.517	.1681	.03671
17.00	29.740	29.740	.31697	.31697	.31750	.31750	.00478	1.506	.1671	.04057
18.00	28.389	28.389	.35134	.35134	.35193	.35193	.00526	1.496	.1663	.04444
19.00	27.167	27.167	.38730	.38730	.38794	.38794	.00577	1.487	.1655	.04833
20.00	26.057	26.057	.42484	.42484	.42554	.42554	.00629	1.478	.1648	.05223
22.00	24.112	24.112	.50457	.50457	.50540	.50540	.00739	1.462	.1634	.06006
24.00	22.465	22.465	.59043	.59043	.59139	.59139	.00856	1.448	.1623	.06793
26.00	21.050	21.050	.68232	.68232	.68342	.68342	.00981	1.435	.1612	.07271
28.00	19.820	19.820	.78013	.78013	.78139	.78139	.01112	1.423	.1603	.07431
30.00	18.742	18.742	.88379	.88379	.88520	.88520	.01251	1.413	.1595	.07597
32.00	17.787	17.787	.99321	.99321	.99479	.99479	.01396	1.403	.1587	.07749
34.00	16.936	16.936	1.1083	1.1083	1.1101	1.1101	.01548	1.395	.1580	.07946
36.00	16.172	16.172	1.2290	1.2290	1.2309	1.2309	.01706	1.386	.1574	.08128
38.00	15.483	15.483	1.3552	1.3552	1.3574	1.3574	.01871	1.379	.1568	.08314
40.00	14.857	14.857	1.4869	1.4869	1.4893	1.4893	.02042	1.371	.1563	.08505
45.00	13.518	13.518	1.8397	1.8397	1.8426	1.8426	.02497	1.355	.1551	.08997
50.00	12.429	12.429	2.2253	2.2253	2.2287	2.2287	.02989	1.341	.1540	.09505
55.00	11.525	11.525	2.6428	2.6428	2.6468	2.6468	.03516	1.328	.1532	.10033
60.00	10.761	10.761	3.0914	3.0914	3.0961	3.0961	.04078	1.317	.1524	.10585
65.00	10.107	10.107	3.5704	3.5704	3.5758	3.5758	.04672	1.307	.1517	.11160
70.00	9.5411	9.5411	4.0791	4.0791	4.0853	4.0853	.05299	1.297	.1511	.11754
75.00	9.0456	9.0456	4.6168	4.6168	4.6237	4.6237	.05957	1.288	.1505	.12364
80.00	8.6083	8.6083	5.1828	5.1828	5.1906	5.1906	.06645	1.280	.1500	.12988
90.00	7.8711	7.8711	6.3975	6.3975	6.4070	6.4070	.08107	1.265	.1491	.14269

MUSCLE

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CM2	MEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	CM		
100.00	7.2733	7.2733	7.7186	7.7186	7.7301	7.7301	.09679	1.252	.1484	.15579
110.00	6.7785	6.7785	9.1419	9.1419	9.1555	9.1555	.11354	1.240	.1478	.16921
120.00	6.3620	6.3620	10.664	10.664	10.679	10.679	.13128	1.229	.1472	.18305
130.00	6.0065	6.0065	12.280	12.280	12.298	12.298	.14994	1.219	.1467	.19719
140.00	5.6994	5.6994	13.987	13.987	14.008	14.008	.16949	1.210	.1462	.21155
150.00	5.4315	5.4315	15.783	15.783	15.806	15.806	.18988	1.201	.1458	.22606
160.00	5.1956	5.1956	17.663	17.663	17.689	17.689	.21106	1.193	.1455	.24072
170.00	4.9865	4.9865	19.626	19.626	19.654	19.654	.23300	1.185	.1451	.25553
180.00	4.7997	4.7997	21.668	21.668	21.699	21.699	.25567	1.178	.1448	.27046
190.00	4.6319	4.6319	23.786	23.786	23.821	23.821	.27903	1.171	.1445	.28543
200.00	4.4803	4.4803	25.979	25.979	26.016	26.016	.30305	1.165	.1442	.30042
210.00	4.3427	4.3427	28.243	28.243	28.284	28.284	.32770	1.159	.1440	.31541
220.00	4.2173	4.2173	30.577	30.577	30.621	30.621	.35295	1.153	.1437	.33041
230.00	4.1026	4.1026	32.978	32.978	33.025	33.025	.37878	1.147	.1435	.34537
240.00	3.9972	3.9972	35.444	35.444	35.495	35.495	.40516	1.141	.1433	.36028
250.00	3.9000	3.9000	37.974	37.974	38.028	38.028	.43207	1.136	.1431	.37509
260.00	3.8098	3.8098	40.565	40.565	40.623	40.623	.45949	1.131	.1428	.38983
270.00	3.7265	3.7265	43.216	43.216	43.277	43.277	.48740	1.126	.1427	.40452
280.00	3.6490	3.6490	45.924	45.924	45.989	45.989	.51578	1.122	.1425	.41912
290.00	3.5769	3.5769	48.688	48.688	48.757	48.757	.54460	1.117	.1423	.43362
300.00	3.5095	3.5095	51.507	51.507	51.581	51.581	.57385	1.113	.1421	.44800
310.00	3.4464	3.4464	54.379	54.379	54.456	54.456	.60352	1.108	.1419	.46237
320.00	3.3873	3.3873	57.302	57.302	57.383	57.383	.63359	1.104	.1418	.47664
330.00	3.3317	3.3317	60.275	60.275	60.360	60.360	.66404	1.100	.1416	.49080
340.00	3.2795	3.2795	63.296	63.296	63.385	63.385	.69486	1.096	.1414	.50482
350.00	3.2302	3.2302	66.364	66.364	66.458	66.458	.72604	1.092	.1413	.51870
360.00	3.1837	3.1837	69.478	69.478	69.576	69.576	.75756	1.089	.1411	.53248
370.00	3.1398	3.1398	72.636	72.636	72.739	72.739	.78940	1.085	.1410	.54620
380.00	3.0981	3.0981	75.838	75.838	75.945	75.945	.82157	1.082	.1408	.55983
390.00	3.0587	3.0587	79.084	79.084	79.195	79.195	.85404	1.078	.1407	.57336
400.00	3.0213	3.0213	82.369	82.369	82.485	82.485	.88681	1.075	.1405	.58677
410.00	2.9857	2.9857	85.694	85.694	85.815	85.815	.91986	1.072	.1404	.59998
420.00	2.9519	2.9519	89.058	89.058	89.183	89.183	.95319	1.069	.1402	.61292
430.00	2.9197	2.9197	92.460	92.460	92.589	92.589	.98678	1.066	.1401	.62558
440.00	2.8891	2.8891	95.898	95.898	96.033	96.033	1.0206	1.063	.1400	.63797
450.00	2.8598	2.8598	99.372	99.372	99.512	99.512	1.0547	1.060	.1398	.65007
460.00	2.8319	2.8319	102.88	102.88	103.03	103.03	1.0891	1.057	.1397	.66188
470.00	2.8052	2.8052	106.43	106.43	106.57	106.57	1.1236	1.054	.1395	.67341
480.00	2.7796	2.7796	110.00	110.00	110.16	110.16	1.1584	1.052	.1394	.68465
490.00	2.7552	2.7552	113.61	113.61	113.77	113.77	1.1935	1.049	.1393	.69560

MUSCLE

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CM	MEV/CH	GM/CH ²	CM	GM/CH ²	CH	GM/CH ²	PERCENT		
500.00	2.7318	2.7318	117.25	117.25	117.41	117.41	1.2287	1.2287	.1391	.70627
510.00	2.7093	2.7093	120.92	120.92	121.09	121.09	1.2641	1.2641	.1390	.71666
520.00	2.6878	2.6878	124.62	124.62	124.80	124.80	1.2997	1.2997	.1389	.72678
530.00	2.6672	2.6672	128.35	128.35	128.53	128.53	1.3356	1.3356	.1387	.73664
540.00	2.6473	2.6473	132.11	132.11	132.29	132.29	1.3716	1.3716	.1386	.74624
550.00	2.6283	2.6283	135.90	135.90	136.08	136.08	1.4077	1.4077	.1385	.75557
560.00	2.6099	2.6099	139.71	139.71	139.90	139.90	1.4441	1.4441	.1383	.76464
570.00	2.5923	2.5923	143.55	143.55	143.75	143.75	1.4806	1.4806	.1382	.77345
580.00	2.5753	2.5753	147.41	147.41	147.62	147.62	1.5173	1.5173	.1381	.78200
590.00	2.5589	2.5589	151.30	151.30	151.51	151.51	1.5542	1.5542	.1379	.79031
600.00	2.5432	2.5432	155.22	155.22	155.43	155.43	1.5912	1.5912	.1378	.79836
620.00	2.5133	2.5133	163.12	163.12	163.34	163.34	1.6656	1.6656	.1375	.81374
640.00	2.4855	2.4855	171.11	171.11	171.35	171.35	1.7407	1.7407	.1373	.82819
660.00	2.4596	2.4596	179.19	179.19	179.44	179.44	1.8163	1.8163	.1370	.84175
680.00	2.4354	2.4354	187.35	187.35	187.61	187.61	1.8923	1.8923	.1368	.85442
700.00	2.4127	2.4127	195.59	195.59	195.86	195.86	1.9689	1.9689	.1365	.86627
720.00	2.3914	2.3914	203.91	203.91	204.19	204.19	2.0459	2.0459	.1362	.87730
740.00	2.3715	2.3715	212.30	212.30	212.59	212.59	2.1234	2.1234	.1360	.88757
760.00	2.3528	2.3528	220.75	220.75	221.05	221.05	2.2013	2.2013	.1357	.89711
780.00	2.3352	2.3352	229.28	229.28	229.59	229.59	2.2796	2.2796	.1355	.90591
800.00	2.3186	2.3186	237.86	237.86	238.18	238.18	2.3582	2.3582	.1352	.91403
820.00	2.3030	2.3030	246.51	246.51	246.84	246.84	2.4372	2.4372	.1350	.92151
840.00	2.2882	2.2882	255.21	255.21	255.55	255.55	2.5166	2.5166	.1347	.92840
860.00	2.2743	2.2743	263.97	263.97	264.32	264.32	2.5963	2.5963	.1344	.93472
880.00	2.2611	2.2611	272.78	272.78	273.14	273.14	2.6763	2.6763	.1342	.94053
900.00	2.2487	2.2487	281.64	281.64	282.02	282.02	2.7566	2.7566	.1339	.94586
920.00	2.2369	2.2369	290.55	290.55	290.94	290.94	2.8373	2.8373	.1337	.95074
940.00	2.2258	2.2258	299.51	299.51	299.91	299.91	2.9181	2.9181	.1334	.95521
960.00	2.2152	2.2152	308.53	308.53	308.94	308.94	2.9993	2.9993	.1331	.95930
1000.00	2.1956	2.1956	326.75	326.75	327.18	327.18	3.1624	3.1624	.1323	.96649

THE ELECTRON DENSITY OF MUSCLE IS 3.314E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.309 BEV, AND THE MINIMUM ENERGY LOSS IS 2.0131 MEV/CM²

THE EFFECTIVE IONIZATION POTENTIAL IS 70.80 ELECTRON VOLTS

NYLON

ELEMENT	ATOMIC NUMBER	ATOMS/MOLECULE	PERCENT BY WEIGHT	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL
H	1	13	9.9393	1.0080	18.30
N	7	1	10.6778	14.007	99.50
C	6	6	54.9391	12.011	77.30
O	8	2	24.3938	15.999	98.50

DENSITY * 1.1300 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS MEV/GH2	PROTON RANGE MG/CH2	PROTON PATH LENGTH MM	MG/CH2	PATH LENGTH STRAGGLING MM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	1031.5	11405	.00101	.11470	.00511	.5691	0.
.15	896.81	.16594	.00147	.16664	.00639	.4205	0.
.20	779.44	.22640	.00200	.22640	.00779	.3548	0.
.30	614.98	.37040	.00329	.37150	.01126	.2950	0.
.40	509.96	.54922	.00485	.55069	.01564	.2672	0.
.50	438.27	.76079	.00673	.76270	.02075	.2509	0.
.60	387.50	1.0034	.00888	1.0050	.02640	.2400	0.
.70	348.72	1.2748	.01128	1.2777	.03251	.2321	0.
.80	317.07	1.5749	.01394	1.5785	.03909	.2259	0.
.90	293.20	1.9019	.01683	1.9061	.04607	.2208	0.
1.00	269.29	2.2572	.01998	2.2621	.05355	.2166	0.
1.20	236.48	3.0499	.02699	3.0563	.06991	.2098	0.
1.40	211.62	3.9438	.03490	3.9519	.08764	.2046	0.
1.60	192.02	4.9359	.04368	4.9458	.10672	.2003	.00001
1.80	176.11	6.0230	.05330	6.0340	.12710	.1967	.00001
2.00	162.91	7.2025	.06374	7.2165	.14875	.1936	.00002
2.20	151.74	8.4728	.07496	8.4890	.17164	.1909	.00003
2.40	142.16	9.8352	.08702	9.8518	.19574	.1884	.00005
2.60	133.83	11.282	.09984	11.303	.22104	.1863	.00007
2.80	126.52	12.817	.11342	12.840	.24751	.1843	.00009
3.00	120.04	14.437	.12776	14.464	.27515	.1825	.00011
3.20	114.25	16.143	.14286	16.172	.30393	.1809	.00013
3.40	109.05	17.932	.15869	17.965	.33383	.1794	.00016
3.60	104.35	19.805	.17527	19.840	.36485	.1780	.00016
3.80	100.07	21.759	.19256	21.798	.39698	.1767	.00021
4.00	96.165	23.795	.21037	23.837	.43019	.1754	.00025
4.20	92.491	25.914	.22832	25.959	.46457	.1743	.00028
4.40	89.201	28.113	.24879	28.162	.50004	.1732	.00031
4.60	86.158	30.389	.26893	30.442	.53655	.1722	.00035
4.80	83.334	32.748	.28981	32.804	.57409	.1713	.00039

NYLON

PROTON ENERGY MEV	ENERGY LOSS MEV/CH	PROTON RANGE CH	PROTON PATH LENGTH GM/CH ²	PROTON PATH LENGTH CM	GM/CH ²	PATH LENGTH STRAGGLING CH	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	80.707	91.198	.03510	.03114	.03524	.03119	.00061	.1704	.00043
5.50	74.869	84.601	.04161	.03682	.04168	.03689	.00071	.1683	.00055
6.00	69.877	78.961	.04852	.04294	.04860	.04301	.00082	.1665	.00158
6.50	65.572	74.056	.05590	.04947	.05599	.04955	.00093	.1649	.00318
7.00	61.810	69.845	.06374	.05641	.06385	.05650	.00105	.1635	.00513
7.50	58.478	66.081	.07205	.06376	.07217	.06386	.00118	.1621	.00726
8.00	55.531	62.750	.08081	.07132	.08094	.07163	.00131	.1609	.00939
8.50	52.892	59.768	.09003	.07967	.09017	.07980	.00145	.1598	.01182
9.00	50.514	57.081	.09969	.08822	.09985	.08836	.00159	.1585	.01365
9.50	48.359	54.645	.10980	.09716	.10997	.09732	.00174	.1579	.01578
10.00	46.396	52.428	.12034	.10649	.12053	.10666	.00189	.1570	.01792
11.00	42.952	48.535	.14273	.12631	.14285	.12650	.00222	.1554	.02218
12.00	40.024	45.228	.16683	.14783	.16708	.14786	.00256	.1540	.02646
13.00	37.504	42.379	.19261	.17045	.19291	.17071	.00293	.1528	.03074
14.00	35.309	39.899	.22007	.19475	.22040	.19505	.00332	.1517	.03503
15.00	33.379	37.718	.24917	.22050	.24954	.22083	.00373	.1507	.03933
16.00	31.668	35.785	.27989	.24749	.28031	.24806	.00416	.1498	.04334
17.00	30.240	34.058	.31223	.27631	.31269	.27672	.00460	.1489	.04796
18.00	28.766	32.506	.34615	.30633	.34667	.30679	.00507	.1482	.05229
19.00	27.524	31.102	.38165	.33774	.38221	.33824	.00556	.1474	.05662
20.00	26.395	29.827	.41871	.37054	.41932	.37108	.00606	.1460	.06097
22.00	24.420	27.594	.49744	.44021	.49817	.44086	.00713	.1456	.06969
24.00	22.746	25.703	.58225	.51526	.58309	.51601	.00827	.1446	.07844
26.00	21.309	24.079	.67302	.59559	.67399	.59645	.00948	.1436	.08371
28.00	20.061	22.669	.76967	.68113	.77077	.68210	.01076	.1428	.08539
30.00	18.966	21.432	.87211	.77178	.87335	.77288	.01211	.1421	.08714
32.00	17.998	20.338	.98025	.86749	.98165	.86871	.01352	.1414	.08895
34.00	17.135	19.362	1.0940	.96817	1.0956	.96953	.01500	.1408	.09082
36.00	16.360	18.487	1.2134	1.0738	1.2151	1.0753	.01654	.1402	.09274
38.00	15.661	17.696	1.3382	1.1842	1.3401	1.1859	.01815	.1397	.09470
40.00	15.026	16.979	1.4684	1.2995	1.4705	1.3013	.01982	.1392	.09670
45.00	13.669	15.446	1.8173	1.6082	1.8198	1.6105	.02425	.1381	.10166
50.00	12.565	14.199	2.1987	1.9458	2.2017	1.9484	.02904	.1372	.10719
55.00	11.649	13.163	2.6118	2.3113	2.6154	2.3145	.03418	.1364	.11270
60.00	10.875	12.289	3.0598	2.7042	3.0699	2.7079	.03966	.1357	.11847
65.00	10.213	11.541	3.5299	3.1238	3.5346	3.1280	.04547	.1350	.12445
70.00	9.6400	10.893	4.0334	3.5694	4.0388	3.5742	.05159	.1345	.13061
75.00	9.1384	10.326	4.5657	4.0404	4.5718	4.0438	.05802	.1340	.13693
80.00	8.6957	9.8261	5.1260	4.5363	5.1329	4.5424	.06474	.1335	.14338
90.00	7.9496	8.9830	6.3328	5.6007	6.3372	5.6082	.07902	.1327	.15656

NYLON

PROTON ENERGY HEV	ENERGY LOSS MEV/CH	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	PATH LENGTH STRAGGLING GM/CM2	PATH LENGTH STRAGGLING PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	7.3447	8.2995	7.6372	6.7586	.09439	1.234	.1320	.16997
110.00	6.5441	7.7339	9.0470	8.0168	.11078	1.223	.1314	.18366
120.00	6.4228	7.2578	10.554	9.3402	.12813	1.212	.1309	.19777
130.00	6.0633	6.8515	12.172	10.771	.14639	1.203	.1305	.21219
140.00	5.7528	6.5006	13.848	12.255	.16553	1.194	.1300	.22683
150.00	5.4819	6.1945	15.627	13.829	.18548	1.185	.1297	.24161
160.00	5.2434	5.9251	17.490	15.478	.20622	1.178	.1293	.25654
170.00	5.0320	5.6861	19.435	17.200	.22771	1.170	.1290	.27164
180.00	4.8432	5.4728	21.459	18.990	.24991	1.163	.1287	.28685
190.00	4.6735	5.2811	23.559	20.849	.27279	1.156	.1284	.30213
200.00	4.5203	5.1080	25.732	22.772	.29632	1.150	.1282	.31742
210.00	4.3813	4.9509	27.977	24.758	.32048	1.144	.1279	.33271
220.00	4.2546	4.8077	30.291	26.806	.34522	1.138	.1277	.34801
230.00	4.1382	4.6762	32.671	28.913	.37054	1.133	.1275	.36328
240.00	4.0316	4.5557	35.117	31.077	.39640	1.127	.1273	.37848
250.00	3.9334	4.4447	37.625	33.339	.42278	1.122	.1271	.39359
260.00	3.8425	4.3421	40.194	35.615	.44966	1.117	.1269	.40859
270.00	3.7583	4.2469	42.823	37.945	.47702	1.113	.1267	.42348
280.00	3.6801	4.1585	45.509	40.325	.50485	1.108	.1265	.43823
290.00	3.6072	4.0761	48.251	42.754	.53311	1.103	.1263	.45283
300.00	3.5391	3.9991	51.111	45.231	.56180	1.099	.1262	.46725
310.00	3.4753	3.9271	53.962	47.754	.59090	1.095	.1260	.48162
320.00	3.4158	3.8596	56.793	50.323	.62039	1.091	.1259	.49588
330.00	3.3595	3.7962	59.743	52.936	.65026	1.087	.1257	.51001
340.00	3.3066	3.7365	62.739	55.522	.68050	1.083	.1255	.52400
350.00	3.2569	3.6803	65.783	58.288	.71108	1.080	.1254	.53782
360.00	3.2099	3.6272	68.872	60.949	.74201	1.076	.1253	.55155
370.00	3.1655	3.5770	72.006	63.722	.77325	1.073	.1251	.56524
380.00	3.1234	3.5295	75.182	66.533	.80482	1.069	.1250	.57886
390.00	3.0836	3.4845	78.401	69.381	.83658	1.066	.1248	.59240
400.00	3.0458	3.4417	81.660	72.265	.86884	1.063	.1247	.60583
410.00	3.0099	3.4011	84.929	75.185	.90127	1.060	.1246	.61907
420.00	2.9757	3.3625	88.206	78.138	.93398	1.053	.1244	.63201
430.00	2.9432	3.3258	91.671	81.125	.96696	1.053	.1243	.64466
440.00	2.9122	3.2908	95.083	84.144	1.0002	1.051	.1242	.65701
450.00	2.8826	3.2574	98.530	87.195	1.0337	1.048	.1240	.66906
460.00	2.8544	3.2255	102.01	90.276	1.0674	1.045	.1239	.68081
470.00	2.8274	3.1950	105.53	93.388	1.1013	1.042	.1238	.69226
480.00	2.8016	3.1658	109.08	96.528	1.1355	1.040	.1236	.70340
490.00	2.7769	3.1379	112.66	99.697	1.1698	1.037	.1235	.71424

NYLON

PROTON ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE CM	PROTON PATH LENGTH GM/CM ²	PROTON PATH LENGTH CM	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	2.7533	116.27	116.41	103.02	1.2044	1.035	.72479
510.00	2.7306	119.91	120.06	106.25	1.2392	1.032	.73504
520.00	2.7089	123.59	123.74	109.50	1.2742	1.030	.74501
530.00	2.6880	127.29	127.44	112.64	1.3094	1.027	.75470
540.00	2.6679	131.02	131.18	115.94	1.3447	1.025	.76412
550.00	2.6487	134.77	134.94	119.42	1.3803	1.023	.77325
560.00	2.6302	138.56	138.73	122.77	1.4160	1.021	.78212
570.00	2.6123	142.31	142.54	126.14	1.4519	1.019	.79072
580.00	2.5952	146.21	146.38	129.54	1.4879	1.016	.79905
590.00	2.5786	150.07	150.25	132.96	1.5241	1.014	.80712
600.00	2.5627	153.95	154.14	136.41	1.5604	1.012	.81492
620.00	2.5325	161.79	161.99	143.36	1.6336	1.008	.82980
640.00	2.5045	169.73	169.93	150.38	1.7073	1.005	.84371
660.00	2.4783	177.75	177.96	157.30	1.7815	1.001	.85670
680.00	2.4538	185.85	186.07	164.47	1.8563	0.9976	.86879
700.00	2.4309	194.03	194.26	171.91	1.9315	0.9942	.88004
720.00	2.4094	202.28	202.53	179.23	2.0072	0.9911	.89047
740.00	2.3892	210.61	210.86	186.38	2.0833	0.9880	.90013
760.00	2.3703	219.00	219.27	194.04	2.1599	0.9850	.90905
780.00	2.3525	227.47	227.74	201.54	2.2368	0.9822	.91726
800.00	2.3357	235.99	236.27	209.09	2.3141	0.9794	.92479
820.00	2.3199	244.57	244.86	216.69	2.3918	0.9768	.93170
840.00	2.3050	253.21	253.51	224.35	2.4698	0.9742	.93802
860.00	2.2910	261.91	262.22	232.05	2.5482	0.9718	.94380
880.00	2.2777	270.66	270.98	239.80	2.6268	0.9694	.94909
900.00	2.2651	279.45	279.79	247.60	2.7058	0.9671	.95391
920.00	2.2532	288.30	288.65	255.44	2.7850	0.9649	.95830
940.00	2.2419	297.20	297.55	263.32	2.8646	0.9627	.96230
960.00	2.2312	306.15	306.51	271.25	2.9444	0.9606	.96595
1000.00	2.2114	324.25	324.63	287.28	3.1047	0.9564	.97229

THE ELECTRON DENSITY OF NYLON IS 3.307E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.323 BEV, AND THE MINIMUM ENERGY LOSS IS 2.0265 MEV/GM/CM²

THE EFFECTIVE IONIZATION POTENTIAL IS 64.45 ELECTRON VOLTS

POLYETHYLENE

ADJUSTED
IONIZATION
POTENTIAL
77,
12

ATOMIC
WEIGHT
12.011
1.0080

PERCENT
BY WEIGHT
85.62/12
14.37/12

ATOMS/
MOLECULE
1
2

ATOMIC
NUMBER
6
1

ELEMENT
C
H

DENSITY = .92000 GM./CMS

ELEMENT	ATOMIC NUMBER	ATOMS/MOLECULE	PERCENT BY WEIGHT	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL	PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
						MG/CM2	MM	MG/CM2	MM	MG/CM2	MM		
1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	0.	
1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	0.	
1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	0.	
1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	0.	
1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	0.	
2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.	
2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	0.	
2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	0.	
2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	0.	
2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	0.	
3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	0.	
3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	0.	
3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	0.	
3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	0.	
3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	0.	
4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	0.	
4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	0.	
4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40	0.	
4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	0.	
4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	0.	

POLYETHYLENE

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GH/CH2	PROTON PATH LENGTH CH	PROTON PATH LENGTH GH/CH2	PATH LENGTH STRAGGLING CH	GH/CH2	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	86.925	0.3529	0.3537	0.3254	0.0052	0.0057	1.763	1.498	0.0043
5.50	80.581	0.3847	0.4187	0.3852	0.0073	0.0067	1.737	1.481	0.0054
6.00	75.170	0.4489	0.4886	0.4495	0.0084	0.0077	1.714	1.466	0.0196
6.50	70.497	0.5175	0.5633	0.5182	0.0095	0.0088	1.694	1.452	0.0463
7.00	66.417	0.5905	0.6428	0.5913	0.0108	0.0099	1.675	1.440	0.0607
7.50	62.822	0.6678	0.7269	0.6688	0.0121	0.0111	1.659	1.429	0.0812
8.00	59.628	0.7494	0.8146	0.7505	0.0134	0.0123	1.644	1.419	0.1016
8.50	56.770	0.8353	0.9079	0.8365	0.0148	0.0136	1.631	1.409	0.1221
9.00	54.196	0.9253	1.0038	0.9266	0.0163	0.0150	1.618	1.401	0.1425
9.50	51.865	1.0196	1.1082	1.0210	0.0178	0.0164	1.607	1.393	0.1630
10.00	49.744	1.1173	1.2151	1.1194	0.0194	0.0179	1.596	1.386	0.1834
11.00	46.024	1.3243	1.4422	1.3263	0.0228	0.0210	1.577	1.372	0.2244
12.00	42.865	1.5516	1.6868	1.5536	0.0264	0.0243	1.561	1.360	0.2654
13.00	40.147	1.7927	1.9486	1.7951	0.0302	0.0277	1.546	1.350	0.3065
14.00	37.782	2.0493	2.2275	2.0520	0.0342	0.0314	1.533	1.341	0.3477
15.00	35.704	2.3243	2.5231	2.3263	0.0384	0.0353	1.520	1.332	0.3890
16.00	33.863	2.6121	2.8392	2.6141	0.0429	0.0394	1.509	1.324	0.4304
17.00	32.219	2.9111	3.1684	2.9130	0.0475	0.0437	1.499	1.317	0.4719
18.00	30.742	3.2286	3.5139	3.2328	0.0524	0.0482	1.489	1.311	0.5135
19.00	29.407	3.5608	3.8705	3.5655	0.0574	0.0528	1.481	1.304	0.5552
20.00	28.195	3.9073	4.2476	3.9129	0.0627	0.0576	1.473	1.299	0.5969
22.00	26.073	4.6452	5.0491	4.6512	0.0737	0.0678	1.459	1.289	0.6807
24.00	24.277	5.4397	5.9127	5.4467	0.0856	0.0787	1.446	1.280	0.7648
26.00	22.736	6.2905	6.8375	6.2985	0.0982	0.0903	1.434	1.272	0.8153
28.00	21.398	7.1965	7.8224	7.2037	0.1115	0.1026	1.423	1.265	0.8310
30.00	20.225	8.1573	8.8666	8.1676	0.1255	0.1154	1.413	1.258	0.8473
32.00	19.187	9.1717	9.9693	9.1833	0.1402	0.1290	1.405	1.252	0.8643
34.00	18.263	1.0239	1.1130	1.0252	0.1556	0.1431	1.396	1.247	0.8817
36.00	17.433	1.1359	1.2347	1.1373	0.1717	0.1579	1.389	1.242	0.8996
38.00	16.685	1.2531	1.3620	1.2546	0.1884	0.1733	1.381	1.238	0.9179
40.00	16.006	1.3753	1.4968	1.3770	0.2057	0.1893	1.375	1.233	0.9367
45.00	14.555	1.7030	1.8511	1.7051	0.2519	0.2318	1.359	1.224	0.9849
50.00	13.275	2.0613	2.2406	2.0638	0.3019	0.2777	1.346	1.216	1.0346
55.00	12.396	2.4495	2.6625	2.4525	0.3555	0.3271	1.334	1.209	1.0860
60.00	11.570	2.8668	3.1161	2.8703	0.4127	0.3797	1.323	1.203	1.1398
65.00	10.863	3.3126	3.6050	3.3166	0.4733	0.4354	1.313	1.197	1.1956
70.00	10.251	3.7861	4.1203	3.7907	0.5372	0.4942	1.304	1.192	1.2531
75.00	9.7155	4.2919	4.6651	4.2919	0.6043	0.5559	1.295	1.188	1.3121
80.00	9.2332	4.8140	5.2327	4.8197	0.6745	0.6205	1.287	1.184	1.3722
90.00	8.4475	5.9459	6.4630	5.9529	0.8237	0.7578	1.273	1.177	1.4951

POLYETHYLENE

PRCTJN ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CH	GH/CH2	CM	GH/CH2	CM	GH/CH2	CM	PERCENT	PERCENT	
100.00	7.8026	7.1784	7.1776	7.8017	7.1860	7.8108	.09056	.09843	1.260	.1171	.16199
110.00	7.2691	6.6876	8.1505	9.2446	9.1549	9.2554	.10632	.11556	1.249	.1166	.17476
120.00	6.8202	6.2746	9.1924	10.788	9.9362	10.800	.12301	.13370	1.238	.1161	.18794
130.00	6.4372	5.9222	11.433	12.427	11.446	12.442	.14058	.15280	1.228	.1157	.20145
140.00	6.1065	5.6180	13.027	14.180	13.042	14.176	.15899	.17281	1.219	.1153	.21519
150.00	5.8180	5.3524	14.704	15.982	14.721	16.001	.17819	.19369	1.211	.1150	.22910
160.00	5.5642	5.1191	16.460	17.891	16.479	17.912	.19816	.21539	1.203	.1147	.24318
170.00	5.3391	4.9120	18.293	19.884	18.314	19.907	.21805	.23788	1.195	.1144	.25745
180.00	5.1381	4.7271	20.201	21.937	20.224	21.982	.24023	.26111	1.188	.1141	.27186
190.00	4.9576	4.5610	22.180	24.109	22.206	24.137	.26226	.28507	1.181	.1138	.28636
200.00	4.7946	4.4110	24.230	26.337	24.257	26.367	.28492	.30970	1.175	.1136	.30090
210.00	4.6466	4.2749	26.346	28.637	26.376	28.670	.30819	.33499	1.168	.1134	.31546
220.00	4.5118	4.1509	28.528	31.009	28.561	31.044	.33203	.36090	1.163	.1132	.33004
230.00	4.3884	4.0373	30.774	33.450	30.809	33.488	.35642	.38741	1.157	.1130	.34458
240.00	4.2751	3.9331	33.080	35.957	33.118	35.997	.38133	.41449	1.151	.1128	.35908
250.00	4.1707	3.8370	35.446	38.528	35.486	38.572	.40675	.44212	1.146	.1126	.37349
260.00	4.0742	3.7482	37.870	41.163	37.912	41.209	.43266	.47026	1.141	.1124	.38780
270.00	3.9847	3.6659	40.349	43.858	40.395	43.907	.45903	.49894	1.136	.1123	.40202
280.00	3.9009	3.5889	42.884	46.613	42.932	46.665	.48584	.52609	1.132	.1121	.41612
290.00	3.8234	3.5175	45.470	49.424	45.521	49.479	.51309	.55771	1.127	.1119	.43008
300.00	3.7510	3.4509	48.108	52.291	48.162	52.350	.54075	.58777	1.123	.1118	.44368
310.00	3.6832	3.3885	50.795	55.212	50.852	55.274	.56880	.61820	1.119	.1116	.45771
320.00	3.6196	3.3301	53.532	58.187	53.592	58.252	.59723	.64917	1.114	.1115	.47149
330.00	3.5599	3.2751	56.315	61.212	56.378	61.280	.62603	.68047	1.110	.1114	.48521
340.00	3.5037	3.2234	59.144	64.287	59.210	64.358	.65519	.71216	1.107	.1112	.49884
350.00	3.4508	3.1747	62.017	67.409	62.086	67.484	.68468	.74422	1.103	.1111	.51237
360.00	3.4008	3.1287	64.933	70.579	65.005	70.657	.71450	.77663	1.099	.1109	.52586
370.00	3.3536	3.0853	67.890	73.704	67.966	73.876	.74463	.80938	1.096	.1108	.53937
380.00	3.3088	3.0441	70.889	77.053	70.968	77.139	.77507	.84247	1.092	.1107	.55287
390.00	3.2664	3.0051	73.927	80.356	74.009	80.445	.80551	.87588	1.089	.1105	.56635
400.00	3.2262	2.9681	77.004	83.701	77.090	83.793	.83682	.90959	1.086	.1104	.57977
410.00	3.1880	2.9336	80.119	87.086	80.208	87.182	.86811	.94360	1.082	.1103	.59304
420.00	3.1516	2.8995	83.270	90.511	83.362	90.611	.89967	.97790	1.079	.1102	.60605
430.00	3.1170	2.8677	86.460	93.978	86.555	94.082	.93146	1.0125	1.076	.1100	.61880
440.00	3.0840	2.8373	89.682	97.480	89.781	97.588	.96353	1.0473	1.073	.1099	.63129
450.00	3.0526	2.8084	92.938	101.02	93.040	101.13	.99583	1.0824	1.070	.1098	.64351
460.00	3.0225	2.7807	96.226	104.59	96.332	104.71	1.0284	1.1178	1.068	.1097	.65545
470.00	2.9938	2.7543	99.547	108.20	99.656	108.32	1.0611	1.1534	1.065	.1096	.66712
480.00	2.9663	2.7290	102.90	111.85	103.01	111.97	1.0941	1.1892	1.062	.1094	.67851
490.00	2.9400	2.7048	106.28	115.52	106.40	115.65	1.1272	1.2253	1.059	.1093	.68962

POLYETHYLENE

PROTON ENERGY MEV	ENERGY LOSS MEV/GH/CM2	PROTON RANGE GH/CM2	PROTON RANGE CM	PROTON PATH LENGTH GH/CM2	PROTON PATH LENGTH CM	PATH LENGTH STRAGGLING GH/CM2	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	2.9148	2.6817	109.69	119.23	109.81	1.1606	1.2615	1.057	.70645
510.00	2.8907	2.6594	113.14	122.97	113.26	1.1942	1.2980	1.054	.71102
520.00	2.8675	2.6381	116.61	126.75	116.73	1.2280	1.3347	1.052	.72133
530.00	2.8453	2.6177	120.10	130.55	120.23	1.2619	1.3716	1.050	.73139
540.00	2.8239	2.5980	123.63	134.38	123.76	1.2960	1.4087	1.047	.74120
550.00	2.8034	2.5791	127.18	138.24	127.32	1.3303	1.4460	1.045	.75075
560.00	2.7837	2.5610	130.75	142.12	130.90	1.3648	1.4835	1.043	.76004
570.00	2.7647	2.5435	134.35	146.04	134.50	1.3994	1.5211	1.040	.76908
580.00	2.7464	2.5267	137.98	149.98	138.13	1.4342	1.5589	1.038	.77787
590.00	2.7288	2.5105	141.63	153.94	141.78	1.4692	1.5969	1.036	.78641
600.00	2.7118	2.4948	145.30	157.94	145.46	1.5043	1.6351	1.034	.79470
620.00	2.6796	2.4652	152.71	165.99	152.88	1.5749	1.7118	1.030	.81057
640.00	2.6497	2.4377	160.21	174.14	160.39	1.6460	1.7892	1.026	.82551
660.00	2.6217	2.4120	167.79	182.38	167.97	1.7177	1.8671	1.023	.83954
680.00	2.5955	2.3879	175.45	190.71	175.64	1.7899	1.9456	1.019	.85270
700.00	2.5711	2.3654	183.19	199.12	183.38	1.8626	2.0245	1.016	.86550
720.00	2.5481	2.3443	190.99	207.60	191.20	1.9357	2.1040	1.012	.87647
740.00	2.5266	2.3243	198.87	216.16	199.08	2.0092	2.1839	1.009	.88715
760.00	2.5064	2.3059	206.81	224.79	207.03	2.0832	2.2643	1.006	.89706
780.00	2.4874	2.2884	214.81	233.49	215.04	2.1575	2.3451	1.003	.90621
800.00	2.4694	2.2719	222.87	242.25	223.11	2.2322	2.4263	1.000	.91462
820.00	2.4525	2.2563	230.99	251.08	231.24	2.3072	2.5078	.9978	.92336
840.00	2.4366	2.2416	239.17	259.97	239.42	2.3826	2.5898	.9951	.93247
860.00	2.4215	2.2278	247.40	268.91	247.66	2.4583	2.6720	.9926	.94195
880.00	2.4072	2.2146	255.67	277.91	255.94	2.5343	2.7547	.9902	.94195
900.00	2.3937	2.2022	264.00	286.96	264.28	2.6106	2.8376	.9878	.94740
920.00	2.3809	2.1905	272.37	296.06	272.66	2.6872	2.9208	.9855	.95239
940.00	2.3688	2.1793	280.80	305.21	281.09	2.7640	3.0044	.9833	.95594
960.00	2.3574	2.1688	289.27	314.42	289.57	2.8412	3.0882	.9812	.96109
1000.00	2.3361	2.1492	306.40	333.04	306.71	2.9962	3.2567	.9769	.96831

THE ELECTRON DENSITY OF POLYETHYLENE IS 3.436E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.350 BEV, AND THE MINIMUM ENERGY LOSS IS 2.1343 MEV/GH/CM2

THE EFFECTIVE IONIZATION POTENTIAL IS 55.92 ELECTRON VOLTS

POLYSTYRENE

ADJUSTED
IONIZATION
POTENTIAL
77.30
18.30

ATOMIC
WEIGHT
12.011
1.0080

PERCENT
BY WEIGHT
92.2578
7.7422

ATOMS/
MOLECULE
1
1

ATOMIC
NUMBER
6
1

ELEMENT
C
H

DENSITY = 1.0600 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS MEV/GM	PROTON RANGE HG/CM2	PROTON PATH LENGTH MM	MG/CM2	MG/CM2	PATH LENGTH STRAGGLING MM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	1028.7	.12272	.00116	.12342	.00510	.00005	4.130	.5622	0.
.15	882.01	.17512	.00165	.17586	.00611	.00006	3.472	.4208	0.
.20	766.95	.23577	.00222	.23661	.00741	.00007	3.132	.3549	0.
.30	604.78	.38296	.00361	.38409	.01075	.00010	2.798	.2926	0.
.40	500.91	.56495	.00533	.56644	.01493	.00014	2.635	.2631	0.
.50	430.52	.78035	.00736	.78228	.01979	.00019	2.530	.2456	0.
.60	380.12	1.0275	.00969	1.0299	.02519	.00024	2.446	.2338	0.
.70	342.19	1.3041	.01230	1.3071	.03105	.00029	2.374	.2254	0.
.80	310.5	1.6105	.01519	1.6140	.03740	.00035	2.317	.2168	0.
.90	287.10	1.9447	.01835	1.9488	.04417	.00042	2.266	.2135	0.
1.00	264.02	2.3073	.02177	2.3121	.05137	.00048	2.222	.2091	0.
1.20	232.10	3.1154	.02939	3.1217	.06710	.00063	2.149	.2020	0.
1.40	207.88	4.0259	.03798	4.0338	.08414	.00079	2.086	.1967	.00001
1.60	188.77	5.0355	.04750	5.0452	.10247	.00097	2.031	.1923	.00001
1.80	173.22	6.1411	.05794	6.1527	.12206	.00115	1.984	.1886	.00002
2.00	160.29	7.3402	.06925	7.3538	.14288	.00135	1.943	.1855	.00003
2.20	149.35	8.6311	.08143	8.6469	.16492	.00156	1.907	.1827	.00004
2.40	139.94	10.013	.09447	10.031	.18815	.00178	1.876	.1802	.00006
2.60	131.76	11.485	.10835	11.505	.21257	.00201	1.848	.1780	.00008
2.80	124.57	13.044	.12306	13.067	.23815	.00225	1.823	.1761	.00010
3.00	118.20	14.690	.13858	14.716	.26487	.00250	1.800	.1743	.00013
3.20	112.50	16.422	.15493	16.451	.29273	.00276	1.779	.1725	.00015
3.40	107.39	18.239	.17207	18.271	.32171	.00303	1.761	.1711	.00018
3.60	102.75	20.142	.19001	20.176	.35179	.00332	1.744	.1697	.00022
3.80	98.541	22.126	.20874	22.164	.38297	.00361	1.728	.1684	.00025
4.00	94.691	24.194	.22824	24.234	.41524	.00392	1.713	.1672	.00029
4.20	91.010	26.347	.24855	26.390	.44873	.00423	1.700	.1660	.00033
4.40	87.776	28.583	.26965	28.630	.48330	.00456	1.688	.1650	.00037
4.60	84.784	30.895	.29146	30.945	.51890	.00490	1.677	.1640	.00041
4.80	82.008	33.293	.31408	33.347	.55552	.00524	1.666	.1630	.00046

POLYSTYRENE

PROTON ENERGY HEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	HEV/CH2	HEV/CH	GH/CH2	CH	GH/CH2	CH	GH/CH2	CH		
5.00	79.423	84.189	.63577	.03374	.03583	.03380	.00059	.00056	.1621	.00051
5.50	73.679	78.100	.04230	.03991	.04237	.03997	.00069	.00065	.1601	.00064
6.00	68.775	73.901	.04932	.04653	.04940	.04658	.00080	.00075	.1583	.00233
6.50	64.534	68.407	.05682	.05360	.05691	.05368	.00091	.00086	.1567	.00474
7.00	60.829	64.479	.06479	.06112	.06489	.06122	.00102	.00097	.1553	.00715
7.50	57.561	61.019	.07323	.06909	.07334	.06919	.00115	.00108	.1540	.00955
8.00	54.655	57.935	.08213	.07749	.08226	.07760	.00128	.00120	.1528	.01195
8.50	52.054	55.177	.09150	.08632	.09164	.08645	.00141	.00133	.1517	.01435
9.00	49.710	52.692	.10132	.09558	.10147	.09573	.00155	.00146	.1507	.01674
9.50	47.586	50.441	.11159	.10527	.11175	.10543	.00170	.00160	.1498	.01914
10.00	45.652	48.391	.12230	.11538	.12248	.11555	.00185	.00174	.1489	.02153
11.00	42.259	44.794	.14506	.13685	.14527	.13705	.00216	.00204	.1474	.02632
12.00	39.375	41.738	.16956	.15996	.16980	.16019	.00251	.00236	.1460	.03112
13.00	36.893	39.106	.19577	.18469	.19605	.18496	.00287	.00270	.1448	.03591
14.00	34.731	36.815	.22369	.21102	.22401	.21133	.00325	.00306	.1438	.04072
15.00	32.831	34.801	.25327	.23893	.25363	.23927	.00365	.00344	.1428	.04552
16.00	31.146	33.015	.28451	.26841	.28492	.26879	.00407	.00384	.1419	.05034
17.00	29.642	31.420	.31739	.29943	.31784	.29985	.00451	.00426	.1411	.05516
18.00	28.290	29.987	.35189	.33197	.35239	.33244	.00497	.00469	.1403	.05999
19.00	27.067	28.691	.38799	.36602	.38853	.36654	.00545	.00514	.1396	.06482
20.00	25.956	27.514	.42568	.40158	.42627	.40214	.00595	.00562	.1390	.06966
22.00	24.012	25.452	.50575	.47712	.50645	.47778	.00700	.00661	.1379	.07935
24.00	22.365	23.707	.59201	.55850	.59282	.55926	.00813	.00767	.1369	.08906
26.00	20.951	22.208	.68434	.64560	.68527	.64648	.00932	.00880	.1360	.09488
28.00	19.723	20.906	.78265	.73835	.78371	.73935	.01059	.00999	.1352	.09669
30.00	18.646	19.765	.88686	.83666	.88803	.83779	.01192	.01124	.1344	.09857
32.00	17.693	18.759	.99687	.94045	.99821	.94171	.01331	.01256	.1338	.10032
34.00	16.844	17.854	1.1126	1.0496	1.1141	1.0510	.01478	.01394	.1332	.10252
36.00	16.082	17.047	1.2340	1.1642	1.2357	1.1657	.01630	.01538	.1326	.10458
38.00	15.394	16.317	1.3610	1.2840	1.3628	1.2857	.01789	.01687	.1321	.10669
40.00	14.770	15.656	1.4935	1.4090	1.4955	1.4108	.01954	.01843	.1316	.10884
45.00	13.455	14.241	1.8485	1.7439	1.8509	1.7461	.02392	.02256	.1306	.11437
50.00	12.350	13.091	2.2366	2.1100	2.2395	2.1127	.02866	.02704	.1297	.12006
55.00	11.448	12.135	2.6569	2.5066	2.6604	2.5096	.03375	.03184	.1289	.12596
60.00	10.688	11.329	3.1087	2.9328	3.1127	2.9365	.03918	.03696	.1283	.13210
65.00	10.037	10.639	3.5912	3.3879	3.5958	3.3922	.04493	.04239	.1277	.13847
70.00	9.4731	10.041	4.1036	3.8713	4.1088	3.8762	.05099	.04811	.1271	.14503
75.00	8.9799	9.5187	4.6453	4.3823	4.6512	4.3879	.05736	.05411	.1266	.15175
80.00	8.5447	9.0573	5.2156	4.9204	5.2222	4.9266	.06402	.06040	.1262	.15859
90.00	7.8112	8.2798	6.4398	6.0753	6.4479	6.0829	.07819	.07376	.1254	.17253

POLYSTYRENE

PROTON ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE CM	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CH	GM/CM2	PATH LENGTH STRAGGLING CH	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	7.2165	7.3316	7.7812	7.3407	.09342	.08814	1.201	.1248	.18667
110.00	6.7245	8.6853	9.2379	8.6961	.10968	.10347	1.190	.1242	.20109
120.00	6.3104	10.133	10.741	10.145	.12689	.11971	1.180	.1237	.21593
130.00	5.9570	11.671	12.386	11.685	.14501	.13680	1.171	.1232	.23109
140.00	5.6517	13.295	14.110	13.312	.16400	.15472	1.162	.1228	.24647
150.00	5.3855	15.004	15.924	15.022	.18381	.17340	1.154	.1224	.26199
160.00	5.1511	16.794	17.823	16.814	.20440	.19283	1.147	.1221	.27766
170.00	4.9433	18.662	19.781	18.684	.22573	.21296	1.140	.1218	.29349
180.00	4.7577	20.630	21.868	20.630	.24778	.23375	1.133	.1215	.30941
190.00	4.5910	22.622	24.008	22.649	.27050	.25519	1.127	.1212	.32539
200.00	4.4405	24.709	26.224	24.739	.29387	.27724	1.121	.1210	.34135
210.00	4.3038	26.865	28.512	26.898	.31786	.29987	1.115	.1208	.35728
220.00	4.1793	29.087	30.870	29.123	.34244	.32306	1.109	.1205	.37317
230.00	4.0653	31.374	33.296	31.412	.36759	.34679	1.104	.1203	.38898
240.00	3.9603	33.723	35.789	33.763	.39329	.37102	1.099	.1201	.40466
250.00	3.8638	36.132	38.346	36.175	.41950	.39575	1.094	.1199	.42020
260.00	3.7746	38.599	40.964	38.646	.44621	.42095	1.089	.1197	.43558
270.00	3.6919	41.124	43.643	41.173	.47340	.44660	1.085	.1196	.45079
280.00	3.6150	43.704	46.381	43.756	.50105	.47269	1.080	.1194	.46582
290.00	3.5433	46.337	49.176	46.392	.52914	.49919	1.076	.1192	.48064
300.00	3.4764	49.022	52.025	49.080	.55766	.52609	1.072	.1190	.49523
310.00	3.4138	51.737	54.928	51.819	.58658	.55338	1.068	.1189	.50972
320.00	3.3552	54.542	57.883	54.607	.61590	.58104	1.064	.1187	.52409
330.00	3.3000	57.374	60.888	57.442	.64559	.60905	1.060	.1186	.53832
340.00	3.2482	60.282	63.943	60.323	.67565	.63741	1.057	.1184	.55239
350.00	3.1993	63.175	67.045	63.250	.70606	.66609	1.053	.1183	.56628
360.00	3.1531	66.143	70.194	66.221	.73680	.69510	1.050	.1181	.58007
370.00	3.1095	69.152	73.388	69.234	.76787	.72441	1.046	.1180	.59380
380.00	3.0682	72.203	76.626	72.289	.79925	.75401	1.043	.1179	.60746
390.00	3.0291	75.294	79.906	75.383	.83094	.78390	1.040	.1177	.62101
400.00	2.9920	78.425	83.228	78.517	.86292	.81407	1.037	.1176	.63444
410.00	2.9567	81.593	86.590	81.689	.89517	.84450	1.034	.1175	.64765
420.00	2.9232	84.798	89.992	84.898	.92770	.87519	1.031	.1173	.66052
430.00	2.8912	88.040	93.432	88.143	.96050	.90613	1.028	.1172	.67307
440.00	2.8608	91.317	96.909	91.424	.99354	.93730	1.025	.1171	.68529
450.00	2.8318	94.627	100.42	94.738	1.0268	.96871	1.023	.1169	.69718
460.00	2.8041	97.972	103.97	98.066	1.0604	1.0003	1.020	.1168	.70873
470.00	2.7776	101.35	107.55	101.47	1.0941	1.0322	1.017	.1167	.71995
480.00	2.7523	104.76	111.17	104.88	1.1281	1.0642	1.015	.1166	.73085
490.00	2.7280	108.20	114.82	108.32	1.1623	1.0965	1.012	.1164	.74141

POLYSTYRENE

PROTON ENERGY MEV	ENERGY LOSS MEV/CM	PROTON RANGE CM	PROTON PATH LENGTH GM/CM ²	PROTON PATH LENGTH CM	PATH LENGTH STRAGGLING CM	GM/CM ²	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	2.7048	118.36	118.50	111.79	1.1967	1.1290	1.010	.1163	.75166
510.00	2.6626	122.67	122.21	115.30	1.2313	1.1816	1.007	.1162	.76159
520.00	2.6212	125.81	125.96	118.83	1.2661	1.1944	1.005	.1161	.77121
530.00	2.6407	129.58	129.73	122.39	1.3011	1.2275	1.003	.1160	.78053
540.00	2.6211	133.38	133.53	125.97	1.3363	1.2606	1.001	.1158	.78955
550.00	2.6021	137.20	137.36	129.59	1.3716	1.2940	.9986	.1157	.79828
560.00	2.5840	141.05	141.22	133.22	1.4072	1.3275	.9965	.1156	.80672
570.00	2.5665	144.93	145.10	136.89	1.4429	1.3612	.9944	.1155	.81487
580.00	2.5496	148.84	149.01	140.57	1.4787	1.3950	.9924	.1154	.82274
590.00	2.5334	152.77	152.94	144.29	1.5147	1.4290	.9904	.1152	.83034
600.00	2.5178	156.72	156.90	148.02	1.5509	1.4631	.9884	.1151	.83767
620.00	2.4882	164.71	164.89	155.56	1.6237	1.5318	.9847	.1149	.85155
640.00	2.4607	172.78	172.98	163.19	1.6970	1.6010	.9811	.1147	.86444
660.00	2.4349	180.94	181.15	170.90	1.7709	1.6707	.9776	.1144	.87638
680.00	2.4109	189.19	189.40	178.62	1.8453	1.7409	.9743	.1142	.88743
700.00	2.3885	197.51	197.74	186.33	1.9202	1.8115	.9711	.1140	.89763
720.00	2.3674	205.92	206.15	194.43	1.9955	1.8826	.9680	.1137	.90702
740.00	2.3477	214.39	214.63	202.49	2.0713	1.9541	.9650	.1135	.91566
760.00	2.3291	222.91	223.19	210.55	2.1475	2.0260	.9622	.1133	.92359
780.00	2.3117	231.55	231.81	218.69	2.2241	2.0982	.9595	.1130	.93084
800.00	2.2952	240.22	240.49	226.88	2.3011	2.1708	.9568	.1128	.93745
820.00	2.2798	248.96	249.24	235.13	2.3784	2.2438	.9543	.1126	.94348
840.00	2.2652	257.75	258.04	243.43	2.4560	2.3170	.9518	.1124	.94897
860.00	2.2514	266.60	266.90	251.79	2.5340	2.3906	.9494	.1121	.95396
880.00	2.2383	275.50	275.81	260.20	2.6124	2.4645	.9472	.1119	.95850
900.00	2.2260	284.45	284.77	268.65	2.6910	2.5387	.9450	.1117	.96261
920.00	2.2144	293.46	293.79	277.16	2.7699	2.6131	.9428	.1115	.96635
940.00	2.2033	302.51	302.85	285.71	2.8491	2.6878	.9408	.1112	.96972
960.00	2.1929	311.62	311.97	294.31	2.9285	2.7628	.9387	.1109	.97279
1000.00	2.1735	330.03	330.40	311.69	3.0882	2.9134	.9347	.1107	.97806

THE ELECTRON DENSITY OF POLYSTYRENE IS 3.239E 23 ELECTRONS PER GRAM
 THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.327 BEV, AND THE MINIMUM ENERGY LOSS IS 1.996E1 MEV/GM/CM2
 THE EFFECTIVE IONIZATION POTENTIAL IS 62.92 ELECTRON VOLTS

SARAN

ELEMENT	ATOMIC NUMBER	ATOMS/MOLECULE	PERCENT BY WEIGHT	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL
C	6	2	24.7795	12.011	77.30
H	1	2	2.0795	1.0080	18.30
CL	17	2	73.1410	35.453	170.0

DENSITY = 1.6900 GM/CM3

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE MM	PROTON PATH LENGTH HG/CM2	PROTON PATH LENGTH MM	ATOMS/MOLECULE	PERCENT BY WEIGHT	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL	FATH LENGTH STRAGGLING MM	FATH LENGTH PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	622.88	1052.7	.32709	.00134	.22959	.00136	.01184	.00007	5.156	1.090	0.	
.15	541.10	914.46	.31297	.00185	.31565	.00187	.01381	.00008	4.376	.8483	0.	
.20	474.71	802.26	.41118	.00243	.41424	.00245	.01640	.00010	3.950	.7391	0.	
.30	379.24	640.92	.64687	.00383	.65104	.00385	.02311	.00014	3.519	.6401	0.	
.40	321.42	543.19	.93298	.00552	.93856	.00555	.03120	.00018	3.324	.5940	0.	
.50	281.11	475.07	1.2646	.00748	1.2717	.00753	.04010	.00024	3.153	.5660	0.	
.60	252.73	427.11	1.6368	.00970	1.6478	.00975	.04966	.00029	3.014	.5462	0.	
.70	230.59	389.70	2.0510	.01214	2.0619	.01220	.05961	.00035	2.891	.5309	0.	
.80	212.17	358.57	2.5010	.01480	2.5140	.01488	.07002	.00041	2.785	.5182	0.	
.90	203.18	343.38	2.9801	.01763	2.9952	.01772	.08029	.00048	2.681	.5072	0.	
1.00	194.18	328.16	3.4816	.02060	3.4790	.02070	.09000	.00053	2.572	.4970	0.	
1.20	172.45	291.44	4.5720	.02705	4.5940	.02718	.11023	.00065	2.399	.4792	0.	
1.40	155.67	263.08	5.7897	.03426	5.8167	.03442	.13273	.00079	2.282	.4645	0.	
1.60	142.23	240.37	7.1392	.04219	7.1626	.04238	.15771	.00093	2.202	.4521	0.	
1.80	131.18	221.69	8.5902	.05083	8.6283	.05106	.18493	.00109	2.143	.4415	.00001	
2.00	121.88	205.97	10.167	.06016	10.211	.06042	.21419	.00127	2.098	.4324	.00001	
2.20	113.94	192.56	11.859	.07017	11.909	.07047	.24535	.00145	2.060	.4243	.00002	
2.40	107.10	181.01	13.664	.08085	13.721	.08119	.27828	.00165	2.028	.4172	.00003	
2.60	101.16	170.96	15.579	.09218	15.643	.09256	.31286	.00185	2.000	.4109	.00003	
2.80	95.839	161.97	17.603	.10416	17.675	.10459	.34904	.00207	1.975	.4052	.00005	
3.00	91.176	154.09	19.736	.11678	19.816	.11725	.38687	.00229	1.952	.4000	.00006	
3.20	87.010	147.05	21.974	.13002	22.051	.13054	.42610	.00252	1.931	.3953	.00007	
3.40	83.246	140.69	24.317	.14389	24.412	.14445	.46675	.00276	1.912	.3910	.00008	
3.60	79.835	134.92	26.763	.15836	26.812	.15897	.50879	.00301	1.894	.3871	.00010	
3.80	76.710	129.64	29.310	.17343	29.423	.17410	.55321	.00327	1.877	.3834	.00012	
4.00	73.843	124.79	31.958	.18910	32.080	.18932	.59699	.00353	1.861	.3800	.00014	
4.20	71.167	120.27	34.709	.20538	34.840	.20516	.64316	.00381	1.846	.3769	.00016	
4.40	68.739	116.17	37.561	.22225	37.702	.22309	.69067	.00409	1.832	.3739	.00018	
4.60	66.491	112.37	40.509	.23970	40.660	.24059	.73947	.00438	1.819	.3712	.00020	
4.80	64.401	108.84	43.557	.25773	43.718	.25868	.78957	.00467	1.806	.3686	.00023	

SARAN

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	PATH LENGTH STRAGGLING GM/CM2	MULTIPLYING SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	62.452	0.4670	0.4687	0.0084	0.3661	0.0025
5.50	58.110	0.5498	0.5518	0.0097	0.3606	0.0033
6.00	54.388	0.6385	0.6408	0.0112	0.3558	0.0094
6.50	51.158	0.7330	0.7356	0.0127	0.3515	0.0180
7.00	48.327	0.8333	0.8362	0.0142	0.3477	0.0266
7.50	45.823	0.9393	0.9425	0.0159	0.3443	0.0353
8.00	43.591	1.0508	1.0544	0.0176	0.3412	0.0457
8.50	41.588	1.1679	1.1719	0.0193	0.3384	0.0568
9.00	39.780	1.2905	1.2948	0.0212	0.3358	0.0680
9.50	38.136	1.4185	1.4233	0.0231	0.3334	0.0792
10.00	36.641	1.5519	1.5570	0.0251	0.3312	0.0905
11.00	34.006	1.8345	1.8406	0.0292	0.3273	0.1182
12.00	31.760	2.1381	2.1451	0.0336	0.3238	0.1537
13.00	29.832	2.4622	2.4701	0.0383	0.3208	0.1894
14.00	28.138	2.8065	2.8155	0.0432	0.3181	0.2252
15.00	26.644	3.1707	3.1808	0.0484	0.3156	0.2611
16.00	25.318	3.5547	3.5659	0.0537	0.3134	0.2972
17.00	24.130	3.9583	3.9706	0.0593	0.3114	0.3334
18.00	23.061	4.3812	4.3948	0.0652	0.3096	0.3698
19.00	22.092	4.8230	4.8379	0.0713	0.3079	0.4063
20.00	21.210	5.2837	5.3000	0.0775	0.3063	0.4429
22.00	19.663	6.2610	6.2801	0.0908	0.3035	0.5166
24.00	18.348	7.3117	7.3338	0.1049	0.3011	0.5909
26.00	17.217	8.4344	8.4597	0.1198	0.2987	0.6371
28.00	16.232	9.6280	9.6567	0.1355	0.2970	0.6542
30.00	15.366	1.0891	1.0924	0.1520	0.2953	0.6721
32.00	14.599	1.2224	1.2260	0.1693	0.2937	0.6906
34.00	13.914	1.3623	1.3663	0.1874	0.2923	0.7098
36.00	13.296	1.5090	1.5134	0.2062	0.2911	0.7295
38.00	12.740	1.6623	1.6671	0.2258	0.2899	0.7497
40.00	12.234	1.8221	1.8274	0.2460	0.2888	0.7705
45.00	11.151	2.2495	2.2560	0.2998	0.2864	0.8242
50.00	10.268	2.7160	2.7238	0.3578	0.2844	0.8802
55.00	9.5325	3.2205	3.2296	0.4198	0.2826	0.9385
60.00	8.9106	3.7619	3.7725	0.4858	0.2811	0.9994
65.00	8.3774	4.3394	4.3516	0.5556	0.2798	1.0627
70.00	7.9149	4.9521	4.9659	0.6290	0.2787	1.1281
75.00	7.5097	5.5992	5.6147	0.7060	0.2776	1.1952
80.00	7.1518	6.2798	6.2973	0.7864	0.2767	1.2638
90.00	6.5475	7.7392	7.7605	0.9571	0.2751	1.4045

SARAN

PROTON ENERGY MEV	ENERGY LOSS MEV/CH	PROTON RANGE GM/CH2	PROTON PATH LENGTH GM/CH2	PROTON PATH LENGTH CH	GM/CH2	PATH LENGTH STRAGGLING CH	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	6.0567	9.3245	5.5326	9.3501	1.1403	.06747	1.220	.2737	.15481
110.00	5.6500	11.031	6.5271	11.061	.13354	.07901	1.207	.2726	.16954
120.00	5.3072	12.883	7.6056	12.888	.15415	.09122	1.196	.2716	.18472
130.00	5.0143	14.788	8.7502	14.828	.17583	.10404	1.186	.2707	.20025
140.00	4.7611	16.830	9.9586	16.876	.19851	.11746	1.176	.2699	.21603
150.00	4.5400	18.976	11.229	19.027	.22214	.13145	1.167	.2693	.23199
160.00	4.3452	21.223	12.558	21.280	.24668	.14597	1.159	.2687	.24813
170.00	4.1724	23.566	13.944	23.629	.27208	.16100	1.151	.2681	.26446
180.00	4.0180	26.002	15.386	26.072	.29831	.17651	1.144	.2676	.28092
190.00	3.8791	28.529	16.881	28.606	.32531	.19249	1.137	.2671	.29746
200.00	3.7537	31.144	18.428	31.227	.35307	.20892	1.131	.2667	.31403
210.00	3.6398	33.843	20.025	33.933	.38154	.22576	1.124	.2663	.33061
220.00	3.5360	36.623	21.671	36.721	.41069	.24301	1.118	.2659	.34719
230.00	3.4409	39.483	23.363	39.588	.44049	.26064	1.113	.2656	.36372
240.00	3.3535	42.420	25.100	42.532	.47092	.27865	1.107	.2653	.38018
250.00	3.2730	45.431	26.882	45.551	.50194	.29701	1.102	.2649	.39653
260.00	3.1985	48.514	28.706	48.642	.53354	.31571	1.097	.2647	.41275
270.00	3.1295	51.667	30.572	51.804	.56569	.33473	1.092	.2644	.42886
280.00	3.0653	54.887	32.478	55.033	.59837	.35407	1.087	.2641	.44481
290.00	3.0055	58.174	34.422	58.328	.63155	.37370	1.083	.2638	.46060
300.00	2.9496	61.524	36.405	61.686	.66522	.39362	1.078	.2636	.47617
310.00	2.8974	64.936	38.424	64.107	.69935	.41382	1.074	.2633	.49161
320.00	2.8484	68.468	40.478	67.509	.73393	.43428	1.070	.2631	.50685
330.00	2.8023	71.939	42.567	72.128	.76895	.45500	1.065	.2629	.52190
340.00	2.7590	75.526	44.690	75.725	.80437	.47596	1.062	.2627	.53673
350.00	2.7182	79.169	46.845	79.377	.84020	.49716	1.058	.2624	.55133
360.00	2.6797	82.865	49.032	83.082	.87641	.51858	1.055	.2622	.56573
370.00	2.6432	86.613	51.250	86.840	.91299	.54023	1.051	.2620	.57996
380.00	2.6088	90.411	53.498	90.648	.94992	.56208	1.048	.2618	.59401
390.00	2.5761	94.259	55.774	94.506	.98720	.58414	1.045	.2616	.60786
400.00	2.5451	98.154	58.080	98.412	1.0248	.60639	1.041	.2614	.62149
410.00	2.5157	102.10	60.412	102.36	1.0627	.62884	1.038	.2612	.63485
420.00	2.4877	106.08	62.772	106.36	1.1010	.65146	1.035	.2610	.64789
430.00	2.4610	110.12	65.157	110.40	1.1395	.67426	1.032	.2608	.66060
440.00	2.4356	114.19	67.568	114.47	1.1783	.69723	1.029	.2606	.67298
450.00	2.4114	118.31	70.003	118.61	1.2174	.72036	1.026	.2604	.68503
460.00	2.3883	122.46	72.463	122.78	1.2568	.74365	1.024	.2602	.69675
470.00	2.3662	126.66	74.946	126.99	1.2964	.76710	1.021	.2600	.70813
480.00	2.3451	130.89	77.451	131.23	1.3363	.79069	1.018	.2598	.71920
490.00	2.3249	135.16	79.979	135.52	1.3764	.81442	1.016	.2596	.72993

SARAN

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH GM/CM2	GM/CM2	CH	GM/CM2	CH	PERCENT	GM/CM2	CH	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	2.3055	139.47	139.84	82.743	1.4167	.83830	1.013	.2595	1.4167	.83830	1.013	.2595	.74034
510.00	2.2870	143.62	144.19	85.320	1.4573	.86230	1.011	.2593	1.4573	.86230	1.011	.2593	.75034
520.00	2.2692	148.20	148.58	87.690	1.4981	.88644	1.008	.2591	1.4981	.88644	1.008	.2591	.76022
530.00	2.2521	152.61	153.00	90.301	1.5391	.91070	1.006	.2589	1.5391	.91070	1.006	.2589	.76970
540.00	2.2358	157.05	157.46	92.931	1.5803	.93509	1.004	.2587	1.5803	.93509	1.004	.2587	.77887
550.00	2.2200	161.53	161.95	95.580	1.6217	.95959	1.001	.2585	1.6217	.95959	1.001	.2585	.78775
560.00	2.2049	166.04	166.47	98.248	1.6633	.98420	.9992	.2583	1.6633	.98420	.9992	.2583	.79633
570.00	2.1903	170.58	171.02	101.20	1.7051	1.0089	.9976	.2581	1.7051	1.0089	.9976	.2581	.80462
580.00	2.1763	175.15	175.60	103.91	1.7471	1.0338	.9949	.2579	1.7471	1.0338	.9949	.2579	.81263
590.00	2.1628	179.75	180.21	106.63	1.7892	1.0587	.9928	.2578	1.7892	1.0587	.9928	.2578	.82037
600.00	2.1499	184.37	184.85	109.38	1.8315	1.0837	.9908	.2576	1.8315	1.0837	.9908	.2576	.82783
620.00	2.1253	193.70	194.20	114.91	1.9167	1.1341	.9869	.2572	1.9167	1.1341	.9869	.2572	.84197
640.00	2.1024	203.14	203.67	120.51	2.0024	1.1849	.9832	.2568	2.0024	1.1849	.9832	.2568	.85511
660.00	2.0811	212.68	213.23	126.17	2.0887	1.2359	.9796	.2564	2.0887	1.2359	.9796	.2564	.86729
680.00	2.0612	222.32	222.89	131.89	2.1756	1.2874	.9761	.2560	2.1756	1.2874	.9761	.2560	.87857
700.00	2.0426	232.04	232.63	137.30	2.2631	1.3391	.9728	.2557	2.2631	1.3391	.9728	.2557	.88900
720.00	2.0251	241.85	242.47	143.11	2.3510	1.3911	.9696	.2553	2.3510	1.3911	.9696	.2553	.89863
740.00	2.0088	251.74	252.38	149.34	2.4394	1.4434	.9666	.2549	2.4394	1.4434	.9666	.2549	.90751
760.00	1.9935	261.71	262.38	155.25	2.5283	1.4960	.9636	.2545	2.5283	1.4960	.9636	.2545	.91568
780.00	1.9791	271.76	272.45	161.21	2.6176	1.5489	.9608	.2541	2.6176	1.5489	.9608	.2541	.92319
800.00	1.9656	281.87	282.59	167.21	2.7073	1.6019	.9580	.2537	2.7073	1.6019	.9580	.2537	.93008
820.00	1.9528	292.06	292.80	173.25	2.7974	1.6553	.9554	.2533	2.7974	1.6553	.9554	.2533	.93639
840.00	1.9406	302.31	303.07	179.33	2.8878	1.7088	.9528	.2529	2.8878	1.7088	.9528	.2529	.94217
860.00	1.9295	312.62	313.41	185.45	2.9787	1.7625	.9504	.2525	2.9787	1.7625	.9504	.2525	.94746
880.00	1.9188	322.99	323.81	191.60	3.0698	1.8165	.9480	.2521	3.0698	1.8165	.9480	.2521	.95229
900.00	1.9087	333.42	334.26	197.79	3.1613	1.8706	.9457	.2517	3.1613	1.8706	.9457	.2517	.95670
920.00	1.8992	343.91	344.78	204.01	3.2531	1.9249	.9435	.2513	3.2531	1.9249	.9435	.2513	.96073
940.00	1.8902	354.45	355.34	210.26	3.3452	1.9794	.9414	.2508	3.3452	1.9794	.9414	.2508	.96440
960.00	1.8816	365.06	365.97	216.55	3.4376	2.0341	.9393	.2503	3.4376	2.0341	.9393	.2503	.96774
1000.00	1.8659	386.50	387.46	229.27	3.6232	2.1439	.9351	.2490	3.6232	2.1439	.9351	.2490	.97356

THE ELECTRON DENSITY OF SARAN IS 2.983E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.220 BEV, AND THE MINIMUM ENERGY LOSS IS 1.7236 MEV/GM/CM2

THE EFFECTIVE IONIZATION POTENTIAL IS 127.22 ELECTRON VOLTS

SCINTILLATOR (ANTHRACENE)

PROTON ENERGY MEV	ENERGY LOSS MEV/GH/CH	PROTON RANGE		ATOMS/MOLECULE		PERCENT BY WEIGHT		ADJUSTED IONIZATION POTENTIAL	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
		MG/CM2	MM	MG/CM2	MM	MG/CM2	MM			
.10	973.22	13094	.00105	.13173	.00106	.00515	.00004	3.912	.5970	0.
.15	830.45	18619	.00150	.18703	.00150	.00617	.00005	3.301	.4475	0.
.20	731.57	24988	.00201	.25022	.00202	.00749	.00006	2.987	.3772	0.
.30	579.03	40386	.00325	.40511	.00326	.01086	.00009	2.681	.3099	0.
.40	480.40	59375	.00476	.59540	.00479	.01509	.00012	2.534	.2773	0.
.50	413.57	81615	.00658	.82026	.00660	.02000	.00016	2.439	.2579	0.
.60	365.69	10752	.00865	1.0778	.00867	.02546	.00020	2.363	.2449	0.
.70	329.33	13626	.01096	1.3659	.01099	.03138	.00025	2.297	.2355	0.
.80	298.75	16808	.01352	1.6847	.01355	.03780	.00030	2.244	.2282	0.
.90	276.65	20277	.01631	2.0322	.01635	.04463	.00036	2.196	.2223	0.
1.00	254.53	24039	.01934	2.4091	.01938	.05192	.00042	2.155	.2174	0.
1.20	223.96	32417	.02608	3.2485	.02613	.06780	.00055	2.087	.2097	0.
1.40	200.75	41848	.03367	4.1934	.03374	.08502	.00068	2.028	.2038	.00001
1.60	182.41	52299	.04207	5.2403	.04216	.10354	.00083	1.976	.1991	.00001
1.80	167.48	63737	.05128	6.3861	.05138	.12333	.00099	1.931	.1951	.00002
2.00	155.05	76134	.06125	7.6281	.06137	.14436	.00116	1.892	.1917	.00003
2.20	144.52	89477	.07198	8.9646	.07212	.16662	.00134	1.859	.1887	.00004
2.40	135.47	10376	.08347	10.395	.08363	.19009	.00153	1.829	.1860	.00006
2.60	127.59	11895	.09570	11.917	.09588	.21472	.00173	1.802	.1837	.00008
2.80	120.66	13505	.10865	13.530	.10885	.24058	.00194	1.778	.1815	.00011
3.00	114.51	15205	.12232	15.232	.12254	.26758	.00215	1.757	.1796	.00013
3.20	109.02	16992	.13670	17.022	.13695	.29571	.00238	1.737	.1778	.00016
3.40	104.08	18867	.15179	18.900	.15206	.32498	.00261	1.719	.1762	.00019
3.60	99.510	20829	.16757	20.866	.16787	.35537	.00286	1.703	.1747	.00023
3.80	95.542	22877	.18404	22.916	.18436	.38686	.00311	1.688	.1733	.00027
4.00	91.824	25009	.20120	25.052	.20154	.41944	.00337	1.674	.1720	.00031
4.20	88.259	27229	.21906	27.275	.21943	.45326	.00365	1.662	.1708	.00035
4.40	85.135	29535	.23761	29.585	.23801	.48818	.00393	1.650	.1697	.00039
4.60	82.244	31918	.25678	31.972	.25721	.52413	.00422	1.639	.1686	.00044
4.80	79.560	34390	.27667	34.448	.27713	.56111	.00451	1.629	.1676	.00048

DENSITY = 1.2430 GH/CM3

ANTHRACENE

PROTON ENERGY PEV	ENERGY LOSS MEV/CH	PROTON RANGE GM/CH2 CM	PROTON PATH LENGTH GM/CH2 CM	GM/CH2	PATH LENGTH STRAGGLING CH PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	77.062	0.3694	0.0000	0.0060	0.0048	1.666	0.0053
5.50	71.507	0.4367	0.03519	0.0070	0.0056	1.645	0.0067
6.00	66.762	0.5090	0.04095	0.0080	0.0065	1.626	0.0245
6.50	62.657	0.5863	0.04716	0.0092	0.0074	1.609	0.0500
7.00	59.070	0.6684	0.05377	0.0103	0.0083	1.594	0.0753
7.50	55.905	0.7553	0.06076	0.0116	0.0093	1.580	0.1006
8.00	53.090	0.8483	0.06814	0.0129	0.0104	1.568	0.1258
8.50	50.569	0.9433	0.07589	0.0142	0.0115	1.556	0.1511
9.00	48.298	1.0444	0.08402	0.0156	0.0126	1.546	0.1763
9.50	46.239	1.1501	0.09253	0.0171	0.0138	1.536	0.2014
10.00	44.364	1.2603	0.10140	0.0186	0.0159	1.527	0.2266
11.00	41.073	1.4945	0.12023	0.0219	0.0176	1.477	0.2769
12.00	38.277	1.7465	0.14051	0.0253	0.0204	1.446	0.3273
13.00	35.868	2.0161	0.16220	0.0289	0.0233	1.433	0.3777
14.00	33.771	2.3032	0.18530	0.0328	0.0264	1.473	0.4281
15.00	31.926	2.6075	0.20977	0.0369	0.0296	1.462	0.4785
16.00	30.291	2.9287	0.23562	0.0411	0.0331	1.453	0.5290
17.00	28.831	3.2668	0.26281	0.0456	0.0367	1.444	0.5795
18.00	27.519	3.6215	0.29177	0.0502	0.0404	1.437	0.6301
19.00	26.330	3.9925	0.32120	0.0551	0.0443	1.429	0.6808
20.00	25.251	4.3799	0.35237	0.0601	0.0483	1.423	0.7314
22.00	23.363	5.2030	0.41917	0.0707	0.0569	1.411	0.8329
24.00	21.763	6.0894	0.49058	0.0821	0.0660	1.400	0.9345
26.00	20.399	7.0382	0.56701	0.0941	0.0757	1.391	0.9953
28.00	19.196	8.0483	0.64749	0.1069	0.0860	1.383	1.0143
30.00	18.149	9.1189	0.73362	0.1203	0.0968	1.375	1.0339
32.00	17.223	1.0249	0.82455	0.1344	0.1081	1.368	1.0543
34.00	16.397	1.1438	0.92020	0.1492	0.1200	1.362	1.0752
36.00	15.656	1.2685	1.0205	0.1646	0.1324	1.356	1.0967
38.00	14.987	1.3990	1.1255	0.1806	0.1453	1.351	1.1187
40.00	14.389	1.5350	1.2366	0.1972	0.1587	1.346	1.1412
45.00	13.083	1.8996	1.5262	0.2415	0.1943	1.335	1.1989
50.00	12.027	2.2981	1.8513	0.2894	0.2338	1.326	1.2583
55.00	11.150	2.7297	2.1961	0.3408	0.2741	1.318	1.3196
60.00	10.410	3.1936	2.5692	0.3955	0.3182	1.311	1.3839
65.00	9.7768	3.6888	2.9677	0.4536	0.3649	1.305	1.4503
70.00	9.2283	4.2148	3.3909	0.5148	0.4141	1.299	1.5186
75.00	8.7483	4.7709	3.8432	0.5791	0.4659	1.294	1.5885
80.00	8.3248	5.3563	4.3092	0.6463	0.5199	1.289	1.6597
90.00	7.6109	6.6127	5.3268	0.7893	0.6350	1.281	1.8047

ANTHRACENE

PROBABILITY OF INELASTIC NUCLEAR INTERACTION

MULTIPLE SCATTERING PERCENT

PATH LENGTH STRAGGLING PERCENT

PROTON PATH LENGTH

PROTON RANGE

ENERGY LOSS

PROTON ENERGY

PROTON ENERGY MEV	ENERGY LOSS MEV/CH2	PROTON RANGE CH	PROTON PATH LENGTH GM/CH2	PATH LENGTH STRAGGLING CH	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	7.0321	6.4194	7.9895	.09431	.1275	.19516
110.00	6.5530	7.6041	9.4639	.11071	.1269	.21012
120.00	6.1499	8.8707	11.040	.12809	.1263	.22551
130.00	5.8058	10.216	12.715	.14638	.1259	.24122
140.00	5.5086	11.638	14.484	.16555	.1255	.25714
150.00	5.2493	13.133	16.344	.18554	.1251	.27318
160.00	5.0211	14.698	18.293	.20632	.1247	.28936
170.00	4.8187	16.332	20.327	.22786	.1244	.30569
180.00	4.6380	18.033	22.442	.25011	.1241	.32210
190.00	4.4756	19.797	24.638	.27304	.1238	.33854
200.00	4.3290	21.623	26.910	.29663	.1236	.35495
210.00	4.1957	23.508	29.257	.32085	.1233	.37131
220.00	4.0744	25.452	31.676	.34566	.1231	.38760
230.00	3.9633	27.452	34.165	.37104	.1229	.40378
240.00	3.8613	29.507	36.722	.39697	.1227	.41983
250.00	3.7673	31.614	39.344	.42343	.1225	.43570
260.00	3.6803	33.772	42.030	.45039	.1223	.45139
270.00	3.5998	35.980	44.778	.47784	.1221	.46689
280.00	3.5249	38.236	47.585	.50574	.1219	.48217
290.00	3.4551	40.539	50.451	.53410	.1218	.49723
300.00	3.3900	42.887	53.373	.56288	.1216	.51203
310.00	3.3290	45.279	56.350	.59207	.1214	.52669
320.00	3.2718	47.714	59.381	.62166	.1213	.54120
330.00	3.2182	50.191	62.463	.65163	.1211	.55555
340.00	3.1676	52.708	65.595	.68197	.1210	.56971
350.00	3.1200	55.264	68.776	.71266	.1208	.58367
360.00	3.0751	57.858	72.005	.74369	.1207	.59750
370.00	3.0326	60.490	75.279	.77504	.1205	.61125
380.00	2.9924	63.157	78.599	.80672	.1204	.62490
390.00	2.9543	65.860	81.962	.83870	.1202	.63843
400.00	2.9182	68.597	85.368	.87097	.1201	.65181
410.00	2.8838	71.367	88.816	.90353	.1200	.66493
420.00	2.8512	74.170	92.303	.93636	.1198	.67771
430.00	2.8201	77.004	95.830	.96945	.1197	.69014
440.00	2.7905	79.868	99.395	1.0028	.1196	.70221
450.00	2.7622	82.763	103.00	1.0364	.1194	.71394
460.00	2.7352	85.686	106.64	1.0702	.1193	.72531
470.00	2.7095	88.638	110.31	1.1043	.1192	.73634
480.00	2.6848	91.618	114.02	1.1386	.1191	.74703
490.00	2.6612	94.624	117.76	1.1731	.1189	.75737

ANTHRACENE

PRCTON ENERGY MEV	ENERGY LOSS		PRCTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CM	GM/CM2	GM/CM2	CM	GM/CM2	CM	GM/CM2	CM	PERCENT	PERCENT	
500.00	2.6386	3.2798	121.39	97.657	121.53	97.773	1.2078	.97172	.9939	.1188	.76738
510.00	2.6170	3.2529	125.19	100.71	125.34	100.83	1.2428	.99981	.9915	.1187	.77706
520.00	2.5962	3.2271	129.02	103.80	129.17	103.92	1.2779	1.0281	.9893	.1186	.78642
530.00	2.5753	3.2023	132.88	106.91	133.04	107.03	1.3132	1.0565	.9871	.1184	.79546
540.00	2.5571	3.1785	136.77	110.04	136.94	110.17	1.3487	1.0850	.9849	.1183	.80420
550.00	2.5387	3.1556	140.70	113.19	140.86	113.32	1.3844	1.1137	.9828	.1182	.81263
560.00	2.5210	3.1336	144.64	116.37	144.81	116.50	1.4202	1.1426	.9807	.1181	.82076
570.00	2.5040	3.1125	148.62	119.56	148.79	119.71	1.4563	1.1716	.9787	.1179	.82860
580.00	2.4876	3.0921	152.62	122.78	152.80	122.93	1.4925	1.2007	.9767	.1178	.83615
590.00	2.4719	3.0720	156.65	126.03	156.83	126.17	1.5288	1.2299	.9746	.1177	.84343
600.00	2.4567	3.0536	160.70	129.29	160.89	129.44	1.5653	1.2593	.9729	.1176	.85043
620.00	2.4279	3.0179	168.88	135.87	169.08	136.03	1.6388	1.3184	.9652	.1173	.86364
640.00	2.4011	2.9846	177.16	142.52	177.37	142.69	1.7128	1.3779	.9657	.1171	.87585
660.00	2.3761	2.9535	185.52	149.25	185.74	149.43	1.7874	1.4379	.9623	.1169	.88713
680.00	2.3528	2.9245	193.97	156.05	194.20	156.23	1.8624	1.4983	.9590	.1166	.89750
700.00	2.3309	2.8973	202.50	162.92	202.74	163.10	1.9380	1.5591	.9559	.1164	.90704
720.00	2.3105	2.8719	211.11	169.84	211.36	170.04	2.0140	1.6203	.9529	.1162	.91579
740.00	2.2913	2.8480	219.80	176.83	220.05	177.03	2.0905	1.6818	.9500	.1159	.92380
760.00	2.2732	2.8256	228.55	183.87	228.82	184.08	2.1674	1.7437	.9472	.1157	.93113
780.00	2.2563	2.8046	237.37	190.97	237.65	191.19	2.2447	1.8058	.9445	.1155	.93780
800.00	2.2403	2.7847	246.26	198.12	246.54	198.35	2.3223	1.8683	.9420	.1152	.94388
820.00	2.2253	2.7661	255.21	205.32	255.50	205.55	2.4004	1.9311	.9395	.1150	.94940
840.00	2.2111	2.7484	264.22	212.56	264.52	212.81	2.4787	1.9942	.9371	.1148	.95441
860.00	2.1978	2.7318	273.28	219.86	273.59	220.11	2.5574	2.0575	.9348	.1145	.95896
880.00	2.1851	2.7161	282.40	227.19	282.72	227.45	2.6365	2.1210	.9325	.1143	.96308
900.00	2.1732	2.7012	291.57	234.57	291.90	234.84	2.7158	2.1849	.9304	.1141	.96681
920.00	2.1619	2.6872	300.80	241.99	301.14	242.27	2.7954	2.2489	.9283	.1138	.97018
940.00	2.1512	2.6739	310.07	249.45	310.42	249.74	2.8753	2.3132	.9263	.1136	.97322
960.00	2.1410	2.6613	319.40	256.96	319.76	257.25	2.9555	2.3777	.9243	.1133	.97597
1000.00	2.1223	2.6380	338.26	272.13	338.64	272.44	3.1167	2.5074	.9204	.1126	.98070

THE ELECTRON DENSITY OF ANTHRACENE IS 3.177E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.319 BEV, AND THE MINIMUM ENERGY LOSS IS 1.9525 MEV/GM/CM2

THE EFFECTIVE IONIZATION POTENTIAL IS 66.32 ELECTRON VOLTS

SCINTILLATOR (CESIUM IODIDE)

ADJUSTED
IONIZATION
POTENTIAL
545.2
525.5

ATOMIC
WEIGHT
132.90
126.90

PERCENT
BY WEIGHT
51.1548
48.8452

ATOMS/
MOLECULE
1
1

ATOMIC
NUMBER
55
53

ELEMENT
CS
I

DENSITY = 4.5100 GM/CM3

PRCTON ENERGY MEV	ENERGY LOSS HEV/ GM/CM2	PROTON RANGE HG/CM2	PH	ATOMS/ MOLECULE	PERCENT BY WEIGHT	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL	PROTON PATH LENGTH HG/CM2	MM	PROTON PATH LENGTH MM	MG/CM2	PATH LENGTH STRAGGLING MM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	228.43	1030.2	.00197	.92269	.00205	.04459	.00010	4.832	3.941	0.					
.15	206.47	931.20	.00247	1.1528	.00256	.04915	.00011	4.264	3.303	0.					
.20	189.83	858.14	.00302	1.4053	.00312	.05462	.00012	3.887	2.986	0.					
.30	162.52	732.96	.00426	1.9753	.00438	.06770	.00015	3.428	2.698	0.					
.40	141.86	639.78	.00569	2.6354	.00584	.08364	.00019	3.174	2.544	0.					
.50	126.95	572.53	.00731	3.3815	.00750	.10299	.00023	3.046	2.455	0.					
.60	114.62	516.93	.00911	4.2109	.00934	.12606	.00028	2.994	2.391	0.					
.70	105.58	476.16	.01169	5.1201	.01135	.15182	.00034	2.965	2.341	0.					
.80	97.699	440.62	.01323	6.1051	.01354	.17961	.00040	2.942	2.299	0.					
.90	89.788	404.94	.01554	7.1720	.01590	.20986	.00047	2.926	2.264	0.					
1.00	81.874	369.25	.01808	8.3383	.01849	.24368	.00054	2.922	2.232	0.					
1.20	74.832	337.45	.02363	10.095	.02416	.31564	.00070	2.897	2.181	0.					
1.40	69.117	311.72	.02968	13.679	.03033	.38843	.00086	2.840	2.141	0.					
1.60	64.376	290.34	.03621	16.681	.03699	.46267	.00103	2.774	2.106	0.					
1.80	60.333	272.10	.04320	19.482	.04411	.53891	.00119	2.709	2.073	0.					
2.00	56.838	256.34	.05063	23.310	.05168	.61740	.00137	2.649	2.043	0.					
2.20	53.653	242.88	.05850	26.924	.05970	.69818	.00155	2.593	2.015	0.					
2.40	51.224	231.02	.06679	30.735	.06815	.78146	.00173	2.543	1.989	0.					
2.60	48.889	220.49	.07550	34.734	.07702	.86797	.00192	2.499	1.965	0.					
2.80	46.787	211.01	.08461	38.917	.08629	.95814	.00212	2.462	1.943	0.					
3.00	44.925	202.61	.09412	43.280	.09596	1.0517	.00233	2.430	1.921	0.					
3.20	43.245	195.07	.10401	47.817	.10603	1.1481	.00255	2.401	1.901	0.					
3.40	41.710	188.11	.11428	52.527	.11647	1.2473	.00277	2.375	1.882	0.					
3.60	40.303	181.77	.12492	57.408	.12729	1.3491	.00299	2.350	1.864	0.					
3.80	39.005	175.91	.13592	62.453	.13848	1.4533	.00322	2.327	1.846	0.					
4.00	37.808	170.52	.14729	67.661	.15002	1.5598	.00346	2.305	1.830	0.					
4.20	36.694	165.49	.15900	73.034	.16194	1.6687	.00370	2.285	1.815	0.					
4.40	35.659	160.82	.17106	78.563	.17420	1.7797	.00395	2.267	1.800	0.					
4.60	34.691	156.46	.18347	84.247	.18680	1.8928	.00420	2.247	1.785	0.					
4.80	33.784	152.37	.19622	90.092	.19976	2.0080	.00445	2.229	1.772	0.					

SCINTILLATOR (CS-I)

PROCTON ENERGY MEV	ENERGY LOSS MEV/GH/CM2	PROTON RANGE GH/CM2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	GM/CM2	PATH LENGTH STRAGGLING GM/CM2	PATH LENGTH STRAGGLING PERCENT	MULTIPLIF SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	32.931	0.9440	0.9609	0.2131	0.0213	0.0047	2.212	1.759	0.
5.50	31.005	1.0981	1.1174	0.2478	0.0243	0.0054	2.172	1.728	0.
6.00	29.326	1.2615	1.2833	0.2846	0.0274	0.0061	2.136	1.701	0.
6.50	27.846	1.4340	1.4584	0.3234	0.0307	0.0068	2.103	1.676	0.
7.00	26.529	1.6153	1.6424	0.3642	0.0340	0.0075	2.073	1.653	0.0001
7.50	25.352	1.8053	1.8353	0.4069	0.0375	0.0083	2.045	1.632	0.0001
8.00	24.290	2.0040	2.0368	0.4516	0.0411	0.0091	2.020	1.612	0.0002
8.50	23.327	2.2111	2.2429	0.4982	0.0448	0.0099	1.996	1.594	0.0003
9.00	22.448	2.4266	2.4655	0.5467	0.0487	0.0108	1.974	1.577	0.0004
9.50	21.643	2.6503	2.6924	0.5970	0.0526	0.0117	1.953	1.562	0.0006
10.00	20.898	2.8822	2.9275	0.6491	0.0566	0.0126	1.934	1.547	0.0009
11.00	19.609	3.3595	3.4215	0.7586	0.0650	0.0144	1.898	1.520	0.0015
12.00	18.474	3.8883	3.9471	0.8752	0.0737	0.0163	1.862	1.497	0.0023
13.00	17.487	4.4377	4.5041	0.9987	0.0828	0.0184	1.838	1.475	0.0033
14.00	16.613	5.0167	5.0908	1.1288	0.0922	0.0205	1.812	1.456	0.0047
15.00	15.848	5.6255	5.7076	1.2655	0.1020	0.0226	1.786	1.438	0.0062
16.00	15.146	6.2627	6.3531	1.4087	0.1122	0.0249	1.766	1.422	0.0080
17.00	14.516	6.9285	7.0274	1.5582	0.1227	0.0272	1.747	1.407	0.0101
18.00	13.944	7.6226	7.7304	1.7141	0.1336	0.0296	1.729	1.394	0.0124
19.00	13.420	8.3451	8.4620	1.8763	0.1449	0.0321	1.713	1.381	0.0149
20.00	12.940	9.0944	9.2207	2.0445	0.1566	0.0347	1.698	1.370	0.0176
22.00	12.088	1.0675	1.0821	2.3994	0.1809	0.0401	1.672	1.348	0.0419
24.00	11.355	1.2363	1.2529	2.7781	0.2066	0.0458	1.649	1.330	0.0610
26.00	10.714	1.4155	1.4343	3.1803	0.2337	0.0518	1.629	1.313	0.0820
28.00	10.153	1.6050	1.6262	3.6057	0.2620	0.0581	1.611	1.298	0.1222
30.00	9.6564	1.8047	1.8282	4.0537	0.2916	0.0647	1.595	1.285	0.1371
32.00	9.2127	2.0144	2.0404	4.5241	0.3224	0.0715	1.580	1.273	0.1520
34.00	8.8138	2.2338	2.2624	5.0163	0.3544	0.0786	1.566	1.262	0.1685
36.00	8.4528	2.4629	2.4941	5.5302	0.3875	0.0859	1.554	1.252	0.1850
38.00	8.1247	2.7015	2.7355	6.0654	0.4218	0.0935	1.542	1.243	0.2020
40.00	7.8248	2.9496	2.9864	6.6218	0.4572	0.1014	1.531	1.234	0.2195
45.00	7.1780	3.3598	3.6542	8.1025	0.5503	0.1220	1.506	1.216	0.2651
50.00	6.6488	4.3260	4.3786	9.7086	0.6499	0.1441	1.484	1.200	0.3131
55.00	6.2041	5.0965	5.1577	1.1436	0.7555	0.1675	1.465	1.187	0.3635
60.00	5.8250	5.9194	5.9898	1.3281	0.8669	0.1922	1.447	1.176	0.4165
65.00	5.4972	6.7938	6.7939	1.5241	0.9840	0.2182	1.432	1.166	0.4718
70.00	5.2121	7.7179	7.8082	1.7313	1.1066	0.2454	1.417	1.157	0.5292
75.00	4.9607	8.6908	8.7918	1.9494	1.2343	0.2737	1.404	1.149	0.5886
80.00	4.7375	9.7113	9.8235	2.1782	1.3672	0.3032	1.392	1.142	0.6497
90.00	4.3586	11.891	12.027	2.6667	1.6476	0.3653	1.370	1.130	0.7767

SCINTILLATOR (CS-1)

PRCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CM2	NEV/CH	GM/CM2	CM	GM/CM2	CM	GM/CM2	CM	PERCENT	PERCENT	
100.00	4.0486	18.260	14.248	3.1592	14.469	3.1950	.19463	.04316	1.351	1.120	.09088
110.00	3.7905	17.095	15.775	3.7195	16.564	3.7614	.22624	.05016	1.334	1.112	.10459
120.00	3.5718	16.109	19.466	4.3161	19.623	4.3643	.25949	.05754	1.318	1.105	.11882
130.00	3.3842	15.263	22.313	4.9475	22.561	5.0024	.29428	.05525	1.304	1.098	.13349
140.00	3.2214	14.529	25.311	5.6122	25.591	5.6743	.33052	.07329	1.292	1.093	.14852
150.00	3.0709	13.890	28.453	6.3090	28.767	6.3784	.36814	.08163	1.280	1.089	.16384
160.00	2.9540	13.326	31.735	7.0366	32.053	7.1137	.40703	.09025	1.269	1.084	.17943
170.00	2.8425	12.820	35.150	7.7939	35.534	7.8790	.44715	.09915	1.258	1.081	.19528
180.00	2.7419	12.366	38.695	8.5799	39.117	8.6773	.48846	.10831	1.249	1.077	.21134
190.00	2.6514	11.958	42.368	9.3943	42.828	9.4963	.53090	.11772	1.240	1.074	.22756
200.00	2.5694	11.588	46.159	10.235	46.659	10.346	.57443	.12737	1.231	1.072	.24390
210.00	2.4949	11.252	50.067	11.101	50.608	11.221	.61897	.13724	1.223	1.069	.26028
220.00	2.4269	10.945	54.091	11.994	54.674	12.123	.66450	.14734	1.215	1.067	.27664
230.00	2.3645	10.654	58.222	12.910	58.849	13.048	.71096	.15764	1.208	1.065	.29294
240.00	2.3067	10.403	62.461	13.849	63.132	13.998	.75832	.16814	1.201	1.063	.30916
250.00	2.2533	10.162	66.800	14.812	67.517	14.970	.80654	.17883	1.195	1.061	.32526
260.00	2.2043	9.9415	71.241	15.796	72.004	15.965	.85560	.18971	1.188	1.059	.34130
270.00	2.1584	9.7365	75.777	16.802	76.588	16.982	.90544	.20076	1.182	1.058	.35735
280.00	2.1166	9.5458	80.409	17.829	81.267	18.019	.95602	.21198	1.176	1.056	.37337
290.00	2.0772	9.3680	85.126	18.875	86.034	19.076	1.00973	.22335	1.171	1.055	.38934
300.00	2.0403	9.2018	89.934	19.941	90.892	20.154	1.0593	.23487	1.165	1.054	.40524
310.00	2.0056	9.0462	94.826	21.026	95.835	21.250	1.1119	.24654	1.160	1.053	.42100
320.00	1.9725	8.9003	99.800	22.129	100.86	22.364	1.1651	.25835	1.155	1.052	.43657
330.00	1.9431	8.7632	104.85	23.249	105.96	23.496	1.2190	.27029	1.150	1.050	.45194
340.00	1.9144	8.6341	109.98	24.386	111.15	24.645	1.2734	.28235	1.146	1.049	.46710
350.00	1.8875	8.5124	115.20	25.542	116.42	25.813	1.3284	.29454	1.141	1.048	.48202
360.00	1.8620	8.3975	120.47	26.713	121.75	26.995	1.3839	.30685	1.137	1.047	.49674
370.00	1.8379	8.2889	125.82	27.899	127.15	28.194	1.4399	.31926	1.132	1.047	.51125
380.00	1.8151	8.1861	131.24	29.101	132.63	29.408	1.4964	.33179	1.128	1.046	.52555
390.00	1.7935	8.0887	136.73	30.317	138.17	30.637	1.5533	.34442	1.124	1.045	.53963
400.00	1.7730	7.9962	142.28	31.547	143.78	31.880	1.6108	.35715	1.120	1.044	.55348
410.00	1.7535	7.9083	147.89	32.791	149.45	33.137	1.6686	.36998	1.117	1.043	.56709
420.00	1.7350	7.8248	153.56	34.050	155.18	34.408	1.7269	.38290	1.113	1.043	.58046
430.00	1.7174	7.7453	159.30	35.321	160.97	35.693	1.7856	.39591	1.109	1.042	.59357
440.00	1.7006	7.6695	165.09	36.605	166.83	36.990	1.8446	.40901	1.106	1.041	.60642
450.00	1.6845	7.5973	170.94	37.901	172.73	38.300	1.9041	.42219	1.102	1.040	.61902
460.00	1.6693	7.5283	176.84	39.210	178.70	39.622	1.9639	.43545	1.099	1.040	.63134
470.00	1.6546	7.4625	182.79	40.531	184.71	40.956	2.0240	.44878	1.096	1.039	.64340
480.00	1.6407	7.3995	188.80	41.863	190.78	42.302	2.0845	.46219	1.093	1.038	.65519
490.00	1.6273	7.3393	194.86	43.206	196.90	43.659	2.1453	.47567	1.090	1.038	.66670

SCINTILLATOR (CS-1)

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH	MEV/CH	GM/CH2	CM	GM/CM2	CM	GM/CM2	CM	PERCENT	PERCENT	
500.00	1.6145	7.2816	200.96	44.560	203.07	45.027	2.2064	.48922	1.087	1.037	.67794
510.00	1.6023	7.2264	207.12	45.924	209.29	46.405	2.2678	.50284	1.084	1.037	.68891
520.00	1.5906	7.1734	213.32	47.299	215.55	47.794	2.3295	.51652	1.081	1.036	.69960
530.00	1.5793	7.1226	219.56	48.683	221.86	49.193	2.3915	.53027	1.078	1.035	.71002
540.00	1.5685	7.0739	225.85	50.078	228.21	50.601	2.4538	.54407	1.075	1.035	.72017
550.00	1.5581	7.0270	232.19	51.482	234.61	52.019	2.5163	.55793	1.073	1.034	.73005
560.00	1.5481	6.9821	238.55	52.895	241.05	53.447	2.5790	.57185	1.070	1.034	.73966
570.00	1.5385	6.9388	244.97	54.317	247.53	54.884	2.6421	.58582	1.067	1.033	.74900
580.00	1.5293	6.8972	251.42	55.747	254.04	56.329	2.7053	.59985	1.065	1.032	.75808
590.00	1.5204	6.8572	257.91	57.187	260.60	57.783	2.7688	.61392	1.062	1.032	.76690
600.00	1.5119	6.8186	264.44	58.634	267.20	59.245	2.8325	.62805	1.060	1.031	.77546
620.00	1.4957	6.7457	277.61	61.554	280.50	62.195	2.9605	.65643	1.055	1.030	.79183
640.00	1.4807	6.6780	290.91	64.504	293.94	65.174	3.0894	.68500	1.051	1.029	.80722
660.00	1.4667	6.6150	304.35	67.482	307.51	68.183	3.2189	.71373	1.047	1.028	.82166
680.00	1.4537	6.5562	317.91	70.489	321.20	71.220	3.3492	.74262	1.043	1.027	.83519
700.00	1.4415	6.5013	331.58	73.522	335.02	74.284	3.4802	.77166	1.039	1.026	.84785
720.00	1.4302	6.4501	345.37	76.580	348.95	77.372	3.6118	.80084	1.035	1.024	.85967
740.00	1.4195	6.4021	359.27	79.661	362.99	80.485	3.7440	.83014	1.031	1.023	.87070
760.00	1.4096	6.3572	373.27	82.765	377.12	83.620	3.8767	.85957	1.028	1.022	.88096
780.00	1.4002	6.3150	387.36	85.890	391.36	86.776	4.0099	.88912	1.025	1.021	.89051
800.00	1.3914	6.2754	401.55	89.035	405.69	89.953	4.1437	.91878	1.021	1.020	.89938
820.00	1.3832	6.2382	415.82	92.200	420.10	93.149	4.2779	.94855	1.018	1.019	.90762
840.00	1.3754	6.2032	430.18	95.383	434.60	96.364	4.4126	.97841	1.015	1.018	.91524
860.00	1.3681	6.1703	444.63	98.588	449.20	99.601	4.5477	1.0084	1.012	1.017	.92230
880.00	1.3613	6.1393	459.16	101.81	463.67	102.85	4.6833	1.0384	1.010	1.015	.92883
900.00	1.3548	6.1101	473.83	105.06	478.69	106.14	4.8192	1.0686	1.007	1.015	.93486
920.00	1.3487	6.0825	488.50	108.31	493.50	109.42	4.9555	1.0988	1.004	1.013	.94042
940.00	1.3429	6.0565	503.32	111.60	508.46	112.74	5.0921	1.1291	1.001	1.012	.94555
960.00	1.3375	6.0320	518.14	114.89	523.43	116.06	5.2291	1.1594	.9990	1.010	.95027
1000.00	1.3275	5.9869	548.07	121.52	553.63	122.76	5.5040	1.2204	.9942	1.005	.95855

THE ELECTRON DENSITY OF SCINTILLATOR (CS-1) IS 2.504E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 1.988 BEV, AND THE MINIMUM ENERGY LOSS IS 1.2516 MEV/GM/CM2

THE EFFECTIVE IONIZATION POTENTIAL IS 535.44 ELECTRON VOLTS

SCINTILLATOR (SODIUM IODIDE)

PROTON ENERGY MEV	ENERGY LOSS MEV/GH/CH2	PROTON RANGE GH/CH2	PROTON PATH LENGTH MM	PROTON PATH LENGTH MM	MG/CH2	PERCENT BY WEIGHT	ATOMS/MOLECULE	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	263.06	.61851	.00169	.63629	.00173	.04033	.04033	.00011	6.339	2.793	0.
.15	241.58	.81558	.00222	.83457	.00227	.04450	.04450	.00012	5.332	2.275	0.
.20	223.20	1.0282	.00280	1.0498	.00286	.04945	.04945	.00013	4.711	2.065	0.
.30	192.10	1.5037	.00410	1.5330	.00418	.06136	.06136	.00017	4.002	1.907	0.
.40	168.47	2.0514	.00559	2.0899	.00569	.07584	.07584	.00021	3.629	1.844	0.
.50	150.87	2.6688	.00727	2.7178	.00741	.09388	.09388	.00026	3.454	1.806	0.
.60	136.31	3.3548	.00914	3.4155	.00931	.11513	.11513	.00031	3.371	1.777	0.
.70	125.03	4.1084	.01119	4.1816	.01139	.13879	.13879	.00038	3.319	1.751	0.
.80	115.75	4.9269	.01342	5.0135	.01366	.16425	.16425	.00045	3.276	1.728	0.
.90	106.91	5.8109	.01583	5.9118	.01611	.19171	.19171	.00052	3.243	1.707	0.
1.00	98.064	6.7722	.01845	6.8885	.01877	.22225	.22225	.00061	3.226	1.688	0.
1.20	88.967	8.8820	.02420	9.0315	.02461	.28700	.28700	.00078	3.178	1.655	0.
1.40	81.603	11.196	.03051	11.381	.03101	.35258	.35258	.00096	3.098	1.626	0.
1.60	75.542	13.709	.03735	13.932	.03796	.41985	.41985	.00114	3.014	1.599	0.
1.80	70.444	16.414	.04473	16.677	.04544	.48917	.48917	.00133	2.933	1.574	0.
2.00	66.082	19.304	.05260	19.623	.05343	.56073	.56073	.00153	2.860	1.552	0.
2.20	62.414	22.375	.06097	22.723	.06192	.63450	.63450	.00173	2.792	1.530	.00001
2.40	59.203	25.622	.06982	26.015	.07089	.71082	.71082	.00194	2.732	1.511	.00001
2.60	56.364	29.039	.07913	29.479	.08032	.79066	.79066	.00215	2.682	1.493	.00001
2.80	53.824	32.622	.08889	33.111	.09022	.87369	.87369	.00238	2.639	1.476	.00001
3.00	51.550	36.370	.09910	36.909	.10057	.95968	.95968	.00261	2.600	1.460	.00002
3.20	49.512	40.277	.10975	40.868	.11136	1.0483	1.0483	.00286	2.565	1.445	.00002
3.40	47.658	44.343	.12082	44.986	.12258	1.1394	1.1394	.00310	2.533	1.431	.00003
3.60	46.004	48.561	.13232	49.259	.13422	1.2329	1.2329	.00336	2.503	1.418	.00003
3.80	44.444	52.927	.14422	53.682	.14627	1.3285	1.3285	.00362	2.475	1.405	.00004
4.00	43.005	57.448	.15653	58.260	.15875	1.4263	1.4263	.00389	2.448	1.394	.00004
4.20	41.672	62.114	.16935	62.985	.17162	1.5261	1.5261	.00416	2.423	1.382	.00005
4.40	40.434	66.926	.18236	67.857	.18490	1.6280	1.6280	.00444	2.399	1.372	.00005
4.60	39.279	71.884	.19587	72.877	.19857	1.7319	1.7319	.00472	2.377	1.362	.00006
4.80	38.199	76.984	.20977	78.039	.21264	1.8378	1.8378	.00501	2.355	1.352	.00007

DENSITY = 3.6700 GH/CM3

SCINTILLATOR (NAI)

PRCTON ENERGY MEV	ENERGY LOSS MEV/CH	PROTON RANGE GM/CH2	PROTON PATH LENGTH CH	PROTON PATH LENGTH GM/CH2	PATH LENGTH STRAGGLING CH	PATH LENGTH STRAGGLING PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	37.187	.08223	.02271	.08335	.00195	.00053	1.343	.00007
5.50	34.909	.09595	.02614	.09723	.00222	.00061	1.321	.00099
6.00	32.933	.11053	.03012	.11199	.00251	.00068	1.302	.00012
6.50	31.200	.12595	.03432	.12759	.00281	.00077	1.285	.00015
7.00	29.665	.14221	.03875	.14403	.00312	.00085	1.269	.00018
7.50	28.297	.15927	.04340	.16129	.00345	.00094	1.254	.00022
8.00	27.068	.17714	.04827	.17937	.00378	.00103	1.241	.00051
8.50	25.954	.19580	.05335	.19824	.00412	.00112	1.228	.00097
9.00	24.940	.21524	.05865	.21789	.00448	.00122	1.217	.00144
9.50	24.015	.23545	.06416	.23833	.00484	.00132	1.206	.00191
10.00	23.160	.25644	.06987	.25954	.00521	.00142	1.196	.00239
11.00	21.699	.30054	.08189	.30413	.00598	.00163	1.178	.00334
12.00	20.407	.34759	.09471	.35168	.00679	.00185	1.162	.00432
13.00	19.278	.39753	.10822	.40214	.00763	.00208	1.148	.00531
14.00	18.284	.45024	.12268	.45541	.00851	.00232	1.135	.00632
15.00	17.396	.50581	.13782	.51155	.00942	.00257	1.123	.00736
16.00	16.609	.56406	.15369	.57040	.01037	.00282	1.112	.00841
17.00	15.897	.62499	.17030	.63195	.01135	.00309	1.102	.00949
18.00	15.253	.68855	.18762	.69616	.01237	.00337	1.093	.01059
19.00	14.665	.75480	.20567	.76307	.01342	.00366	1.084	.01171
20.00	14.127	.82359	.22441	.83255	.01451	.00395	1.077	.01284
22.00	13.174	.96887	.26400	.97927	.01679	.00457	1.062	.01683
24.00	12.356	1.1242	.30632	1.1361	.01919	.00523	1.050	.02174
26.00	11.559	1.2893	.35131	1.3028	.02172	.00592	1.039	.02499
28.00	11.034	1.4640	.39891	1.4792	.02436	.00664	1.029	.02653
30.00	10.483	1.6484	.44916	1.6654	.02712	.00739	1.021	.02812
32.00	9.9909	1.8419	.50187	1.8607	.03000	.00817	1.013	.02978
34.00	9.5498	2.0449	.55719	2.0656	.03299	.00899	1.005	.03149
36.00	9.1508	2.2568	.61494	2.2796	.03609	.00983	.9988	.03326
38.00	8.7868	2.4779	.67518	2.5027	.03929	.01071	.9927	.03508
40.00	8.4592	2.7079	.73785	2.7349	.04261	.01161	.9871	.03694
45.00	7.7495	3.3204	.90475	3.3531	.05134	.01399	.9745	.04179
50.00	7.1683	3.9858	1.0861	4.0246	.06068	.01653	.9642	.04688
55.00	6.6811	4.7023	1.2813	4.7477	.07059	.01923	.9551	.05221
60.00	6.2666	5.4666	1.4901	5.5209	.08106	.02209	.9476	.05760
65.00	5.9094	6.2834	1.7121	6.3430	.09207	.02503	.9410	.06363
70.00	5.5982	7.1454	1.9470	7.2128	.10360	.02823	.9352	.06968
75.00	5.3245	8.0533	2.1943	8.1288	.11563	.03151	.9299	.07692
80.00	5.0819	9.0064	2.4541	9.0905	.12815	.03492	.9252	.08434
90.00	4.6704	11.043	3.0091	11.146	.15457	.04212	.9174	.09561

SCINTILLATOR (NAI)

PRCTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	MEV/CM	PROTON RANGE GM/CM2	CM	PROTON PATH LENGTH GM/CM2	CM	GM/CM2	PATH LENGTH STRAGGLING CM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	4.3346	15.908	13.249	3.6100	13.370	3.6432	.18274	.04979	1.367	.9108	.10936
110.00	4.0550	14.882	15.615	4.2547	15.757	4.2935	.21257	.05792	1.349	.9052	.12358
120.00	3.8185	14.014	18.135	4.9415	18.300	4.9864	.24395	.06647	1.333	.9006	.13829
130.00	3.6158	13.270	20.805	5.6689	20.993	5.7202	.27681	.07542	1.319	.8966	.15340
140.00	3.4400	12.625	23.617	6.4352	23.830	6.4932	.31106	.08476	1.305	.8931	.16884
150.00	3.2880	12.067	26.565	7.2385	26.804	7.3035	.34659	.09444	1.293	.8900	.18451
160.00	3.1520	11.568	29.647	8.0783	29.913	8.1506	.38335	.10446	1.282	.8873	.20041
170.00	3.0310	11.124	32.854	8.9521	33.148	9.0320	.42131	.11480	1.271	.8849	.21656
180.00	2.9228	10.727	36.187	9.8602	36.509	9.9481	.46040	.12545	1.261	.8828	.23288
190.00	2.8254	10.369	39.639	10.801	39.991	10.897	.50057	.13640	1.252	.8808	.24933
200.00	2.7373	10.046	43.202	11.772	43.585	11.876	.54177	.14762	1.243	.8791	.26587
210.00	2.6571	9.7516	46.880	12.774	47.295	12.887	.58395	.15912	1.235	.8775	.28244
220.00	2.5840	9.4832	50.665	13.805	51.113	13.927	.62707	.17086	1.227	.8760	.29898
230.00	2.5159	9.2371	54.552	14.864	55.037	14.995	.67107	.18285	1.219	.8747	.31547
240.00	2.4522	9.0143	58.541	15.951	59.057	16.092	.71591	.19507	1.212	.8735	.33187
250.00	2.3933	8.8054	62.624	17.064	63.175	17.214	.76152	.20750	1.205	.8724	.34814
260.00	2.3386	8.6120	66.805	18.203	67.392	18.363	.80791	.22014	1.199	.8714	.36434
270.00	2.2877	8.4326	71.077	19.367	71.701	19.537	.85506	.23299	1.193	.8704	.38051
280.00	2.2393	8.2658	75.431	20.554	76.093	20.734	.90291	.24603	1.187	.8696	.39662
290.00	2.2009	8.1102	79.874	21.764	80.574	21.955	.95146	.25925	1.181	.8688	.41265
300.00	2.1703	7.9649	84.404	22.998	85.143	23.200	1.0007	.27266	1.175	.8680	.42858
310.00	2.1332	7.8289	89.014	24.254	89.792	24.467	1.0505	.28623	1.170	.8671	.44435
320.00	2.0984	7.7013	93.701	25.532	94.520	25.755	1.1009	.29997	1.165	.8665	.45994
330.00	2.0658	7.5814	98.465	26.830	99.325	27.064	1.1519	.31387	1.160	.8658	.47533
340.00	2.0350	7.4686	103.300	28.148	104.200	28.393	1.2035	.32792	1.155	.8652	.49049
350.00	2.0061	7.3622	108.220	29.487	109.160	29.744	1.2556	.34211	1.150	.8645	.50543
360.00	1.9787	7.2618	113.190	30.843	114.180	31.112	1.3082	.35644	1.146	.8639	.52014
370.00	1.9528	7.1669	118.240	32.218	119.270	32.498	1.3612	.37091	1.141	.8633	.53463
380.00	1.9284	7.0771	123.350	33.610	124.420	33.903	1.4148	.38550	1.137	.8627	.54891
390.00	1.9052	6.9919	128.530	35.020	129.640	35.325	1.4688	.40022	1.133	.8622	.56295
400.00	1.8831	6.9111	133.760	36.446	134.920	36.763	1.5233	.41506	1.129	.8617	.57674
410.00	1.8622	6.8344	139.050	37.889	140.260	38.218	1.5781	.43001	1.125	.8612	.59027
420.00	1.8423	6.7614	144.410	39.348	145.660	39.690	1.6334	.44507	1.121	.8607	.60354
430.00	1.8234	6.6919	149.820	40.823	151.120	41.177	1.6890	.46023	1.118	.8602	.61652
440.00	1.8054	6.6257	155.290	42.312	156.630	42.679	1.7451	.47550	1.114	.8597	.62923
450.00	1.7882	6.5626	160.810	43.816	162.200	44.196	1.8015	.49086	1.111	.8592	.64165
460.00	1.7718	6.5024	166.380	45.334	167.820	45.727	1.8582	.50632	1.107	.8588	.65378
470.00	1.7561	6.4448	172.000	46.866	173.490	47.272	1.9153	.52188	1.104	.8583	.66562
480.00	1.7411	6.3898	177.670	48.412	179.210	48.831	1.9727	.53752	1.101	.8579	.67718
490.00	1.7268	6.3372	183.390	49.970	184.980	50.403	2.0304	.55324	1.098	.8574	.68844

SCINTILLATOR (NAI)

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CM	GM/CM2	GM/CM2	CM	GM/CM2	CM	GM/CM2	CM	PERCENT	PERCENT	
506.00	1.7130	6.2868	189.16	51.542	190.79	51.987	2.0884	.56905	1.095	.8570	.69941
510.00	1.6999	6.2386	194.97	53.125	196.65	53.584	2.1467	.58493	1.092	.8565	.71009
520.00	1.6873	6.1923	200.83	54.721	202.56	55.193	2.2053	.60089	1.089	.8561	.72049
530.00	1.6752	6.1479	206.72	56.328	208.51	56.814	2.2641	.61693	1.086	.8556	.73060
540.00	1.6636	6.1053	212.67	57.947	214.50	58.447	2.3232	.63303	1.083	.8552	.74042
550.00	1.6524	6.0644	218.55	59.577	220.53	60.091	2.3826	.64921	1.080	.8548	.74996
560.00	1.6417	6.0251	224.67	61.218	226.60	61.745	2.4422	.66545	1.078	.8544	.75923
570.00	1.6314	5.9873	230.73	62.869	232.72	63.410	2.5020	.68176	1.075	.8539	.76822
580.00	1.6215	5.9509	236.83	64.530	238.87	65.086	2.5621	.69813	1.073	.8535	.77694
590.00	1.6120	5.9159	242.96	66.202	245.05	66.772	2.6224	.71455	1.070	.8531	.78539
600.00	1.6028	5.8822	249.13	67.883	251.27	68.467	2.6829	.73104	1.068	.8527	.79358
620.00	1.5854	5.8185	261.58	71.275	263.83	71.887	2.8045	.76418	1.063	.8518	.80920
640.00	1.5693	5.7593	274.15	74.701	276.51	75.343	2.9269	.79753	1.059	.8510	.82382
660.00	1.5543	5.7041	286.86	78.162	289.32	78.833	3.0501	.83108	1.054	.8502	.83748
680.00	1.5402	5.6527	299.68	81.656	302.24	82.355	3.1739	.86482	1.050	.849	.85023
700.00	1.5272	5.6047	312.61	85.180	315.29	85.909	3.2984	.89874	1.046	.8485	.86212
720.00	1.5149	5.5598	325.65	88.734	328.44	89.493	3.4234	.93282	1.042	.8477	.87317
740.00	1.5035	5.5178	338.80	92.316	341.69	93.104	3.5491	.96705	1.039	.8468	.88345
760.00	1.4928	5.4785	352.04	95.924	355.05	96.743	3.6753	1.0014	1.035	.8460	.89298
780.00	1.4827	5.4416	365.38	99.557	368.49	100.41	3.8020	1.0360	1.032	.8451	.90182
800.00	1.4733	5.4069	378.80	103.21	382.02	104.09	3.9291	1.0706	1.029	.8442	.91000
820.00	1.4644	5.3743	392.30	106.89	395.64	107.80	4.0568	1.1054	1.025	.8434	.91756
840.00	1.4561	5.3438	405.89	110.60	409.34	111.54	4.1848	1.1403	1.022	.8425	.92455
860.00	1.4482	5.3149	419.55	114.32	423.11	115.29	4.3133	1.1753	1.019	.8417	.93099
880.00	1.4408	5.2878	433.31	118.07	436.99	119.07	4.4422	1.2104	1.017	.8408	.93693
900.00	1.4339	5.2622	447.12	121.83	450.91	122.86	4.5715	1.2456	1.014	.8398	.94240
920.00	1.4273	5.2381	461.00	125.61	464.90	126.68	4.7011	1.2809	1.011	.8388	.94743
940.00	1.4211	5.2154	475.00	129.43	479.02	130.52	4.8310	1.3164	1.009	.8389	.95205
960.00	1.4152	5.1939	489.03	133.25	493.16	134.38	4.9613	1.3518	1.006	.8374	.95629
1000.00	1.4045	5.1545	517.36	140.97	521.70	142.15	5.2227	1.4231	1.001	.8359	.96372

THE ELECTRON DENSITY OF SCINTILLATOR (NAI) IS 2.572E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.027 BEV, AND THE MINIMUM ENERGY LOSS IS 1.3231 MEV/GM/CM2

THE EFFECTIVE IONIZATION POTENTIAL IS 423.68 ELECTRON VOLTS

SCINTILLATOR (PILOT B)

ELEMENT ATOMIC NUMBER ATOMS/MOLECULE PERCENT BY WEIGHT ADJUSTED IONIZATION POTENTIAL

C 6 1.0 91.5490 75.10

H 1 1.1 8.4510 18.30

DENSITY = 1.0200 GM/CM3

PROTON ENERGY KEV	ENERGY LOSS MEV/CM	PROTON RANGE MM	ATOMS/MOLECULE	PERCENT BY WEIGHT	ATOMIC WEIGHT	PATH LENGTH MM	MG/CM2	PROTON PATH LENGTH MM	MG/CM2	PATH LENGTH STRAGGLING PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	1047.5	1068.5	.12016	.00118	.12083	.00118	.00508	.00005	4.202	.5514	0.	
.15	896.81	914.74	.17165	.00169	.17236	.00169	.00608	.00006	3.529	.4324	0.	
.20	778.96	794.54	.23133	.00227	.23214	.00227	.00738	.00007	3.181	.3480	0.	
.30	613.52	625.79	.37636	.00369	.37745	.00370	.01071	.00010	2.836	.2875	0.	
.40	507.87	518.03	.55582	.00545	.55726	.00546	.01487	.00015	2.668	.2587	0.	
.50	436.28	445.00	.76832	.00753	.77018	.00755	.01972	.00019	2.560	.2417	0.	
.60	385.01	392.71	1.0123	.00992	1.0146	.00995	.02510	.00025	2.474	.2304	0.	
.70	346.55	353.49	1.2854	.01263	1.2883	.01263	.03094	.00030	2.401	.2222	0.	
.80	314.02	320.30	1.5880	.01557	1.5914	.01560	.03726	.00037	2.342	.2158	0.	
.90	291.60	297.43	1.9215	.01880	1.9215	.01880	.04397	.00043	2.288	.2107	0.	
1.00	269.15	274.54	2.2739	.02229	2.2786	.02234	.05102	.00050	2.239	.2064	0.	
1.20	236.45	241.18	3.0669	.03007	3.0730	.03013	.06637	.00065	2.160	.1995	0.	
1.40	211.67	215.90	3.9609	.03883	3.9686	.03891	.08308	.00081	2.093	.1942	0.	
1.60	192.12	195.96	4.9527	.04856	4.9622	.04865	.10108	.00099	2.037	.1899	.00001	
1.80	176.23	179.76	6.0393	.05921	6.0505	.05932	.12036	.00118	1.989	.1862	.00002	
2.00	163.03	166.29	7.2181	.07077	7.2313	.07090	.14087	.00138	1.948	.1831	.00003	
2.20	151.85	154.89	8.4076	.08321	8.5030	.08336	.16259	.00159	1.912	.1803	.00004	
2.40	142.26	145.10	9.8472	.09654	9.8647	.09671	.18550	.00182	1.880	.1779	.00006	
2.60	133.91	136.59	11.295	.11073	11.315	.11093	.20959	.00205	1.852	.1757	.00008	
2.80	126.58	129.11	12.829	.12578	12.851	.12599	.23483	.00230	1.827	.1737	.00010	
3.00	120.09	122.49	14.449	.14166	14.474	.14190	.26122	.00256	1.805	.1719	.00012	
3.20	114.29	116.57	16.154	.15838	16.182	.15865	.28872	.00283	1.784	.1703	.00013	
3.40	109.07	111.25	17.943	.17592	17.974	.17621	.31734	.00311	1.766	.1688	.00010	
3.60	104.35	106.44	19.816	.19428	19.850	.19460	.34706	.00340	1.748	.1674	.00021	
3.80	100.06	102.06	21.771	.21344	21.807	.21379	.37787	.00370	1.733	.1661	.00025	
4.00	96.144	98.067	23.807	.23340	23.846	.23379	.40974	.00402	1.718	.1649	.00028	
4.20	92.400	94.248	25.927	.25419	25.970	.25461	.44284	.00434	1.705	.1638	.00032	
4.40	89.109	90.891	28.130	.27579	28.176	.27624	.47700	.00468	1.693	.1628	.00036	
4.60	86.064	87.785	30.408	.29811	30.457	.29360	.51218	.00502	1.682	.1618	.00040	
4.80	83.238	84.903	32.770	.32128	32.823	.32179	.54838	.00538	1.671	.1608	.00045	

PILOT 8 SCINT.

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2	PROTON PATH LENGTH CH	PROTON PATH LENGTH CH	GM/CM2	PATH LENGTH STRAGGLING CH	MULTIPLYING SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	86.609	0.3521	0.3527	0.3457	0.0059	0.0057	1.660	0.0049
5.50	74.766	0.4155	0.4171	0.4089	0.0068	0.0067	1.637	0.0062
6.00	69.779	0.4856	0.4761	0.4768	0.0079	0.0077	1.617	0.0228
6.50	65.468	0.5595	0.5604	0.5494	0.0090	0.0088	1.599	0.0464
7.00	61.701	0.6381	0.6391	0.6266	0.0101	0.0099	1.583	0.0699
7.50	58.380	0.7214	0.7225	0.7083	0.0113	0.0111	1.568	0.0934
8.00	55.428	0.8092	0.8104	0.7945	0.0126	0.0124	1.555	0.1169
8.50	52.785	0.9015	0.9028	0.8851	0.0139	0.0137	1.543	0.1498
9.00	50.404	0.9983	0.9998	0.9802	0.0153	0.0150	1.532	0.1638
9.50	48.247	1.0996	1.1012	1.0796	0.0168	0.0164	1.521	0.1873
10.00	46.283	1.2053	1.2071	1.1834	0.0183	0.0179	1.512	0.2107
11.00	42.837	1.4298	1.4319	1.4038	0.0214	0.0210	1.495	0.2577
12.00	39.910	1.6715	1.6387	1.6411	0.0248	0.0243	1.480	0.3046
13.00	37.390	1.9301	1.9329	1.8950	0.0283	0.0278	1.466	0.3516
14.00	35.196	2.2056	2.2087	2.1654	0.0321	0.0315	1.454	0.3987
15.00	33.268	2.4975	2.5010	2.4520	0.0361	0.0354	1.444	0.4458
16.00	31.559	2.8059	2.8098	2.7547	0.0403	0.0395	1.434	0.4930
17.00	30.032	3.1304	3.1347	3.0733	0.0447	0.0438	1.424	0.5402
18.00	28.661	3.4709	3.4757	3.4076	0.0492	0.0482	1.416	0.5876
19.00	27.421	3.8272	3.8325	3.7573	0.0540	0.0529	1.408	0.6350
20.00	26.294	4.1993	4.2050	4.1226	0.0589	0.0577	1.401	0.6824
22.00	24.322	4.9898	4.9966	4.8986	0.0693	0.0680	1.387	0.7775
24.00	22.652	5.8414	5.8493	5.7346	0.0805	0.0789	1.375	0.8728
26.00	21.218	6.7531	6.7621	6.6296	0.0923	0.0905	1.365	0.9300
28.00	19.973	7.7239	7.7324	7.5826	0.1048	0.1027	1.355	0.9478
30.00	18.881	8.7529	8.7646	8.5927	0.1180	0.1157	1.346	0.9663
32.00	17.915	9.8394	9.8525	9.6593	0.1318	0.1292	1.338	0.9854
34.00	17.054	1.0983	1.0997	1.0781	0.1463	0.1434	1.330	1.0051
36.00	16.282	1.2182	1.2198	1.1958	0.1614	0.1582	1.323	1.0253
38.00	15.585	1.3436	1.3454	1.3190	0.1771	0.1737	1.317	1.0460
40.00	14.952	1.4745	1.4764	1.4475	0.1935	0.1897	1.310	1.0671
45.00	13.600	1.8251	1.8275	1.7917	0.2369	0.2323	1.296	1.1214
50.00	12.500	2.2086	2.2114	2.1680	0.2839	0.2783	1.284	1.1774
55.00	11.587	2.6238	2.6272	2.5757	0.3344	0.3278	1.273	1.2353
60.00	10.817	3.0702	3.0741	3.0139	0.3882	0.3806	1.263	1.2958
65.00	10.157	3.5469	3.5514	3.4818	0.4452	0.4364	1.253	1.3584
70.00	9.5865	4.0533	4.0584	3.9788	0.5053	0.4954	1.245	1.4229
75.00	9.0870	4.5846	4.5944	4.5043	0.5684	0.5572	1.237	1.4890
80.00	8.6462	5.1522	5.1587	5.0575	0.6344	0.6220	1.230	1.5563
90.00	7.9034	6.3621	6.3700	6.2451	0.7749	0.7597	1.216	1.6936

PILOT B SCINI.

PRCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CH	GM/CH2	CM	GM/CH2	CM	GM/CH2	CM		
100.00	7.3013	7.4473	7.6763	7.5277	7.6878	7.5370	.09260	.09078	.1234	.18328
110.00	6.8031	6.9391	9.0967	8.7163	9.1079	8.9293	.10871	.10658	.1229	.19748
120.00	6.3638	6.5115	10.613	10.405	10.626	10.418	.12578	.12332	.1224	.21210
130.00	6.0260	6.1466	12.225	11.985	12.240	12.000	.14375	.14094	.1219	.22705
140.00	5.7171	5.8314	13.927	13.654	13.944	13.671	.16298	.15940	.1215	.24222
150.00	5.4475	5.5565	15.718	15.410	15.737	15.428	.18223	.17865	.1212	.25754
160.00	5.2103	5.3145	17.593	17.265	17.615	17.269	.20265	.19868	.1209	.27301
170.00	4.9999	5.0999	19.551	19.144	19.574	19.191	.22381	.21942	.1206	.28864
180.00	4.8121	4.9082	21.588	21.134	21.614	21.190	.24568	.24086	.1203	.30437
190.00	4.6434	4.7362	23.701	23.237	23.730	23.265	.26822	.26296	.1200	.32016
200.00	4.4910	4.5808	25.889	25.381	25.920	25.412	.29140	.28568	.1198	.33595
210.00	4.3527	4.4397	28.149	27.597	28.182	27.630	.31520	.30902	.1195	.35172
220.00	4.2266	4.3112	30.478	29.880	30.514	29.916	.33958	.33292	.1193	.36744
230.00	4.1113	4.1935	32.874	32.230	32.914	32.268	.36453	.35738	.1191	.38310
240.00	4.0053	4.0854	35.336	34.643	35.378	34.685	.39002	.38237	.1189	.39864
250.00	3.9074	3.9855	37.861	37.119	37.906	37.163	.41602	.40786	.1187	.41404
260.00	3.8171	3.8934	40.448	39.655	40.496	39.702	.44252	.43384	.1185	.42930
270.00	3.7333	3.8080	43.094	42.249	43.145	42.299	.46950	.46029	.1183	.44440
280.00	3.6555	3.7286	45.798	44.900	45.852	44.953	.49693	.48718	.1182	.45932
290.00	3.5830	3.6547	48.559	47.607	48.616	47.663	.52480	.51451	.1180	.47404
300.00	3.5153	3.5856	51.374	50.366	51.434	50.426	.55309	.54225	.1179	.48855
310.00	3.4520	3.5210	54.241	53.178	54.305	53.240	.58179	.57038	.1177	.50296
320.00	3.3926	3.4604	57.160	56.039	57.227	56.105	.61087	.59890	.1175	.51727
330.00	3.3368	3.4035	60.129	58.950	60.200	59.019	.64034	.62778	.1174	.53145
340.00	3.2843	3.3500	63.146	61.908	63.220	61.981	.67016	.65702	.1172	.54548
350.00	3.2348	3.2995	66.211	64.912	66.288	64.989	.70033	.68660	.1171	.55934
360.00	3.1881	3.2519	69.321	67.962	69.402	68.041	.73083	.71650	.1170	.57311
370.00	3.1440	3.2069	72.476	71.055	72.561	71.138	.76166	.74673	.1168	.58682
380.00	3.1022	3.1642	75.676	74.192	75.764	74.279	.79280	.77726	.1167	.60048
390.00	3.0626	3.1239	78.916	77.369	79.009	77.459	.82424	.80808	.1166	.61403
400.00	3.0250	3.0855	82.198	80.587	82.294	80.681	.85597	.83919	.1164	.62748
410.00	2.9893	3.0491	85.520	83.843	85.620	83.941	.88798	.87057	.1163	.64071
420.00	2.9554	3.0145	88.881	87.138	88.984	87.239	.92026	.90222	.1162	.65362
430.00	2.9231	2.9815	92.279	90.470	92.387	90.575	.95280	.93412	.1160	.66621
440.00	2.8923	2.9501	95.715	93.838	95.826	93.947	.98559	.96627	.1159	.67848
450.00	2.8629	2.9201	99.186	97.241	99.301	97.354	1.0186	.99866	.1158	.69042
460.00	2.8348	2.8915	102.69	100.68	102.81	100.80	1.0519	1.0313	.1157	.70204
470.00	2.8080	2.8642	106.23	104.15	106.36	104.27	1.0854	1.0641	.1155	.71333
480.00	2.7824	2.8380	109.81	107.65	109.93	107.78	1.1191	1.0972	.1154	.72430
490.00	2.7579	2.8130	113.41	111.19	113.54	111.32	1.1531	1.1305	.1153	.73495

PILOT B SCINT.

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	HEV/CH2	MEV/CH	GH/CH2	CM	GH/CH2	CM	GH/CH2	PERCENT		
500.00	2.7344	2.7890	117.05	114.76	117.19	114.89	1.1872	1.1639	.1152	.74528
510.00	2.7118	2.7661	120.72	118.35	120.86	118.49	1.2216	1.1976	.1150	.75530
520.00	2.6902	2.7440	124.42	121.93	124.56	122.12	1.2561	1.2315	.1149	.76502
530.00	2.6695	2.7229	128.14	125.63	128.29	125.78	1.2908	1.2655	.1148	.77445
540.00	2.6496	2.7026	131.90	129.31	132.05	129.46	1.3257	1.2997	.1147	.78358
550.00	2.6304	2.6830	135.66	133.02	135.84	133.18	1.3608	1.3341	.1146	.79242
560.00	2.6120	2.6643	139.50	136.76	139.66	136.92	1.3961	1.3687	.1145	.80097
570.00	2.5943	2.6462	143.33	140.52	143.50	140.68	1.4315	1.4034	.1143	.80924
580.00	2.5773	2.6288	147.20	144.31	147.36	144.47	1.4671	1.4383	.1142	.81724
590.00	2.5609	2.6121	151.08	148.12	151.26	148.29	1.5028	1.4734	.1141	.82496
600.00	2.5450	2.5959	155.00	151.96	155.17	152.13	1.5387	1.5086	.1140	.83241
620.00	2.5151	2.5654	162.89	159.70	163.08	159.88	1.6110	1.5794	.1138	.84655
640.00	2.4872	2.5369	170.88	167.53	171.08	167.72	1.6838	1.6508	.1135	.85971
660.00	2.4611	2.5104	178.96	175.45	179.16	175.65	1.7571	1.7227	.1133	.87192
680.00	2.4368	2.4856	187.12	183.45	187.33	183.65	1.8310	1.7951	.1131	.88323
700.00	2.4141	2.4625	195.35	191.52	195.57	191.74	1.9053	1.8679	.1128	.89369
720.00	2.3927	2.4406	203.67	199.67	203.90	199.90	1.9801	1.9412	.1126	.90334
740.00	2.3727	2.4202	212.05	207.89	212.29	208.12	2.0553	2.0150	.1124	.91223
760.00	2.3539	2.4010	220.51	216.18	220.75	216.43	2.1309	2.0891	.1122	.92040
780.00	2.3363	2.3830	229.03	224.54	229.28	224.79	2.2069	2.1637	.1119	.92787
800.00	2.3196	2.3660	237.61	232.95	237.88	233.21	2.2833	2.2386	.1117	.93471
820.00	2.3039	2.3500	246.25	241.42	246.53	241.69	2.3601	2.3138	.1115	.94094
840.00	2.2891	2.3349	254.95	249.95	255.24	250.23	2.4372	2.3894	.1113	.94663
860.00	2.2752	2.3207	263.71	258.54	264.00	258.83	2.5146	2.4653	.1110	.95181
880.00	2.2620	2.3072	272.52	267.18	272.82	267.47	2.5924	2.5415	.1108	.95651
900.00	2.2495	2.2945	281.38	275.86	281.69	276.17	2.6704	2.6180	.1106	.96079
920.00	2.2377	2.2824	290.29	284.50	290.51	284.91	2.7487	2.6948	.1104	.96467
940.00	2.2265	2.2710	299.25	293.38	299.58	293.71	2.8274	2.7719	.1101	.96819
960.00	2.2158	2.2602	308.26	302.22	308.60	302.55	2.9063	2.8493	.1098	.97138
1000.00	2.1962	2.2402	326.49	320.08	326.84	320.43	3.0848	3.0047	.1092	.97689

THE ELECTRON DENSITY OF PILOT B SCINT. IS 5.260E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.333 BEV, AND THE MINIMUM ENERGY LOSS IS 2.0153 MEV/GH/CH2

THE EFFECTIVE IONIZATION POTENTIAL IS 60.34 ELECTRON VOLTS

SCINTILLATOR (TRANS-STILBENE)

PROCTON ENERGY MEV	ENERGY LOSS MEV/CH	ELEMENT	ATOMIC NUMBER	ATOMS/MOLECULE	PERCENT BY WEIGHT	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION	PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING	
										MG/CM2	MM	MG/CM2	MM	MG/CM2	PERCENT
.10	944.54	C	6	14	55.4240	12.011	77.30	.6169	0.	.13563	.00117	.13648	.00118	.00518	3.797
.15	815.92	H	1	8.	4.5760	1.0000	18.30	.4629	0.	.19249	.00166	.19338	.00167	.00621	3.210
.20	713.28							.3900	0.	.25787	.00222	.25688	.00223	.00753	2.910
.30	565.71							.3197	0.	.41561	.00358	.41694	.00359	.01092	2.620
.40	469.80							.2854	0.	.60987	.00526	.61161	.00527	.01517	2.480
.50	404.81							.2649	0.	.83921	.00723	.84144	.00725	.02011	2.390
.60	358.23							.2512	0.	1.1017	.00950	1.1045	.00952	.02560	2.318
.70	322.68							.2412	0.	1.3951	.01203	1.3985	.01206	.03155	2.256
.80	292.86							.2335	0.	1.7198	.01483	1.7238	.01486	.03800	2.205
.90	271.25							.2273	0.	2.0735	.01788	2.0783	.01792	.04467	2.159
1.00	249.62							.2222	0.	2.4572	.02118	2.4627	.02123	.05219	2.119
1.20	219.76							.2140	0.	3.3112	.02874	3.3183	.02861	.06816	2.054
1.40	197.06							.2078	.00001	4.2721	.03683	4.2810	.03691	.08547	1.997
1.60	179.12							.2029	.00001	5.3366	.04630	5.3474	.04610	.10409	1.946
1.80	164.51							.1987	.00002	6.5011	.05660	6.5140	.05616	.12398	1.903
2.00	152.34							.1931	.00003	7.7631	.06692	7.7782	.06705	.14512	1.866
2.20	142.03							.1892	.00004	9.1209	.07853	9.1384	.07878	.16749	1.833
2.40	133.15							.1868	.00006	10.574	.09115	10.594	.09133	.19108	1.804
2.60	125.43							.1868	.00039	12.120	.10448	12.142	.10468	.21587	1.778
2.80	118.63							.1868	.00011	13.757	.11860	13.783	.11882	.24184	1.755
3.00	112.61							.1826	.00014	15.485	.13349	15.514	.13374	.26897	1.734
3.20	107.22							.1807	.00017	17.303	.14916	17.334	.14943	.29725	1.715
3.40	102.37							.1790	.00020	19.209	.16560	19.244	.16589	.32666	1.697
3.60	97.984							.1775	.00024	21.204	.18280	21.242	.18312	.35720	1.682
3.80	93.991							.1760	.00027	23.245	.20073	23.326	.20109	.38885	1.667
4.00	90.341							.1747	.00031	25.452	.21942	25.497	.21980	.42160	1.654
4.20	86.836							.1734	.00036	27.709	.23887	27.757	.23928	.45559	1.641
4.40	83.769							.1723	.00040	30.074	.25907	30.104	.25952	.49068	1.630
4.60	80.930							.1712	.00045	32.472	.27995	32.530	.28043	.52682	1.619
4.80	78.295							.1701	.00050	34.986	.30161	35.046	.30212	.56398	1.609

DENSITY = 1.1600 GM/CM3

STILBENE

PROCTON ENERGY HEV	ENERGY LOSS MEV/CH	PROCTON RANGE GH/CH2	PROCTON PATH LENGTH GH/CH2	PROCTON PATH LENGTH CM	GM/CH2	GM/CH2	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	75.840	0.3758	0.3764	0.3245	0.0060	0.0052	1.600	1.691	0.0055
5.50	70.383	0.4442	0.4442	0.3835	0.0070	0.0061	1.578	1.669	0.0069
6.00	65.720	0.5176	0.5185	0.4470	0.0081	0.0070	1.559	1.650	0.0252
6.50	61.687	0.5961	0.5971	0.5147	0.0092	0.0079	1.542	1.632	0.0513
7.00	58.160	0.6795	0.6806	0.5867	0.0104	0.0090	1.527	1.617	0.0774
7.50	55.048	0.7677	0.7687	0.6629	0.0116	0.0100	1.514	1.602	0.1033
8.00	52.280	0.8608	0.8622	0.7433	0.0129	0.0112	1.501	1.589	0.1293
8.50	49.801	0.9587	0.9602	0.8278	0.0143	0.0123	1.490	1.578	0.1552
9.00	47.567	1.0613	1.0630	0.9164	0.0157	0.0136	1.479	1.567	0.1825
9.50	45.542	1.1686	1.1704	1.0090	0.0172	0.0148	1.470	1.557	0.2109
10.00	43.698	1.2806	1.2825	1.1056	0.0187	0.0162	1.461	1.549	0.2327
11.00	40.461	1.5183	1.5206	1.3108	0.0220	0.0189	1.445	1.531	0.2844
12.00	37.709	1.7741	1.7758	1.5317	0.0254	0.0219	1.431	1.516	0.3360
13.00	35.338	2.0478	2.0509	1.7680	0.0291	0.0251	1.418	1.503	0.3877
14.00	33.274	2.3392	2.3427	2.0195	0.0330	0.0284	1.407	1.492	0.4393
15.00	31.459	2.6492	2.6538	2.2861	0.0370	0.0319	1.397	1.481	0.4911
16.00	29.849	2.9739	2.9785	2.5675	0.0413	0.0356	1.387	1.471	0.5428
17.00	28.411	3.3170	3.3218	2.8637	0.0458	0.0395	1.379	1.463	0.5946
18.00	27.118	3.6769	3.6822	3.1743	0.0505	0.0435	1.371	1.455	0.6464
19.00	25.949	4.0534	4.0593	3.4994	0.0553	0.0477	1.363	1.447	0.6983
20.00	24.887	4.4465	4.4529	3.8387	0.0604	0.0521	1.356	1.440	0.7502
22.00	23.027	5.2815	5.2891	4.5595	0.0711	0.0613	1.344	1.428	0.8541
24.00	21.451	6.1808	6.1896	5.3359	0.0825	0.0711	1.332	1.417	0.9581
26.00	20.098	7.1433	7.1534	6.1667	0.0946	0.0815	1.322	1.408	1.0204
28.00	18.923	8.1681	8.1795	7.0513	0.1074	0.0926	1.313	1.399	1.0397
30.00	17.892	9.2541	9.2670	7.9888	0.1209	0.1042	1.305	1.392	1.0599
32.00	16.979	1.0400	1.0415	8.9784	0.1351	0.1164	1.297	1.385	1.0807
34.00	16.166	1.1606	1.1622	1.0019	0.1499	0.1292	1.290	1.378	1.1021
36.00	15.436	1.2871	1.2889	1.1111	0.1654	0.1426	1.283	1.372	1.1241
38.00	14.777	1.4194	1.4214	1.2253	0.1815	0.1564	1.277	1.367	1.1466
40.00	14.179	1.5574	1.5596	1.3444	0.1982	0.1709	1.271	1.362	1.1696
45.00	12.900	1.9271	1.9298	1.6636	0.2406	0.2092	1.257	1.351	1.2286
50.00	11.860	2.3313	2.3344	2.0124	0.2908	0.2507	1.246	1.341	1.2893
55.00	10.996	2.7689	2.7726	2.3902	0.3424	0.2952	1.235	1.333	1.3521
60.00	10.267	3.2393	3.2436	2.7962	0.3974	0.3426	1.225	1.326	1.4176
65.00	9.6424	3.7415	3.7464	3.2297	0.4558	0.3929	1.217	1.320	1.4854
70.00	9.1016	4.2748	4.2804	3.6900	0.5173	0.4459	1.208	1.314	1.5552
75.00	8.6286	4.8385	4.8449	4.1766	0.5819	0.5016	1.201	1.309	1.6265
80.00	8.2110	5.4320	5.4391	4.6820	0.6494	0.5598	1.194	1.304	1.6992
90.00	7.5073	6.7058	6.7145	5.7884	0.7931	0.6837	1.181	1.296	1.8472

STILBENE

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CH	GH/CH2	CM	GH/CH2	CM	GH/CH2	CM	PERCENT	PERCENT	
100.00	6.9366	8.0465	8.10912	6.9752	8.1017	6.9842	.09476	.02169	1.170	.1289	.19970
110.00	6.4644	7.4987	9.15840	8.12621	9.1593	8.2727	.11125	.02590	1.159	.1283	.21495
120.00	6.0669	7.0376	11.180	9.6379	11.194	9.6502	.12870	.11095	1.150	.1278	.23063
130.00	5.7276	6.6940	12.875	11.099	12.892	11.114	.14708	.12660	1.141	.1273	.24662
140.00	5.4346	6.3041	14.666	12.643	14.685	12.659	.16634	.14340	1.133	.1269	.26282
150.00	5.1789	6.0075	16.550	14.267	16.571	14.285	.18643	.16071	1.125	.1265	.27914
160.00	4.9539	5.7465	18.522	15.968	18.546	15.988	.20731	.17872	1.118	.1261	.29559
170.00	4.7543	5.5150	20.581	17.742	20.607	17.765	.22895	.19737	1.111	.1258	.31217
180.00	4.5761	5.3082	22.723	19.589	22.752	19.633	.25130	.21664	1.105	.1255	.32863
190.00	4.4169	5.1225	24.945	21.505	24.977	21.532	.27435	.23651	1.096	.1252	.34551
200.00	4.2713	4.9548	27.246	23.488	27.280	23.517	.29805	.25694	1.093	.1250	.36215
210.00	4.1401	4.8025	29.621	25.536	29.658	25.567	.32238	.27791	1.087	.1247	.37873
220.00	4.0205	4.6637	32.070	27.646	32.110	27.681	.34731	.29940	1.082	.1245	.39523
230.00	3.9108	4.5365	34.589	29.818	34.632	29.855	.37281	.32139	1.076	.1243	.41160
240.00	3.8102	4.4198	37.177	32.059	37.223	32.089	.39887	.34385	1.072	.1241	.42783
250.00	3.7275	4.3123	39.831	34.337	39.880	34.380	.42545	.36677	1.067	.1239	.44387
260.00	3.6318	4.2129	42.550	36.681	42.603	36.726	.45254	.39012	1.062	.1237	.45971
270.00	3.5523	4.1207	45.331	39.078	45.387	39.127	.48011	.41389	1.058	.1235	.47535
280.00	3.4781	4.0350	48.172	41.528	48.232	41.579	.50815	.43806	1.054	.1233	.49076
290.00	3.4097	3.9552	51.073	44.028	51.136	44.083	.53664	.46262	1.049	.1231	.50593
300.00	3.3454	3.8807	54.030	46.578	54.097	46.635	.56556	.48755	1.045	.1230	.52064
310.00	3.2853	3.8110	57.043	49.175	57.113	49.236	.59489	.51283	1.042	.1228	.53557
320.00	3.2290	3.7456	60.111	51.819	60.184	51.883	.62462	.53846	1.038	.1226	.55015
330.00	3.1760	3.6842	63.230	54.508	63.307	54.575	.65473	.56442	1.034	.1225	.56454
340.00	3.1262	3.6264	66.400	57.241	66.481	57.311	.68521	.59070	1.031	.1223	.57974
350.00	3.0793	3.5720	69.619	60.016	69.704	60.090	.71604	.61728	1.027	.1222	.59273
360.00	3.0350	3.5206	72.886	62.833	72.976	62.930	.74722	.64415	1.024	.1220	.60657
370.00	2.9931	3.4720	76.201	65.690	76.294	65.770	.77872	.67131	1.021	.1219	.62032
380.00	2.9535	3.4260	79.560	68.586	79.657	68.670	.81054	.69875	1.018	.1217	.63395
390.00	2.9159	3.3824	82.964	71.521	83.065	71.608	.84267	.72644	1.014	.1216	.64745
400.00	2.8803	3.3411	86.411	74.492	86.516	74.582	.87510	.75490	1.011	.1215	.66079
410.00	2.8464	3.3018	89.899	77.599	90.008	77.693	.90781	.78259	1.009	.1213	.67386
420.00	2.8142	3.2645	93.420	80.742	93.542	80.839	.94079	.81103	1.006	.1212	.68657
430.00	2.7836	3.2289	96.997	83.918	97.115	83.939	.97404	.83969	1.003	.1210	.69893
440.00	2.7544	3.1950	100.60	86.728	100.73	86.833	1.0076	.86858	1.000	.1209	.71092
450.00	2.7265	3.1627	104.25	89.870	104.33	89.979	1.0413	.89768	.9977	.1208	.72235
460.00	2.6999	3.1319	107.93	93.044	108.06	93.156	1.0753	.92699	.9951	.1207	.73382
470.00	2.6745	3.1024	111.65	96.246	111.78	96.364	1.1095	.95650	.9926	.1205	.74474
480.00	2.6502	3.0742	115.40	99.483	115.54	99.603	1.1440	.98620	.9901	.1204	.75531
490.00	2.6269	3.0472	119.19	102.75	119.33	102.87	1.1787	1.0161	.9877	.1203	.76582

STILBENE

PROTON ENERGY MEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2 CM	PROTON PATH LENGTH GM/CM2 CM	PATH LENGTH STRAGGLING GM/CM2 CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
500.00	2.6047	123.00	123.15	1.2136	.9854	.77540
510.00	2.5833	126.86	127.01	1.2486	.9831	.78494
520.00	2.5629	130.74	130.89	1.2839	.9809	.79415
530.00	2.5432	134.65	134.81	1.3194	.9787	.80305
540.00	2.5243	138.59	138.76	1.3551	.9766	.81163
550.00	2.5062	142.56	142.73	1.3909	.9745	.81990
560.00	2.4888	146.56	146.74	1.4269	.9724	.82786
570.00	2.4720	150.59	150.77	1.4631	.9704	.83554
580.00	2.4559	154.64	154.83	1.4995	.9685	.84292
590.00	2.4403	158.72	158.91	1.5360	.9666	.85002
600.00	2.4253	162.83	163.02	1.5727	.9647	.85685
620.00	2.3970	171.12	171.32	1.6465	.9611	.86971
640.00	2.3706	179.50	179.71	1.7209	.9576	.88157
660.00	2.3450	187.97	188.19	1.7958	.9542	.89249
680.00	2.3230	196.53	196.76	1.8712	.9510	.90252
700.00	2.3015	205.17	205.41	1.9471	.9479	.91172
720.00	2.2813	213.89	214.14	2.0235	.9449	.92013
740.00	2.2624	222.68	222.94	2.1003	.9421	.92783
760.00	2.2447	231.55	231.82	2.1776	.9393	.93485
780.00	2.2280	240.48	240.76	2.2552	.9367	.94124
800.00	2.2123	249.46	249.77	2.3332	.9341	.94704
820.00	2.1975	258.54	258.84	2.4116	.9317	.95231
840.00	2.1835	267.66	267.97	2.4903	.9293	.95708
860.00	2.1704	276.84	277.16	2.5694	.9270	.96140
880.00	2.1579	286.08	286.41	2.6488	.9248	.96531
900.00	2.1462	295.36	295.71	2.7285	.9227	.96885
920.00	2.1350	304.70	305.05	2.8085	.9207	.97204
940.00	2.1245	314.09	314.46	2.8888	.9187	.97492
960.00	2.1145	323.54	323.91	2.9693	.9167	.97752
1000.00	2.0961	342.63	343.02	3.1312	.9128	.98197

THE ELECTRON DENSITY OF STILBENE IS 3.145E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.315 BEV, AND THE MINIMUM ENERGY LOSS IS 1.9303 MEV/GM/CM2

THE EFFECTIVE IONIZATION POTENTIAL IS 66.20 ELECTRON VOLTS

SCINTILLATOR (TOLUENE IN SOLUTION)

PROCTON ENERGY MEV	ENERGY LOSS MEV/CM	ELEMENT	ATOMIC NUMBER	ATOMS/ MOLECULE	PERCENT BY WEIGHT	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	1045.6	C	6	9	91.4709	12.011	77.39	.5502	0.
.15	898.44	H	1	10	8.5291	1.0080	18.30	.4115	0.
.20	780.29							.3473	0.
.30	614.49							.2869	0.
.40	508.64							.2582	0.
.50	436.91							.2413	0.
.60	385.55							.2300	0.
.70	347.04							.2218	0.
.80	314.44							.2155	0.
.90	291.04							.2104	0.
1.00	267.60							.2061	0.
1.20	235.17							.1993	0.
1.40	210.57							.1941	0.
1.60	191.16							.1899	.00001
1.80	175.39							.1863	.00002
2.00	162.27							.1833	.00003
2.20	151.17							.1806	.00004
2.40	141.63							.1782	.00006
2.60	133.33							.1760	.00008
2.80	126.05							.1741	.00010
3.00	119.59							.1724	.00012
3.20	113.82							.1708	.00013
3.40	108.63							.1693	.00018
3.60	103.94							.1679	.00021
3.80	99.671							.1665	.00025
4.00	95.772							.1654	.00028
4.20	92.047							.1643	.00032
4.40	88.772							.1633	.00036
4.60	85.742							.1623	.00040
4.80	82.931							.1614	.00045

DENSITY = .87000 GM/CM3

TOLUENE

PRCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	HEV/CH2	HEV/CH	GM/CH2	CM	GM ² /CH2	CH	GM/CH2	CM		
5.00	80.314	69.873	.03534	.04063	.03540	.04069	.00059	.00068	1.669	.00050
5.50	74.498	64.814	.04181	.04805	.04187	.04813	.00069	.00070	1.645	.00063
6.00	69.534	60.494	.04875	.05603	.04882	.05612	.00079	.00091	1.625	.00228
6.50	65.242	56.761	.05616	.06456	.05625	.06466	.00090	.00104	1.606	.00465
7.00	61.492	53.498	.06405	.07362	.06415	.07373	.00102	.00117	1.590	.00701
7.50	58.195	50.621	.07240	.08322	.07251	.08335	.00114	.00131	1.575	.00937
8.00	55.246	48.064	.08121	.09334	.08133	.09349	.00127	.00146	1.562	.01172
8.50	52.614	45.774	.09047	.10399	.09062	.10415	.00140	.00161	1.550	.01407
9.00	50.242	43.711	.10019	.11515	.10034	.11533	.00154	.00177	1.538	.01643
9.50	48.094	41.842	.11035	.12684	.11051	.12703	.00169	.00194	1.528	.01878
10.00	46.138	40.140	.12095	.13902	.12113	.13923	.00184	.00211	1.518	.02113
11.00	42.706	37.154	.14347	.16491	.14368	.16515	.00216	.00248	1.501	.02583
12.00	39.789	34.617	.16771	.19277	.16795	.19305	.00250	.00287	1.486	.03053
13.00	37.279	32.433	.19365	.22259	.19393	.22291	.00286	.00328	1.472	.03524
14.00	35.093	30.531	.22128	.25435	.22160	.25471	.00324	.00372	1.460	.03996
15.00	33.172	28.860	.25056	.28841	.25091	.28841	.00364	.00418	1.449	.04468
16.00	31.469	27.378	.28148	.32394	.28188	.32400	.00406	.00466	1.439	.04941
17.00	29.948	26.055	.31403	.36095	.31447	.36146	.00450	.00517	1.430	.05414
18.00	28.581	24.865	.34817	.40020	.34866	.40076	.00496	.00570	1.421	.05888
19.00	27.345	23.790	.38390	.44127	.38444	.44138	.00543	.00625	1.413	.06363
20.00	26.222	22.813	.42121	.48415	.42179	.48482	.00593	.00682	1.406	.06839
22.00	24.256	21.103	.50048	.57526	.50116	.57605	.00698	.00802	1.392	.07791
24.00	22.592	19.655	.58586	.67341	.58666	.67432	.00819	.00931	1.380	.08746
26.00	21.163	18.412	.67727	.77847	.67819	.77952	.00925	.01068	1.370	.09318
28.00	19.922	17.332	.77460	.89035	.77564	.89154	.01055	.01212	1.360	.09496
30.00	18.833	16.385	.87777	1.0089	.87894	1.0103	.01187	.01355	1.351	.09681
32.00	17.870	15.547	.98670	1.1341	.98801	1.1356	.01326	.01525	1.343	.09873
34.00	17.012	14.801	1.1013	1.2659	1.1028	1.2675	.01472	.01692	1.335	.10070
36.00	16.242	14.131	1.2215	1.4040	1.2231	1.4059	.01624	.01867	1.328	.10273
38.00	15.547	13.526	1.3472	1.5485	1.3490	1.5506	.01782	.02048	1.321	.10480
40.00	14.916	12.977	1.4784	1.6994	1.4804	1.7016	.01946	.02237	1.315	.10691
45.00	13.568	11.804	1.8299	2.1034	1.8323	2.1061	.02383	.02739	1.301	.11236
50.00	12.471	10.850	2.2142	2.5451	2.2171	2.5484	.02856	.03282	1.289	.11798
55.00	11.561	10.058	2.6305	3.0236	2.6339	3.0274	.03363	.03866	1.279	.12377
60.00	10.793	9.3895	3.0779	3.5378	3.0818	3.5423	.03904	.04487	1.272	.12981
65.00	10.135	8.8173	3.5557	4.0870	3.5602	4.0922	.04477	.05146	1.266	.13608
70.00	9.5654	8.3219	4.0632	4.6703	4.0683	4.6762	.05081	.05840	1.261	.14254
75.00	9.0572	7.8884	4.5996	5.2869	4.6054	5.2936	.05715	.06569	1.241	.14915
80.00	8.6276	7.5060	5.1645	5.9362	5.1710	5.9436	.06379	.07332	1.234	.15589
90.00	7.8867	6.8614	6.13769	7.3298	6.3848	7.3389	.07790	.08955	1.220	.16963

TOLUENE

PRCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CH	GM/CH2	CH	GM/CH2	CH	GM/CH2	CH PERCENT		
100.00	7.2861	6.3389	7.6959	8.8458	7.7054	8.8568	.09309	1.0700	1.238	.18356
110.00	6.7891	5.9065	9.1172	10.480	9.1285	10.492	.10928	1.2561	1.232	.19778
120.00	6.3709	5.5427	10.637	12.226	10.650	12.241	.12644	1.4533	1.227	.21241
130.00	6.0140	5.2521	12.252	14.082	12.267	14.099	.14449	1.6608	1.223	.22737
140.00	5.7057	4.9640	13.958	16.043	13.975	16.063	.16341	1.8783	1.219	.24256
150.00	5.4368	4.7300	15.752	18.105	15.771	18.127	.18315	2.1052	1.215	.25788
160.00	5.2002	4.5241	17.631	20.265	17.652	20.290	.20367	2.3410	1.212	.27336
170.00	4.9903	4.3415	19.592	22.520	19.616	22.547	.22493	2.5854	1.209	.28900
180.00	4.8029	4.1785	21.633	24.845	21.659	24.895	.24689	2.8379	1.206	.30474
190.00	4.6345	4.0320	23.751	27.299	23.779	27.332	.26954	3.0981	1.203	.32054
200.00	4.4825	3.8998	25.942	29.819	25.974	29.859	.29282	3.3658	1.201	.33633
210.00	4.3445	3.7797	28.206	32.421	28.240	32.460	.31673	3.6406	1.198	.35211
220.00	4.2187	3.6703	30.540	35.103	30.576	35.145	.34122	3.9221	1.196	.36784
230.00	4.1036	3.5702	32.941	37.863	32.980	37.908	.36628	4.2102	1.194	.38350
240.00	3.9979	3.4782	35.407	40.698	35.449	40.747	.39189	4.5044	1.192	.39905
250.00	3.9005	3.3935	37.937	43.606	37.982	43.658	.41801	4.8047	1.190	.41446
260.00	3.8105	3.3151	40.528	46.584	40.576	46.639	.44462	5.1106	1.188	.42971
270.00	3.7270	3.2425	43.179	49.631	43.230	49.690	.47172	5.4220	1.186	.44482
280.00	3.6495	3.1750	45.888	52.744	45.942	52.807	.49927	5.7387	1.185	.45974
290.00	3.5768	3.1118	48.652	55.922	48.710	55.988	.52726	6.0605	1.183	.47446
300.00	3.5093	3.0531	51.472	59.163	51.533	59.233	.55568	6.3871	1.181	.48897
310.00	3.4461	2.9981	54.345	62.465	54.409	62.539	.58450	6.7184	1.074	.50339
320.00	3.3869	2.9466	57.268	65.826	57.336	65.903	.61371	7.0541	1.070	.51769
330.00	3.3312	2.8981	60.242	69.244	60.315	69.325	.64330	7.3942	1.067	.53187
340.00	3.2788	2.8526	63.266	72.719	63.349	72.805	.67325	7.7385	1.063	.54590
350.00	3.2295	2.8096	66.335	76.247	66.413	76.337	.70355	8.0868	1.059	.55976
360.00	3.1829	2.7691	69.451	79.829	69.532	79.922	.73418	8.4389	1.056	.57353
370.00	3.1388	2.7308	72.611	83.461	72.696	83.559	.76514	8.7948	1.053	.58724
380.00	3.0972	2.6945	75.815	87.143	75.903	87.245	.79641	9.1542	1.049	.60089
390.00	3.0577	2.6602	79.061	90.874	79.153	90.981	.82799	9.5171	1.046	.61445
400.00	3.0202	2.6275	82.348	94.652	82.444	94.763	.85985	9.8833	1.043	.62790
410.00	2.9846	2.5966	85.675	98.476	85.775	98.591	.89199	1.0253	1.040	.64112
420.00	2.9507	2.5671	89.040	102.35	89.144	102.46	.92441	1.0625	1.037	.65403
430.00	2.9184	2.5390	92.444	106.26	92.552	106.38	.95709	1.1001	1.034	.66661
440.00	2.8877	2.5123	95.885	110.21	95.996	110.34	.99002	1.1379	1.031	.67887
450.00	2.8584	2.4868	99.362	114.21	99.477	114.34	1.0232	1.1761	1.029	.69081
460.00	2.8304	2.4625	102.87	118.25	102.99	118.38	1.0566	1.2145	1.026	.70243
470.00	2.8037	2.4392	106.42	122.32	106.54	122.47	1.0902	1.2531	1.023	.71371
480.00	2.7781	2.4170	110.00	126.44	110.13	126.58	1.1241	1.2921	1.021	.72466
490.00	2.7536	2.3957	113.61	130.59	113.74	130.74	1.1582	1.3312	1.018	.73532

TOLUENE

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CM	GM/CM2	GM/CM2	CM	GM/CM2	CM	GM/CM2	CM		
500.00	2.7302	2.3753	117.26	134.78	117.39	134.93	1.1925	1.3706	.1154	.74565
510.00	2.7077	2.3557	120.93	139.00	121.07	139.16	1.2269	1.4103	.1153	.75565
520.00	2.6862	2.3370	124.63	143.26	124.78	143.42	1.2656	1.4901	.1152	.76580
530.00	2.6655	2.3190	128.37	147.55	128.51	147.72	1.2965	1.4902	.1151	.77480
540.00	2.6456	2.3017	132.13	151.87	132.28	152.05	1.3315	1.5305	.1149	.78392
550.00	2.6265	2.2851	135.92	156.23	136.07	156.41	1.3668	1.5710	.1148	.79276
560.00	2.6081	2.2691	139.73	160.61	139.89	160.80	1.4022	1.6117	.1147	.80131
570.00	2.5905	2.2537	143.58	165.03	143.74	165.22	1.4377	1.6526	.1146	.80957
580.00	2.5735	2.2389	147.45	169.48	147.61	169.67	1.4735	1.6937	.1145	.81756
590.00	2.5571	2.2247	151.34	173.95	151.51	174.15	1.5094	1.7349	.1143	.82528
600.00	2.5413	2.2109	155.26	178.46	155.44	178.66	1.5454	1.7763	.1142	.83273
620.00	2.5114	2.1849	163.17	187.55	163.35	187.76	1.6179	1.8597	.1140	.84665
640.00	2.4836	2.1607	171.17	196.74	171.36	196.97	1.6910	1.9437	.1138	.85999
660.00	2.4576	2.1381	179.25	206.04	179.46	206.27	1.7647	2.0284	.1135	.87219
680.00	2.4334	2.1170	187.42	215.43	187.64	215.67	1.8388	2.1136	.1133	.88349
700.00	2.4107	2.0973	195.67	224.91	195.89	225.17	1.9134	2.1993	.1131	.89394
720.00	2.3894	2.0788	204.00	234.48	204.23	234.75	1.9885	2.2856	.1128	.90350
740.00	2.3694	2.0614	212.39	244.13	212.63	244.41	2.0640	2.3724	.1126	.91246
760.00	2.3507	2.0451	220.86	253.86	221.11	254.15	2.1399	2.4597	.1124	.92062
780.00	2.3331	2.0298	229.39	263.67	229.65	263.97	2.2162	2.5474	.1122	.92809
800.00	2.3165	2.0153	237.99	273.55	238.25	273.86	2.2929	2.6355	.1119	.93491
820.00	2.3008	2.0017	246.64	283.50	246.92	283.81	2.3700	2.7241	.1117	.94114
840.00	2.2861	1.9889	255.35	293.51	255.64	293.84	2.4474	2.8131	.1115	.94681
860.00	2.2721	1.9767	264.12	303.59	264.42	303.93	2.5251	2.9024	.1113	.95198
880.00	2.2589	1.9653	272.94	313.73	273.25	314.08	2.6031	2.9921	.1110	.95667
900.00	2.2465	1.9544	281.82	323.93	282.13	324.29	2.6815	3.0822	.1108	.96094
920.00	2.2347	1.9442	290.74	334.18	291.06	334.55	2.7601	3.1726	.1106	.96481
940.00	2.2235	1.9345	299.71	344.50	300.04	344.88	2.8390	3.2633	.1103	.96832
960.00	2.2129	1.9253	308.74	354.87	309.06	355.26	2.9182	3.3543	.1101	.97151
1000.00	2.1934	1.9082	326.98	375.84	327.34	376.25	3.0774	3.5372	.1094	.97700

THE ELECTRON DENSITY OF TOLUENE IS 3.263E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.330 BEV, AND THE MINIMUM ENERGY LOSS IS 2.0132 MEV/GM/CM2

THE EFFECTIVE IONIZATION POTENTIAL IS 61.72 ELECTRON VOLTS

SILVER BROMIDE

ADJUSTED
IONIZATION
POTENTIAL
465.0
348.5

ATOMIC
WEIGHT
107.87
79.909

PERCENT
BY WEIGHT
57.4452
42.5548

ATOMS/
MOLECULE
1
1

ATOMIC
NUMBER
47
35

ELEMENT
AG
BR

DENSITY = 6.4730 GM/CM³

PROCTON ENERGY MEV	ENERGY LOSS MEV/ GM/CM ²	PROTON RANGE HG/CM ²	PROTON RANGE MM	ATOMS/ MOLECULE	PERCENT BY WEIGHT	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL	PROBABILITY OF INELASTIC NUCLEAR INTERACTION	MULTIPLE SCATTERING PERCENT	PATH LENGTH STRAGGLING MM	PERCENT
.10	263.57	1706.1	.00107	1	57.4452	107.87	465.0	0.	3.186	.03440	4.792
.15	234.99	1521.1	.00138	1	57.4452	107.87	465.0	0.	2.633	.03856	4.197
.20	212.00	1372.3	.00172	1	57.4452	107.87	465.0	0.	2.378	.04368	3.823
.30	178.43	1154.9	.00251	1	42.5548	79.909	348.5	0.	2.155	.05659	3.412
.40	156.02	1009.9	.00342	1	42.5548	79.909	348.5	0.	2.056	.07325	3.242
.50	140.31	908.24	.00445	1	42.5548	79.909	348.5	0.	1.995	.09227	3.143
.60	128.37	830.94	.00558	1	42.5548	79.909	348.5	0.	1.950	.11288	3.066
.70	118.52	767.18	.00681	1	42.5548	79.909	348.5	0.	1.914	.13487	3.002
.80	110.66	716.28	.00814	1	42.5548	79.909	348.5	0.	1.881	.15816	2.947
.90	104.80	678.40	.00955	1	42.5548	79.909	348.5	0.	1.851	.18222	2.894
1.00	98.947	640.49	.01104	1	42.5548	79.909	348.5	0.	1.823	.20700	2.844
1.20	89.887	581.84	.01427	1	42.5548	79.909	348.5	0.	1.772	.25898	2.755
1.40	82.671	535.13	.01780	1	42.5548	79.909	348.5	0.	1.727	.31359	2.675
1.60	76.072	497.59	.02152	1	42.5548	79.909	348.5	0.	1.687	.37050	2.602
1.80	71.935	465.63	.02572	1	42.5548	79.909	348.5	0.	1.650	.42996	2.540
2.00	67.703	438.24	.03009	1	42.5548	79.909	348.5	0.	1.618	.49276	2.489
2.20	64.031	414.47	.03472	1	42.5548	79.909	348.5	0.	1.587	.55851	2.446
2.40	60.810	393.62	.03960	1	42.5548	79.909	348.5	0.	1.560	.62694	2.408
2.60	57.957	375.16	.04474	1	42.5548	79.909	348.5	0.	1.535	.69784	2.373
2.80	55.408	358.65	.05012	1	42.5548	79.909	348.5	0.	1.512	.77105	2.341
3.00	53.110	343.78	.05575	1	42.5548	79.909	348.5	0.	1.490	.84649	2.311
3.20	51.025	330.29	.06161	1	42.5548	79.909	348.5	0.	1.470	.92408	2.283
3.40	49.125	317.98	.06770	1	42.5548	79.909	348.5	0.	1.452	1.0038	2.257
3.60	47.390	306.76	.07403	1	42.5548	79.909	348.5	0.	1.434	1.0855	2.233
3.80	45.787	296.38	.08058	1	42.5548	79.909	348.5	0.	1.418	1.1692	2.210
4.00	44.323	286.90	.08735	1	42.5548	79.909	348.5	0.	1.403	1.2548	2.188
4.20	42.964	278.11	.09435	1	42.5548	79.909	348.5	0.	1.388	1.3422	2.167
4.40	41.699	269.92	.10156	1	42.5548	79.909	348.5	0.	1.375	1.4315	2.148
4.60	40.519	262.28	.10899	1	42.5548	79.909	348.5	0.	1.362	1.5226	2.129
4.80	39.414	255.13	.11664	1	42.5548	79.909	348.5	0.	1.350	1.6155	2.111

SILVER BROMIDE

PRCTON ENERGY MEV	ENERGY LOSS MEV/CH2	PROTON RANGE GM/CH2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	GM/CH2	PATH LENGTH STRAGGLING CM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	38.379	248.43	.08167	.01262	.00171	.00026	2.094	1.338	0.
5.50	36.038	233.28	.09513	.01470	.00195	.00030	2.055	1.312	.00001
6.00	34.014	220.17	.10941	.01690	.00221	.00034	2.019	1.288	.00001
6.50	32.235	208.66	.12452	.01924	.00247	.00038	1.988	1.267	.00002
7.00	30.670	198.53	.14043	.02169	.00275	.00042	1.959	1.248	.00004
7.50	29.269	189.46	.15712	.02427	.00304	.00047	1.933	1.231	.00005
8.00	28.007	181.29	.17247	.02664	.00333	.00051	1.909	1.215	.00007
8.50	26.862	173.88	.19051	.02943	.00364	.00056	1.888	1.200	.00010
9.00	25.819	167.13	.20931	.03234	.00396	.00061	1.867	1.187	.00013
9.50	24.865	160.95	.22884	.03535	.00428	.00066	1.849	1.175	.00017
10.00	23.986	155.26	.24910	.03848	.00462	.00071	1.832	1.163	.00021
11.00	22.435	145.22	.29517	.04560	.00531	.00082	1.800	1.142	.00032
12.00	21.095	136.55	.34116	.05271	.00605	.00093	1.772	1.124	.00045
13.00	19.927	128.99	.38956	.06024	.00681	.00105	1.748	1.108	.00060
14.00	18.895	122.31	.44151	.06821	.00762	.00118	1.725	1.093	.00079
15.00	17.977	116.36	.49579	.07659	.00846	.00131	1.707	1.080	.00099
16.00	17.168	111.13	.54683	.08448	.00934	.00144	1.689	1.068	.00161
17.00	16.424	106.31	.61230	.09459	.01025	.00158	1.673	1.057	.00254
18.00	15.753	101.97	.66742	.10420	.01119	.00173	1.658	1.047	.00368
19.00	15.142	98.016	.73163	.11421	.01216	.00188	1.645	1.038	.00508
20.00	14.583	94.394	.79827	.12460	.01316	.00203	1.632	1.029	.00663
22.00	13.594	87.993	.94871	.14656	.01527	.00236	1.609	1.014	.01084
24.00	12.746	82.504	1.1008	.17006	.01749	.00270	1.589	1.001	.01512
26.00	12.011	77.747	1.2625	.19504	.01983	.00306	1.571	.9890	.01802
28.00	11.367	73.576	1.4197	.22149	.02228	.00344	1.554	.9787	.01948
30.00	10.796	69.885	1.6144	.24940	.02485	.00384	1.539	.9694	.02101
32.00	10.287	66.590	1.7869	.27873	.02752	.00425	1.525	.9609	.02259
34.00	9.8338	63.654	1.9840	.30945	.03030	.00468	1.513	.9533	.02423
36.00	9.4241	61.002	2.1900	.34155	.03318	.00513	1.501	.9464	.02592
38.00	9.0524	58.596	2.4047	.37502	.03616	.00559	1.490	.9400	.02766
40.00	8.7132	56.401	2.6280	.40982	.03924	.00606	1.479	.9342	.02945
45.00	7.9840	51.681	3.2230	.50254	.04735	.00732	1.456	.9214	.03412
50.00	7.3828	47.789	3.9049	.60325	.05604	.00866	1.435	.9107	.03903
55.00	6.8794	44.530	4.6070	.71172	.06528	.01008	1.417	.9016	.04419
60.00	6.4514	41.760	5.3501	.82775	.07505	.01159	1.401	.8938	.04961
65.00	6.0827	39.373	6.1566	.95111	.08534	.01318	1.386	.8870	.05527
70.00	5.7614	37.294	6.9401	1.0817	.09612	.01485	1.373	.8810	.06114
75.00	5.4792	35.467	7.8228	1.2192	.10737	.01659	1.361	.8756	.06720
80.00	5.2290	33.847	8.7490	1.3636	.11909	.01840	1.349	.8709	.07344
90.00	4.8049	31.102	10.730	1.6271	.02222	.02222	1.329	.8628	.08636

SILVER BROMIDE

PRCTON ENERGY MEV	ENERGY LOSS MEV/CH2	PROTON RANGE GM/CH2	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	GM/CM2	PATH LENGTH STRAGGLING CM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	4.4588	12.875	12.986	2.0062	1.7029	.02631	1.311	.8561	.09977
110.00	4.1707	15.177	15.307	2.3648	1.9830	.03064	1.296	.8504	.11366
120.00	3.9284	17.629	17.779	2.7234	2.2777	.03519	1.281	.8456	.12803
130.00	3.7178	20.225	20.396	3.1245	2.5865	.03996	1.268	.8415	.14280
140.00	3.5368	22.962	23.156	3.5473	2.9090	.04494	1.256	.8378	.15791
150.00	3.3784	25.833	26.050	4.0244	3.2440	.05012	1.245	.8346	.17327
160.00	3.2386	28.831	29.073	4.4541	3.5910	.05548	1.235	.8318	.18888
170.00	3.1143	31.957	32.225	4.9370	3.9493	.06101	1.226	.8293	.20475
180.00	3.0030	35.201	35.495	5.4381	4.3185	.06672	1.217	.8270	.22084
190.00	2.9029	38.561	38.882	5.9573	4.6979	.07258	1.208	.8251	.23709
200.00	2.8104	42.034	42.383	6.4937	5.0873	.07859	1.200	.8233	.25345
210.00	2.7281	45.619	45.997	7.0476	5.4867	.08476	1.193	.8214	.26987
220.00	2.6530	49.305	49.712	7.6799	5.8950	.09107	1.186	.8199	.28628
230.00	2.5841	53.097	53.535	8.2929	6.3117	.09751	1.179	.8184	.30265
240.00	2.5208	56.984	57.454	8.8934	6.7365	.10407	1.172	.8171	.31894
250.00	2.4624	60.965	61.466	9.4958	7.1690	.11075	1.166	.8159	.33512
260.00	2.4084	65.037	65.571	10.047	7.6089	.11755	1.160	.8147	.35123
270.00	2.3582	69.198	69.766	10.778	8.0559	.12445	1.155	.8137	.36734
280.00	2.3116	73.444	74.046	11.439	8.5097	.13147	1.149	.8127	.38340
290.00	2.2661	77.775	78.412	12.114	8.9700	.13858	1.144	.8117	.39939
300.00	2.2275	82.190	82.861	12.801	9.4366	.14578	1.139	.8109	.41529
310.00	2.1894	86.680	87.388	13.500	9.9091	.15308	1.134	.8101	.43107
320.00	2.1537	91.247	91.992	14.212	1.0387	.16047	1.129	.8093	.44671
330.00	2.1202	95.888	96.670	14.934	1.0871	.16795	1.125	.8085	.46218
340.00	2.0887	100.60	101.42	15.668	1.1360	.17550	1.120	.8078	.47748
350.00	2.0589	105.40	106.26	16.415	1.1854	.18313	1.116	.8075	.49258
360.00	2.0308	110.25	111.15	17.171	1.2353	.19084	1.111	.8068	.50746
370.00	2.0043	115.11	116.04	17.927	1.2857	.19863	1.108	.8062	.52210
380.00	1.9791	120.08	121.06	18.702	1.3365	.20648	1.104	.8056	.53650
390.00	1.9553	125.12	126.14	19.487	1.3878	.21440	1.100	.8049	.55064
400.00	1.9327	130.22	131.28	20.281	1.4395	.22238	1.096	.8044	.56452
410.00	1.9112	135.38	136.48	21.084	1.4915	.23042	1.093	.8038	.57813
420.00	1.8908	140.60	141.74	21.897	1.5440	.23853	1.089	.8032	.59148
430.00	1.8714	145.87	147.05	22.718	1.5968	.24669	1.086	.8027	.60456
440.00	1.8529	151.20	152.42	23.547	1.6500	.25491	1.083	.8022	.61736
450.00	1.8352	156.57	157.84	24.389	1.7036	.26318	1.079	.8017	.62989
460.00	1.8184	162.00	163.31	25.227	1.7574	.27150	1.076	.8011	.64213
470.00	1.8023	167.48	168.83	26.082	1.8116	.27988	1.073	.8006	.65409
480.00	1.7869	173.00	174.40	26.943	1.8661	.28830	1.070	.8001	.66577
490.00	1.7722	178.58	180.02	27.810	1.9210	.29676	1.067	.7996	.67716

SILVER BROMIDE

PROCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH	MEV/CM	GM/CM2	CH	GM/CM2	CM	GM/CM2	CM		
500.00	1.7581	11.380	184.19	23.456	185.68	20.585	1.9766	.30528	.7992	.68827
510.00	1.7446	11.293	189.86	29.331	192.39	29.567	2.0314	.31383	.7987	.69910
520.00	1.7316	11.209	195.56	30.212	197.14	30.455	2.0871	.32243	.7982	.70964
530.00	1.7192	11.128	201.31	31.100	202.93	31.350	2.1430	.33107	.7977	.71989
540.00	1.7073	11.051	207.10	31.994	208.76	32.251	2.1992	.33974	.7973	.72987
550.00	1.6958	10.977	212.93	32.895	214.64	33.159	2.2556	.34846	.7968	.73957
560.00	1.6848	10.906	218.79	33.801	220.55	34.072	2.3122	.35721	.7964	.74900
570.00	1.6742	10.837	224.70	34.713	226.50	34.992	2.3691	.36599	.7959	.75815
580.00	1.6641	10.772	230.64	35.631	232.49	35.917	2.4262	.37481	.7954	.76704
590.00	1.6543	10.708	236.61	36.554	238.51	36.847	2.4835	.38366	.7950	.77566
600.00	1.6449	10.647	242.63	37.483	244.57	37.783	2.5410	.39255	.7945	.78402
620.00	1.6270	10.532	254.75	39.356	256.79	39.671	2.6566	.41041	.7936	.79998
640.00	1.6104	10.424	267.01	41.249	269.14	41.579	2.7730	.42839	.7927	.81495
660.00	1.5950	10.324	279.38	43.161	281.61	43.506	2.8900	.44648	.7918	.82896
680.00	1.5806	10.231	291.88	45.091	294.20	45.451	3.0078	.46467	.7909	.84207
700.00	1.5672	10.144	304.48	47.039	306.91	47.413	3.1261	.48295	.7900	.85431
720.00	1.5546	10.065	317.19	49.002	319.71	49.391	3.2451	.50133	.7891	.86571
740.00	1.5429	9.9869	330.17	51.007	332.79	51.412	3.3646	.51979	.7885	.87634
760.00	1.5316	9.9156	343.08	53.002	345.80	53.423	3.4847	.53834	.7876	.88621
780.00	1.5215	9.8488	356.08	55.011	358.91	55.447	3.6052	.55696	.7868	.89538
800.00	1.5118	9.7860	369.12	57.025	372.04	57.476	3.7262	.57566	.7831	.90359
820.00	1.5027	9.7270	382.29	59.060	385.32	59.527	3.8477	.59442	.7843	.91177
840.00	1.4941	9.6715	395.54	61.106	398.67	61.589	3.9696	.61325	.7833	.91907
860.00	1.4861	9.6193	408.67	63.165	412.09	63.663	4.0919	.63215	.7824	.92551
880.00	1.4785	9.5701	422.26	65.234	425.59	65.748	4.2146	.65110	.7814	.93204
900.00	1.4713	9.5238	435.71	67.312	439.14	67.842	4.3376	.67011	.7803	.93779
920.00	1.4646	9.4801	449.12	69.383	452.65	69.929	4.4610	.68917	.7798	.94365
940.00	1.4582	9.4388	462.73	71.486	466.36	72.047	4.5847	.70829	.7788	.94797
960.00	1.4522	9.3999	476.40	73.598	480.13	74.174	4.7088	.72745	.7769	.95245
1000.00	1.4411	9.3284	504.06	77.671	507.99	78.478	4.9578	.76592	.7745	.96033

THE ELECTRON DENSITY OF SILVER BROMIDE IS 2.631E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.032 BEV, AND THE MINIMUM ENERGY LOSS IS 1.3570 MEV/GM/CM2

THE EFFECTIVE IONIZATION POTENTIAL IS 411.14 ELECTRON VOLTS

SILVER CHLORIDE

ADJUSTED IONIZATION POTENTIAL
 465.0
 170.0

ATOMS/MOLECULE
 1
 1

PERCENT BY WEIGHT
 75.2636
 24.7364

ATOMIC NUMBER
 47
 17

ELEMENT AG CL

DENSITY * 5.5600 GM/CM3

PRCTON ENERGY MEV	ENERGY LOSS MEV/CH	PROTON RANGE MM	PROTON PATH LENGTH MM		HG/CM2	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
			MM	PERCENT			
.10	307.25	1708.3	.60080	.00108	.03399	2.695	0.
.15	272.92	1517.5	.77336	.00139	.03749	2.216	0.
.20	244.67	1360.3	.94749	.00174	.04215	1.994	0.
.30	203.09	1129.2	1.4171	.00255	.05353	1.799	0.
.40	176.56	981.70	1.9133	.00344	.06909	1.715	0.
.50	157.25	874.28	2.5475	.00458	.08742	1.666	0.
.60	142.49	792.23	3.2165	.00579	.10778	1.631	0.
.70	130.37	724.86	3.9506	.00711	.12997	1.604	0.
.80	121.33	674.43	4.7472	.00854	.15360	1.581	0.
.90	116.35	646.92	5.5681	.01005	.17748	1.561	0.
1.00	111.40	619.37	6.4372	.01163	.20162	1.542	0.
1.20	100.63	559.53	8.2327	.01503	.25165	1.507	0.
1.40	92.098	512.07	10.439	.01877	.30395	1.472	0.
1.60	85.321	474.38	12.698	.02284	.35835	1.440	0.
1.80	79.522	442.14	15.128	.02721	.41539	1.410	0.
2.00	74.596	414.75	17.727	.03188	.47613	1.383	0.
2.20	70.352	391.16	20.487	.03685	.54004	1.358	0.
2.40	66.657	370.61	23.409	.04210	.60674	1.335	0.
2.60	63.407	352.55	26.487	.04764	.67595	1.314	0.
2.80	60.488	336.31	29.718	.05345	.74750	1.295	.00001
3.00	57.892	321.88	33.099	.05953	.82129	1.277	.00001
3.20	55.550	308.96	36.625	.06587	.89718	1.261	.00001
3.40	53.418	297.01	40.300	.07248	.97512	1.245	.00001
3.60	51.468	286.16	44.115	.07934	1.0551	1.231	.00001
3.80	49.677	276.20	48.070	.08646	1.1369	1.218	.00002
4.00	48.024	267.02	52.164	.09382	1.2207	1.205	.00002
4.20	46.496	258.52	56.400	.10144	1.3063	1.194	.00002
4.40	45.078	250.63	60.768	.10930	1.3938	1.183	.00003
4.60	43.758	243.29	65.272	.11740	1.4830	1.172	.00003
4.80	42.525	236.44	69.910	.12574	1.5740	1.162	.00004

SILVER CHLORIDE

PPCTON ENERGY MEV	ENERGY LOSS MEV/GH/CH2	PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
		GM/CH2	CM	GM/CH2	CM	GM/CH2	PERCENT		
5.00	41.369	.07382	.01528	.07468	.01343	.00167	.00030	1.153	.00004
5.50	38.769	.08618	.01550	.08717	.01568	.00191	.00034	1.132	.00006
6.00	36.523	.09235	.01787	.10047	.01807	.00216	.00039	1.113	.00008
6.50	34.557	.11329	.02039	.11455	.02060	.00242	.00043	1.096	.00010
7.00	32.837	.12800	.02302	.12940	.02327	.00269	.00048	1.081	.00013
7.50	31.302	.14345	.02580	.14500	.02608	.00296	.00053	1.067	.00016
8.00	29.923	.15964	.02871	.16134	.02902	.00325	.00059	1.055	.00028
8.50	28.675	.17656	.03175	.17842	.03209	.00355	.00064	1.043	.00044
9.00	27.540	.19419	.03493	.19622	.03529	.00386	.00069	1.033	.00061
9.50	26.504	.21253	.03822	.21473	.03862	.00417	.00075	1.023	.00078
10.00	25.551	.23157	.04165	.23394	.04208	.00450	.00081	1.014	.00095
11.00	23.874	.27172	.04887	.27445	.04936	.00517	.00093	.9978	.00157
12.00	22.427	.31457	.05650	.31770	.05714	.00587	.00106	.9835	.00258
13.00	21.172	.36008	.06476	.36361	.06540	.00662	.00119	.9707	.00361
14.00	20.063	.40820	.07342	.41215	.07413	.00739	.00133	.9593	.00466
15.00	19.077	.45889	.08253	.46329	.08332	.00821	.00148	.9490	.00574
16.00	18.211	.51209	.09210	.51695	.09298	.00905	.00163	.9398	.00683
17.00	17.414	.56777	.10212	.57311	.10308	.00993	.00179	.9314	.00795
18.00	16.692	.62598	.11259	.63182	.11364	.01083	.00195	.9237	.00912
19.00	16.035	.68665	.12350	.69300	.12464	.01177	.00212	.9165	.01060
20.00	15.434	.74964	.13483	.75652	.13606	.01275	.00229	.9097	.01226
22.00	14.374	.88288	.15879	.89080	.16023	.01478	.00266	.8979	.01694
24.00	13.466	1.02556	.18446	1.0348	.18612	.01693	.00305	.8875	.02169
26.00	12.681	1.1774	.21177	1.1879	.21365	.01920	.00345	.8781	.02486
28.00	11.993	1.3384	.24072	1.3501	.24263	.02157	.00388	.8700	.02637
30.00	11.385	1.5083	.27127	1.5214	.27363	.02405	.00433	.8628	.02794
32.00	10.842	1.6869	.30339	1.7014	.30601	.02664	.00479	.8560	.02958
34.00	10.360	1.8741	.33707	1.8902	.33996	.02933	.00528	.8501	.03127
36.00	9.9244	2.0698	.37237	2.0875	.37544	.03212	.00578	.8447	.03302
38.00	9.5298	2.2740	.40899	2.2932	.41245	.03501	.00630	.8398	.03481
40.00	9.1700	2.4863	.44717	2.5072	.45094	.03799	.00683	.8352	.03666
45.00	8.3947	3.0524	.54899	3.0778	.55396	.04585	.00825	.8251	.04147
50.00	7.7581	3.6678	.65967	3.6980	.66510	.05426	.00976	.8168	.04652
55.00	7.2254	4.3309	.77894	4.3663	.78530	.06321	.01137	.8096	.05181
60.00	6.7728	5.0407	.90660	5.0815	.91394	.07268	.01307	.8035	.05737
65.00	6.3831	5.7957	1.0424	5.8424	.10508	.08264	.01486	.7981	.06316
70.00	6.0440	6.5950	1.1862	6.6473	1.1956	.09308	.01674	.7935	.06916
75.00	5.7460	7.4374	1.3377	7.4966	1.3483	.10398	.01870	.7892	.07535
80.00	5.4819	8.3219	1.4967	8.3878	1.5086	.11533	.02074	.7855	.08171
90.00	5.0346	10.213	1.8369	10.294	1.8514	.13932	.02506	.7792	.09486

SILVER CHLORIDE

FRACTION ENERGY MEV	ENERGY LOSS MEV/CH	PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
		GM/CH2	CH	GM/CH2	CH	GM/CM2	CH		
100.00	4.6698	12.262	2.2055	12.358	2.2227	.16492	.02966	1.335	.10846
110.00	4.3664	14.462	2.6011	14.574	2.6213	.19206	.03454	1.318	.12252
120.00	4.1117	16.866	3.0227	16.936	3.0460	.22060	.03968	1.303	.13705
130.00	3.8916	19.268	3.4691	19.437	3.4958	.25050	.04505	1.289	.15199
140.00	3.7011	21.906	3.9399	22.074	3.9701	.28170	.05066	1.276	.16725
150.00	3.5344	24.351	4.4336	24.839	4.4674	.31412	.05650	1.265	.18276
160.00	3.3873	27.520	4.9497	27.730	4.9873	.34771	.06254	1.254	.19851
170.00	3.2565	30.742	5.4875	30.742	5.5292	.38240	.06876	1.244	.21450
180.00	3.1395	33.616	6.0460	33.870	6.0918	.41814	.07521	1.235	.23070
190.00	3.0342	36.833	6.6247	37.112	6.6747	.45489	.08181	1.226	.24703
200.00	2.9399	40.157	7.2225	40.460	7.2770	.49257	.08859	1.217	.26346
210.00	2.8533	43.586	7.8391	43.914	7.8981	.53113	.09553	1.209	.27992
220.00	2.7742	47.116	8.4741	47.470	8.5378	.57056	.10262	1.202	.29637
230.00	2.7017	50.739	9.1257	51.120	9.1942	.61093	.10986	1.195	.31276
240.00	2.6351	54.461	9.7952	54.869	9.8686	.65186	.11724	1.188	.32907
250.00	2.5736	58.275	10.481	58.711	10.560	.69369	.12477	1.182	.34527
260.00	2.5168	62.176	11.183	62.641	11.266	.73623	.13242	1.175	.36140
270.00	2.4641	66.164	11.900	66.650	11.989	.77946	.14019	1.169	.37751
280.00	2.4150	70.236	12.632	70.760	12.727	.82335	.14809	1.164	.39358
290.00	2.3693	74.387	13.379	74.942	13.479	.86788	.15609	1.158	.40958
300.00	2.3266	78.617	14.140	79.203	14.245	.91302	.16421	1.153	.42549
310.00	2.2866	82.922	14.914	83.539	15.025	.95874	.17244	1.148	.44127
320.00	2.2491	87.300	15.702	87.950	15.818	1.0050	.18076	1.143	.45689
330.00	2.2139	91.751	16.502	92.432	16.625	1.0518	.18918	1.138	.47233
340.00	2.1807	96.270	17.315	96.985	17.443	1.0992	.19769	1.133	.48758
350.00	2.1495	100.85	18.138	101.60	18.273	1.1470	.20629	1.129	.50261
360.00	2.1200	105.150	18.975	106.28	19.115	1.1953	.21498	1.125	.51743
370.00	2.0921	110.21	19.822	111.03	19.969	1.2441	.22375	1.120	.53203
380.00	2.0657	114.99	20.681	115.84	20.834	1.2933	.23260	1.116	.54638
390.00	2.0406	119.62	21.551	120.71	21.710	1.3429	.24153	1.113	.56049
400.00	2.0169	124.72	22.431	125.64	22.597	1.3929	.25052	1.109	.57434
410.00	1.9944	129.67	23.321	130.62	23.494	1.4433	.25959	1.105	.58793
420.00	1.9729	134.67	24.222	135.67	24.400	1.4941	.26873	1.101	.60124
430.00	1.9525	139.73	25.131	140.76	25.317	1.5453	.27793	1.098	.61427
440.00	1.9330	144.84	26.051	145.91	26.243	1.5968	.28720	1.094	.62702
450.00	1.9145	150.00	26.979	151.11	27.178	1.6487	.29652	1.091	.63948
460.00	1.8968	155.21	27.916	156.36	28.122	1.7008	.30591	1.088	.65165
470.00	1.8798	160.47	28.862	161.65	29.074	1.7533	.31535	1.085	.66353
480.00	1.8636	165.77	29.816	166.95	30.035	1.8061	.32484	1.082	.67511
490.00	1.8482	171.12	30.778	172.38	31.004	1.8592	.33439	1.079	.68641

SILVER CHLORIDE

PRCTON ENERGY MEV	ENERGY LOSS MEV/GM/CH2	PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION		
		GM/CH2	CM	GM/CH2	CM	GM/CH2	CM				
500.00	1.8333	10.193	176.52	31.748	177.82	31.981	1.9126	.34399	1.076	.7297	.69741
510.00	1.8191	10.114	181.96	32.726	183.29	32.966	1.9662	.35364	1.073	.7293	.70812
520.00	1.8055	10.039	187.43	33.711	188.81	33.959	2.0201	.36333	1.070	.7289	.71854
530.00	1.7924	9.9659	192.95	34.704	194.37	34.958	2.0743	.37308	1.067	.7285	.72868
540.00	1.7799	9.8961	198.51	35.703	199.97	35.965	2.1287	.38286	1.065	.7281	.73852
550.00	1.7678	9.8291	204.11	36.710	205.60	36.979	2.1834	.39269	1.062	.7278	.74809
560.00	1.7562	9.7646	209.74	37.724	211.28	38.000	2.2383	.40256	1.059	.7274	.75738
570.00	1.7451	9.7027	215.41	38.744	216.99	39.027	2.2934	.41247	1.057	.7270	.76639
580.00	1.7344	9.6431	221.12	39.770	222.74	40.061	2.3487	.42242	1.054	.7266	.77513
590.00	1.7240	9.5857	226.86	40.803	228.52	41.101	2.4042	.43241	1.052	.7263	.78361
600.00	1.7141	9.5304	232.64	41.842	234.34	42.148	2.4599	.44244	1.050	.7259	.79182
620.00	1.6953	9.4258	244.29	43.937	246.07	44.258	2.5720	.46259	1.045	.7251	.80747
640.00	1.6778	9.3285	256.06	46.055	257.93	46.391	2.6848	.48288	1.041	.7244	.82213
660.00	1.6615	9.2379	267.96	48.194	269.91	48.545	2.7983	.50329	1.037	.7236	.83583
680.00	1.6463	9.1533	279.97	50.354	279.97	50.720	2.9125	.52382	1.033	.7228	.84862
700.00	1.6321	9.0743	292.08	52.533	292.08	52.915	3.0272	.54446	1.029	.7221	.86054
720.00	1.6189	9.0004	304.30	54.730	306.51	55.128	3.1426	.56521	1.025	.7213	.87164
740.00	1.6063	8.9312	316.63	56.947	318.92	57.361	3.2585	.58606	1.022	.7205	.88195
760.00	1.5947	8.8663	329.04	59.179	331.42	59.608	3.3749	.60700	1.018	.7197	.89153
780.00	1.5837	8.8053	341.53	61.427	344.01	61.872	3.4919	.62803	1.015	.7189	.90040
800.00	1.5734	8.7481	354.15	63.695	356.71	64.156	3.6093	.64915	1.012	.7184	.90862
820.00	1.5637	8.6942	366.81	65.973	369.46	66.450	3.7271	.67034	1.009	.7177	.91623
840.00	1.5546	8.6435	379.55	68.265	382.29	68.758	3.8454	.69162	1.006	.7169	.92325
860.00	1.5460	8.5957	392.37	70.570	395.20	71.078	3.9641	.71296	1.003	.7160	.92974
880.00	1.5379	8.5507	405.25	72.887	408.17	73.412	4.0831	.73438	1.000	.7152	.93572
900.00	1.5303	8.5082	418.21	75.217	421.22	75.758	4.2026	.75586	.9977	.7144	.94123
920.00	1.5230	8.4681	431.23	77.559	434.32	78.116	4.3224	.77740	.9952	.7135	.94630
940.00	1.5162	8.4303	444.33	79.916	447.52	80.489	4.4425	.79901	.9927	.7126	.95097
960.00	1.5098	8.3945	457.49	82.283	460.77	82.872	4.5629	.82067	.9903	.7113	.95525
1000.00	1.4979	8.3286	484.16	87.078	487.61	87.700	4.8047	.86416	.9854	.7091	.96276

THE ELECTRON DENSITY OF SILVER CHLORIDE IS 2.690E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.056 BEV, AND THE MINIMUM ENERGY LOSS IS 1.4027 MEV/GH/CH2

THE EFFECTIVE IONIZATION POTENTIAL IS 355.94 ELECTRON VOLTS

STEEL (STAINLESS)

FRCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		ATOMS/ MOLECULE		PERCENT BY WEIGHT		ADJUSTED IONIZATION POTENTIAL		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	GH/CM2	MEV/CH	MG/CM2	MM	MG/CM2	MM	MG/CM2	MM	MG/CM2	MM	MG/CM2	MM		
.10	336.96	2672.1	.46353	.00058	.47406	.00060	.02052	.00003	72.9000	273.0	4.328	2.220	0.	
.15	318.85	2528.5	.61534	.00078	.62658	.00079	.02429	.00003	55.847	244.4	3.877	1.793	0.	
.20	299.40	2374.2	.77570	.00098	.78838	.00099	.02793	.00004	18.0000	312.0	3.543	1.608	0.	
.30	265.59	2106.1	1.1265	.00142	1.1428	.00144	.03533	.00004	9.0000	75.10	3.091	1.431	0.	
.40	229.24	1817.9	1.5270	.00193	1.5476	.00195	.04392	.00006	.1900		2.838	1.332	0.	
.50	199.76	1584.1	1.9909	.00251	2.0163	.00254	.05515	.00007			2.735	1.262	0.	
.60	181.46	1439.0	2.5117	.00317	2.5425	.00321	.06820	.00009			2.682	1.210	0.	
.70	164.20	1302.1	3.0849	.00389	3.1213	.00394	.08253	.00010			2.644	1.169	0.	
.80	151.92	1204.7	3.7139	.00468	3.7566	.00474	.09827	.00012			2.616	1.135	0.	
.90	143.13	1135.0	4.3851	.00553	4.4341	.00559	.11442	.00014			2.581	1.106	0.	
1.00	134.34	1065.3	5.0998	.00643	5.1556	.00650	.13100	.00017			2.541	1.081	0.	
1.20	120.28	953.80	6.6620	.00840	6.7320	.00849	.16628	.00021			2.470	1.040	0.	
1.40	109.49	868.22	8.3920	.01058	8.4773	.01069	.20394	.00026			2.406	1.007	0.	
1.60	100.82	799.48	10.282	.01297	10.384	.01309	.24375	.00031			2.347	.9789	0.	
1.80	93.659	742.71	12.324	.01554	12.443	.01569	.28558	.00036			2.295	.9551	0.	
2.00	87.635	694.95	14.516	.01831	14.653	.01848	.32932	.00042			2.247	.9344	0.	
2.20	82.502	654.24	16.850	.02125	17.005	.02144	.37488	.00047			2.204	.9162	0.	
2.40	78.066	619.06	19.323	.02437	19.499	.02459	.42214	.00053			2.165	.8998	0.	
2.60	74.135	587.89	21.933	.02766	22.129	.02790	.47110	.00059			2.129	.8853	0.	
2.80	70.642	560.19	24.677	.03112	24.894	.03139	.52174	.00066			2.096	.8720	0.	
3.00	67.512	535.37	27.552	.03474	27.791	.03504	.57410	.00072			2.066	.8598	0.	
3.20	64.685	512.95	30.556	.03853	30.818	.03886	.62819	.00079			2.038	.8487	0.	
3.40	62.116	492.58	33.689	.04248	33.974	.04284	.68403	.00086			2.013	.8384	0.	
3.60	59.769	473.97	36.948	.04659	37.257	.04698	.74187	.00094			1.991	.8288	.00001	
3.80	57.616	456.89	40.384	.05086	40.665	.05128	.80166	.00101			1.971	.8199	.00001	
4.00	55.631	441.16	43.840	.05528	44.199	.05574	.86334	.00109			1.953	.8116	.00001	
4.20	53.796	426.60	47.473	.05985	47.856	.06035	.92689	.00117			1.937	.8038	.00002	
4.40	52.093	413.10	51.223	.06454	51.634	.06511	.99225	.00125			1.922	.7966	.00002	
4.60	50.506	400.51	55.096	.06943	55.534	.07003	1.0594	.00134			1.908	.7897	.00002	
4.80	49.029	388.80	59.087	.07451	59.553	.07510	1.1262	.00142			1.894	.7831	.00003	

DENSITY = 7.9300 GM/CM3

STEEL (STAINLESS)

PRCTON ENERGY MEV	ENERGY LOSS MEV/CH2	PROTON RANGE GM/CH2	PROTON PATH LENGTH CM	GM/CH2	PATH LENGTH STRAGGLING CM	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	47.648	.06320	.06369	.00803	.00120	.7770	.00004
5.50	44.554	.07398	.07455	.00940	.00138	.7630	.00006
6.00	41.885	.08548	.08613	.01086	.00158	.7506	.00009
6.50	39.555	.09769	.09842	.01241	.00178	.7396	.00012
7.00	37.494	.11060	.11141	.01405	.00199	.7297	.00016
7.50	35.664	.12419	.12509	.01577	.00221	.7207	.00021
8.00	34.030	.13845	.13945	.01758	.00244	.7125	.00027
8.50	32.549	.15339	.15448	.01948	.00268	.7051	.00034
9.00	31.225	.16898	.17017	.02146	.00293	.6983	.00041
9.50	30.016	.18520	.18649	.02352	.00318	.6919	.00049
10.00	28.906	.20208	.20347	.02566	.00344	.6860	.00056
11.00	26.947	.23771	.23933	.03018	.00399	.6754	.00077
12.00	25.263	.27583	.27768	.03502	.00457	.6662	.00105
13.00	23.799	.31638	.31848	.04016	.00518	.6579	.00144
14.00	22.513	.35935	.36170	.04561	.00582	.6506	.00194
15.00	21.374	.40469	.40731	.05136	.00649	.6439	.00259
16.00	20.358	.45236	.45527	.05741	.00718	.6379	.00346
17.00	19.444	.50234	.50554	.06375	.00790	.6324	.00466
18.00	18.619	.55461	.55811	.07038	.00865	.6274	.01094
19.00	17.869	.60914	.61296	.07730	.00943	.6228	.01344
20.00	17.184	.66590	.67004	.08449	.01023	.6185	.01596
22.00	15.978	.78600	.79085	.09973	.01192	.6108	.01850
24.00	14.950	.91476	.92032	.11606	.01370	.6041	.02364
26.00	14.062	1.0520	1.0583	.13346	.01559	.5983	.02885
28.00	13.285	1.1976	1.2047	.15192	.01757	.5930	.03227
30.00	12.601	1.3514	1.3594	.17142	.01965	.5883	.03385
32.00	11.993	1.5132	1.5221	.19194	.02181	.5841	.03550
34.00	11.449	1.6830	1.6929	.21348	.02407	.5802	.03721
36.00	10.958	1.8607	1.8715	.23600	.02642	.5767	.03899
38.00	10.514	2.0461	2.0579	.25950	.02885	.5735	.04062
40.00	10.109	2.2391	2.2519	.28397	.03137	.5705	.04271
45.00	9.2403	2.7543	2.7699	.34929	.03802	.5640	.04466
50.00	8.5287	3.3151	3.3337	.42039	.04517	.5565	.04973
55.00	7.9346	3.9221	3.9420	.49710	.05289	.5539	.05507
60.00	7.4306	4.5683	4.5936	.57927	.06090	.5499	.06086
65.00	6.9974	5.2585	5.2874	.66676	.06943	.5463	.06656
70.00	6.6223	5.9897	6.0224	.75944	.07839	.5432	.07267
75.00	6.2928	6.7606	6.7974	.85717	.08776	.5405	.07899
80.00	5.9987	7.569	7.6114	.95983	.09753	.5381	.08550
90.00	5.5035	9.3045	9.3544	1.1733	.11922	.5338	.09218
							.10593

STEEL (STAINLESS)

PRCTON ENERGY HEV	ENERGY LOSS MEV/GM/CM2	PROTON RANGE GM/CM2	PROTON RANGE CM	PROTON PATH LENGTH GM/CM2	PROTON PATH LENGTH CM	GM/CM2	PATH LENGTH STRAGGLING CH	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
100.00	5.1001	40.444	11.184	11.243	1.4178	.14038	.01770	1.249	.5302	.12009
110.00	4.7650	37.786	13.250	13.274	1.6738	.16391	.02067	1.235	.5273	.13468
120.00	4.4820	35.542	15.358	15.439	1.9469	.18874	.02380	1.222	.5247	.14978
130.00	4.2397	33.621	17.042	17.735	2.2364	.21479	.02709	1.211	.5225	.16530
140.00	4.0300	31.958	20.050	20.155	2.5416	.24201	.03052	1.201	.5205	.18115
150.00	3.8466	30.504	22.578	22.696	2.8620	.27034	.03409	1.191	.5188	.19725
160.00	3.6849	29.221	25.221	25.352	3.1970	.29971	.03779	1.182	.5173	.21359
170.00	3.5412	28.085	27.977	28.122	3.5462	.33008	.04162	1.174	.5159	.23019
180.00	3.4128	27.063	30.840	30.599	3.9091	.36140	.04557	1.166	.5146	.24697
190.00	3.2972	26.147	33.807	33.981	4.2851	.39362	.04964	1.158	.5135	.26389
200.00	3.1926	25.318	36.874	37.064	4.6739	.42671	.05381	1.151	.5125	.28089
210.00	3.0977	24.565	40.039	40.245	5.0750	.46062	.05809	1.145	.5115	.29794
220.00	3.0110	23.877	43.297	43.519	5.4879	.49532	.06246	1.138	.5106	.31502
230.00	2.9316	23.248	46.647	46.886	5.9124	.53076	.06693	1.132	.5090	.33267
240.00	2.8587	22.669	50.084	50.340	6.3481	.56693	.07149	1.126	.5091	.34907
250.00	2.7914	22.136	53.607	53.881	6.7946	.60378	.07614	1.121	.5084	.36598
260.00	2.7292	21.642	57.212	57.504	7.2515	.64129	.08087	1.115	.5077	.38279
270.00	2.6714	21.185	60.898	61.208	7.7186	.67943	.08568	1.110	.5071	.39949
280.00	2.6178	20.759	64.661	64.990	8.1955	.71817	.09056	1.105	.5065	.41605
290.00	2.5677	20.362	68.499	68.847	8.6819	.75749	.09552	1.100	.5059	.43245
300.00	2.5210	19.992	72.410	72.778	9.1776	.79736	.10055	1.096	.5054	.44867
310.00	2.4773	19.645	76.393	76.780	9.6822	.83777	.10565	1.091	.5049	.46468
320.00	2.4362	19.319	80.443	80.851	10.196	.87869	.11081	1.087	.5044	.48048
330.00	2.3977	19.014	84.561	84.989	10.717	.92009	.11603	1.083	.5039	.49605
340.00	2.3614	18.726	88.743	89.192	11.247	.96197	.12131	1.079	.5034	.51138
350.00	2.3273	18.455	92.988	93.458	11.785	1.0043	.12665	1.075	.5030	.52644
360.00	2.2950	18.199	97.294	97.785	12.331	1.0471	.13204	1.071	.5026	.54127
370.00	2.2645	17.957	101.66	102.17	12.884	1.0903	.13749	1.067	.5021	.55588
380.00	2.2356	17.729	106.08	106.62	13.445	1.1339	.14298	1.063	.5017	.57026
390.00	2.2083	17.512	110.56	111.12	14.012	1.1778	.14853	1.060	.5013	.58440
400.00	2.1823	17.306	115.09	115.67	14.587	1.2222	.15412	1.057	.5009	.59830
410.00	2.1577	17.110	119.68	120.28	15.168	1.2669	.15976	1.053	.5006	.61191
420.00	2.1342	16.924	124.32	124.94	15.756	1.3120	.16544	1.050	.5002	.62520
430.00	2.1119	16.747	129.00	129.65	16.350	1.3574	.17117	1.047	.4998	.63818
440.00	2.0906	16.579	133.74	134.41	16.950	1.4031	.17693	1.044	.4995	.65084
450.00	2.0704	16.418	138.52	139.22	17.556	1.4491	.18274	1.041	.4991	.66319
460.00	2.0510	16.265	143.35	144.07	18.168	1.4954	.18858	1.038	.4987	.67521
470.00	2.0325	16.118	148.23	148.97	18.785	1.5420	.19446	1.035	.4984	.68691
480.00	2.0149	15.978	153.14	153.91	19.409	1.5889	.20037	1.032	.4980	.69829
490.00	1.9980	15.844	158.10	158.89	20.037	1.6361	.20632	1.030	.4977	.70935

STEEL (STAINLESS)

PROCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/GM/CM2	MEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	PERCENT		
500.00	1.9818	15.715	163.11	20.568	163.92	20.671	1.6835	.21230	.4974	.72010
510.00	1.9663	15.593	168.25	21.204	168.99	21.310	1.7312	.21831	.4970	.73053
520.00	1.9514	15.475	173.23	21.845	174.09	21.954	1.7792	.22436	.4967	.74066
530.00	1.9371	15.362	178.35	22.490	179.24	22.602	1.8273	.23043	.4963	.75048
540.00	1.9234	15.253	183.50	23.140	184.42	23.255	1.8757	.23653	.4960	.75999
550.00	1.9103	15.149	188.69	23.795	189.63	23.913	1.9243	.24266	.4957	.76921
560.00	1.8977	15.048	193.92	24.454	194.89	24.576	1.9732	.24882	.4953	.77814
570.00	1.8855	14.952	199.18	25.117	200.17	25.242	2.0222	.25501	.4950	.78677
580.00	1.8738	14.859	204.48	25.785	205.49	25.913	2.0714	.26121	.4947	.79513
590.00	1.8626	14.770	209.80	26.457	210.84	26.588	2.1209	.26745	.4943	.80321
600.00	1.8517	14.684	215.16	27.133	216.23	27.267	2.1705	.27371	.4940	.81101
620.00	1.8312	14.522	225.97	28.496	227.09	28.637	2.2703	.28629	.4934	.82584
640.00	1.8121	14.370	236.90	29.874	238.07	30.022	2.3707	.29896	.4927	.83965
660.00	1.7944	14.230	247.94	31.266	249.16	31.420	2.4719	.31171	.4920	.85250
680.00	1.7778	14.098	259.08	32.671	260.36	32.832	2.5736	.32454	.4914	.86443
700.00	1.7624	13.975	270.33	34.089	271.66	34.257	2.6759	.33744	.4907	.87550
720.00	1.7479	13.861	281.67	35.519	283.06	35.694	2.7788	.35041	.4901	.88575
740.00	1.7343	13.753	293.10	36.961	294.54	37.143	2.8821	.36345	.4894	.89524
760.00	1.7216	13.653	304.62	38.414	306.12	38.603	2.9860	.37655	.4887	.90400
780.00	1.7097	13.558	316.23	39.877	317.78	40.073	3.0903	.38970	.4881	.91210
800.00	1.6985	13.469	327.91	41.350	329.52	41.553	3.1951	.40291	.4874	.91956
820.00	1.6880	13.386	339.67	42.833	341.33	43.043	3.3003	.41618	.4867	.92643
840.00	1.6781	13.307	351.50	44.325	353.21	44.541	3.4059	.42949	.4860	.93276
860.00	1.6687	13.233	363.40	45.825	365.17	46.049	3.5118	.44285	.4853	.93857
880.00	1.6599	13.163	375.36	47.334	377.19	47.565	3.6182	.45626	.4847	.94392
900.00	1.6516	13.098	387.39	48.851	389.27	49.089	3.7248	.46971	.4840	.94882
920.00	1.6438	13.035	399.48	50.376	401.42	50.620	3.8318	.48321	.4832	.95332
940.00	1.6364	12.977	411.63	51.908	413.63	52.160	3.9392	.49674	.4824	.95745
960.00	1.6294	12.921	423.85	53.449	425.91	53.708	4.0468	.51031	.4815	.96123
1000.00	1.6166	12.820	448.58	56.568	450.74	56.840	4.2629	.53756	.4792	.96784

THE ELECTRON DENSITY OF STEEL (STAINLESS) IS 2.807E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.101 BEV, AND THE MINIMUM ENERGY LOSS IS 1.5139 MEV/GM/CM2

THE EFFECTIVE IONIZATION POTENTIAL IS 270.60 ELECTRON VOLTS

TEFLON

FRCTON ENERGY MEV	ENERGY LOSS MEV/CH	PROTON RANGE MH	ATOMS/ MOLECULE	PERCENT BY WEIGHT	ATOMIC WEIGHT	ADJUSTED IONIZATION POTENTIAL	PROTON PATH LENGTH MH	MG/CH2	MG/CH2	PATH LENGTH STRAGGLING MH	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
.10	653.28	1437.2	C	24.0185	12.011	77.30	.19488	.00089	.00700	.00003	.9064	0.
.15	580.42	1276.9	F	75.9815	18.998	120.7	.27603	.00125	.00876	.00004	.6843	0.
.20	518.60	1140.9					.36712	.00167	.01066	.00005	.5824	0.
.30	423.14	930.91					.58119	.00264	.01505	.00007	.4851	0.
.40	357.65	786.83					.83905	.00381	.02043	.00009	.4361	0.
.50	313.78	690.31					1.1383	.00517	.02682	.00012	.4058	0.
.60	284.11	625.05					1.4738	.00670	.03376	.00015	.3846	0.
.70	262.13	576.68					1.8404	.00837	.04096	.00019	.3687	0.
.80	242.24	532.93					2.2371	.01017	.04844	.00022	.3557	0.
.90	221.77	487.90					2.6684	.01213	.05653	.00026	.3448	0.
1.00	201.29	442.83					3.1415	.01428	.06566	.00030	.3355	0.
1.20	177.60	390.71					4.2015	.01910	.08612	.00039	.3207	0.
1.40	159.66	351.25					5.3745	.02451	.10823	.00049	.3096	0.
1.60	145.45	320.00					6.7058	.03048	.13192	.00060	.3007	.00001
1.80	133.86	294.48					8.1411	.03700	.15715	.00071	.2934	.00001
2.00	124.18	273.20					9.6554	.04406	.18387	.00084	.2873	.00002
2.20	115.97	255.14					11.328	.05164	.21206	.00096	.2820	.00004
2.40	108.91	239.59					13.142	.05973	.24169	.00110	.2773	.00005
2.60	102.75	226.86					15.033	.06833	.27271	.00124	.2732	.00007
2.80	97.340	214.15					17.034	.07743	.30510	.00139	.2696	.00009
3.00	92.534	203.57					19.142	.08701	.33883	.00154	.2662	.00011
3.20	88.234	194.11					21.356	.09707	.37389	.00170	.2632	.00013
3.40	84.360	185.59					23.675	.10761	.41025	.00186	.2604	.00016
3.60	80.851	177.87					26.098	.11863	.44789	.00204	.2579	.00019
3.80	77.653	170.84					28.622	.13010	.48680	.00221	.2555	.00022
4.00	74.726	164.40					31.240	.14204	.52696	.00240	.2534	.00025
4.20	71.997	158.39					33.976	.15444	.56839	.00258	.2513	.00029
4.40	69.520	152.94					36.804	.16687	.61104	.00278	.2494	.00033
4.60	67.225	147.90					39.728	.18058	.65491	.00298	.2476	.00037
4.80	65.093	143.20					42.754	.19434	.69997	.00318	.2460	.00041

DENSITY = 2.2000 GM/CM3

TFEFLON

PRCTON ENERGY MEV	ENERGY LOSS MEV/CM2	MEV/CM	PROTON RANGE GM/CM2	CM	PROTON PATH LENGTH GM/CM2	CM	GM/CM2	PATH LENGTH STRAGGLING CM	PERCENT	MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
5.00	63.106	138.83	.04576	.02080	.04587	.02085	.00075	.00034	1.627	.2444	.00045
5.50	58.630	129.10	.05397	.02459	.05410	.02459	.00087	.00039	1.603	.2408	.00057
6.00	54.890	120.76	.06276	.02853	.06291	.02860	.00099	.00045	1.581	.2376	.00122
6.50	51.604	113.53	.07214	.03279	.07231	.03287	.00113	.00051	1.563	.2348	.00211
7.00	48.725	107.20	.08210	.03732	.08228	.03740	.00127	.00058	1.546	.2323	.00301
7.50	46.180	101.60	.09262	.04210	.09283	.04220	.00142	.00065	1.530	.2300	.00519
8.00	43.912	96.607	.10370	.04714	.10394	.04725	.00158	.00072	1.517	.2279	.00761
8.50	41.877	92.130	.11534	.05243	.11560	.05255	.00174	.00079	1.504	.2260	.01003
9.00	40.041	88.089	.12753	.05797	.12782	.05810	.00191	.00087	1.492	.2243	.01245
9.50	38.348	84.366	.14026	.06376	.14058	.06390	.00208	.00095	1.481	.2227	.01487
10.00	36.832	81.030	.15354	.06979	.15388	.06995	.00226	.00103	1.472	.2212	.01729
11.00	34.163	75.160	.16171	.08259	.16211	.08278	.00265	.00120	1.454	.2185	.02212
12.00	31.889	70.156	.21196	.09634	.21242	.09655	.00305	.00139	1.438	.2162	.02697
13.00	29.925	65.835	.24429	.11104	.24481	.11128	.00349	.00158	1.424	.2141	.03181
14.00	28.211	62.064	.27865	.12666	.27925	.12693	.00394	.00179	1.411	.2122	.03667
15.00	26.701	58.741	.31503	.14319	.31569	.14350	.00442	.00201	1.400	.2105	.04153
16.00	25.359	55.790	.35339	.16063	.35413	.16097	.00492	.00224	1.389	.2090	.04640
17.00	24.159	53.150	.39373	.17897	.39455	.17934	.00544	.00247	1.380	.2076	.05127
18.00	23.079	50.773	.43602	.19819	.43692	.19860	.00599	.00272	1.371	.2064	.05616
19.00	22.101	48.621	.48022	.21828	.48121	.21873	.00656	.00298	1.362	.2052	.06105
20.00	21.210	46.663	.52633	.23924	.52741	.23973	.00715	.00325	1.355	.2041	.06596
22.00	19.650	43.230	.62419	.28372	.62545	.28430	.00839	.00381	1.341	.2021	.07578
24.00	18.325	40.316	.72946	.33157	.73092	.33224	.00971	.00441	1.329	.2004	.08563
26.00	17.186	37.810	.84201	.38273	.84369	.38349	.01112	.00505	1.318	.1989	.09162
28.00	16.195	35.629	.96173	.43715	.96363	.43801	.01260	.00573	1.308	.1976	.09363
30.00	15.325	33.714	1.0885	.49477	1.0906	.49575	.01416	.00644	1.298	.1963	.09571
32.00	14.554	32.018	1.2222	.55556	1.2246	.55664	.01580	.00718	1.290	.1952	.09767
34.00	13.866	30.504	1.3628	.61945	1.3654	.62066	.01751	.00796	1.282	.1942	.10009
36.00	13.247	29.144	1.5101	.68643	1.5131	.68776	.01929	.00877	1.275	.1933	.10237
38.00	12.689	27.916	1.6642	.75644	1.6674	.75790	.02115	.00961	1.268	.1925	.10471
40.00	12.182	26.800	1.8248	.82944	1.8283	.83103	.02307	.01049	1.262	.1917	.10710
45.00	11.096	24.411	2.2546	1.0248	2.2589	1.0268	.02818	.01281	1.248	.1900	.11324
50.00	10.211	22.465	2.7240	1.2382	2.7291	1.2405	.03371	.01532	1.235	.1885	.11959
55.00	9.4756	20.846	3.2315	1.4600	3.2379	1.4718	.03963	.01801	1.224	.1873	.12617
60.00	8.8538	19.478	3.7771	1.7169	3.7842	1.7201	.04594	.02088	1.214	.1862	.13304
65.00	8.3211	18.306	4.3589	1.9813	4.3670	1.9850	.05261	.02392	1.205	.1852	.14016
70.00	7.8592	17.290	4.9765	2.2620	4.9856	2.2662	.05965	.02711	1.196	.1843	.14751
75.00	7.4548	16.401	5.6288	2.5585	5.6392	2.5633	.06702	.03047	1.189	.1836	.15504
80.00	7.0977	15.615	6.3152	2.8706	6.3268	2.8758	.07474	.03397	1.181	.1829	.16273
90.00	6.4952	14.289	7.7873	3.5397	7.8015	3.5461	.09113	.04142	1.168	.1817	.17844

TEFLON

PRCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CH	GH/CH2	CM	GM/CH2	CH	GH/CH2	CH PERCENT		
100.00	6.0061	13.213	9.3872	4.2669	9.4042	4.2747	.10874	.04943	1.156	.19443
110.00	5.6009	12.322	11.110	5.0499	11.130	5.0590	.12750	.05796	1.146	.21074
120.00	5.2597	11.571	12.950	5.8865	12.974	5.8971	.14736	.06698	1.136	.22746
130.00	4.9682	10.930	14.904	6.7747	14.931	6.7868	.16825	.07648	1.127	.24446
140.00	4.7163	10.376	16.968	7.7126	16.998	7.7263	.19012	.08642	1.118	.26164
150.00	4.4964	9.8921	19.136	8.6983	19.170	8.7138	.21292	.09678	1.111	.27890
160.00	4.3028	9.4661	21.407	9.7303	21.445	9.7476	.23662	.10755	1.103	.29625
170.00	4.1309	9.0881	23.775	10.807	23.817	10.826	.26115	.11871	1.096	.31370
180.00	3.9775	8.7504	26.239	11.927	26.285	11.948	.28649	.13022	1.090	.33118
190.00	3.8395	8.4470	28.794	13.088	28.845	13.111	.31260	.14209	1.084	.34865
200.00	3.7149	8.1728	31.438	14.290	31.493	14.315	.33944	.15429	1.078	.36603
210.00	3.6018	7.9239	34.168	15.531	34.227	15.558	.36699	.16681	1.072	.38332
220.00	3.4986	7.6970	36.980	16.809	37.045	16.839	.39520	.17964	1.067	.40052
230.00	3.4042	7.4893	39.874	18.124	39.943	18.156	.42405	.19275	1.062	.41760
240.00	3.3175	7.2984	42.845	19.475	42.919	19.509	.45352	.20615	1.057	.43450
250.00	3.2375	7.1225	45.891	20.860	45.971	20.896	.48357	.21981	1.052	.45120
260.00	3.1636	6.9599	49.011	22.278	49.096	22.316	.51419	.23372	1.047	.46770
270.00	3.0951	6.8092	52.202	23.728	52.292	23.769	.54535	.24789	1.043	.48403
280.00	3.0314	6.6690	55.461	25.210	55.557	25.253	.57703	.26228	1.039	.50013
290.00	2.9720	6.5385	58.783	26.722	58.889	26.768	.60920	.27691	1.034	.51601
300.00	2.9166	6.4166	62.179	28.263	62.286	28.312	.64185	.29175	1.030	.53163
310.00	2.8648	6.3025	65.633	29.833	65.746	29.884	.67496	.30580	1.027	.54701
320.00	2.8161	6.1955	69.148	31.431	69.267	31.495	.70852	.32205	1.623	.56217
330.00	2.7705	6.0950	72.722	33.055	72.847	33.112	.74249	.33750	1.019	.57708
340.00	2.7275	6.0005	76.354	34.706	76.485	34.766	.77688	.35313	1.016	.59174
350.00	2.6870	5.9114	80.042	36.383	80.179	36.445	.81166	.36894	1.012	.60612
360.00	2.6488	5.8274	83.784	38.004	83.928	38.149	.84681	.38492	1.009	.62027
370.00	2.6127	5.7479	87.579	39.609	87.729	39.877	.88234	.40106	1.006	.63422
380.00	2.5785	5.6727	91.426	41.157	91.582	41.628	.91821	.41737	1.003	.64795
390.00	2.5461	5.6014	95.323	43.328	95.485	43.402	.95442	.43383	.9995	.66145
400.00	2.5154	5.5338	99.268	45.122	99.437	45.199	.99096	.45044	.9966	.67470
410.00	2.4862	5.4696	103.26	46.936	103.44	47.016	1.0278	.46719	.9937	.68763
420.00	2.4584	5.4085	107.30	48.772	107.48	48.855	1.0650	.48408	.9908	.70017
430.00	2.4320	5.3504	111.38	50.628	111.57	50.714	1.1024	.50110	.9881	.71234
440.00	2.4068	5.2950	115.51	52.504	115.70	52.593	1.1402	.51825	.9854	.72412
450.00	2.3826	5.2422	119.68	54.399	119.88	54.491	1.1782	.53553	.9828	.73555
460.00	2.3599	5.1918	123.89	56.312	124.10	56.408	1.2164	.55293	.9802	.74656
470.00	2.3380	5.1436	128.14	58.244	128.35	58.343	1.2550	.57044	.9777	.75722
480.00	2.3171	5.0976	132.43	60.194	132.65	60.296	1.2938	.58807	.9753	.76752
490.00	2.2970	5.0535	136.75	62.161	136.99	62.266	1.3328	.60580	.9729	.77746

TEFLON

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CM	GH/CH2	CM	GH/CH2	CM	GH/CH2	CM	PERCENT	PERCENT	
500.00	2.2779	5.0113	141.12	64.145	141.36	64.254	1.3720	.62365	.9706	.1685	.78704
510.00	2.2595	4.9709	145.52	66.146	145.77	66.257	1.4115	.64259	.9683	.1484	.79629
520.00	2.2419	4.9321	149.96	68.162	150.21	68.277	1.4512	.65953	.9661	.1682	.80519
530.00	2.2250	4.8949	154.43	70.194	154.69	70.312	1.4911	.67777	.9639	.1680	.81373
540.00	2.2087	4.8592	158.93	72.241	159.20	72.363	1.5312	.69637	.9618	.1679	.82201
550.00	2.1931	4.8249	163.47	74.303	163.74	74.428	1.5715	.71532	.9597	.1677	.82994
560.00	2.1781	4.7919	168.03	76.380	168.32	76.508	1.6120	.73477	.9577	.1676	.83757
570.00	2.1637	4.7602	172.63	78.470	172.92	78.602	1.6527	.75422	.9557	.1674	.84490
580.00	2.1498	4.7296	177.26	80.574	177.56	80.709	1.6935	.76980	.9538	.1672	.85193
590.00	2.1365	4.7002	181.92	82.692	182.23	82.830	1.7346	.78815	.9519	.1671	.85869
600.00	2.1236	4.6719	186.61	84.822	186.92	84.964	1.7758	.80718	.9500	.1669	.86517
620.00	2.0992	4.6183	196.07	89.121	196.39	89.270	1.8587	.84487	.9464	.1666	.87734
640.00	2.0766	4.5685	205.63	93.469	205.97	93.625	1.9423	.88284	.9430	.1663	.88851
660.00	2.0554	4.5220	215.30	97.862	215.66	98.025	2.0264	.92108	.9396	.1660	.89875
680.00	2.0357	4.4786	225.06	102.30	225.43	102.47	2.1111	.95958	.9365	.1656	.90813
700.00	2.0173	4.4381	234.91	106.78	235.30	106.96	2.1963	.99831	.9334	.1653	.91670
720.00	2.0000	4.4001	244.86	111.30	245.26	111.48	2.2820	1.0373	.9304	.1650	.92453
740.00	1.9839	4.3645	254.88	115.85	255.30	116.05	2.3682	1.0765	.9276	.1647	.93167
760.00	1.9687	4.3311	264.99	120.45	265.42	120.65	2.4549	1.1158	.9249	.1644	.93817
780.00	1.9544	4.2998	275.17	125.08	275.62	125.28	2.5419	1.1554	.9223	.1641	.94409
800.00	1.9410	4.2703	285.42	129.76	285.89	129.95	2.6294	1.1952	.9197	.1638	.94947
820.00	1.9284	4.2425	295.74	134.43	296.23	134.65	2.7173	1.2351	.9173	.1634	.95435
840.00	1.9165	4.2163	306.13	139.15	306.63	139.38	2.8056	1.2753	.9150	.1631	.95878
860.00	1.9053	4.1917	316.58	143.90	317.10	144.14	2.8942	1.3153	.9127	.1628	.96280
880.00	1.8947	4.1684	327.10	148.68	327.63	148.92	2.9832	1.3560	.9105	.1625	.96645
900.00	1.8847	4.1464	337.67	153.49	338.22	153.74	3.0725	1.3966	.9084	.1622	.96974
920.00	1.8753	4.1256	348.30	158.32	348.86	158.57	3.1621	1.4373	.9064	.1619	.97273
940.00	1.8663	4.1060	358.99	163.18	359.57	163.44	3.2520	1.4782	.9044	.1615	.97543
960.00	1.8579	4.0874	369.73	168.06	370.33	168.33	3.3422	1.5192	.9025	.1612	.97787
1000.00	1.8423	4.0531	391.46	177.94	392.09	178.22	3.5235	1.6016	.8986	.1602	.98202

THE ELECTRON DENSITY OF TEFLON IS 2.891E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.246 BEV, AND THE MINIMUM ENERGY LOSS IS 1.7051 MEV/GH/CH2

THE EFFECTIVE IONIZATION POTENTIAL IS 107.98 ELECTRON VOLTS

WATER

ADJUSTED IONIZATION POTENTIAL
 18.30
 98.50

ATOMIC WEIGHT 15.999
 PERCENT BY WEIGHT 88.8099
 ATOMS/MOLECULE 2
 1

ELEMENT H 1
 O 8

DENSITY = 1.0000 GM/CM3

PROCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION	
	GM/CM2	MEV/CH	MG/CM2	MM	MG/CM2	MM	MG/CM2	MM			
.10	931.91	931.91	.11378	.00114	.11449	.00114	.00552	.00006	4.822	.6173	0.
.15	847.65	847.65	.16996	.00170	.17073	.00171	.00735	.00007	4.303	.4502	0.
.20	743.55	743.55	.23277	.00233	.23366	.00234	.00896	.00009	3.835	.3830	0.
.30	595.40	595.40	.38328	.00383	.38453	.00385	.01265	.00013	3.290	.3243	0.
.40	496.45	496.45	.56736	.00567	.56965	.00569	.01737	.00017	3.053	.2972	0.
.50	429.20	429.20	.78401	.00784	.78622	.00786	.02291	.00023	2.914	.2811	0.
.60	381.79	381.79	1.0308	.01031	1.0336	.01034	.02896	.00029	2.802	.2699	0.
.70	343.23	343.23	1.3063	.01306	1.3097	.01310	.03550	.00036	2.711	.2616	0.
.80	314.91	314.91	1.6098	.01610	1.6140	.01614	.04249	.00042	2.633	.2550	0.
.90	291.44	291.44	1.9389	.01939	1.9438	.01944	.04980	.00050	2.562	.2495	0.
1.00	267.95	267.95	2.2960	.02296	2.3017	.02302	.05764	.00058	2.504	.2448	0.
1.20	235.04	235.04	3.0930	.03093	3.1003	.03100	.07487	.00075	2.415	.2371	0.
1.40	210.12	210.12	3.9927	.03993	4.0020	.04002	.09367	.00094	2.341	.2311	0.
1.60	190.50	190.50	4.9221	.04921	4.9394	.05003	.11394	.00114	2.277	.2262	.00001
1.80	174.62	174.62	6.3878	.06088	6.4104	.06101	.13563	.00135	2.223	.2221	.00001
2.00	161.46	161.46	7.2775	.07278	7.2935	.07293	.15868	.00159	2.176	.2186	.00002
2.20	150.36	150.36	8.5592	.08559	8.5776	.08578	.18304	.00183	2.134	.2155	.00003
2.40	140.85	140.85	9.9317	.09932	9.9529	.09953	.20867	.00209	2.097	.2127	.00004
2.60	132.60	132.60	11.393	.11393	11.417	.11417	.23554	.00236	2.063	.2103	.00005
2.80	125.36	125.36	12.942	.12942	12.969	.12969	.26363	.00264	2.033	.2081	.00006
3.00	118.96	118.96	14.577	.14577	14.607	.14607	.29291	.00293	2.005	.2061	.00008
3.20	113.24	113.24	16.298	.16298	16.331	.16331	.32337	.00323	1.980	.2042	.00010
3.40	108.10	108.10	18.103	.18103	18.139	.18139	.35498	.00355	1.957	.2026	.00012
3.60	103.46	103.46	19.991	.19991	20.032	.20032	.38774	.00388	1.936	.2010	.00014
3.80	99.234	99.234	21.962	.21962	22.006	.22006	.42162	.00422	1.916	.1995	.00016
4.00	95.376	95.376	24.014	.24014	24.062	.24062	.45662	.00457	1.898	.1982	.00018
4.20	91.836	91.836	26.148	.26148	26.200	.26200	.49271	.00493	1.881	.1969	.00021
4.40	88.575	88.575	28.362	.28362	28.417	.28417	.52990	.00530	1.865	.1957	.00024
4.60	85.559	85.559	30.655	.30655	30.715	.30715	.56817	.00568	1.850	.1946	.00026
4.80	82.763	82.763	33.028	.33028	33.092	.33092	.60751	.00608	1.836	.1936	.00029

WATER

PRCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CM	GM/CH2	CM	GM/CH2	CM	GM/CM2	PERCENT		
5.00	80.160	80.160	.03548	.03548	.03555	.03555	.00065	.00065	1.823	.00033
5.50	74.379	74.379	.04195	.04195	.04203	.04203	.00075	.00075	1.793	.00041
6.00	69.446	69.446	.04890	.04890	.04899	.04899	.00087	.00087	1.767	.00052
6.50	65.181	65.181	.05632	.05632	.05643	.05643	.00098	.00098	1.744	.00063
7.00	61.454	61.454	.06421	.06421	.06433	.06433	.00111	.00111	1.723	.00171
7.50	58.118	58.118	.07257	.07257	.07270	.07270	.00124	.00124	1.704	.00349
8.00	55.205	55.205	.08138	.08138	.08153	.08153	.00138	.00138	1.688	.00527
8.50	52.595	52.595	.09064	.09064	.09081	.09081	.00152	.00152	1.673	.00705
9.00	50.242	50.242	.10036	.10036	.10054	.10054	.00167	.00167	1.659	.00883
9.50	48.109	48.109	.11052	.11052	.11072	.11072	.00182	.00182	1.646	.01061
10.00	46.166	46.166	.12111	.12111	.12133	.12133	.00198	.00198	1.634	.01239
11.00	42.754	42.754	.14360	.14360	.14386	.14386	.00232	.00232	1.612	.01597
12.00	39.852	39.852	.16780	.16780	.16810	.16810	.00268	.00268	1.593	.01956
13.00	37.352	37.352	.19370	.19370	.19403	.19403	.00306	.00306	1.576	.02316
14.00	35.175	35.175	.22125	.22125	.22163	.22163	.00346	.00346	1.561	.02677
15.00	33.259	33.259	.25045	.25045	.25088	.25088	.00388	.00388	1.548	.03040
16.00	31.560	31.560	.28128	.28128	.28176	.28176	.00433	.00433	1.535	.03404
17.00	30.043	30.043	.31372	.31372	.31425	.31425	.00479	.00479	1.524	.03770
18.00	28.678	28.678	.34774	.34774	.34833	.34833	.00527	.00527	1.513	.04137
19.00	27.444	27.444	.38334	.38334	.38398	.38398	.00577	.00577	1.503	.04505
20.00	26.322	26.322	.42050	.42050	.42120	.42120	.00629	.00629	1.494	.04874
22.00	24.357	24.357	.49943	.49943	.50025	.50025	.00739	.00739	1.478	.05617
24.00	22.693	22.693	.58443	.58443	.58539	.58539	.00857	.00857	1.463	.06364
26.00	21.263	21.263	.67539	.67539	.67649	.67649	.00981	.00981	1.451	.06820
28.00	20.021	20.021	.77222	.77222	.77347	.77347	.01113	.01113	1.439	.06974
30.00	18.931	18.931	.87484	.87484	.87625	.87625	.01251	.01251	1.428	.07134
32.00	17.967	17.967	.98316	.98316	.98474	.98474	.01397	.01397	1.418	.07300
34.00	17.107	17.107	1.0971	1.0971	1.0988	1.0988	.01549	.01549	1.409	.07471
36.00	16.336	16.336	1.2166	1.2166	1.2185	1.2185	.01707	.01707	1.401	.07647
38.00	15.639	15.639	1.3416	1.3416	1.3437	1.3437	.01872	.01872	1.393	.07827
40.00	15.007	15.007	1.4719	1.4719	1.4743	1.4743	.02043	.02043	1.386	.08011
45.00	13.655	13.655	1.8212	1.8212	1.8240	1.8240	.02497	.02497	1.369	.09486
50.00	12.554	12.554	2.2029	2.2029	2.2063	2.2063	.02969	.02969	1.355	.08977
55.00	11.641	11.641	2.6162	2.6162	2.6203	2.6203	.03516	.03516	1.342	.09488
60.00	10.869	10.869	3.0604	3.0604	3.0651	3.0651	.04077	.04077	1.330	.09023
65.00	10.209	10.209	3.5347	3.5347	3.5401	3.5401	.04671	.04671	1.320	.09580
70.00	9.6367	9.6367	4.0383	4.0383	4.0445	4.0445	.05298	.05298	1.310	.11156
75.00	9.1362	9.1362	4.5706	4.5706	4.5776	4.5776	.05955	.05955	1.301	.11749
80.00	8.6944	8.6944	5.1310	5.1310	5.1388	5.1388	.06643	.06643	1.293	.12356
90.00	7.9498	7.9498	6.3337	6.3337	6.3432	6.3432	.08104	.08104	1.278	.13603

WATER

PROTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT		PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CM	MEV/CM	GM/CM2	CM	GM/CM2	CM	GM/CM2	CM	PERCENT	PERCENT	
100.00	7.3459	7.3459	7.6417	7.6417	7.6532	7.6532	.09674	.09674	1.264	.1499	.14881
110.00	6.8461	6.8461	9.0509	9.0509	9.0645	9.0645	.11348	.11348	1.252	.1492	.16194
120.00	6.4254	6.4254	10.558	10.558	10.573	10.573	.13120	.13120	1.241	.1487	.17546
130.00	6.0663	6.0663	12.158	12.158	12.176	12.176	.14985	.14985	1.231	.1482	.18930
140.00	5.7561	5.7561	13.849	13.849	13.869	13.869	.16938	.16938	1.221	.1477	.20336
150.00	5.4855	5.4855	15.626	15.626	15.649	15.649	.18974	.18974	1.212	.1473	.21757
160.00	5.2473	5.2473	17.488	17.488	17.514	17.514	.21090	.21090	1.204	.1469	.23192
170.00	5.0360	5.0360	19.431	19.431	19.460	19.460	.23282	.23282	1.196	.1466	.24644
180.00	4.8474	4.8474	21.453	21.453	21.485	21.485	.25547	.25547	1.189	.1463	.26106
190.00	4.6779	4.6779	23.551	23.551	23.585	23.585	.27860	.27860	1.182	.1460	.27574
200.00	4.5248	4.5248	25.722	25.722	25.759	25.759	.30279	.30279	1.175	.1457	.29043
210.00	4.3858	4.3858	27.964	27.964	28.004	28.004	.32741	.32741	1.169	.1454	.30513
220.00	4.2592	4.2592	30.275	30.275	30.319	30.319	.35264	.35264	1.163	.1452	.31984
230.00	4.1433	4.1433	32.652	32.652	32.700	32.700	.37844	.37844	1.157	.1450	.33452
240.00	4.0368	4.0368	35.094	35.094	35.145	35.145	.40479	.40479	1.152	.1447	.34914
250.00	3.9387	3.9387	37.599	37.599	37.653	37.653	.43167	.43167	1.146	.1445	.36368
260.00	3.8475	3.8475	40.165	40.165	40.223	40.223	.45906	.45906	1.141	.1443	.37817
270.00	3.7633	3.7633	42.789	42.789	42.851	42.851	.48693	.48693	1.136	.1441	.39262
280.00	3.6851	3.6851	45.471	45.471	45.536	45.536	.51527	.51527	1.132	.1439	.40701
290.00	3.6122	3.6122	48.208	48.208	48.277	48.277	.54406	.54406	1.127	.1437	.42133
300.00	3.5441	3.5441	51.000	51.000	51.073	51.073	.57329	.57329	1.122	.1436	.43556
310.00	3.4804	3.4804	53.843	53.843	53.920	53.920	.60291	.60291	1.118	.1434	.44980
320.00	3.4207	3.4207	56.737	56.737	56.819	56.819	.63294	.63294	1.114	.1432	.46396
330.00	3.3646	3.3646	59.681	59.681	59.766	59.766	.66332	.66332	1.110	.1431	.47803
340.00	3.3118	3.3118	62.673	62.673	62.762	62.762	.69413	.69413	1.106	.1429	.49198
350.00	3.2620	3.2620	65.711	65.711	65.805	65.805	.72527	.72527	1.102	.1427	.50580
360.00	3.2151	3.2151	68.794	68.794	68.893	68.893	.75675	.75675	1.098	.1426	.51954
370.00	3.1706	3.1706	71.922	71.922	72.025	72.025	.78855	.78855	1.095	.1424	.53320
380.00	3.1286	3.1286	75.093	75.093	75.200	75.200	.82067	.82067	1.091	.1423	.54679
390.00	3.0888	3.0888	78.307	78.307	78.418	78.418	.85310	.85310	1.088	.1421	.56029
400.00	3.0510	3.0510	81.560	81.560	81.676	81.676	.88583	.88583	1.085	.1420	.57366
410.00	3.0151	3.0151	84.852	84.852	84.973	84.973	.91884	.91884	1.081	.1418	.58685
420.00	2.9809	2.9809	88.184	88.184	88.309	88.309	.95212	.95212	1.078	.1417	.59978
430.00	2.9484	2.9484	91.552	91.552	91.682	91.682	.98567	.98567	1.075	.1415	.61245
440.00	2.9174	2.9174	94.957	94.957	95.092	95.092	1.0195	1.0195	1.072	.1414	.62486
450.00	2.8878	2.8878	98.398	98.398	98.537	98.537	1.0535	1.0535	1.069	.1413	.63699
460.00	2.8596	2.8596	101.87	101.87	102.02	102.02	1.0878	1.0878	1.066	.1411	.64885
470.00	2.8326	2.8326	105.38	105.38	105.53	105.53	1.1223	1.1223	1.064	.1410	.66043
480.00	2.8068	2.8068	108.92	108.92	109.08	109.08	1.1571	1.1571	1.061	.1409	.67174
490.00	2.7821	2.7821	112.50	112.50	112.66	112.66	1.1921	1.1921	1.058	.1407	.68278

WATER

PRCTON ENERGY MEV	ENERGY LOSS		PROTON RANGE		PROTON PATH LENGTH		PATH LENGTH STRAGGLING		MULTIPLE SCATTERING PERCENT	PROBABILITY OF INELASTIC NUCLEAR INTERACTION
	MEV/CH2	MEV/CH	GM/CH2	CM	GM/CM2	CM	GM/CM2	PERCENT		
500.00	2.7585	2.7585	116.10	116.10	116.27	116.27	1.2272	1.056	.1406	.69354
510.00	2.7358	2.7358	119.74	119.74	119.91	119.91	1.2626	1.053	.1404	.70403
520.00	2.7140	2.7140	123.40	123.40	123.58	123.58	1.2982	1.051	.1403	.71427
530.00	2.6932	2.6932	127.10	127.10	127.27	127.27	1.3340	1.048	.1402	.72425
540.00	2.6731	2.6731	130.82	130.82	131.00	131.00	1.3699	1.046	.1400	.73398
550.00	2.6538	2.6538	134.57	134.57	134.76	134.76	1.4060	1.043	.1399	.74346
560.00	2.6353	2.6353	138.34	138.34	138.54	138.54	1.4424	1.041	.1398	.75268
570.00	2.6175	2.6175	142.15	142.15	142.35	142.35	1.4788	1.039	.1396	.76166
580.00	2.6003	2.6003	145.97	145.97	146.18	146.18	1.5155	1.037	.1395	.77039
590.00	2.5838	2.5838	149.83	149.83	150.04	150.04	1.5523	1.035	.1394	.77887
600.00	2.5679	2.5679	153.70	153.70	153.92	153.92	1.5892	1.033	.1392	.78710
620.00	2.5377	2.5377	161.53	161.53	161.75	161.75	1.6636	1.028	.1390	.80287
640.00	2.5096	2.5096	169.44	169.44	169.68	169.68	1.7385	1.025	.1387	.81774
660.00	2.4834	2.4834	177.45	177.45	177.69	177.69	1.8140	1.021	.1385	.83172
680.00	2.4589	2.4589	185.53	185.53	185.79	185.79	1.8899	1.017	.1382	.84483
700.00	2.4360	2.4360	193.69	193.69	193.96	193.96	1.9664	1.014	.1379	.85712
720.00	2.4145	2.4145	201.93	201.93	202.21	202.21	2.0433	1.011	.1377	.86861
740.00	2.3943	2.3943	210.24	210.24	210.52	210.52	2.1207	1.007	.1374	.87933
760.00	2.3754	2.3754	218.61	218.61	218.91	218.91	2.1984	1.004	.1372	.88931
780.00	2.3576	2.3576	227.05	227.05	227.36	227.36	2.2766	1.001	.1369	.89856
800.00	2.3408	2.3408	235.56	235.56	235.88	235.88	2.3551	.9985	.1366	.90710
820.00	2.3250	2.3250	244.12	244.12	244.45	244.45	2.4340	.9957	.1364	.91499
840.00	2.3101	2.3101	252.74	252.74	253.08	253.08	2.5133	.9931	.1361	.92227
860.00	2.2960	2.2960	261.41	261.41	261.77	261.77	2.5929	.9905	.1359	.92897
880.00	2.2827	2.2827	270.14	270.14	270.51	270.51	2.6727	.9880	.1356	.93514
900.00	2.2701	2.2701	278.92	278.92	279.30	279.30	2.7529	.9857	.1353	.94081
920.00	2.2582	2.2582	287.75	287.75	288.14	288.14	2.8334	.9834	.1351	.94602
940.00	2.2469	2.2469	296.62	296.62	297.02	297.02	2.9142	.9811	.1348	.95081
960.00	2.2362	2.2362	305.55	305.55	305.96	305.96	2.9952	.9789	.1345	.95520
1000.00	2.2164	2.2164	323.61	323.61	324.04	324.04	3.1581	.9746	.1337	.96295

THE ELECTRON DENSITY OF WATER IS 3.344E 23 ELECTRONS PER GRAM

THE PROTON KINETIC ENERGY FOR MINIMUM IONIZATION IS 2.310 BEV, AND THE MINIMUM ENERGY LOSS IS 2.0307 MEV/GM/CM2

THE EFFECTIVE IONIZATION POTENTIAL IS 70.35 ELECTRON VOLTS

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