

6762TX

UNCLASSIFIED

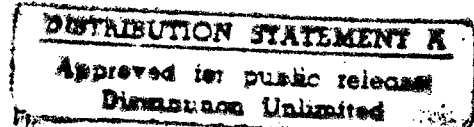
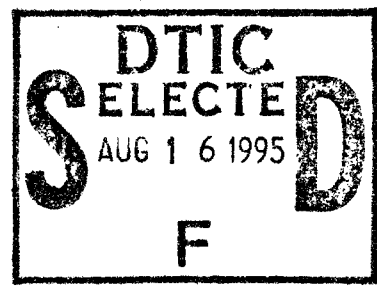
LA-1250

Subject Category: PHYSICS

UNITED STATES ATOMIC ENERGY COMMISSION

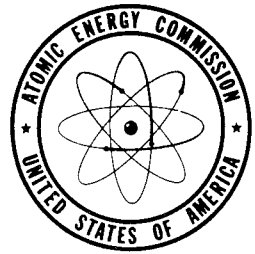
THE AVERAGE FISSION CROSS SECTION OF  
U<sup>233</sup>, U<sup>234</sup>, AND U<sup>236</sup> IN THE FAST REACTOR  
NEUTRON SPECTRUM

By  
E. Jurney



May 18, 1951

Los Alamos Scientific Laboratory  
Los Alamos, New Mexico



Technical Information Extension, Oak Ridge, Tennessee

19950815 064

DTIC QUALITY INSPECTED 5

UNCLASSIFIED

Date Declassified: April 4, 1956.

**LEGAL NOTICE**

This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:

A. Makes any warranty or representation, express or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or

B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission to the extent that such employee or contractor prepares, handles or distributes, or provides access to, any information pursuant to his employment or contract with the Commission.

This report has been reproduced directly from the best available copy.

Issuance of this document does not constitute authority for declassification of classified material of the same or similar content and title by the same authors.

Printed in USA, Price 15 Cents. Available from the Office of Technical Services, Department of Commerce, Washington 25, D. C.

LOS ALAMOS SCIENTIFIC LABORATORY

of

THE UNIVERSITY OF CALIFORNIA

May 18, 1951

LA-1250

Work performed under Contract No. W-7405-Eng-36

THE AVERAGE FISSION CROSS SECTION OF  $U^{233}$ ,  $U^{234}$ , AND  $U^{236}$   
IN THE FAST REACTOR NEUTRON SPECTRUM.

Work done by:

E. Journey

Accession For	
NTIS CRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification .....	
By .....	
Distribution /	
Availability Codes	
Dist	Avail and/or Special
A-1	

Report written by:

E. Journey

THE AVERAGE FISSION CROSS SECTION OF  $U^{233}$ ,  $U^{234}$ , AND  $U^{236}$   
IN THE FAST REACTOR NEUTRON SPECTRUM.

The report to follow gives results of a series of fission cross section measurements in the high-energy neutron spectrum of the fast reactor. These measurements are a continuation of those reported in LA-1201, and the same equipment and counting techniques were employed for the present experiments.

I. Weighing of Foils.

The isotopic fractions of the foils used in the measurements are shown in the following table:

<u>U isotope</u>	<u>25 Std</u>	<u>23 Foil</u>	<u>24 Foil</u>	<u>26 Foil</u>
233	-	0.982	-	-
234	-	-	0.941	.0064
235	.9985	-	0.0445	0.588
236	-	-	-	0.375
238	-	0.018	0.0151	0.03

The tabulated fractions are all results of Oak Ridge mass spectrographic analyses, except in the case of the  $U^{233}$  foil, for which the figure of 98.2% is an Oak Ridge figure, with the remaining 1.8% of the content assumed to be  $U^{238}$ .

Each of the three unknown foils was "weighed" by determining the amount of thermal fissionable material on them relative to the amount

of 25 on a foil made of 99.85% material. This procedure required the use of thermal fission cross sections for  $U^{233}$  and  $U^{234}$ , but it is a much better one for the foils involved than that of alpha counting because of the low specific  $\alpha$ -activity of  $U^{235}$ . The values of these cross sections which were used were

$$\begin{aligned}\sigma_{th}(23)/\sigma_{th}(25) &= 0.933 \pm 0.03 \quad (\text{CK2737}) \quad \text{and} \\ \sigma_{th}(24)/\sigma_{th}(25) &= 0.0038 \quad (\text{LA140A}).\end{aligned}$$

The ratio  $R_{th}$  of the thermal fission rate of the foils containing  $U^{233}$ ,  $U^{234}$ , and  $U^{236}$  to that of the  $U^{235}$  "standard" foil was determined and inserted into an appropriate equation of the following kind:

$$R_{th} = \frac{N_x}{N_{25}} \left( f(23) \frac{\sigma_{th}(23)}{\sigma_{th}(25)} + f(24) \frac{\sigma_{th}(24)}{\sigma_{th}(25)} + f(25) \right),$$

which yielded values of  $N_x/N_{25}$ , the ratio of the number of fissionable atoms on each foil to the number of 25 atoms on the standard foil.

Values of  $R_{th}$  and  $N_x/N_{25}$  are shown in the following table:

Foil	$R_{th}$	$N_x/N_{25}$
23	0.2478 $\pm$ .00053	0.2705 $\pm$ .0085
24	0.0550 $\pm$ .00022	1.239 $\pm$ .005
26	0.7392 $\pm$ .0036	1.257 $\pm$ .0016

## II. Fast Neutron Fission Cross Sections.

Fast neutron fission counting was carried out, as described in LA-1201, with the foils inserted in the fast reactor 5W port, approxi-

mately 1 3/4" from the edge of the reactor's active material. The determination of  $R_f$ , the ratio of the fast neutron fission rate of one of the unknown foils to that of the 25 foil, together with the values of  $N_x/N_{25}$  previously determined makes it possible to solve the following equation for  $\bar{\sigma}_f(x)/\bar{\sigma}_f(25)$ :

$$R_f(x) = \frac{N_x}{N_{25}} \left( f(23) \frac{\bar{\sigma}_f(23)}{\bar{\sigma}_f(25)} + \dots + f(28) \frac{\bar{\sigma}_f(28)}{\bar{\sigma}_f(25)} \right)$$

The table following lists the measured values of  $R_f(x)$  and the corresponding values of  $\bar{\sigma}_f(x)/\bar{\sigma}_f(25)$  and  $\bar{\sigma}_f(x)$ :

Foil (x)	$R_f$	$\bar{\sigma}_f(x)/\bar{\sigma}_f(25)$	$\bar{\sigma}_f(x)$ (b.)
23	0.4234 ± .00095	1.59 ± .057	2.53 ± .09
24	0.4380 ± .0016	0.327 ± .0017	0.52 ± .003
26	0.7928 ± .0014	0.114 ± .0085	0.181 ± .0135

The average fission cross sections  $\bar{\sigma}_f(x)$  in barns are obtained from  $\bar{\sigma}_f(x) = 1.59 \frac{\bar{\sigma}_f(x)}{\bar{\sigma}_f(25)}$ . This value of the average fission cross section of  $U^{235}$  in the reactor spectrum was arrived at by averaging  $\sigma(E)$  (IA-994) over the measured spectrum (IA-1234).

The indicated limits of error are based on the r.m.s. counting errors and, in the case of the  $U^{236}$  measurement, on the estimated error in the mass analysis of the foil material. Because of the relatively small percentage of  $U^{236}$  on this foil, the small error in its determination is responsible for most of the error in the value of the cross section. The uncertainty of approximately three percent in  $\sigma_{th}(23)/\sigma_{th}(25)$  as given in CK2737 is included in the error shown for  $\bar{\sigma}_f(23)/\bar{\sigma}_f(25)$ .