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No. 34

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JPRS 69001

27 April 1977

# USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

## PHYSICS AND MATHEMATICS

No. 34

This serial publication contains abstracts of articles and news items from USSR and Eastern Europe scientific and technical journals on the specific subjects reflected in the table of contents.

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USSR

UDC 518:519.3

OPTIMAL PASSIVE AND SEQUENTIALLY OPTIMAL ALGORITHMS FOR CONSTRUCTING THE  
BEST APPROXIMATIONS FOR FUNCTIONS WHICH SATISFY THE LIPSCHITZ CONDITIONS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 231, No 4, Dec 76 pp 814-817  
manuscript received 20 Jul 76

SUKHAREV, A. G., Moscow State University imeni M. V. Lomonosov

[Abstract] In this article the author states that the function  $f$  may be computed without error at any point  $x$  of the set  $K$  of Euclidean space, however, the expenditures of computer resources for each computation are high. The values of  $f$  must be computed repeatedly and approximately at points of  $K$  that are not previously known. The resources of the computer are limited. One knows only that the function  $f$  belongs to a class of functions which satisfy the lipschitz condition with a known constant  $M$ :  $L = \{f: |f(u) - f(v)| < M\rho(u, v); u, v \in K\}$ , where  $\rho$  is a function such that  $\rho(u, v) = \rho(v, u)$ ,  $\rho(u, v) \geq 0$ ,  $\rho(u, u) = 0$ ,  $\rho(u, v) + \rho(v, w) \geq \rho(u, w)$ ,  $\rho$  is bounded,  $u, v, w \in K$ . In the described situation it is legitimate to selection  $x_1, \dots, x_v \in K$ ; to compute the values  $y_1, \dots, y_v$  of the function  $f$  at these points; to construction the function  $\varphi_{Z^v} \in \Phi = \{\varphi: K \rightarrow R^1\}$  that gives the best uniform approximation with respect to vector  $Z^v = (X^v, Y^v)$ , where  $X^v = (x_1, \dots, x_v)$ ,  $Y^v = (y_1, \dots, y_v)$ ; and to substitute calculation of  $\varphi_{Z^v}(x)$  for computation of the values of  $f(x)$  in subsequent steps. The number of points  $v$  is fixed by the machine resources.

The author considers the problem of finding

$$\inf_{X^v \in K^v} \sup_{Y^v \in L} \inf_{\varphi \in \Phi} \sup_{f \in L_{Z^v}} \sup_{x \in K} |f(x) - \varphi(x)|,$$

and also the vector  $X_0^v$  and the function  $\varphi_{Z^v}$ , that realize the lower bounds.

$$L_{Z^v} = \{f: f \in L, f(x_i) = y_i, i=1, \dots, v\}, \quad L_{X^v} = \{Y^v: L_{Z^v} \neq \emptyset\},$$

$K^v$  is the  $v$ -th cartesian power of  $K$ . The vector  $X_0^v$  is called the optimum passive strategy of construction of the best algorithm. References 15 Russian.

## ON THE HOMOLOGY OF FUNCTIONS AND OVER DYNAMIC SYSTEMS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 231, No 4, 1 Dec 76 pp 795-798 manuscript received 4 Jun 76

KOCHERGIN, A. V., Moscow State University imeni M. V. Lomonosov

[Abstract] Let  $X$  be a Lebesgue space with normed measure  $\mu$ , let  $T$  be an ergodic automorphism that preserves measure  $\mu$ , and let  $G$  be a topological abelian group. Two measurable functions  $f, h: X \rightarrow G$  are called  $(T, G)$ -homologous if there is a measurable function  $\phi: X \rightarrow G$  such that for almost all  $x \in X$

$$f(x) - h(x) = \phi(Tx) - \phi(x)$$

(using the additive form of recording the group operation in  $G$ ). In this case, the notation  $f \underset{G}{\sim}^T h$  is used, or  $f \sim h$  where the meaning is clear. The function  $\phi$  is called a transfer function. It is obvious that the homology relation is an equivalence relation. Besides that, this relation is additive, i. e. if  $f_1 \sim h_1$ ,  $f_2 \sim h_2$ , then  $f_1 + f_2 \sim h_1 + h_2$ . The interest in homologous functions is explained by the following. Let  $f, h$  be non-negative functions taken from  $L^1(X, \mu)$ . If  $f \underset{R}{\sim}^T h$ , then the special streams constructed in accordance with automorphism  $T$ , and in accordance with functions  $f$  and  $h$  respectively are metrically isomorphic. Analogously, for integer functions  $f$  and  $h$ , the condition  $f \underset{Z}{\sim}^T h$  implies metric isomorphism of the special automorphisms constructed in accordance with automorphism  $T$  and functions  $f$  and  $h$ . All functions and sets considered in the paper are measurable. The author examines functions taken from the class  $L^1 = L^1(X, \mu)$  with values in  $G$  when this abelian group is the ring of integers, and when it is the field of real numbers. References 4: 3 Russian, 1 Western.

USSR

UDC 518.09

ON A SOLUTION OF ONE CLASS OF NONANTAGONISTIC GAMES

Moscow ZHURNAL VYCHISLITEL'NOY MATEMATIKI I MATEMATICHESKOY FIZIKI in Russian  
Vol 16, No 6, Nov/Dec 76 pp 1451-1456 manuscript received 21 Feb 75

MOLODTSOV, D. A., Moscow

[Russian abstract provided by the source]

[Text] The author of this article makes a study of a nonantagonistic game between two players with transfer of information. The winning function of the second player  $G(x,y)$  is replaced by  $G_\beta(x,y) = G(x,y) - \beta F(x,y)$ ; here  $F(x,y)$  is the winning function of the first player. This substitution permits reducing the solution of the game to a problem for the maximum. In the event that the first player knows the winning function of the second player imprecisely, the game is then reduced to one without undetermined factors. References 8: 8 Russian.

USSR

UDC 518.90

GAMES IN A FUZZY ENVIRONMENT

Moscow ZHURNAL VYCHISLITEL'NOY MATEMATIKI I MATEMATICHESKOY FIZIKI in Russian  
Vol 16, No 6, Nov/Dec 76 pp 1427-1435 manuscript received 12 Feb 75

ORLOVSKIY, S. A., Moscow

[Russian abstract provided by the source]

[Text] The author conducted a study of two-person games in which the sets of strategies and the goals of the players are described by the F-sets proposed by L. A. Zadeh. These sets differ from the ordinary ones in that there is no distinct understanding for them as to which set an element belongs. The author finds that use of the F-sets allows modeling of indistinctly determined concepts such as "several," "very many," etc. He formulates the concept of opposition of indistinct goals of the players and analyzes certain properties of equilibrium situations of the respective games. References 5: 2 Russian, 3 Western.

## MIXED EXTENSIONS OF ORDERED-OUTCOME GAMES

Moscow ZHURNAL VYCHISLITEL'NOY MATEMATIKI I MATEMATICHESKOY FIZIKI in Russian  
Vol 16, No 6, Nov/Dec 76 pp 1436-1450 manuscript received 24 Feb 75

ROZEN, V. V., Saratov

[Russian abstract provided by the source]

[Text] The author makes a study of games in which the preferences of the players are assigned by relations of (partial) order on the set of results. For such games the author introduces equilibrium situations (after Nash) of two types: the situation  $u$  is called a type I (type II) equilibrium situation if for each player  $i$  the condition  $F(u|u_i) \not\leq F(u|\omega_i)$  ( $F(u|u_i) \leq F(u|\omega_i)$ ) is satisfied. Here  $F(u)$  is the outcome to situations  $u$ ,  $\omega_i$  is the order relation which determines the preference of player  $i$ . For finite games the author constructs a mixed extension in which the strategies are probability measures on the set of results of the initial game. The author describes the equilibrium situations of these two types for the mixed extension. Procedures are examined for continuing the order, assigned on the set, to the set of its probability measures. References 8: 6 Russian, 2 Western.

USSR

UDC 519.24

## RELATIVE BAHADUR ASYMPTOTIC EFFECTIVENESS OF STATISTICS BASED ON AN EMPIRICAL DISTRIBUTION FUNCTION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 231, No 4, Dec 76 pp 802-805  
manuscript received 26 Jun 76

NIKITIN, YA. YU., Leningrad State University imeni A. A. Zhdanov

[Abstract] The author undertakes a study for the purpose of comparing significance tests in mathematical statistics, utilizing Bahadur's concept of relative asymptotic effectiveness. He compares exact results with the experimental data from other works and finds that they agree well. The author describes the Bahadur relative asymptotic effectiveness, gives a theorem, and proves it. After demonstrating certain large aberrations in integral type situations, he cites examples which show that the best of the examined statistics are those proposed by Anderson and Darling.

$$A_n^2 = n \int_{-\infty}^{\infty} \frac{(F_n(x) - F(x))^2}{F(x)(1-F(x))} dF(x),$$

Watson

$$U_n^2 = n \int_{-\infty}^{\infty} \left( F_n(x) - F(x) - \int_{-\infty}^{\infty} (F_n(x) - F(x)) dF(x) \right)^2 dF(x).$$

and Kniper

$$V_n = \sqrt{n} \left[ \sup_x (F_n(x) - F(x)) - \inf_x (F_n(x) - F(x)) \right].$$

where  $x_1, x_2, \dots, x_n$  is repeated sampling from a set with continuous general distribution function  $F$ , and  $F_n$  is an empirical distribution function constructed in accordance with this sample. References 15: 5 Russian, 9 Western.

USSR

UDC 532.

CALCULATION OF THE PROPAGATION VELOCITY OF SOUND IN SIMPLE FLUIDS ACCORDING  
TO THE THEORY OF PERTURBATIONS

Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 21, No 11, Nov 76 pp  
1782-1788 manuscript received 22 Mar 76

MARININ, V. S., and PASHKOV, V. V., Institute of Low Temperature Physics  
and Technology, Acad. Sci. UkSSR, Khar'kov

[Abstract] The propagation velocity of sound in the low frequency area is a value which is closely related to other thermodynamic quantities, so that it can be used to check concepts concerning the physical nature of the liquid state. The theory of perturbations as modified by Barker and Henderson leads to good results for calculation of compressibility and, consequently, sonic velocity. An expression developed from the theory of perturbations in this modification was used to calculate the propagation velocity of sound in liquid Ar, Kr and Ne in the range of pressures up to 60 atm at various temperatures. Agreement with the experimental data is good. It was found that zero and first order terms make the primary contribution to the results. The accuracy could be increased by using more accurate potentials and by determining a successful method for estimating higher-order terms in the series and considering their precise dependence on temperature and density. References 18: 4 Russian, 14 Western.

## Atmospheric Contamination

USSR

UDC 636.56

### REMOTE DETECTOR OF ATMOSPHERIC POLLUTION BY RAMAN SPECTRA

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 26, No 1, Jan 77  
pp 174-179

MALYAVKIN, L. P., VAYNER, YU. G., and ZOLOTAREV, V. V.

[Abstract] A remote detector of atmospheric pollution by Raman spectra is described and test results are cited. The minimum detectable concentration (MDC) for some gases ranges from 4-20 mg/l (or:  $10^3$ - $10^4$  ppm). Measurements are made in a special cell placed some 80 meters distant. For atmospheric vapor, the MDC is 0.12 mg liter (or: 150 ppm). The device employs a laser, prisms, expander, mirrors, integrator, oscillograph, signal counter, etc. Tables 2; Illustrations 3; References 14: 3 Russian, 11 Western.

USSR

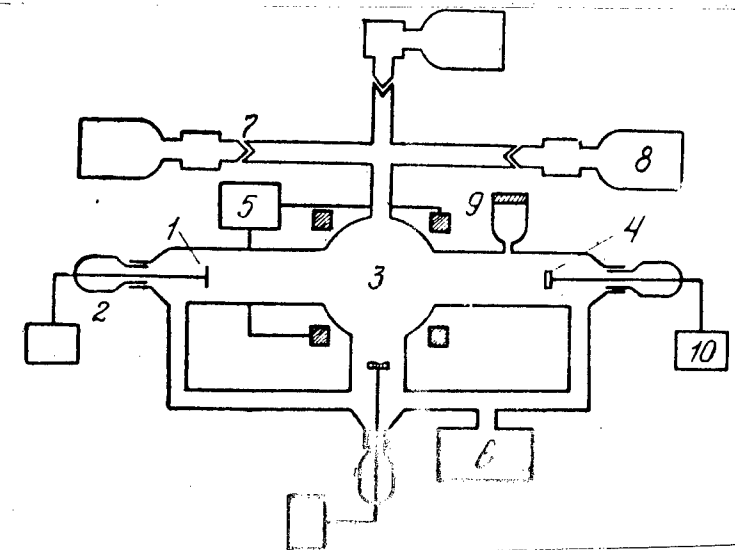
UDC 547.12+550.388

### CHEMICAL DETECTORS AND INVESTIGATIONS OF TRACE IMPURITIES IN THE ATMOSPHERE

Funze IZVESTIYA AKADEMII NAUK KIRGIZSKOY SSR in Russian No 4, Jul/Aug 76  
pp 19-24 manuscript received 23 Feb 76

TOKTOMYSHEV, S. ZH., Kirgiz State University imeni the Fiftieth Anniversary of the USSR

[Abstract] The author discusses various techniques for determination of trace impurities in the lower ionosphere and mesosphere that are based on the selective change in physical and chemical properties of a given substance when it interacts with certain atoms and radicals. Experiments with thin films of silver have been of the greatest practical value for studying the behavior of atomic oxygen and other atmospheric impurities. Shown in the figure is a diagram of a unit for studying the influence that different trace impurities in the atmosphere have on the physical and chemical properties of various detector substances.



1--working space; 2--vacuum-tight ground glass joint; 3--discharge space; 4--study specimen; 5--rf oscillator; 6--exhaust system; 7--inlet valve, 8--bottle containing the gas to be studied; 9--vacuum gage; 10--recording instruments.

Atomic components of air are obtained by dissociating air molecules in an electrodeless rf discharge. The molecular flow is controlled by inlet valves with continuous evacuation. This technique of producing neutral atoms enables one to vary the concentration of trace impurities of the atmosphere and work for long periods with pure gases at constant concentrations. Experiments were done with  $H_2$ ,  $O_2$ , Ar,  $CO_2$ ,  $N_2$ ,  $O_3$ , NO, air, propane, butane, methane at pressures of  $10^{-3}$ - $10^{-1}$  mm Hg and degrees of dissociation of 1-10%. It was found that interaction of oxygen atoms with thin films increases electrical resistance. The change in electrical conductivity is due to the reduction in the number of current carriers in the silver films as a result of the reactions  $Ag + O \rightarrow AgO$ ,  $2Ag + O \rightarrow Ag_2O$ . Theoretical and experimental studies show that these films can be used for detecting atomic oxygen, and that oxidized silver films might be used for determination of atomic hydrogen and nitrogen. Experiments done with high-altitude rockets and standard telemetry in the United States and the Soviet Union have shown that the concentration of atomic oxygen varies over a range of  $10^{10}$ - $10^{12}$  atoms per cc at altitudes of 80-120 km. It should be possible to develop analogous techniques for detecting other trace impurities.

USSR

UDC 621.375.8

INFLUENCE OF SURFACE PROCESSING ON CATHODE LUMINESCENCE OF CdS SINGLE CRYSTALS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 4, No 1, Jan 77 pp 58-62  
manuscript received 16 Mar 76

BOROVICH, L. N., DUDENKOVA, A. V., POPOV, YU. M., TALAT, G. KH., KOMOLOVA, L. F., SAPARIN, G. V., and SPIVAK, G. V., Institute of Physics imeni P. N. Lebedev, Academy of Sciences USSR Moscow, Moscow State University

[Abstract] The local radiation properties of CdS crystals were studied following various surface treatments. All investigated crystals gave off emission in the exciton region of the spectrum (495-505 nm) and in the red band (689-750 nm). The minimum intensity of cathode luminescence (CL) and the minimum glow area are observed following mechanical polishing of the surface of the crystals. The dominant radiation for crystals treated in this way is in the red area of the spectrum. Etching of the outer layer leads to an increase in total CL intensity and an increase in the fraction of the glow area. However, etching does not provide a mirror-smooth surface, necessary for the creation of semiconductor laser resonators. Chemical and mechanical polishing most completely satisfies the requirements of a mirror-smooth surface with good radiating capacity. All of the surface treatments used caused local heterogeneity of CL radiation intensity, particularly in the exciton area of the spectrum. This heterogeneity results primarily from heterogeneous distribution of nonradiative recombination centers both on the surface and in the volume of the crystal. References 9: 5 Russian, 4 Western.

USSR

UDC 621.382(088.8)

INSTRUMENTS FOR REGISTRATION OF PULSED INFRARED LASER EMISSION BASED ON THE EFFECT OF PHOTON DRAG OF CHARGE CARRIERS IN SEMICONDUCTORS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 4, No 1, Jan 77 pp 95-102  
manuscript received 13 Apr 76

VALOV, P. M., GONCHARENKO, K. V., MARKOV, YU. V., PERSHIN, V. V., RYVKIN, S. M., and YAROSHETSKIY, I. D., Physico-Technical Institute imeni A. F. Ioffe, Academy of Sciences USSR, Leningrad

[Russian abstract provided by the source]

[Text] The paper describes fast-action uncooled sensors for recording far infrared emission. The operation of these devices is based on the effect

of photon drag of charge carriers in semiconductors. The authors study the photosensitivity, time resolution and immunity to interference of photocells based on the photon drag effect from the standpoint of optimizing these parameters. Actual designs are developed and described for devices without amplifiers (type FP) and with amplifiers (type FPU) that have high time resolution ( $\geq 7 \cdot 10^{-10}$  s), a wide range of measurable powers ( $10-4 \cdot 10^8$  W), and excellent immunity to interference. The instruments are calibrated for CO<sub>2</sub> laser emission. Two models with amplifiers (types FPU-50 and FPU-100) are equipped with a set of interchangeable detectors, and a single instrument can be used to measure powers from 10 to  $2 \cdot 10^6$  W. References 29: 14 Russian, 2 Polish, 13 Western.

USSR

UDC 530.145.6

#### TUNNELING WITH CONSIDERATION OF THE ANGLE OF ELECTRON INCIDENCE

Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 21, No 12, Dec 76 pp 2043-2046 manuscript received 9 Apr 76, after revision 21 Jun 76

SIVERS, V. N., and KRICHEVETS, YU. M., L'vov State University imeni Iv. Franko

[Abstract] The electrical conductivity of finely divided media depends on the particle size and on the surface state, which determines the parameters of potential barriers. When the effective mass of a carrier is anisotropic, the electric conductivity of the specimen decreases due to additional scattering of carriers on surfaces of variation in effective mass. One of the authors (Krichevets) previously calculated the probability that a carrier would pass through the interface of crystallites with consideration of a possible change in effective masses; the problem was solved in the one-dimensional approximation. In this paper, a solution is found that corresponds more nearly to realistic conditions with consideration of particle incidence on the interface between two media (crystallites, granules) at an arbitrary angle. The problem is solved in the "quasi-free carrier" approximation. Conditions of resonant tunneling are found, and relations are derived for the critical angles of incidence. It is found that the resistance of thin films of anisotropic materials depends appreciably on the degree of ordering of the substructure. References 4 Russian.

USSR

UDC 621.315.592:537.311.33

CONDUCTIVITY OF A POWDERED SEMICONDUCTOR MATERIAL AS A FUNCTION OF BENDING OF ENERGY BANDS ON ITS SURFACE

Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 21, No 11, Nov 76 pp 1794-1797 manuscript received 6 Apr 76

CHERNENKO, I. M., and TONKOSHKUR, A. S., Dnepropetrovsk University imeni 300th Anniversary of the Union of the Ukraine with Russia

[Abstract] This work is intended to establish the way that conductivity of a powdered semiconductor material depends on bending of energy bands on the surface of individual powder particles, allowing determination of  $Y_{s0}$  based on dielectric measurements. Since the conductivity of a dispersed material is expressed through the imaginary component of its complex permittivity, the problem can be reduced to determination of permittivity for a system of semiconductor spherical particles dispersed in a dielectric. To calculate the electric dipole moment of an individual semiconductor particle, one must solve the continuity equations for electrons and holes simultaneously with Poisson's equation and find the distribution of potentials in the particle and nonconducting medium excited by the electric field. References 7: 6 Russian, 1 Western.

USSR

UDC 621.382.2

RHODIUM-DOPED SILICON DIODES WITH NEGATIVE RESISTANCE

Tashkent IZVESTIYA AKADEMII NAUK UZBEKSKOY SSR, SERIYA FIZIKO-MATEMATICHESKIKH NAUK in Russian No 6, 1976 pp 75-76 manuscript received 21 Jan 76

SULTANOV, N. A., and RAKHMATULLAYEV, M., Fergana State Pedagogical Institute imeni Ulugbek

[Abstract] An investigation is made of the possibility of making diodes with negative differential resistance from silicon doped with rhodium. Rhodium was diffused into p-type and n-type silicon with resistivity of 460-3100 and 25-880  $\Omega \cdot \text{cm}$  respectively at 1100-1250°C for 4-8 hours. Nearly all the n-type plates kept their initial conductivity type, while the p-type plates changed conductivity with increasing annealing temperature. The contacts were made of aluminum wire on one side and an alloy of Au + 0.1% As on the other with fusion for 1-3 minutes at 600-700°C. The current-voltage characteristics of all diodes showed a section of S-type negative differential resistance at room temperature. There is a characteristic rapid drop in mean voltage with increasing temperature; at 100°C the section with negative

differential resistance disappears in most of the diodes. Exposing the diodes to light in the natural absorption band ( $h\nu > 1.2$  eV) increased the forward and reverse currents. With an increase in the intensity of the light there was a monotonic drop in the average voltage and at sufficiently high intensities the section with negative differential resistance disappeared, i.e. the diode went into the open state. References 3: 2 Russian, 1 Western.

USSR

UDC 621.382.233

#### ELECTRICAL PROPERTIES OF HETEROJUNCTIONS WITH $\text{GaAs}_{1-x}\text{P}_x$

Tashkent IZVESTIYA AKADEMII NAUK UZBEKSKOY SSR, SERIYA FIZIKO-MATEMATICHESKIKH NAUK in Russian No 6, 1976 pp 42-45 manuscript received 7 Jan 76

AZIMOV, S. A., BABAYEVA, A. V., BUSTANOV, KH. KH., ISKANDEROV, A., MIRZABAYEV, M., RASULOV, K., and TURSUNOV, M., Physicotechnical Institute imeni S. V. Starodubtsev, Academy of Sciences UzbekSSR

[Abstract] The authors investigate the structure and electrophysical properties of  $\text{GaAs}_{1-x}\text{P}_x$ -GaP p-n heterojunctions ( $0.7 < x < 1$ ). The n-type layers were grown by liquid epitaxy to a thickness of 5-30  $\mu\text{m}$  on zinc-doped p-GaP substrates. The ohmic contacts were made from tin for the  $\text{GaAs}_{1-x}\text{P}_x$  layer and from tin plus indium for the GaP substrate. The resultant heterojunctions were rectifying structures with rectification factor of  $10^4$ - $10^5$  at 1 V. The current-voltage characteristics of the heterojunctions are plotted with forward and reverse biasing at temperatures of 95-430 K. The results can be interpreted by assuming a mechanism of multistage tunneling and recombination to explain transfer of charge carriers through heterojunctions. References 4 Western.

USSR

UDC 621.382.2

#### DETERMINING THE PARAMETERS OF THE GOLD LEVEL FROM THE FREQUENCY CHARACTERISTICS OF A SILICON SCHOTTKY-BARRIER DIODE

Tashkent IZVESTIYA AKADEMII NAUK UZBEKSKOY SSR, SERIYA FIZIKO-MATEMATICHESKIKH NAUK in Russian No 6, 1976 pp 37-41 manuscript received 29 Oct 75

KOTOV, B. A., YUNUSOV, M. S., SHAKIROV, U. A., and MURATOV, Z., Physico-technical Institute imeni S. V. Starodubtsev, Academy of Sciences UzbekSSR

[Abstract] Previous research has shown that frequency dependence of the capacitance of a reverse-biased Schottky barrier containing impurities with

deep levels in the base arises because of the finite time of charge exchange of the deep levels in the depletion layer. Zohta (Solid State Electronics Vol 16, No 9, 1973) showed that the parameters of deep impurity centers can be determined by measuring the dependence of  $\Delta V / \Delta C_h^{-2}$  on the frequency of an rf signal and the frequency of alternation of the biasing voltage  $\Delta V$  ( $C_h$  is the rf capacitance of the Schottky barrier). Dmitruk et al. (Fizika i Tekhnika Poluprovodnikov Vol 7, No 4, 1973 p 671) analyzed the properties of  $C_h$  and derived relations for determining the concentration and activation energy of deep levels. In this paper the authors examine the frequency characteristics of capacitance and its derivative with respect to bias voltage for 1) determining the concentration, activation energy, capture cross section and charge exchange time of the gold acceptor level in n-type silicon, and 2) measuring the distribution profile of gold acceptors in the space-charge layer of the Schottky barrier. The analysis is based on the Schottky barrier model used by Zohta and by Dmitruk et al. The results show a concentration of Au acceptor centers  $N_{Au} = (8.13 \pm 0.05) \cdot 10^{14} \text{ cm}^{-3}$ , acceptor activation energy  $E_{Au} (0.56 \pm 0.01) \text{ eV}$ , electron capture cross section  $\sigma_n = 3.2 \cdot 10^{-15} \text{ cm}$  and charge exchange time of the gold level  $\tau = 9.1 \cdot 10^{-4} \text{ s}$ . References 12: 4 Russian, 8 Western.

USSR

UDC 535.372

#### LUMINESCENCE OF CdS CRYSTALS DOPED WITH Mn AND Co

Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 21, No 11, Nov 76 pp 1849-1852 manuscript received 13 May 76

PROTSYUK, L. P., and ROZHKO, A. KH., Institute of Physics, Acad. Sci. UkSSR

[Abstract] A study is made of the spectral composition and intensity of the luminescence of CdS crystals with various impurity concentrations. The studies were performed on fracture surfaces of single crystals of CdS:Mn and CdS:Co, doped by adding the required concentration of impurities to the initial CdS material. Mn varied from  $3 \cdot 10^{17}$  to  $4 \cdot 10^{20} \text{ cm}^{-3}$ , Co -- from  $8 \cdot 10^{16}$  to  $1 \cdot 10^{18} \text{ cm}^{-3}$ . The studies are performed at 4.2 K. Experimental results indicate the dependence of the nature of distribution of Mn impurities as a function of the degree of doping and the capability of both Co and Mn to damp blue and green radiation in the spectra of CdS, both due to direct transmission of energy from excitons to the impurity, and due to a decrease in the number of radiation centers (acceptors and donors, and in the case of CdS:Co, free carriers as well). Co is more effective at damping of luminescence. References 14: 4 Russian, 10 Western.

USSR

UDC 539.264;548.75

PECULIARITIES OF DYNAMIC SCATTERING OF X-RAYS IN CRYSTALS OF LITHIUM DOPED GERMANIUM

Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 21, No 11, Nov 76 pp 1874-1881 manuscript received 20 May 76

GUREYEV, A. N., DATSENKO, L. I., and NIZKOVA, A. I., Institute of Semiconductors, Acad. Sci. UkSSR

[Abstract] A study is made of the intensity of anomalous transmission of x-rays in Ge crystals doped with Li during the process of growth, allowing achievement of the maximum possible concentration of Li in the specimens. Due to the breakdown of the solid Li solution, even at room temperature, according to the data from the literature, localized defects such as clusters or loops may be present. The intensity of anomalous transmission of x-rays was measured on a single-crystal spectrometer using a specimen of high-resistance, dislocation-free Ge crystal as a standard. One particular result of the work is the fact that for the  $\bar{1}11$  reflection, the absolute and relative interference absorption factor for the disrupted crystal in relationship to its values for the standard crystal is less than for all of the other reflections studied. The authors explain this fact by the singular structure of the  $[111]$  planes, for the coordinate portion of the structural factor  $F$  of which the presence of an imaginary component is characteristic. Information on dynamic scattering of x-rays with wavelengths near the K absorption edge obtained by measurements in two reflections allows determination of the contribution of  $\mu_{ph}$  and  $\mu_{ds}$  to the interference absorption factor for a number of reflections using only the characteristic radiation. References 15: 5 Russian, 10 Western.

USSR

UDC 621.382.232

FORMATION OF p-n AND n-p JUNCTIONS IN SEMICONDUCTORS BY LASER RADIATION

Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 21, No 11, Nov 76 pp 1918-1920 manuscript received 29 Jun 76

TOVSTYUK, K. D., PLYATSKO, G. V., ORLETSKIY, V. B., KIYAK, S. G., and BOBITSKIY, YA. V., Chernovtsy Department of Material Science, Institute of Semiconductors, Acad. Sci. UkSSR; L'vov Affiliate of Mathematical Physics, Institute of Mathematics, Acad. Sci. UkSSR

[Abstract] The authors produced conductivity type inversions and manufactured p-n junctions in doped n-type crystals by means of a laser without applying

any additional impurities to the surface of the semiconductor. For the first time, the manufacture of a p-n junction in p-type semiconductors by laser is reported. A possible mechanism is presented for the formation of the p-n junctions in the doped semiconductors, based on the principle of critical transition of impurities from the n-(p-) state to the p-(n-) state under the influence of defects created by the laser radiation. The material used for creation of the p-n junctions consisted of single crystals of solid solutions of PbSe and  $\text{Pb}_{1-x}\text{Sn}_x\text{Se}$  of p-type with charge carrier concentration  $1-2 \cdot 10^{17} \text{ cm}^{-3}$ . The p-n junctions were formed using a neodymium laser. References 12: 9 Russian, 3 Western.

USSR

UDC 621.382.232

INVERSION OF CONDUCTIVITY TYPE OF  $\text{CdS}_x\text{Te}_{1-x}$  IN THE ZONE OF ACTION OF A POWERFUL RUBY LASER PULSE OF RADIATION

Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 21, No 11, Nov 76  
pp 1920-1922 manuscript received 29 Jun 76

PLYATSKO, G. V., KIPEN', A. A., VITRIKHOVSKIY, N. I., FRANIV, O. V., and KOTLYARCHUK, B. K., L'vov Affiliate of Mathematical Physics, Mathematics Institute, Acad. Sci. UkSSR; Institute of Physics, Acad. Sci. UkSSR; Institute of Semiconductors, Acad. Sci. UkSSR

[Abstract] A report is presented on the production of a conductivity-type inversion in the zone of action of a powerful pulse of ruby laser radiation in mixed semiconductor single crystals of  $\text{CdS}_x\text{Te}_{1-x}$  for a broad range of values of x. Bulk single crystals of  $\text{CdS}_x\text{Te}_{1-x}$  of n-type, grown at  $0 < x < 0.8$  by the Bridgman technique from a melt and at  $0.8 \leq x \leq 1$  by the method of crystallization from gas phase were studied. It was found that the conductivity of the surface layer of  $\text{CdS}_x\text{Te}_{1-x}$  crystals after impingement of a powerful ruby laser beam was inverted and that a p-n junction was formed at the boundary of areas with different types of conductivity, the depth of deposition of which was proportional to the energy density of the radiation and the pulse length. References 6 Russian.

USSR

TWO-PHOTON SELECTIVE FILLING OF ENERGY TROUGHS IN PbTe AND JUMPS IN THE DIRECTION OF POLARIZATION OF RECOMBINATION RADIATION

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 24, No 11, 5 Dec 76 pp 594-598 manuscript received 16 Oct 76

ARESHEV, I. P., DANISHEVSKIY, A. M., KOCHEGAROV, S. F., and SUBASHIYEV, V. K., Physics and Engineering Institute imeni A. F. Ioffe

[Abstract] A report is presented on an observation of linearly polarized stimulated recombination radiation (RR) from a crystal of lead telluride with two-photon pumping by linearly polarized radiation at a wavelength of 10.6  $\mu\text{m}$ . With slight changes in direction of polarization of the pumping radiation (between  $-8$  and  $+8^\circ$ ) in plane (100) of the crystal relative to the [010] direction, the direction of the polarization of the RR undergoes a jump of about  $90^\circ$ . As the direction of polarization of the pumping radiation is varied between  $-45$  and  $0^\circ$ , the degree of polarization of the RR varies between 0.85 and 0.15. These facts are explained by the development of selective population of energy troughs. The experiments confirming the predicted effect were performed on a specimen of n-Pb Te ( $n=4 \cdot 10^{16} \text{ cm}^{-3}$ ) consisting of a plate about 1 mm thick, freely mounted in liquid He at 4.2 K. The surfaces of the plate were not parallel. The pumping radiation was provided by a CO<sub>2</sub> laser. References 4: 2 Russian, 2 Western.

USSR

GENERATION OF HIGH FREQUENCY MAGNONS IN A FERROMAGNETIC SEMICONDUCTOR

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 24, No 11, 5 Dec 76 pp 598-601 manuscript received 18 Oct 76

KORENBLIT, I. YA., and TANKHILEVICH, B. G., Institute of Nuclear Physics imeni B. P. Konstantinov

[Abstract] It is demonstrated that in a ferromagnetic semiconductor with accessible levels for pumping electrons with downward spin into the conduction band, it is possible to generate an intensive beam of high frequency monochromatic and, under certain conditions, narrowly directed magnons. The analysis is based on examination of processes of relaxation of nonequilibrium electrons thrown into the conduction band, which is split into sub-bands with upward and downward spins. It is shown that optical phonons and a magnon are emitted by electrons thrown into the sub-band with downward spin, after which they fall to the bottom of the band.

The number of magnons emitted equals the number of electrons thrown into the upper sub-band, and can be made to exceed the thermal background by a considerable factor. Conditions are determined that give a sharp peak in the magnon distribution function. References 3: 1 Russian, 2 Western.

USSR

#### THE STRUCTURE OF VACANCIES IN SOLID $\text{He}^3$

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 24, No 11, 5 Dec 76 pp 608-610 manuscript received 2 Nov 76

ANDREYEV, A. F., Institute of Physical Problems, Acad. Sci. USSR

[Abstract] It is demonstrated that a macroscopic ferromagnetic area should arise around a vacancy in an  $\text{He}^3$  crystal, in which the nuclear spins of the atoms are fully polarized. The situation which arises is quite similar to the well-known problem of the behavior of an electron in liquid helium or a "fluctuon" in a solid. The effect discussed should be manifested experimentally in all phenomena defined by vacancies (mobility of charges and impurities, heat capacity, direct measurement of a number of vacancies by means of x-rays). The large ferromagnetic moment of a vacancy should significantly influence the magnetic properties of  $\text{He}^3$  crystals as well. References 7: 2 Russian, 5 Western.

USSR

UDC 548.524

#### CONDITIONS FOR REPULSION OF A SOLID PARTICLE BY THE SOLIDIFICATION FRONT OF A WEAK ELECTROLYTE SOLUTION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 231, No 4, Dec 76 pp 849-852 manuscript received 14 Jul 76

CHERNOV, A. A., and BRONSHTEYN, V. L., Institute of Crystallography imeni A. V. Shubnikov, Academy of Sciences USSR, Moscow

[Abstract] The authors are concerned with the repulsion of a foreign particle by the surface of a growing crystal by disjoining pressure arising in the gap between them when the thickness of the gap is decreased to  $10^{-5}$  -  $10^{-7}$  cm. A previous paper described repulsion involving the van der Waals component of the disjoining pressure  $\pi$ . The authors are

interested here in exploring the contribution of the electrostatic (Debye) component of  $\pi$ . It is shown that steady-state repulsion of a particle is possible only when the dimensionless growth rate is less than a critical value. The function defining the critical growth rate is derived, and it is shown how it depends on the parameters of the electrolyte solution.

USSR

UDC 621.315.592

#### ENERGY RELAXATION MECHANISMS IN GALLIUM ARSENIDE AT LOW TEMPERATURES

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 10, No 12, Dec 76  
pp 2344-2348 manuscript received 9 Apr 76 (revised 7 Jul 76)

ZVEREV, L. P., MIN'KOV, G. M., NEGASHEV, S. A., and KRUSHAYEV, V. V.,  
A. M. Gor'kiy Ural State University, Sverdlovsk

[Abstract] For a study of the energy relaxation mechanisms in GaAs, measurements were made of the electrical conductivity as a function of the electric field intensity over the 1.7-20.4 K temperature range. These measurements were made by the four-point method in both constant and pulse fields, with specially uncompensated epitaxial n-GaAs specimens having an electron concentration of about  $10^{16} \text{ cm}^{-3}$  and with helium or hydrogen cooling. The dependence of the electron temperature on the electric field intensity is determined from an evaluation of the electron mobility as a function of the electric field intensity and as a function of the specimen (lattice) temperature respectively. A subsequent comparison with theoretical relations for the rate of energy relaxation, taking into account the degeneracy and the shielding of electron-phonon interaction, establishes as the basic mechanism of energy relaxation: scattering by the piezoelectric potential of equilibrium acoustic phonons when the electron temperature is below 30 K, or scattering by longitudinal optical phonons when the electron temperature is above 35 K. Figures 4; Tables 1; References 15: 6 Russian, 9 Western.

USSR

EXCITATION OF EXCESS CHARGE CARRIERS IN GERMANIUM AND IN SILICON BY MEANS OF A CO<sub>2</sub> LASER

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 232, No 6, 1977 pp 1296-1298 manuscript received 12 Oct 76

DANILEYKO, YU. K., YEPIFANOV, A. S., LEBEDEVA, T. P., MANENKOV, A. A., MILYAYEV, V. A., and SIDORIN, A. V., P. N. Lebedev Institute of Physics, USSR Academy of Sciences, Moscow

[Abstract] Excess charge carriers have been found to appear in pure Ge and Si crystals irradiated with short pulses from a CO<sub>2</sub> laser. The high purity and perfection of these two crystalline substances, together with the long lifetime of excess charge carriers in them, made it possible to detect such carriers and thus to directly track the avalanche buildup. The CO<sub>2</sub> laser in the experiment was operating with a transverse discharge in a CO<sub>2</sub>-He mixture, in the fundamental transverse mode with 4.0 MW peak power and the pulse duration equal to 60 ns. An analysis of the test data obtained at 77 K and 295 K indicates that collision ionization, rather than thermal ionization, of atoms in the crystal lattice may be the only plausible mechanism of excitation which leads here to the evidently high concentration of excess charge carriers. Qualitatively, this concentration increases with the intensity of laser radiation in both germanium and silicon alike. In silicon, however, excess charge carriers could be detected only under precisely focused radiation and the emission threshold was found to be about one order of magnitude lower than in germanium. The effect of self-defocusing has been estimated and theoretical data regarding the caustic surface found to agree closely with the results of measurements. Figures 2; References 2: Russian.

USSR

UDC 621.315.592

ANOMALOUS PHOTOCONDUCTIVITY AND DARK CONDUCTIVITY OF SEMI-INSULATING CADMIUM TELLURIDE

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 10, No 12, Dec 77 pp 2349-2351 manuscript received 7 Jul 76

DIDKOVSKIY, A. P., MATLAK, V. V., KUTS, V. I., and KHIVRICH, V. I., Institute of Nuclear Research, Academy of Sciences, Ukrainian SSR, Kiev; State University, Chernovtsy

[Abstract] An anomalous photoconductivity of CdTe was found in fully compensated single crystals, whose electrical properties had earlier

indicated the presence of inhomogeneities. Tests at 77 K have shown that, after illumination has ceased, the photocurrent relaxes with an increasing time constant and within a few hours drops to a level which is an inverse function of the original wavelength. With the photon energy within the 1.6-0.6 eV range (0.8-2.0  $\mu$  wavelengths), there remains a residual conductivity: the short-wave limit of this range corresponding to the forbidden band and the long-wave limit corresponding to the conductivity activation energy of CdTe. The temperature characteristic of the dark conductivity, measured within the ohmic range of the current-voltage characteristic, becomes anomalous beyond the activation point. The increase in this conductivity by four orders of magnitude, following a temperature drop from 260 to 77 K, is more than can be attributed to a higher electron mobility. It is most probably due to fluctuations of the potential profile and the resulting higher number of trapped charge carriers. Figures 3; Table 1; References 11: 8 Russian, 3 Western.

USSR

UDC 621.315.592

#### CHARACTERISTICS OF GUNN-EFFECT AMPLIFIER DIODES WITH A STEPPED DOPING PROFILE

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 10, No 12, Dec 77  
pp 2375-2378 manuscript received 8 Dec 75 (revised 5 Jul 76)

VUGAL'TER, G. A., GUREVICH, G. I., and KOGAN, A. L.

[Abstract] In order to produce a uniform field in the interelectrode region of a Gunn-effect diode, which is important for low-noise stable amplification, it becomes necessary to step the doping profile. The passive layer with a positive differential conductivity at the cathode and contributes heavily to noise and, since it may also be sizable, depletion of this layer is particularly critical. The purpose is to minimize the amplifier noise factor, with the diode impedance made nearly insensitive to drift in the supply. Diodes with an ohmic contact and diodes with a limited-injection contact are considered in the analysis. Calculations are based on a hydrodynamic model, with the diffusion current disregarded but random extraneous currents as sources of thermal noise taken into account. Shot noise plays an important part in limited-injection contacts but none in ohmic contacts. Figures 2; References 10: 5 Russian, 5 Western.

## METASTABLE MAGNETIC CRYSTALS

Moscow USPEKHI FIZICHESKIKH NAUK in Russian Vol 120, No 4, Dec 76 pp 692-697

SMIRNOV, B. M., and SHLYAPNIKOV, G. V., Institute of Atomic Energy imeni I. V. Kurchatov

[Russian abstract provided by the source]

[Text] The parameters of a metastable crystal of alkali metal made up of atoms with spins oriented in the same direction are presented, such as the distance between closest neighbors, sublimation energy, Debye temperature, change in energy with spin flip, rate of vaporization of atoms from the surface, etc. The distance between closest neighbors in such crystals appreciably exceeds the atomic dimensions, so that these ferromagnetic crystals are dielectrics. Analysis shows that they can actually be produced at a low temperature of the order of a few kelvins. References 18: 10 Russian, 8 Western.

USSR

UDC 537.52

EVALUATION OF SOME PARAMETERS OF A HIGH-FREQUENCY JET DISCHARGE IN AIR IN THE PRESSURE RANGE OF 400-760 mm Hg

Tomsk IZVESTIYA TOMSKOGO POLITEKHNICHESKOGO INSTITUTA [Bulletin of Tomsk Polytechnic Institute] in Russian No 276, 1976 pp 40-43

[From REFERATIVNYY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10G218]

FEDYANIN, V. YA., TIKHOMIROV, V. V., KUZ'MINYKH, A. I., and PUGOVKIN, M.M.

[Text] The authors propose a simple formula that relates the total current and power that is released per unit of length of the jet of discharge to the average parameters characterizing the state of the gas-discharge plasma. They measure the total current, the thermal power and temperature of the gas of the jet discharge in air in the pressure range of 400-760 mm Hg. From the experimental results they estimate the effective temperature of the electrons.

USSR

STUDY OF THE DISTRIBUTION OF MAGNETIZATION IN SMALL FERROMAGNETIC ELEMENTS

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 18, No 12, Dec 76 pp 3581-3584 manuscript received 25 May 76

KRINCHIK, G. S., CHEPUROVA, YE. YE., SHAMATOV, U. N., RAYEV, V. K., and ANDREYEV, A. K., Moscow State University

[Abstract] A study is made of the distribution of magnetization in permalloy elements of T and I shape of micron dimensions, which are the elements used in circuits for shifting of cylindrical magnetic domains, by means of a magnetic-optical method with micron resolution. It is demonstrated that the method allows not only measurement of the magnetic characteristics of a small ferromagnetic specimen, but also a study of the topography of distribution of magnetization within the element. References 3: 1 Russian, 2 Western.

USSR

UDC 537.52

SEVERAL CHARACTERISTICS OF THE BREAKDOWN OF A GAS DIELECTRIC IN A MAGNETIC FIELD

Rostov-na-Donu TRUDY Pervoy Regional'noy Konferentsii Molodykh Uchenykh-Fizikov Severnogo Kavkaza [Works of the First Regional Conference of Junior Scientists-Physicists of the Northern Caucasus] in Russian, Rostov University Press, 1975 pp 6-10 (Deposited in the All-Union Institute of Scientific and Technical Information on 19 Apr 76, No 1344-76 Dep)

[From REFERATIVNYY Zhurnal, Fizika No 10, 1976 Abstract No 10G180 DEP by the authors]

Ktshov, M.-R. G. and Efendiyev, A. Z.

[Text] The authors investigate the breakdown of He in uniform electrical and longitudinal magnetic (up to 250 kOe) fields at an interelectrode distance of 0.1-0.4 cm. They obtain a decrease in the time of formation of the breakdown and an abrupt drop in voltage, a 16% increase in duration of the overvoltage stage across the gap, which is associated with the decrease in the output of material of the electrodes because of the change in intensity of the cathode processes. References 4.

USSR

UDC 533.951.7

HIGH-FREQUENCY NOISES AND TRANSPORT PHENOMENA IN PLASMA PENETRATED BY AN ELECTRON BEAM

Radiotekhnika. Respublikanskiy mezhvedomstvenniy tematicheskiy nauchno-tekhnicheskiy sbornik [Radio Engineering. Republic Interdepartmental Thematic Scientific-Technical Collection] in Russian No 39, 1976 pp 64-68

[From REFERATIVNYY Zhurnal, Fizika No 10, 1976 Abstract No 10G103 by the authors]

Volkolupov, Yu. Ya., and Kuribeda, A. D.

[Text] With the aid of the x-ray method the authors measured the rate of expansion of plasma perpendicular to the force lines of the magnetic field. The x-ray procedure permitted determining the coefficient of plasma diffusion in the stage of heating it with an electron beam. Simultaneously they investigated the rf oscillations excited in the system. The interaction of the particles with the oscillations led to their heating and to more active diffusion across the force lines of the magnetic field. They established

a substantial influence of the magnetic field on the transfer coefficient. In particular, with a magnetic field up to 3 kGauss, they observed the dependence of the turbulent coefficient of diffusion  $D_{\text{tur}} \propto D_{\text{tur}} (1/H^2)$ .

USSR

UDC 537.52

INVESTIGATION OF THE BREAKDOWN OF GASES IN THE PRESENCE OF INTENSE RADIATION

BOLGARSKIY FIZICHNIY ZHURNAL [Bulgarian Physics Journal] in Russian Vol 2, No 5, 1975 (1976) pp 504-512

[From REFERATIVNIY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10G181 by D. O.]

MIKHAYLOVA, R. M.

[Text] The author investigated the breakdown of air,  $N_2$ , He and Ar in a uniform electric field, the strength of which is less than the strength of the static breakdown, during the initiation of ionization by a burst of light from an external flare discharge. The author measured the dependences of the strength of the static breakdown and minimum strength of the breakdown of the irradiated space from the material of the cathode and the gas pressure (in the range of 157-1500 mm Hg). The author shows that the time of formation of the discharge is decreased with growth in intensity of radiation and depends on the strength, material of the cathode, type of gas, and its pressure.

USSR

UDC 537.52

INFLUENCE OF THE GEOMETRY OF AN ANNULAR CONTRACTING SLIT WITH A RADIAL MAGNETIC FIELD ON THE DEGREE OF GAS IONIZATION PENETRATING FROM A DISCHARGE TO A VACUUM

Tomsk VLIYANIYE GEOMETRII KOL'TSEVOY KONTRAGIRUYUSHCHEY SCHELI S RADIAL'NYM MAGNITNYM POLEM NA STEPEN' IONIZATSII GAZA, PRONIKAYUSHCHEGO IZ RAZRYADA V VAKUUM in Russian 1976 6 pp (Manuscript deposited in the All-Union Institute of Scientific and Technical Information on 15 Jun 76, No 2208-76 Dep)

[From REFERATIVNIY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10G204 DEP by the authors]

ZAKHAROV, A. S., and NIKITINSKIY, V. A., Editorial Staff of "Izvestiya VUZov, Fizika"

[Text] On the basis of a computational model for an arc discharge contracted in crossed electric and magnetic fields, the authors determine the influence

of the geometry of an annular slit on the degree of gas ionization penetrating from a discharge to a vacuum. They showed that from the viewpoint of gas savings the slit has an optimal ratio of depth to width, which depends on the parameter of ionization  $D = 1.89 (I_e \sigma_i / \pi d v)^{2/3}$ , where  $I_e$  is the ionizing current of electrons,  $\sigma_i$  is the cross section of ionization of the atom by electron impact,  $d$  is the average diameter of the slit,  $v$  is the thermal velocity of the neutral particles. They established that the given discharge permits obtaining larger values of  $I_e$  with relatively small currents, and the decrease in  $d$  is limited by the heating of ferromagnetic electrodes forming the contracting slit. The results of the computation are presented in the form of graphs. References 2.

USSR

UDC 537.52

# INVESTIGATION OF A FLOW OF IONS FROM A PENNING DISCHARGE WITH HOLLOW CATHODES

BOLGARSKIY FIZICHNIY ZHURNAL [Bulgarian Physics Journal] in English  
Vol 2, No 5, 1975 (1976) pp 513-519

[From REFERATIVNIY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10G207 from the resume]

KUCHERENKO, E. T., IVANOV, S. I., and PECHENYAKOVA, V. P.

[Text] The authors experimentally investigated the influence of a hollow cathode on the ion and discharge flow in a Penning discharge. The discharge flow is increased by introducing thin cavities into the cathode, since in this case the ions are focused. Such a system may be used as an ion source. This effect is most significant with a small thickness of the cathode cavities and with a small magnetic field. The improvement in focusing of the ion flow toward the center of the hollow cathode is caused by the radial component of the electric field in the cavities of the cathode and correspondingly by the growth in ionization on the axis of the discharge.

USSR

UDC 537.52

SOME ELECTROPHYSICAL CHARACTERISTICS OF A HIGH-FREQUENCY JET DISCHARGE

Tomsk IZVESTIYA TOMSKOGO POLITEKHNICHESKOGO INSTITUTA [Bulletin of Tomsk Polytechnic Institute] in Russian No 276, 1976 pp 60-65

[From REFERATIVNYY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10G217]

TIKHOMIROV, I. A., TEPLOUKHOV, V. L., VERNYAYEV, V. A., TEPLOUKHOV, VIK. L., KARENGIN, A. G., and GOGLEV, S. M.

[Text] The authors experimentally studied the power distribution in a system made up of an rf generator and a jet discharge of medium power at atmospheric pressure. They obtained the values of the efficiency and  $\cos \phi$  in the discharge. They determined the active resistance of the electrons with heavy particles in the channel of the jet discharge. They showed that the electrophysical parameters of the jet discharge to a strong degree depend on the power applied to the discharge.

USSR

UDC 537.52

ON THE CONTRACTING OF A LOW-PRESSURE RF-DISCHARGE

Tomsk IZVESTIYA TOMSKOGO POLITEKHNICHESKOGO INSTITUTA [Bulletin of Tomsk Polytechnic Institute] in Russian No 276, 1976 pp 19-21

[From REFERATIVNYY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10G219]

SHISHKOVSKIY, V. I., SOLOV'YEV, A. A., and SERGEYEV, V. N.

[Text] The authors examine the contracting of a low-pressure rf discharge. They give the results of the experiments in air plasma. They show that as a function of the pressure and current, the rf discharge has a different mechanism of contraction.

USSR

UDC 537.52

# JET DISCHARGE AS A LINE WITH DISTRIBUTED PARAMETERS

Tomsk IZVESTIYA TOMSKOGO POLITEKHNICHESKOGO INSTITUTA [Bulletin of Tomsk Polytechnic Institute] in Russian No 276 1976 pp 12-15

[From REFERATIVNYY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10G221]

TIKHOMIROV, I. A., TIKHOMIROV, V. V., and LEVASHOV, V. S.

[Text] The authors examine the equivalent circuit of a jet discharge. On the basis of analyzing the equations for a line with distributed parameters they suggest a method of determining the capacitance, inductance and active resistance for the measured input resistance, frequency and length of the discharge, as well as for the coefficient of current damping in the discharge. They show that the results of these electrical measurements agree satisfactorily with the microwave measurements of electron concentration.

USSR

UDC 537.52

# SOME PROBLEMS IN THE FORMATION OF A FREE HIGH-FREQUENCY JET DISCHARGE

Tomsk IZVESTIYA TOMSKOGO POLITEKHNICHESKOGO INSTITUTA [Bulletin of Tomsk Polytechnic Institute] in Russian No 276, 1976 pp 8-11

[From REFERATIVNYY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10G220]

TEPLOUKHOV, VL. L., KOLMAKOV, G. N., and TEPLOUKHOV, VIK. L.

[Text] The authors examine the formation of a free jet rf-discharge. They suggest two models of the excitation of a flow of plasma in a discharge channel and make evaluation computations of the absolute velocities. They show that with currents up to 10 A, the convective mechanism predominates for exciting flows of plasma in the channel of a jet rf-discharge; at higher currents an important role begins to be played by the pinch-effect.

USSR

UDC 532.545

THE MEAN VELOCITY OF BUBBLES IN A FLUIDIZED BED WITH PACKING

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 31, No 4, 1976 pp 601-606 manuscript received 11 Dec 75

GALERSHTEYN, D. M., TAMARIN, A. I., ZABRODSKIY, S. S., and BORISENKO, V. P.,  
Institute of Heat and Mass Transfer imeni A. V. Lykov, Acad. Sci. BSSR

[Abstract] The expansion of a fluidized bed was measured with various packings in columns of several diameters. The mean velocity of bubbles and the influence of packing parameters on it were estimated. A two-phase model of the fluidized bed is assumed and the pressure drop is measured throughout the length of the column. It is found that certain types of packing stabilize the mean relative velocity of the bubbles, which can be calculated from the formula  $u_n^* = 37(u_0 l_p)^{0.45}$ , where  $u_n^*$  is the stabilized relative bubble velocity, cm/s;  $u_0$  is the rate of onset of fluidization, cm/s;  $l_p$  is the mean diameter of the channels in the packing. This formula summarizes data found in layers of different scales, which indicates that effective packings can stabilize the bubble velocity and, consequently, the dimensions of bubbles not only as to rate of filtration, but also throughout the space of the bed. References 17: 13 Russian, 4 Western.

USSR

UDC 532.694:536.421.4

CONCERNING THE DISTRIBUTION OF DISSOLVED GAS IN WATER AND THE DISTRIBUTION OF BUBBLES IN ICE WITH ADVANCEMENT OF THE CRYSTALLIZATION FRONT

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 31, No 4, Oct 76  
pp 632-637 manuscript received 24 Sep 75

ZHEKAMUKHOV, M. K.

[Russian abstract provided by the source]

[Text] The solubility of air in water is 10-100 times as great as in ice. Therefore the process of crystallization of water is accompanied by release of the dissolved air and diffusion into the liquid. Preceding the crystallization front one should observe separation of gas molecules having different mobilities. In particular, ions of different signs may be separated with formation of a potential difference with magnitude depending on the rate of advancement of the crystallization front. A diffusion equation described the distribution of gas in water during crystallization assuming that bubbles do not form. This equation is solved for two special

cases: 1) when the velocity of the crystallization front is proportional to  $t^{-1/2}$ , where  $t$  is time; 2) when the velocity of the crystallization front is constant. In the first case, supersaturation of gas on the phase interface remains constant, and in the second case it increases in proportion to  $t$ . Problems are discussed that relate to the most favorable conditions of freezing of water where uniform ice will be formed. References 4: 3 Russian, 1 Western.

USSR

UDC 532.546

THE USE OF A MIXTURE OF A LIQUID WITH GAS BUBBLES FOR TRANSMISSION OF SHOCKWAVE PERTURBATIONS

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 31, No 4, 1976  
pp 674-677 manuscript received 5 Sep 75

VOSKOBOYNIKOV, I. M., GEL'FAND, B. YE., GUBIN, S. A., KOGARKO, S. M., and POPOV, O. YE., Institute of Chemical Physics, Acad. Sci. USSR

[Abstract] A study is made of the problem of transmission of energy by shockwave perturbations from a gas into a liquid and in a mixture of a liquid with gas bubbles. It is shown that when the liquid is replaced by a liquid with gas bubbles, the flow of energy transmitted from the gas is increased. References 4 Russian.

USSR

UDC 532.529.6

THE DIFFUSION OF BUBBLES IN A TURBULENT STREAM

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 31, No 4, 1976 pp 678-683 manuscript received 19 Aug 75

FEDOTOVSKIY, V. S., and BOBKOV, V. P.

[Abstract] The ratio of coefficients of diffusion of bubbles and liquid particles of the carrier medium in a turbulent stream is calculated under simplifying assumptions. A study is made of the case of low concentrations of bubbles in order that the influence of the bubbles on each other and on the turbulent characteristics of the stream might be ignored. Using this assumption, it is sufficient to analyze the motion of a single bubble. It is found that the coefficient of diffusion of bubbles under certain conditions may significantly exceed the coefficient of turbulent diffusion

of liquid particles of the carrier stream. If the gas density in the bubble is much less than the liquid density, the maximum value of ratio of diffusion coefficients is 4.5. The viscosity of the carrier fluid and time scale of turbulence are also significant. References 6: 5 Russian, 1 Western.

USSR

UDC 532.526.75

HYDRODYNAMICS AND HEAT EXCHANGE IN A LAYER OF LIQUID ON A ROTATING SURFACE  
CONSIDERING THE INTERACTION WITH A GAS STREAM

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 31, No 4, 1976 pp 684-690 manuscript received 5 Aug 75

MOCHALOVA, N. S., KHOLPANOV, L. P., and SHKADOV, V. YA., Institute of New Chemical Problems, Acad. Sci. USSR, Moscow

[Abstract] The problem of the hydrodynamics and mass transfer in a layer of liquid on a rotating surface in the form of an Archimedes spiral is solved considering the forces of friction on the interface and the heat transfer from the film of fluid to the rotating surface is calculated under these conditions. The Prandtl and energy equations are numerically solved in the boundary layer approximation. Reference 1 Russian.

USSR

UDC 532.525.2

NUMERICAL MODELING OF JET FLOWS OF A VISCOUS FLUID

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 31, No 4, 1976 pp 691-697 manuscript received 13 Aug 75

DORFMAN, A. L., and MAYEV, V. A.

[Abstract] A study is made of the problem of the jet flow of a viscous, incompressible fluid. A numerical finite-difference method is used to study the flow in the boundary layer. The numerical solution algorithm suggested is based on the idea of conversion. First the preliminary value of the desired functions is found for a half step of the difference grid, using the values of the functions from the previous layer in the coefficients of the difference equations. These preliminary values are then used for the entire step. Theoretical and experimental data agree well. References 14: 10 Russian, 4 Western.

USSR

UDC 532.526;532.501.118;553.607.13

DRAG OF SHORT CYLINDRICAL PROJECTIONS IN A TURBULENT BOUNDARY LAYER

Novosibirsk IZVESTIYA SIBIRSKOGO OTDELENIYA AKADEMII NAUK SSSR, SERIYA  
TEKHNICHESKIKH NAUK in Russian No 13, Issue 3, Oct 76 pp 3-8 manuscript  
received 24 Dec 74

DOLGOV, V. N., NESTEROVICH, N. I., and SHULEMOVICH, V. M., Institute of  
Theoretical and Applied Mechanics, Novosibirsk

[Abstract] A study is made of the characteristics of a turbulent boundary layer and the drag of short cylindrical projections on the side wall of a wind tunnel at Mach numbers of 0.75 and 2.5 at various Reynolds numbers, in order to determine the resistance of isolated projections and groups or arrays of projections. The projections were arranged on a disc, as individual projections, transversely oriented (to the airflow) rows of projections, parallel oriented rows of projections and both "box" and staggered arrays of projections. The measurements in the boundary layer were performed with a Pitot tube, the drag factor of the irregularities were determined by means of electromagnetic balances with a floating element carrying the disc and displacement compensation. Several dimensionless parameters are suggested, and a number of regularities are revealed in the influence of the Mach number, density and method of placement of the projections on their drag. References 10: 4 Russian, 6 Western.

USSR

UDC 532.526

DEVELOPMENT OF A TURBULENT BOUNDARY LAYER FOLLOWING INTERACTION WITH A  
COMPRESSION SHOCK AT  $M=2-6$

Novosibirsk IZVESTIYA SIBIRSKOGO OTDELENIYA AKADEMII NAUK SSSR, SERIYA  
TEKHNICHESKIKH NAUK in Russian No 13, Issue 3, Oct 76 pp 9-14 manuscript  
received 3 Feb 75

GOL'DFEL'D, M. A., and DOLGOV, V. N., Institute of Theoretical and Applied  
Mechanics

[Abstract] Results are presented from an experimental study of the development of the turbulent boundary layer after interaction with a compression shock at compression angles at Mach numbers of 2-6 and at wedge angles of 11-25°. Ten chromel-alumel thermocouples were used to measure the surface temperature of the model. Full pressure profiles were measured by means of an array of 18 pressure sensors. It is shown that at  $M=2$  and 3 with a wedge angle of 18 and 25°, flow separation occurs. When the pressure ratio

on the shock exceeds a critical value, the velocity profile is strongly deformed and is described by a power law in a two-layer scheme with a different exponent in the external and internal areas of the boundary layer. The method of calculation suggested yields satisfactory results with separation of the boundary layer. The agreement of experimental and calculated values improves with increasing distance from the leading edge of the wedge inducing the compression shock, up to 15-20 times the thickness of the boundary layer. The experimental and calculated values agree well if the length of the initial laminar layer is not great. References 9: 5 Russian, 4 Western.

USSR

UDC 533.6.082.61

# A DC HOT WIRE ANEMOMETER FOR MEASUREMENT OF TURBULENCE AT SUPERSONIC VELOCITIES

Novosibirsk IZVESTIYA SIBIRSKOGO OTDELENIYA AKADEMII NAUK SSSR, SERIYA TEKHNIЧЕСКИХ НАУК in Russian No 13, Issue 3, Oct 76 pp 15-18 manuscript received 20 Dec 73

YELFIMOV, A. G., LEBIGA, V. A., and CHERNYKH, V. V., Institute of Theoretical and Applied Mechanics

[Abstract] The basic characteristics are presented of the TPT-1A hot wire anemometer, developed at the authors' institute, with an operating range of 70 Hz to 110 kHz, with sensor time constants of up to  $1.1 \cdot 10^{-3}$  s. A photograph and block diagram of the instrument are presented. The instrument is designed for measurement of turbulence characteristics in supersonic airstreams. Diagrams of the frequency characteristics, fluctuation and summary signal plus noise spectrum are presented. The data presented indicate that the TPT-1A can perform accurate measurements of pulsations in supersonic streams, that it is reliable and convenient for use and superior to previous models of hot wire anemometers. It has a constant frequency band, independent of heating of the filament, allowing it to be used when several types of pulsations are present simultaneously. References 3: 2 Russian, 1 Western.

USSR

UDC 532.517.2+532.526/592+534.13

THE INTERACTION OF A SONIC FIELD WITH AN INCOMPRESSIBLE LAMINAR BOUNDARY LAYER

Novosibirsk IZVESTIYA SIBIRSKOGO OTDELENIYA AKADEMII NAUK SSSR, SERIYA TEKHNIЧЕСКИХ НАУК in Russian No 13, Issue 3, Oct 76 pp 19-26 manuscript received 14 Jan 75

POLYAKOV, N. F., DOMARATSKIY, A. N., and SKURLATOV, A. I., Institute of Theoretical and Applied Mechanics; Institute of Automation and Electrometry

[Abstract] This work is dedicated to an experimental study of the relationship between velocity pulsations in a boundary layer and sonic oscillations of discrete frequencies in the external flow by methods of correlation analysis. Only one type of this interaction -- direct resonance -- was studied in the stage of a perturbed laminar boundary layer with sonic pressure levels  $P < 110$  dB. The results indicate that in the range of parameters studied ( $Re^* = 1500-3500$ ,  $2\pi f_0 \nu / U_\infty^2$  from  $17 \cdot 10^{-6}$  to  $55 \cdot 10^{-6}$  as a result of the effect of a flat sonic wave at a discrete frequency, propagating longitudinally in a laminar boundary layer, stable hydrodynamic waves of the same frequency develop. The area of existence of the intensive hydrodynamic waves is located between the axial line of the area of instability and the branch of the second curve of neutral stability calculated by the linear theory. References 9: 5 Russian, 4 Western.

USSR

UDC 533.6

SOME SELF-SIMILAR PROBLEMS OF A NONSTATIONARY BOUNDARY LAYER

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNIЧЕСКОЙ ФИЗИКИ in Russian No 6(100), Nov/Dec 76 pp 56-60 manuscript received 24 Dec 75

PROZOROVA, E. V., Leningrad

[Russian abstract provided by the source]

[Text] The following problems are considered: 1) formation of a boundary layer in a compressible fluid for a semi-infinite plate set into motion by an impulse; 2) formation of a boundary layer behind a shock wave incident on a semi-infinite plate; 3) the problem of a magnetic boundary layer on a plate set in motion by an impulse, for small and large magnetic Reynolds numbers ( $Re_H$ ). Numerical results are found for all the listed problems. References 3 Russian.

USSR

UDC 532.517.4

SELF-SIMILAR PROBLEMS OF TURBULENT MIXING OF THE INTERFACE OF COMPRESSIBLE GASES

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian  
No 6, Dec 76 pp 82-90 manuscript received 27 Jan 76

NEUVAZHAYEV, V. YE., Chelyabinsk

[Abstract] The gas dynamic equations are obtained for specified boundary conditions. The structure of the self-similar problem and the instability of the interface are investigated by numerical integration of these equations. Two regions are yielded by this integration: a shock wave of heavy gas, and a rarefaction wave of light gas, separated by the interface. The theory and equations of the turbulence are derived and the self-similarity of the turbulence problem is demonstrated; examples are given. The piston problem is solved by an approximate solution both with and without turbulence. The author expresses his gratitude to V. G. Yakovlev, R. A. Zhilina, and R. G. Islamova. Five illustrations; References 5 Russian.

USSR

UDC 532.135

STRUCTURAL-PHENOMENOLOGICAL THEORY OF THE STRESSED STATE IN A RANDOM FLOW OF DILUTE SUSPENSION OF RIGID DUMBBELL-SHAPED PARTICLES IN A POWER-LAW FLUID

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian  
No 6(100), Nov/Dec 76 pp 68-75 manuscript received 17 Sep 75

TARAN, YE. YU., Kiev

[Russian abstract provided by the source]

[Text] Rheological equations of state are derived for dilute suspensions of dumbbell-shaped particles in a power-law fluid without consideration of rotational brownian motion of the suspended particles, their inertia or the external force fields (electrical and magnetic), using a structural-phenomenological approach. As an example, the author considers plane Couette flow, and finds that the given medium behaves as a power-law fluid with consistency dependent on the number of suspended particles in a unit of volume, their dimensions, and the consistency and degree of non-newtonian behavior of the solvent. References 10: 2 Russian, 8 Western.

USSR

UDC 532.529

# STATIONARY PERTURBATIONS IN A LIQUID CONTAINING GAS BUBBLES

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian No 6, Dec 76 pp 90-96 manuscript received 17 Nov 75

GONCHAROV, V. V., NAUGOL'NYKH, K. A., and RYBAK, S. A., Moscow

[Abstract] The unidimensional acoustic wave equations are stated for a bubbly liquid medium together with the Rayleigh equations for the oscillations of a bubble. Only the stationary solutions of this system of equations are of use. The case of small perturbations is analyzed, and the nonlinear distortion of the small-amplitude harmonic wave is obtained. Conditions of relative values for high-frequency and low-frequency waves are examined, and a qualitative examination is made of the types of solution in each interval of variation of the wave velocity. Illustrations 4; References 4 Russian.

USSR

UDC 532.526

# TWO-PHASE FLOWS WITH FRICTION

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian No 1, 1977 pp 96-101 manuscript received 7 Oct 75

ZHIZHIN, G. V.

[Abstract] Results are given of a theoretical analysis of the equations for uniform, stationary, two-phase flow with the effect of friction along the walls of the channel taken into account. The magnitude of the pressure loss in the channel due to the work done against the friction force is an important engineering characteristic. These results are applicable to the practically significant problem of the flow of a self-vaporizing liquid. This flow is on the whole unbalanced but has a quasi-balanced vaporous region along the channel wall over the channel length considered. The cross-sectional area of the channel occupied by the vapor and the rate of flow are assumed to vary from cross section to cross section because of the vaporization of the metastable liquid at the channel center. The temperature of the liquid then remains practically constant, and leads to the compensation of the geometric action on the flow of the vapor in the region near the channel wall. The analysis begins with the equations of continuity, motion, and energy corresponding to equilibrium flow of vapor in a channel of constant cross section. The conditions under which vapor condensation occurs are determined. Illustrations 2; References 10: 8 Russian; 2 Western.

## MOTION OF A DROPLET IN A VARIABLE VELOCITY FLOW

Minsk INZHENERNO-FIZICHESKIY ZHURNAL [Engineering-Physics Journal] in Russian  
Izd-vo "Nauka i tekhnika" No 1, 1977 pp 90-95 manuscript received 8 Dec 75

ANANIKOV, S. V., TALANTOV, A. V., and AZIZOV, B. M., Kazan' Chemical-  
Technological Institute imeni S. M. Kirov

[Abstract] A theoretical discussion is given of the problem of a moving droplet in the flow of a gas whose velocity falls off linearly with distance, a type of gas flow which occurs in air-jet engines, in carburetor equipment, and in Venturi tube devices. The analysis begins with a system of equations for the velocity of the gas in terms of the distance, the equation for the motion of a spherical droplet in uniform flow in terms of the relative velocity of the droplet, and the equation for the relative velocity of the droplet. Three possible hydrodynamic modes for the flow around the droplet are examined: laminar, transitional, and turbulent. Solution of the problem for laminar flow takes account of the aerodynamic and gravitational components of the effective forces, while only the aerodynamic effect is considered for turbulent and transient flow. An expression is developed for the velocity of the droplet at any time for the various flow modes. In the piecewise-linear approximation, the results can be applied to a nonlinear change in flow velocity. References 17: 16 Russian, 1 Western.

USSR

UDC 621.375.826

A MODEL OF A NITROGEN LASER USING A RELATIVISTIC ELECTRON BEAM FOR PUMPING

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 4, No 1, Jan 77 pp 76-83  
manuscript received 12 Apr 76

BASHMAKOVA, T. I., and MAGDA, I. I., Institute of Physics and Technology,  
Academy of Sciences UkSSR, Khar'kov

[Abstract] This work presents a description of a numerical model of a pulsed laser using a high-current relativistic electron beam as an energy source. Molecular nitrogen is used as the lasing substance, and the system of working levels is in the second positive system of the molecule. The system of equations describing the heating of a high-density gas by the electron beam is solved numerically simultaneously with the equations for the nitrogen laser. The model considers the quasilinear theory of relaxation of the beam in the dense gas. Optimal pumping modes are studied. The results of the model are compared with experimental data. References 26: 17 Russian, 9 Western.

USSR

UDC 621.375.826.038.8

HIGH-EFFICIENCY LASER OPERATING IN THE SHORT PULSE MODE WITH PUMPING BY A COAXIAL FLASH LAMP

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 4, No 1, Jan 77 pp 122-128  
manuscript received 21 Apr 76

ZHOLOBOV, YE. F., ZENKOV, D. I., PAVLOVSKIY, A. I., ROMANENKO, N. V.,  
SUKHANOV, L. V., and TIKHONOV, A. I.

[Abstract] Results are reported from an experimental study of the characteristics of a coaxial flash lamp and the parameters of a neodymium glass laser rod 45 mm in diameter and 920 mm long pumped by the lamp. With a flash duration of 250  $\mu$ s, emission energy of 660 J and an efficiency of 3.3% were achieved. An increase in flash duration allows an increase in the maximum emission energy and in the efficiency. The use of a single lamp for pumping of a large rod decreases the number of elements used in the laser, simplifying the design and increasing reliability, and also permits the creation of a compact laser head which can be used in the development of powerful laser installations consisting of a large number of rods. The reflecting coating increases the brightness temperature of the plasma in the visible spectral range by a factor of 1.2. The brightness depends essentially on the thickness of the plasma layer and increases with increasing thickness from 5 to 10 mm by approximately 2.5 times. The optimum xenon pressure for the lamp is 80-120 mm Hg. References 9: 7 Russian, 2 Western.

USSR

UDC 621.378.33

ENERGY CHARACTERISTICS OF A CHEMICAL HYDROGEN FLUORIDE LASER EXCITED BY AN ELECTRON BEAM

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 4, No 1, Jan 77 pp 169-171  
manuscript received 29 Apr 76

BASHKIN, A. S., ORAYEVSKIY, A. N., and TOMASHOV, V. N., Institute of Physics imeni P. N. Lebedev, Academy of Sciences USSR, Moscow

[Abstract] Experimental studies were performed of the energy characteristics of a hydrogen fluoride laser based on mixtures of  $\text{SF}_6 + \text{H}_2$  and  $\text{H}_2 + \text{SF}_6$ . In order to study the possibility of increasing pumping efficiency, experiments were performed involving the application of an additional electrostatic field and preionization of the working fluid with an electron beam. This was done by introducing an additional anode to the laser cell to which a capacitor with a capacitance of  $0.01 \mu\text{F}$  was connected through a low-inductance circuit. A significant increase in laser output energy was achieved upon application of the external electrostatic field. References 9: 2 Russian, 7 Western.

USSR

UDC 621.373.8.029.71:539.196.6

PURIFICATION OF SUBSTANCES IN THE GAS PHASE BY IR LASER RADIATION

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 4, No 1, Jan 77 pp 171-173  
manuscript received 29 Apr 76

AMBARTSUMYAN, R. V., GOROKHOV, YU. A., GRIGOROVICH, S. L., LETOKHOV, V. S., MAKAROV, G. N., MALININ, YU. A., PURETSKIY, A. A., FILIPPOV, E. P., and FURZIKOV, N. P., Institute of Spectroscopy, Academy of Sciences USSR, Moscow

[Abstract] Results are presented from a study of the possibility of laser purification of arsenic trichloride  $\text{AsCl}_3$  to remove 1,2-dichloroethane  $\text{C}_2\text{H}_4\text{Cl}_2$  and carbon tetrachloride  $\text{CCl}_4$ . Ordinary methods of purification cannot reduce the content of these impurities below  $10^{-2}$ - $10^{-3}\%$ . The laser radiation produced selective dissociation of the molecules in the gas mixture. The number of pulses necessary for a 10-times reduction in the concentration of  $\text{C}_2\text{H}_4\text{Cl}_2$  and  $\text{CCl}_4$  was  $3 \cdot 10^3$  and  $2 \cdot 10^4$  respectively, with a laser radiation energy utilization factor of about  $10^{-2}$ . The final content of the impurity achieved was determined by the sensitivity of recording, not the ultimate capacity of the method. In the case of 1,2-dichloroethane, the products formed differ greatly in their physical properties from arsenic trichloride, allowing them to be separated easily to increase the purity of the  $\text{AsCl}_3$ . References 7: 4 Russian, 3 Western.

USSR

UDC 662.613+535.339.+533.601

GAIN IN A GAS-DYNAMIC USING THE PRODUCTS OF COMBUSTION OF BENZENE

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 4, No 1, Jan 77 pp 173-176  
manuscript received 29 Apr 76

KTALKHERMAN, M. G., MAL'KOV, V. M., PETUKHOV, A. V., and KHARITONOVA, YA. I.,  
Institute of Theoretical and Applied Mechanics, Siberian Affiliate, Academy  
of Sciences USSR, Novosibirsk

[Abstract] Results are presented from measurement of the gain in a continuous gas-dynamic laser utilizing the products of combustion of a benzene-air mixture at combustion temperatures up to 1700 K and pressures of  $30 \pm 3$  atm. Experimental data are compared with calculated data and with previous experiments involving combustion of mixtures of CO and H<sub>2</sub> in the same experimental apparatus. The results indicate that the utilization of benzene as a fuel for a gas-dynamic laser is promising. References 9: 3 Russian, 6 Western.

USSR

UDC 621.378.33

THE STABILITY OF EMISSION OF A FAST-FLOW CO<sub>2</sub> LASER WITH TRANSVERSE PUMPING

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 4, No 1, Jan 77 pp 178-180  
manuscript received 29 Apr 76

ARTAMONOV, A. V., and NAUMOV, V. G.

[Abstract] Studies were performed of the time characteristics of the output radiation for a model of a fast-flow gas-discharge CO<sub>2</sub> laser, operating continuously with an output power on the order of several kilowatts arranged so that the direction of flow of the working fluid, discharge current and optical axis were mutually perpendicular and the carbon dioxide gas was mixed in the stream of excited working fluid immediately before the resonator zone. Amplitude modulation of radiation was observed in both stable and unstable resonators. The modulation of the radiation is shown not to be the result of variations in gain at the input of the resonator. Reference 1 Russian.

USSR

UDC 621.378.33

# A CONTINUOUS CO<sub>2</sub> LASER USING ATMOSPHERIC AIR

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 4, No 1, Jan 77 pp 184-186  
manuscript received 15 May 76

ARTAMONOV, A. V., VEDENOV, A. A., VITSHAS, A. F., and NAUMOV, V. G.

[Abstract] A description is presented of the design of a fast-flow continuous CO<sub>2</sub> laser operating with a mixture of air and carbon dioxide. Population of the lower laser level with CO<sub>2</sub> molecules in this case is provided for not by helium but by water vapor. The air flow formed in the prechamber passes through the discharge chamber in which the oscillating levels of the nitrogen molecules are excited by a glow discharge plasma. Immediately before the resonator a predetermined quantity of carbon dioxide gas is added to the excited air by a special metering system, and this mixture enters the resonator, where a portion of the stored vibrational energy is transferred to radiation energy. The spent mixture is exhausted into the atmosphere. The experimental installation had the following parameters: cross section of discharge chamber 30·1000 mm<sup>2</sup>; length of discharge zone 280 mm; volumetric flow rate of working fluid  $G = 1.5-2.0 \text{ m}^3/\text{s}$ , operating pressure in chamber 40-100 mm Hg; power input  $W = 0-50 \text{ kW}$ . The maximum radiated power extracted through an NaCl window in the stable mode was about 2.6 kW for an efficiency of 6.3%. References 4 Russian.

USSR

UDC 621.373.826.038.823

# GASEOUS N<sub>2</sub>O<sub>3</sub> AS A POSSIBLE OPERATING MEDIUM IN A PHOTORECOMBINATION LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3, No 12, Dec 76 pp 2591-2595  
manuscript received 28 Jan 76

GORDON, YE. B., MOSKVIN, YU. L., and SOTNICHENKO, S. A., Institute of Chemical Physics, Academy of Sciences, USSR, Moscow

[Abstract] A study is made of the possibility of having large stationary concentrations of gaseous NO·NO<sub>2</sub>. The advantage of such a situation is that the N<sub>2</sub>O<sub>3</sub> molecule is a convenient donor of oxygen atoms. The experiments produced optimum values of temperature, pressure, and initial composition conditions for the realization of a photoinitiated recombination laser. The requirements for the laser are listed: use of a high-quality resonator; use of ultraviolet light of specified pulse interval and intensity; experimentation at low temperatures in the laser compartment and in the method of preparing the gas mixture. In addition to high efficiency

and the possibility of adjusting the frequency of the laser emission within broad limits, this type of laser offers the advantage of repeated use of the operating mixture. Table 1; Illustrations 2; References 15: 8 Russian, 7 Western.

USSR

UDC 621.378.325

CONTROL OF DURATION OF ULTRASHORT PULSES IN MODE-LOCKED LASERS

ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 26, No 1, Jan 77 pp 37-40  
manuscript received 29 Jan 76

ZAPOROZHECHENKO, R. G., and ZAPOROZHECHENKO, V. A.

[Russian abstract provided by the source]

[Text] The relationship of duration and intensity of ultrashort pulses in a mode-locked ruby laser with Q-switching on the frequency of intermode beats is investigated as a function of modulator position in the cavity. It is shown that when the modulator is moved with respect to the mirror, the pulse duration of stimulated emission can be continuously varied. Theory and experiment agree well. Illustrations 3; References 7: 3 Russian, 4 Western.

USSR

UDC 535.3612

EFFECT OF DIFFUSE SCATTERING ON THE INTENSITY DISTRIBUTION OVER THE MIRRORS OF AN UNSTABLE RESONATOR

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3, No 11(53), Nov 76 pp 2362-2368 manuscript received 6 Dec 75

DREYZIN, YU. A., and PRUDOV, A. YA.

[Abstract] Weak diffuse scattering at the surface of resonator mirrors results in an energy transfer from the fundamental divergent wave to the convergent wave and this, in turn, alters the emission threshold and distorts the field distribution at the mirrors. While smooth mirror edges minimize the transformation from a divergent to a convergent wave, surface roughness or other small-scale inhomogeneities may affect the characteristics of an unstable resonator even when the coefficient of diffuse

reflection is very low ( $D_{\text{diffuse}} \approx 10^{-2}$ ). The effect of surface roughness on the intensity distribution is analyzed here by solving the integral equation for the field amplitudes in the first-order perturbation theory, with diffraction at the mirror edges disregarded (i.e., the mirrors assumed infinitely large). The theoretical results are then applied to unstable resonators found in practice such as, for example, a compound resonator where a mismatch between center and periphery is caused by the difference between the reflection coefficients at the respective locations. The calculations are made for the case of a narrow scattering indicatrix, but can be extended also to mirrors with a wide indicatrix. Figures 1; References 7: 4 Russian, 3 Western.

USSR

UDC 537.52

STUDY OF THE FORMATION AND DYNAMICS OF DISPERSION OF MULTICHARGED IONS OF LASER PLASMA

Uzhgorod IZUCHENIYE OBRAZOVANIYA I DINAMIKI RAZLETA MNOGOZARYADNYKH IONOV LAZERNOY PLAZMY in Russian, Uzhgorod University Press, 1976, 6 pp (Manuscript deposited in the All-Union Institute of Scientific and Technical Information on 21 Jun 76 No 2269-76 Dep)

[From REFERATIVNYY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10G227 DEP]

OPACHKO, I. I., ZAPESOCHNYY, I. P., and POP, S. S.

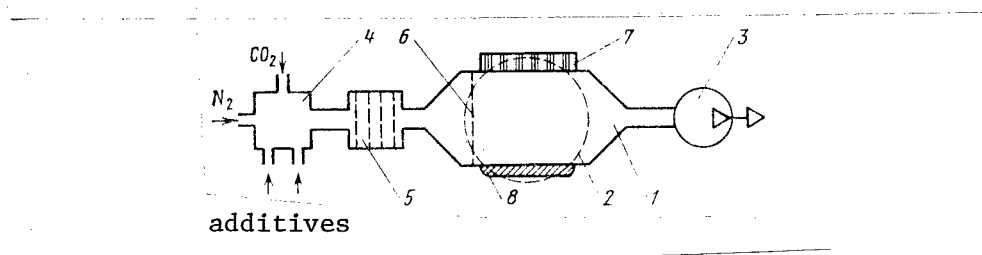
[Text] The authors investigated the formation and acceleration of multi-charged ions of laser plasma as a function of density of the radiation flux incident on the target (C, Al, Ca). For flux densities of laser radiation of  $10^{12}$  W/cm they estimate the parameters of the nucleus of the laser flare from its radiation in the x-ray region of the spectrum. They show that the optical thickness of the nucleus of the flare with these parameters is approximately 1. The threshold values of the flux density of the incident radiation  $q$ , corresponding to the appearance of the ions with potential ionization  $\kappa$ , are connected by the relationship  $\kappa_i = Aq^{0.5}$ . References 6.

A PERIODIC OPEN-CYCLE PULSED CO<sub>2</sub> LASER WITH AVERAGE POWER OF 500 W

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3, No 11(53), Nov 76 pp 2480-2483 manuscript received 5 Apr 76

VEDENOV, A. A., DROBYAZKO, S. V., YEGOROV, A. A., ZHURAVSKIY, L. G., and TURUNDAYEVSKIY, V. B.

[Abstract] Experiments are done on an open-cycle periodic pulsed gas laser on helium-free working mixtures. An electrode system with plasma cathode was used with ultraviolet pre-ionization of the discharge gap on a CO<sub>2</sub> - air mixture at a pressure of 130 mm Hg to achieve an average power of 500 W at a pulse recurrence rate of 250 Hz, the energy per pulse being 2 J. A diagram of the installation is shown in the figure.



1--discharge chamber, 2--cavity, 3--evacuation system, 4--input unit, 5--mixer, 6--choke grating, 7--cathode, 8--anode

By using easily ionizable additives (0.1% xylene or N,N-dimethylaniline) the E/p ratio of the discharge (E is the electric field of the plasma, p is the pressure of the working mixture) was reduced from 24 to 17 V/(cm·mm Hg), and the efficiency was raised from 7 to 11%. It is shown that E/p and the efficiency of the discharge do not depend on the voltage across the storage capacitor, but are determined only by the composition of the working mixture. The average laser power increases linearly with increasing pulse recurrence rate. The maximum pulse recurrence rate was lower than the theoretical value by a factor of 1.3. References 13: 4 Russian, 9 Western.

USSR

UDC 548.162:539.16.04;548-162:539.12.04

CONCERNING THE SIZE EFFECT THAT ARISES WHEN MATERIALS ARE EXPOSED TO LASER PULSES

Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 21, No 12, Dec 76  
pp 1965-1969 manuscript received 27 Feb 76

GEGUZIN, YA. YE., YEMETS, A. K., and KONONENKO, V. G., Khar'kov State University imeni A. M. Gor'kiy

[Russian abstract provided by the source]

[Text] An investigation is made of the influence that the size of a structural element of a specimen has on its behavior during exposure to laser radiation. It is shown that the presence of boundaries that reflect heat (pore surfaces, edges of the workpiece and so forth) change the effective coefficient of thermal conductivity, resulting in alteration of the size of the region of localization of the energy absorbed by the surface of the workpiece, and consequently changing the nature of destruction. Studies of copper foils and stampings shows that the nature of destruction depends on size in the case of foils, and on porosity in the case of stampings. References 6: 5 Russian, 1 Western.

USSR

UDC 536.423.1:545.21

THERMAL EXPLOSION OF WATER PARTICLES UNDER THE INFLUENCE OF A POWERFUL LASER BEAM

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 4, No 1, Jan 77 pp 157-159  
manuscript received 16 Mar 76

POGODAYEV, V. A., ROZHDESTVENSKIY, A. YE., KHMELEVTSOV, S. S., and CHISTYAKOVA, L. K., Institute of Atmospheric Optics, Siberian Affiliate Academy of Sciences USSR, Tomsk

[Abstract] The explosion of a water droplet under the influence of a laser pulse is a threshold process consisting of a number of stages: a) emission of a portion of the matter of the drop in the form of smaller droplets under the influence of excess pressure at hot spots; b) a change in the form of the drop and corresponding new ejection of additional matter; c) the threshold effect, consisting in superheating of the central area of the drop during ejection and explosive evaporation according to the condition  $WK_a\pi r^2 t_p = (4/3)\pi r^3 \gamma c \Delta T$ , where  $W$  is the power of the radiation;  $t_p$  is the pulse duration;  $K_a$  is the radiation absorption effectiveness factor of the

water sphere;  $a^2$  is the temperature coefficient of thermal conductivity of the drop;  $r$  is its radius;  $\Delta T = T_{cr} - T_0$ ;  $T_{cr}$  is the critical temperature of the substance of the drop;  $T_0$  is the initial temperature of the drop;  $\gamma$  and  $c$  are the density and heat capacity of the substance of the drop. The authors estimate the position of hot spots in large drops with index of absorption of  $\kappa \sim 10^{-4}$ , and from these data they draw conclusions as to the nonhomogeneities of the light field in such drops. References 8 Russian.

USSR

UDC 539.196

ELECTRICAL AND EMISSION CHARACTERISTICS OF A CARBON DIOXIDE PHOTOIONIZATION LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3, No 12(54), Dec 76 pp 2570-2575

GALAKTIONOV, I. I., GORELOV, V. YU., and PODMOSHENSKIY, I. V.

[Russian abstract provided by the source]

[Text] The paper gives the electrical and emission characteristics of a carbon dioxide photoionization laser as found under conditions where the laser cell is separated from the light source by a quartz tube. It is shown that there is ionization amplification on N, N-dimethylaniline vapor added to the emission mixture. Absorption losses in the vapor of the additive are found to be 7% per pass. An efficiency of 10% is attained when the energy input to the space discharge is  $180 \text{ J}/(\text{l} \cdot \text{atm})$  in an active volume of 0.32 liter. References 11: 6 Russian, 1 East German, 4 Western.

USSR

UDC 621.375.826:541.127:546

DETERMINING THE RATE CONSTANT OF THE ELEMENTARY REACTION  $\text{H} + \text{ClF} \rightarrow \text{HCl}^* + \text{F}$

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3, No 12(54), Dec 76 pp 2552-2556 manuscript received 12 Mar 76

CHEBOTAREV, N. F., TRAKHTENBERG, L. I., and PSHEZHETSKIY, S. YA., Scientific Research Physico-Chemical Institute imeni L. Ya. Karpov, Moscow

[Russian abstract provided by the source]

[Text] The rate constant of elementary reaction  $\text{H} + \text{ClF} \rightarrow \text{HCl}^* + \text{F}$  is measured by analysis of delays in stimulated emission on transitions  $P_2(3)$

of the HF molecule and  $P_2(5)$  of the HCl molecule that occur in a laser on a mixture of ClF-H<sub>2</sub>. The rate constant was found to be  $0.13 \pm 0.15 \text{ } (\mu\text{s} \cdot \text{mm Hg})^{-1}$ , which is equivalent to  $(3.7 \pm 0.4) \cdot 10^{-12} \text{ cm}^3/\text{s}$  at temperatures of 300-400 K. References 18: 7 Russian, 11 Western.

USSR

UDC 533.92:621.039.01

DISTORTION OF MAGNETIC SURFACES UNDER THE INFLUENCE OF HELICAL CURRENT

PERTURBATIONS IN A STELLARATOR WITH OHMIC HEATING OF THE PLASMA

Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 21, No 11, Nov 76  
pp 1915-1917 manuscript received 29 Jun 76

SEBKO, V. P., and TYUPA, V. I., Physics and Engineering Institute, Acad.  
Sci. UkSSR

[Abstract] This work has as its purpose to explain the influence that helical current perturbations upon ohmic heating of a plasma in a stellarator have on the structure of its magnetic configuration. The calculation is performed using the following model: suppose at some point at radius  $r_0^*$  on the rational, unperturbed surface within a current-carrying plasma, a slight increase (or decrease) of current occurs. The influence of this helical perturbation on the magnetic surface of a stellarator with longitudinal current is calculated. For simplicity, it is assumed that the perturbing current flows over a thin helical plate with a certain angular width and with a period which may be equal to integral multiples of the length of the installation. It is shown that rosette-shaped magnetic surfaces may arise with appreciable width when the helical reverse currents reach 0.1-0.5% of the total longitudinal current. This is due to the reduction of shear in the stellarator as the longitudinal current increases. References 6 Russian.

USSR

UDC 533.95:537.84

SOME RESULTS OF RADIOGRAPHIC AND X-RAY SPECTRAL INVESTIGATIONS OF THE EFFECT OF HIGH-TEMPERATURE PLASMA OF AN MHD-CHANNEL ON ELECTRODES

Moscow NEKOTORYYE REZUL'TATY RENTGENOGRAFICHESKIKH I RENTGENOSPEKTRAL'NYKH ISSLEDOVANIY VOZDEYSTVIYA VYSOKOTEMPERATURNY PLAZMY MGD-KANALA NA ELEKTRODY in Russian 1976 12 pp (Manuscript deposited in the All-Union Institute of Scientific and Technical Information on 1 Jul 76, No 2476-76 Dep)

[From REFERATIVNYY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10G257 DEP]

BORODINA, T. I., VAL'YANO, G. YE., GUTNOVA, L. B., DOLINSKIY, YU. L., KUZNETSOV, V. N., RAUTBORT, A. YE., and FOMINA, G. A., Editorial Staff of the Journal "TEPLOFIZIKA VYSOKIKH TEMPERATUR"

[Text] Using the methods of x-ray phase and x-ray spectral analyses, the authors investigated the changes in composition of the laminar electrodes

on a base of  $Y_2O_3 - Cr$ ,  $YCrO_3 - Cr$  under the influence of high-temperature plasma of an MHD-channel. They established that the layers forming on the working surfaces of the electrodes appear to a significant degree as a result of the deposition of materials eroding from different parts of the channel. They observed a difference between the compositions of the surface layers both on unlike and on like electrodes and a nonuniform distribution of phases over the surface of the electrodes. References 2.

USSR

UDC 539.196.6

SELECTIVE NONRESONANT PHOTODISSOCIATION OF MOLECULES

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 4, No 1, Jan 77 pp 136-141  
manuscript received 30 Nov 75

GENKIN, V. N., KITAY, M. S., and SOKOLOV, V. V., Scientific Research Institute for Radio Physics, Gor'kiy

[Abstract] It is shown that the probabilities of transitions from the ground state to highly excited oscillating states of molecules depend strongly on the binding energy and mass of the atoms. The possibility is discussed of using this effect for selective photodissociation of molecules of various isotope composition. The primary purpose of the article is to demonstrate that selective dissociation can be produced without preliminary selective excitation, due to the difference in the cross sections of absorption by reagents for quanta with energies on the order of the dissociation energy. References 6 Russian.

USSR

UDC 533.93

ON THREE-PARTICLE RECOMBINATION IN GASES AND PLASMA

Novosibirsk NEKOTORYYE ZADACHI GIDRODINAMIKI I TEPLOOBMENA [Some Problems of Hydrodynamics and Heat Exchange, Collection of Works] in Russian 1976 pp 226-230

[From REFERATIVNYY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10G28 by G. V. S.]

KOROBENNIKOV, YU. G.

[Text] The author theoretically determines the rate of the process of three-particle recombination. He uses the method of generalized kinetic equations. He assumes that the recombining particles interact among themselves by the Morse potential, and with the third particle -- by the law of solid spheres. By computer the author finds the value of the distance  $z$ , at which the potential  $\varphi_{\text{eff}}$  has a maximum barrier value  $B$ . To determine the production cross section for a quasimolecule with a given initial energy  $E$  he finds the value of the impact parameter  $b_{\text{max}}$ , at which the value of  $B$  at point  $z$  is equal to the given  $E$ . The theoretical values of the Morse potential are compared with the experimental values obtained by the Klein-Rydberg method. In examining the recombination of oxygen on Ar he took into account the possibility of the formation of four electron states of the  $O_2$  molecule and bore in mind the decrease in the diameter of the particles with increase in temperature. He also examines the three-particle (electron-ion) recombination in plasma with a not too low degree of ionization.

## ROTARY RELAXATION AND SPECTRUM OF INFRARED RADIATION IN VIBRATIONAL-ROTATIONAL TRANSITIONS OF MOLECULES IN THE UPPER ATMOSPHERE

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 41, No 6, Dec 76 pp 936-943 manuscript received 3 Jun 75

GORDIYETS, B. F., MARKOV, M. N., and SABUROVA, L. A.

[Abstract] A study is made of rotational relaxation of molecules under the conditions of the upper atmosphere. The purpose of the article is to provide a theoretical study, considering multiple-quantum conversions, of the rotational relaxation of radiating molecules and to produce analytic expressions for the rotational distribution function considering both the positive sources of rotationally-excited molecules and radiative vibrational-rotational transitions. Analytic expressions are produced for the quasi-stable rotational distribution function when there are positive sources of rotationally-excited molecules, radiation decay of levels and collisional relaxation. Conditions are determined under which the radiation spectra of such molecules as NO, CO and  $\text{NO}^+$  become nonequilibrium spectra in the upper atmosphere. References 13: 7 Russian, 6 Western.

USSR

UDC 621.384.6

THE QUESTION OF THE USE OF ELECTRIC EXPLOSION OF WIRES FOR SELF-ACCELERATION OF INTENSIVE ELECTRON BEAMS

Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 21, No 11, Nov 76  
pp 1910-1912 manuscript received 2 Jun 76

NASONOV, N. N., Physics and Engineering Institute, Acad. Sci. UkSSR

[Abstract] This work is dedicated to a study of the possibility of self-acceleration of intensive electron beams in systems containing exploding wires. A formula is presented for the accelerating field induced upon explosion of the wire. Significantly stronger fields can be achieved by using exploding wires in resonant systems for self-acceleration upon interruption of the beam, the maximum effectiveness being achieved in the case of a flat line with apertures in the plates for passage of the beam. References 7: 5 Russian, 2 Western.

USSR

UDC 533.9

INSTABILITY OF BEAMS IN PLASMA WAVEGUIDES WITH DIFFUSE BOUNDARIES

Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 21, No 11, Nov 76 pp 1882-1889 manuscript received 25 May 76

KONDRATENKO, A. N., KUKLIN, V. M., and TKACHENKO, V. I., Khar'kov State University

[Abstract] A study is made of the excitation of slanted surface oscillations by nonrelativistic monoenergetic electron beams of low density, matched or spatially separated with a plasma cylinder of radius  $a$  placed in a permanent magnetic field. Where  $0 < r \leq a$ , the density of single-charge ions and electrons in the plasma is constant at  $n_e$ . At the boundary of the plasma, the density monotonically varies from  $n_e$  to 0. Further, a study is made of the excitation of a plasma waveguide, a circular cylindrical cavity of radius  $a$  in an unlimited homogeneous magnetically active plasma with density  $n_e$ , by beams of electrons. It is found that almost all of the energy lost by the beam as a result of development of instability is expended in increasing the temperature of the plasma. References 13: 12 Russian, 1 Western.

USSR

PARTICULARS OF THE FISSIONABILITY OF MODERATELY HEAVY ELEMENTS

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian  
Vol 24, No 11, 5 Dec 76 pp 619-622 manuscript received 25 Oct 76

ANDRONENKO, L. N., VAYSHNENE, L. A., GORSHKOV, B. L., KOVSHEVNYI, G. G.,  
KOTOV, A. A., SEMENCHUK, G. G., and SOLYAKIN, G. YE., Institute of Nuclear  
Physics imeni B. P. Konstantinov

[Abstract] Experimental data are presented on the fissionability of nuclei from U to Sm, demonstrating the presence of a singularity in the fissionability behavior as a function of parameter  $Z^2/A$  of the target, occurring in the area of the rare-earth elements. Fissionability of the elements was studied using a beam of protons with an energy of 1 GeV by means of a mosaic of semiconductor surface-barrier Si(Au) detectors. The criteria for selection of events were: 1) agreement of momenta from fragments within predetermined time intervals; 2) value of minimum kinetic energy of recorded fragments; 3) recording of fragments in the range of mass ratios from 1 to 4. The preliminary experimental estimates of fissionability of the nuclei of Te and Ni indicate that upon transition to light nuclei, no increase in fissionability occurs: the fissionability of these nuclei was significantly less than the fissionability of Sm nuclei. References 12: 5 Russian, 7 Western.

USSR

UDC 539.1.08

OPTICAL SYSTEM FOR REGISTRATION OF SYNCHROTRON RADIATION IN THE IR REGION

Dubna OPTICHESKAYA SISTEMA DLYA REGISTRATSII SINKHROTRONNOGO IZLUCHENIYA V IK-OBLASTI in Russian, Report No 13-9663, Joint Institute of Nuclear Research Press, 1976 8 pp

[From REFERATIVNYY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10V320]

MAL'TSEV, A. A.

[Text] The author describes an optical system for registration of radiation in the IR region of 1 - 8  $\mu$ m, that is part of the diagnostic apparatus for the electron ring of a heavy ion accelerator for synchrotron radiation.

USSR

UDC 539.1.08

INVESTIGATION OF THE STABILITY OF AZIMUTHAL OSCILLATIONS OF AN ELECTRON RING  
IN A RESONATOR WITH THE AID OF A COMPUTER

Kiev UPRAVLENIYA OB'YEKTAMI S RASPREDELENNYMI PARAMETRAMI [Control of Objects  
With Distributed Parameters, Collection of Works] in Russian 1975 pp 48-57

[From REFERATIVNYY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10V326 by  
Ye. G. Krastelev]

GIGINYAK, V. F.

[Text] The author examines the problem of constructing an algorithm for the longitudinal (azimuthal) oscillations of an electron ring in a vacuum chamber. The necessity of using a computer is dictated in this case by the requirement of obtaining sufficiently precise quantitative evaluations of the stability of the ring and chamber system, which cannot be given by analytical methods of investigation because of the complexity of the obtained differential equation and, as a result of this, the inescapable introduction of a whole series of simplifying assumptions. The author examines the basic stages of solving the problem and obtains an algorithm for the machine investigation of the ring stability.

USSR

INCREASE IN THE RADIATION YIELD OF CURRENT CARRIERS UPON IR ILLUMINATION OF  
A  $\gamma$ -IRRADIATED AMORPHOUS ORGANIC DIELECTRIC

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 18, No 12, Dec 76 pp 3720-  
3721 manuscript received 5 Jul 76

AMETOV, K. K., NOVIKOV, G. F., and YAKOVLEV, B. S., Institute of Chemical  
Physics, Acad. Sci. USSR, Chernogolovka

[Abstract] An attempt is made to discover the difference in the radiation yield of pairs of current carriers  $G_{fi}$  upon thermal and photon-stimulated liberation of an electron from a localized state, to allow a judgment to be made concerning the effective electron temperature during the lifetime before localization at low initial kinetic energy ( $\sim 1$  eV). The displacement of the electron during the time before localization is  $8 \cdot 10^{-7}$  cm and the quantum yield for photoionization is  $\approx 1$ . This means that electrons with low initial energy retain their excess kinetic energy over a significant portion of the path to localization. References 8: 1 Russian, 7 Western.

USSR

UDC 539.1.08

STANDARD NEUTRON SPECTRUM IN THE INTERMEDIATE ENERGY REGION OF THE INSTITUTE OF NUCLEAR TECHNOLOGY

OPYT EKSPLUATATSII I ISPOL'ZOVANIYA ISSLEDOVATEL'SKIKH REAKTOROV. SIMPOZIUM [Experience in Operating and Utilizing Research Reactors, Symposium, Collection of Works] in Russian, Subjects B-V, 1974 pp 982-998

[From REFERATIVNYY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10V455 by A. V.]

GYRLYA, Y., TURZO, A., KYRSTOYU, B., ILIYE, P., and MOYSIN, L.

[Text] The authors describe a device designed for the creation and reproduction of a field of intermediate neutrons with a standard spectrum. The device was created at the Institute of Nuclear Technology in Bucharest. The field of neutrons is created in a cavity surrounded by spherical layers of boron carbide,  $U_{nat}$  (3 layers), and graphite. The graphite sphere (diameter 50 cm) is introduced into the heated column of the VVR-S reactor. The authors give the resultant neutron spectrum: the spectrum is compared with the standard spectra of two other devices.

USSR

UDC 621.039.5

ON THE REFLECTION OF ULTRACOLD NEUTRONS FROM A ROUGH SURFACE

Moscow OB OTRAZHENII UL'TRAKHOLODNYKH NEYTRONOV OT SHEROKHOVATOY POVERKHNOSTI in Russian No IAE-2657, Press of the Institute of Atomic Energy imeni I. V. Kurchatov, 1976, 16 pp

[From REFERATIVNYY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10V518 from the resume]

GALITSKIY, V. M., and SATAROV, L. M.

[Text] The authors examine the reflection of ultracold neutrons from an absorbing wall with a rough surface. They compute the coefficient of absorption of the ultracold neutrons during reflection from a saw-tooth shaped periodic surface with characteristic dimensions of irregularities larger than the depth of penetration of the neutron into a medium with a flat surface. They demonstrate that in this case the ratio of the coefficient of absorption for the rough and smooth boundaries is on the order of magnitude of the ratio of their areas. On the basis of comparing these results with the results obtained by the method of perturbation theory, they derive an interpolation formula which encompasses a broad range of rough surfaces.

## FREE DRIFT OF AN AXIALLY SYMMETRIC RELATIVISTIC ELECTRON BEAM

Tashkent IZVESTIYA AKADEMII NAUK UZBEKSKOY SSR, SERIYA FIZIKO-MATEMATICHESKIKH NAUK in Russian No 6, 1976 pp 76-77 manuscript received 8 Oct 75

GULYAMOV, U. G., ZAKHAROV, N. V., KVASOV, A. I., KOLESNIK, V. G., and KHON-CHER-SUN, Institute of Nuclear Physics, Academy of Sciences UzbekSSR

[Abstract] Description of intense accelerated electron beams in free space is important because of the need for delivering them to the target after extraction from the accelerating system. Beam expansion under these conditions is caused by forces of Coulomb repulsion and depends on particle energy. This paper examines the motion of an axially symmetric relativistic electron beam in the laminar approximation, and gives the characteristics of beam broadening for different currents and energies. Curves are given for the radius of the trajectory of an edge electron as a function of longitudinal coordinate for different  $A = \frac{2J}{p^3}$  where  $J$  is dimensionless current  $I/I_0$  and  $P$

is dimensionless momentum of the particle  $\gamma v/c$ , taking  $I_0 = 4\pi\epsilon_0 mc^3/e$  (all symbols have their conventional meaning). Curves are also given for the angle of inclination of the trajectory of an edge electron as a function of the transverse dimension of the electron beam for the same values of  $A$ . References 2 Russian.

USSR

## MECHANISM FOR THE GENERATION OF CUMULATIVE HADRONS OF NUCLEI

Moscow YADERNAYA FIZIKA in Russian Vol 24, No 6(12), 1976 pp 1208-1211

YEFREMOV, A. V., Joint Institute for Nuclear Research

[Abstract] The purpose of this theoretical paper is to show that the quark-parton modification offers the possibility of understanding the following characteristics of the production of cumulative hadrons on nuclei: the independence of the invariant cross section on the energy of the incident hadron; the degree of growth of the cross section with the atomic number of the nucleus, the growth index attaining 1.5-2 for heavy particles (d,t); the spectrum of the emitted particles dropping exponentially, with the slope increasing with increasing particle mass; the approximately isotropic cross section for small momenta and falling off with increases in angle for large momenta. An expression is derived for the invariant cross section. It is noted that an important prediction

of the mechanism discussion is the high correlation of two cumulative particles, such as pi mesons, since they are formed by the decay of one parton. The author thanks A. M. Baldin, D. I. Blokhintsev, S. B. Gerasimov, I. F. Ginzburg, B. N. Kalinkin, and A. V. Radyushkin. Illustrations 3; References 13: 9 Russian, 4 Western.

USSR

UDC 621.039.5

USE OF THE METHOD OF STATISTICAL REGULARIZATION FOR RECONSTRUCTING THE ENERGY SPECTRA OF FAST NEUTRONS FROM THE READINGS OF ACTIVATION THRESHOLD DETECTORS

Dubna PRIMENENIYE METODA STATISTICHESKOY REGULARIZATSII DLYA VOSSTANOVLENIYA ENERGETICHESKIKH SPEKTROV BYSTRYKH NEYTRONOV PO POKAZANIYAM AKTIVATSIONNYYKH POROGOVIKH DETEKTOROV in Russian, Press of the Joint Institute of Nuclear Research, No R16-9621, 9 pp

[From REFERATIVNYY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10V519]

ALEYNIKOV, V. YE., BAMBLEVSKIY, V. P., and KOMOCHKOV, M. M.

[No abstract]

USSR

UDC 621.039.5

USE OF THE METHOD OF CORRELATION ANALYSIS FOR INVESTIGATING THE SPECTRUM OF SCATTERING OF SLOW NEUTRONS. THEORY

Dubna PRIMENENIYE METODA KORRELYATSIONNOGO ANALIZA DLYA ISSLEDOVANIYA SPEKTRA RASSEYANIYA MEDLENNYKH NEYTRONOV. TEORIYA in Russian, Press of the Joint Institute of Nuclear Research, No 14-9485, 1976 16 pp

[From REFERATIVNYY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10V522]

GLADKIKH, I. A., KROO, N., SALAI, SH., SIMKIN, V. G., and CHER, L.

[Text] The authors discuss the problems of statistical accuracy and the resolving capacity of the correlation method. They show that for improving the statistical accuracy of measuring inelastic peaks it is necessary to eliminate the elastic component from the scattering spectrum and to accomplish strict monitoring of the number of revolutions of the chopper. They suggest a new definition of the resolving capacity and give the conditions for its optimization.

## STORAGE OF ULTRACOLD NEUTRONS IN COPPER CONTAINERS

Dubna KHRANENIYE UL'TRAKHOLODNYKH NEYTRONOV V MEDNYKH SOSUDAKH in Russian, Press of the Joint Institute of Nuclear Research, No R3-9534, 1976 12 pp

[From REFERATIVNYY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10V523 from the resume]

GROSHEV, L. V., LUSHCHIKOV, V. I., NIKOLAYEV, S. A., PANIN, YU. N., POKOTILOVSKIY, YU. N., and STRELKOV, A. V.

[Text] The authors give the results of measuring the angle-averaged coefficient of absorption of ultracold neutrons with a copper surface as a function of neutron speed. The results are compared with computations on various models.

## USSR

INVESTIGATING THE FORMATION OF  $\pi^+$  MESONS IN THE  $pp \rightarrow \kappa^+ pn$  REACTION AT 1000 Mev

Moscow YADERNAYA FIZIKA in Russian Vol 24, No 6(12), 1976 pp 1161-1169  
manuscript received 4 Jan 76

VOVCHENKO, V. G., ZHELEZNYAKOV, V. M., KOMAROV, YE. N., POLYAKOV, V. V., SUSLENKO, V. K., Radium Institute, imeni V. G. Khlopin, FEDOROV, O. YA., CHIZHIKOV, V. I., Kuban State University; and SHVEDCHIKOV, A. V., Leningrad Institute of Nuclear Physics, Academy of Sciences of the USSR

[Abstract] The following reactions have been studied for the formation of  $\pi$  mesons in a hydrogen bubble chamber:  $pp \rightarrow pp$ ;  $pp \rightarrow \kappa^+ pn$ ;  $pp \rightarrow \kappa^0 pp$ . The present paper uses the second reaction to measure the spectra of  $\pi$  mesons at several angles to establish the dependence of the pulse spectra on the escape angle of  $\kappa^+$  mesons and to obtain the angular distribution of the mesons at 1000 Mev. The analysis is conducted in the center-of-mass system of two colliding protons, in which there are no kinematic factors tending to change the shape of the pulse spectrum from angle to angle, and the spectrum is symmetrical relative to  $90^\circ$ . The experimental equipment is described and its diagram given. The proton beam was obtained from the synchrocyclotron of the Leningrad Institute of Nuclear Physics, and was focused on a target of liquid hydrogen by a quadrupole lens. A table of the differential cross sections of the  $pp \rightarrow \kappa^+ pn$  reaction is reproduced together with diagrams of the spectra. The authors thank L. P. Kondrat'eva, V. I. Grigor'yev, A. M. Pereverzev, and A. I. Shchetkovskiy. Table 1; Illustrations 6; References 15: 6 Russian, 9 Western.

## TIME DISTRIBUTION OF THE VELOCITY OF PLASMA COMPONENTS IN A PULSED ELECTRO-MAGNETIC ACCELERATOR

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 26, No 1, Jan 77  
pp 19-25 manuscript received 14 Nov 75

IVANOVA, L. YE

[Russian abstract provided by the source]

[Text] The paper gives the results of an investigation of the distribution of the velocity of various plasma components beyond the cutoff end of a pulsed electromagnetic accelerator (initial voltage across the capacitor bank 3-5 kV, characteristic discharge time 38-40  $\mu$ s, residual gas pressure  $5 \cdot 10^{-5}$  mm Hg, working fluid -- fluorocarbon polymer insulator material and in part the electrode material). Two accelerator models differing in length ( $l_1 = 26$  cm,  $l_2 = 4$  cm) were studied. The velocity was measured by the slit-scanning technique, the time-of-flight method with photoelectric registration, and the method of determining the Doppler shift of spectral lines.

It is shown that when the voltage changes from 3 to 5 kV, the directional velocity remains practically constant, and a considerable increase in charged particle concentration is observed. In the first 3-4  $\mu$ s, a protobunch typically appears with a velocity of  $2 \cdot 10^7$  and  $0.8 \cdot 10^7$  cm/s for the 26 cm and 4 cm models respectively. During the main discharge time (6-24  $\mu$ s) the directional velocity changes slightly (5-8%), and amounts to  $6 \cdot 10^6$  and  $4 \cdot 10^6$  cm/s respectively for the 26 cm and 4 cm models. The velocity remains almost unchanged over a distance of 10-12 cm from the accelerator cutoff. Measurement of the velocities of separate plasma components showed that the nature of the change in velocity with time is analogous for all investigated ions (C II, C III, F II, Al II, Al III). Some difference in velocity for the different ions is observed in the 26 cm model. This difference is probably due to the point of ion production (C III, Al III and F II ions appear close to the breakdown point and are accelerated in the channel, whereas C II and Al II ions are formed chiefly at the outlet from the accelerator and at later times). Differences in the charge and mass of the ions also make some contribution to the difference in velocities. For the 4 cm model the concentration is an order of magnitude greater  $n_e = 10^{17}$  cm $^{-3}$ , and therefore the velocities of the different plasma components are very close. For this model there is typically a sharper reduction in velocity at the end of the first half-period, which is due to a slow plasmoid that arises because of strong erosion of the inner electrode (cathode); this plasmoid slows down the fast plasmoid [protobunch].  
References 14 Russian.

USSR

BARRIERS OF EMITTED FRAGMENTS IN THE FISSION OF  $^{232}\text{Th}$  BY NEUTRONS

Moscow YADERNAYA FIZIKA in Russian Vol 24, No 6(12), 1976 pp 1089-1097  
manuscript received 9 Mar 76

LISIN, S. K., MOROZOV, L. N., PCHELIN, V. A., CHISTYAKOV, L. V., SHIGIN, V. A., and SHUBKO, V. M., Institute of Atomic Energy imeni I. V. Kurchatov

[Abstract] There are two models to explain the asymmetry of the fission products in which the dominating role is played by the potential energy: the first, by a model with one barrier; the second, by a model with two. Both models are explained. The behavior of the yields of a number of products in the fission of  $^{232}\text{Th}$  by neutrons is experimentally studied using neutrons with energies of less than 2 Mev, by a T(p,n) reaction, and of energies of 2 Mev or more with the D(d,n) reaction. The thorium specimen weighed five or 10 grams, and was irradiated for 50 hours by a current of 40-50  $\mu\text{A}$ . The results of the experiment, given in tabular and curve forms, are compared with the explanations provided by the two models. Behavior of the yield can be explained by the two-barrier model but not by the single-barrier fission model. The authors express their gratitude to B. M. Gokhberg and A. G. Zelenkov for their assistance. Illustration 1; Table 1; References 16: 7 Russian, 9 Western.

USSR

UDC 621.039.58

A METHOD OF INVESTIGATING EMERGENCY PROCESSES IN A REACTOR WITH A DISSOCIATING COOLANT

Minsk IZVESTIYA AN BSSR, SERIYA FIZIKO-ENERGETICHESKIKH NAUK in Russian No 4, 1976 pp 24-31 manuscript received 9 Jul 75

SHAROVAROV, G. A., TASHCHILOVA, A. M., and ZENICH, T. S., Institute of Nuclear Energy, Academy of Sciences, Belorussian SSR

[Abstract] A method is considered of investigating the emergency processes, a mathematical model of the processes in a reactor with a dissociating coolant, as well as the program and some results of the computations. The subject of the investigation is the separate fuel element with equivalent surrounding medium. The method of the theoretical discussion is outlined. A simplified mathematical model of the reactor core is used to determine the coolant parameters at the core inlet in the emergency situation, and a detailed model of the core is investigated without taking into account the acoustic phenomena. The equations for determining the nonstationary

temperature field in the core are discussed. A system of differential equations describing the dynamics of the nuclear reactor is derived. It was solved on the "Minsk-22" computer by the Euler method. This method can be used to examine in detail the dynamics of a core accident in atomic power stations. Illustrations 5; References 9: 7 Russian, 2 Western.

USSR

UDC 533.92:621.039.61

ION RECUPERATOR WITH COMPENSATION OF SPACE CHARGE IN CROSSED  $E \times H$  FIELDS

Moscow REKUPERATOR IONOV S KOMPENSATSIYEV OB"YEMNOGO ZARYADA V SKRESHCHENNYKH  $E \times H$  POLYAKH in Russian Moscow Engineering-Physics Institute Press, 1975 18 pp (Manuscript deposited in the All-Union Institute of Scientific and Technical Information on 15 Jun 76, No 2179-76 Dep]

[From REFERATIVNYY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10G159 DEP by the authors]

VINOGRADOVA, O. A., DIMITROV, S. K., LUTS'KO, A. S., SMIRNOV, V. M., TEL'KOVSKIY, V. G., and KHARITONOV, D. YU.

[Text] The authors propose a new type of ion recuperator designed for increasing the energy efficiency of a monochromatic ion injector. They give the theoretical analyses of the energy losses and give recommendations for using the various versions of the proposed recuperator. Compensation of the positive volume charge of ion beams with a retarding electric field is accomplished with the aid of secondary electrons drifting in the  $E \times H$  fields or specially emitted electrons. The maximum theoretical efficiency of converting electrical energy of the ions into electrical energy on the models of the recuperator is equal to 0.99; for real injectors this efficiency is limited in the optimal regime by a value of 0.92; the efficiency obtained in the model experiment is  $0.8 \pm 0.04$ . References 5.

USSR

UDC 533.92:621.039.61

SLOWING AND SCATTERING OF EPITHERMAL ELECTRONS IN A DENSE LASER PLASMA

KRATKIYE SOOBSHCHENIYA PO FIZIKE [Brief Reports on Physics] in Russian No 3, 1976 pp 37-41

[From REFERATIVNYY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10G161 by Ye. P. Potanin]

AFANAS'YEV, YU. V., VOLOSEVICH, P. P., GAMALIY, YE. G., MASH, I. D., and ROZANOV, V. B.

[Text] On the basis of solving the kinetic equation without allowing for the electrical field associated with the separation of charges, the authors investigate the propagation and absorption of electrons in a dense plasma. They assume that at the boundary of totally ionized plasma the source of the fast electrons is given. They take into account the interaction of the fast electrons with electrons and ions of the plasma. They obtain the distribution function of the fast electrons arising because of the nonlinear mechanism of light absorption from the laser, during their slowing in plasma. They evaluate the role of the preliminary heating for a number of studied targets.

USSR

UDC 533.92:621.039.61

TREATMENT OF GLASS LASER TARGETS

KRATKIYE SOOBSHCHENIYA PO FIZIKE [Brief Reports on Physics] in Russian No 5, 1976 pp 38-42

[From REFERATIVNYY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10G172]

ISAKOV, A. I., LEONOV, YU. S., MATVEYEVA, F. I., MERKUL'YEV, YU. A., NIKITENKO, A. I., and RYCHKOVA, YE. R.

[Text] The authors propose a method of treating microspheres in the buoyant state which permits decreasing the dimensions of the heterogeneities and simplifying subsequent selection of regular shells for laser targets. They describe a simple and convenient method of optical laser monitoring which gives a high degree of accuracy in measuring the thickness of the shell wall.

USSR

UDC 533.92:621.039.61

CRYOGENIC DEVICES FOR PREPARING AND BRINGING SPHERICAL TARGETS INTO LASER FOCUS

KRATKIYE SOOBSHCHENIYA PO FIZIKE [Brief Reports on Physics] in Russian No 5, 1976 pp 3-7

[From REFERATIVNYY ZHURNAL, FIZIKA No 10, 1976 Abstract No 10G171 by D. O.]

ISAKOV, A. I., KRUPININA, L. A., MERKUL'YEV, YU. A., NIKITENKO, A. I., and RYCHKOVA, YE. R.

[Text] The authors developed simple and convenient to handle cryogenic devices for preparing spherical laser targets on thin suspensions directly in the focus of the laser device. The proposed method was checked on a simplified model with liquid hydrogen. They showed that the uniformity of the solid-hydrogen beads depends on the rate of pressure reduction.

USSR

UDC 621.311.25:621.039:536.7.001.25

A METHOD FOR ESTIMATING THE THERMODYNAMIC EFFICIENCY OF HETEROGENEOUS REACTORS

Minsk IZVESTIYA AN BSSR, SERIYA FIZIKO-ENERGETICHESKIKH NAUK in Russian No 4, 1976 pp 14-20 manuscript received 1 May 76

GOKHSHEYN, D. P., KIROV, V. S., and FEDOROV, O. M., Odessa Polytechnical Institute

[Abstract] A method is proposed for estimating the efficiency of heterogeneous reactors on the basis of the system of coefficients in the entropy method. A theoretic analysis is made of the problems of the two basic processes in any power reactor: the process of heating the coolant, and the process of secondary nuclear fuel breeding. An expression is derived for the sum of the losses in these processes. A comparison is made between the efficiencies of the VVER-365 and VVER-440 reactors on the one hand and the VVER-210 reactor on the other to illustrate the method developed here. Results of the computations are given in tabular form. The limitations of the method are explained. Illustrations 2; Tables 2; References 3 Russian.

CHOICE OF SYSTEM AND UPPER TEMPERATURE OF A LOW-TEMPERATURE VARIANT OF  
ATOMIC POWER PLANT USING A HIGH-POWER FAST REACTOR ON DISSOCIATING GAS  
(NBRGD)

Minsk IZVESTIYA AN BSSR, SERIYA FIZIKO-ENERGETICHESKIKH NAUK in Russian  
No 4, 1976 pp 5-7 manuscript received 5 Apr 76

BUBNOV, V. P., BUNIN, YE. N., and NESTERENKO, I. E., Institute of Nuclear  
Energy, AN BSSR

[Abstract] Describes the thermodynamic and economic investigation of the maximum cyclical temperature range of 230-350°C in this type of atomic electric-power plant, using  $N_2O_4$ . The interest in low temperatures is due to the fact that use can be made of a nuclear reactor with the fast neutrons of low-alloy metallic uranium as the fuel supply. The discussion is based on the principle that in all variations of thermodynamic computation involving a dissociating gas, the basic requirement is that the coolant in the reactor be in the gaseous state. Variants of atomic power stations for industrial generation are examined. Results are given of the computations for the NBRGD-1000. The authors express their gratitude to A. K. Krasin of the Belorussian Academy of Sciences and to V. B. Nesterenko, Corresponding Member of the Academy. Tables 2; References 4 Russian.

USSR

UDC 535.21:621.373.8.029.71

CHANGE IN THE OPTICAL THICKNESS OF AN AQUEOUS AEROSOL STRUCK BY A PULSE OF RADIATION FROM A CO<sub>2</sub> LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 4, No 1, Jan 77 pp 160-162  
manuscript received 29 Mar 76

POZHIDAYEV, V. N., Institute of Radio Engineering and Electronics, Academy of Sciences USSR, Moscow

[Abstract] A study is made of the effect on an aqueous aerosol of intensive radiation at 10.6  $\mu\text{m}$ , consisting of pulses several 10ths of a second in length with a duty factor of 0.2-1. This operating mode was achieved by mechanical modulation of the continuous radiation of a CO<sub>2</sub> laser. The efficiency of evaporation of the aqueous aerosol by the CO<sub>2</sub> laser radiation at  $W_0 = 50 \text{ W/cm}^2$  is about 70%, the remaining 30% being used for heating of the ambient medium. References 5: 3 Russian, 2 Western.

USSR

UDC 533.9.07

STUDY OF PULSATIONS OF AN ARC IN A TURBULENT STREAM BY THE PHOTOELECTRIC METHOD

Novosibirsk IZVESTIYA SIBIRSKOGO OTDELENIYA AKADEMII NAUK SSSR, SERIYA TEKHNICHESKIKH NAUK in Russian No 13, Issue 3, Oct 76 pp 50-57 manuscript received 5 Feb 76

LEBEDEV, A. D., and NAZARUK, V. I., Institute of Thermal Physics

[Abstract] A description is presented of a system for photoelectric recording of the position of an arc burning in the channel of a plasmotron and its dimensions, with output of the information in a form convenient for direct input to a computer. This completely eliminates the intermediate stage of processing of large quantities of photographic materials. Two lenses project the field of possible displacements of the arc onto two lines of photocells forming the X and Y axes of a coordinate system. The outputs of the X and Y axis of a coordinate system. The outputs of the X and Y axis photocells form signals which are convenient for computer input. References 8 Russian.

## Superfluidity

USSR

### LINE AND POINT SINGULARITIES IN SUPERFLUID $\text{He}^3$

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian  
Vol 24, No 11, 5 Dec 76 pp 605-608 manuscript received 10 Nov 76

VOLOVIK, G. YE., and MINEYEV, V. P., Institute of Theoretical Physics imeni  
L. D. Landau, Institute of Solid State Physics, Acad. Sci. USSR

[Abstract] A classification is presented of topologically stable singularities in the A and B phases of  $\text{He}^3$  considering the spin-orbital interaction. The analysis, based on the use of homotopy groups, allows each line singularity to be set in correspondence with an element of a homotopy group  $\pi_1$ , and each point singularity to be set in correspondence with an element of a homotopy group  $\pi_2$ . The classification of singularities is thus reduced to determination of these groups for each type of order parameter.

References 10: 6 Russian, 4 Western.

USSR

UDC 535+534.222

SELF-FOCUSING OF WAVE PACKETS IN NONLINEAR MEDIA

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3, No 12, Dec 76 pp 2557-2561  
manuscript received 18 Mar 76

ZAKHAROV, V. YE., MASTRYUKOV, A. F., and SYNAKH, V. S., Computer Center of  
the Siberian Division of the Academy of Sciences, USSR, Novosibirsk;  
Institute of Theoretical Physics imeni L. D. Landau, Moscow

[Abstract] The self-focusing phenomenon occurs when the waves are propagated in nonlinear media whose index of refraction increases with increasing wave intensity. With the propagation of pulses much shorter than  $10^{-10}$  s, effects of dispersion and relaxation of the nonlinearity take place which are absent in the stationary case. The influence of these effects on the self-focusing process is investigated by a combination of numerical and analytic methods. Analytic estimates are given of the conditions for the focusing and of the nature of the wave field near the focus points. Results of the numerical modeling of the propagation of axially symmetrical nonstationary three-dimensional wave packets in nonlinear media are also presented. Illustrations 5; References 7: 6 Russian, 1 Western.

USSR

UDC 621.311.2.004.86:621.165

MATHEMATICAL MODELING OF THE THERMOPHYSICAL PROPERTIES OF FREONS

Novosibirsk IZVESTIYA SIBIRSKOGO OTDELENIYA AKADEMII NAUK SSSR, SERIYA  
TEKHNICHESKIKH NAUK in Russian No 13, Issue 3, Oct 76 pp 27-34 manuscript  
received 5 Sep 76

MOSKVICHEVA, V. N., OGURECHNIKOV, L. A., and PETIN, YU. M., Institute of  
Thermal Physics

[Abstract] Freons have been shown to be the most promising working fluids for utilization of low-potential heat such as the heat found deep in the earth and waste heat from industrial enterprises. Therefore, a freon power installation operating in closed cycle is studied. A mathematical model of this installation has been developed as a copy of an actual installation in operation at a geothermal electric power plant. The mathematical model, developed at the authors' institute, properly reflects the physical phenomena occurring upon changing of the parameters of the various types of freons used. A machine algorithm has been developed, allowing the difficulties involved in the use of tabular and graphic information to be avoided. In contrast to earlier published works, this mathematical model is significantly broader in its properties, both as concerns the quantities defined, and as concerns the set of substances analyzed. It can define not only the thermodynamic, but also the transport parameters (viscosity and heat conductivity) of the freons. References 24: 14 Russian, 10 Western.

CSO: 1862

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