

JPRS 68676

24 February 1977

USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS
PHYSICS AND MATHEMATICS
No. 33

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BIBLIOGRAPHIC DATA SHEET	1. Report No. JPRS 68676	2.	3. Recipient's Accession No.
4. Title and Subtitle USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS - PHYSICS AND MATHEMATICS, No. 33		5. Report Date 24 February 1977	
7. Author(s)		6.	
9. Performing Organization Name and Address Joint Publications Research Service 1000 North Glebe Road Arlington, Virginia 22201		8. Performing Organization Rept. No.	
12. Sponsoring Organization Name and Address		10. Project/Task/Work Unit No.	
		11. Contract/Grant No.	
		13. Type of Report & Period Covered	
		14.	
15. Supplementary Notes			
16. Abstracts The report contains abstracts and news items on aerohydrodynamics, magnetohydrodynamics, thermodynamics, physics of crystals and semiconductors, molecular, atomic and plasma physics, optics, spectroscopy, physical measurements, and on theoretical and applied mathematics.			
17. Key Words and Document Analysis. 17a. Descriptors USSR Lasers Eastern Europe Nuclear Physics Mathematics Structural Mechanics Acoustics Thermodynamics Optics Plasma Physics			
17b. Identifiers/Open-Ended Terms			
17c. COSATI Field/Group 12A, 20A, 20F, 20E, 20H, 20K, 20M, 20I			
18. Availability Statement		19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 84
		20. Security Class (This Page) UNCLASSIFIED	22. Price

JPRS 68676

24 February 1977

USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

PHYSICS AND MATHEMATICS

No. 33

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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MATHEMATICS
Higher Algebra and Geometry and Topology

USSR

UDC 519.4

LIE ALGEBRAS OF HOMOTOPIC GROUPS OF MINIMUM SULLIVAN MODELS

Moscow MATEMATICHESKIYE ZAMETKI in Russian Vol 20, No 6, Dec 76 pp 793-804
manuscript received 11 Feb 76

BABENKO, I. K., Moscow State University imeni M. V. Lomonosov

[Russian abstract provided by the source]

[Text] The paper examines a minimum model in the Sullivan sense of a singly connected triangulable space. Homotopic groups of the model are considered, and it is shown that they form a graded Lie algebra. A theorem is proved on the isomorphism of this algebra and the tensor product of a classical Lie algebra of homotopic space groups by the field of rational numbers. References 3: 1 Russian, 2 Western.

USSR

UDC 513.8

EXISTENCE AND UNIQUENESS OF THE SOLUTION OF THE POISSON EQUATION FOR GENERALIZED MEASURES ON AN INFINITE-DIMENSIONAL SPACE

Moscow MATEMATICHESKIYE ZAMETKI in Russian Vol 20, No 6, Dec 76 pp 825-834
manuscript received 28 May 75

BENTKUS, V. YU., Moscow State University imeni M. V. Lomonosov

[Russian abstract provided by the source]

[Text] It is proved that the solution of the Poisson equation in the space of generalized measures of an infinite-dimensional separable Hilbert space exists and is unique. Every generalized function concentrated at a point in the infinite-dimensional Hilbert space is equal to zero. References 7 Russian.

USSR

UDC 534.24

CORRELATION PROPERTIES OF AN ACOUSTIC WAVE WHEN MULTIPLY REFLECTED FROM A
ROUGH SURFACE

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 6, Nov/Dec 76 pp 847-857
manuscript received 1 Jul 74, after revision 16 Mar 76

GULIN, E. P., Acoustics Institute, Academy of Sciences USSR, Sukhumi Branch

[Abstract] Reducing multiple reflections to single, multiply repeated reflections is the simplest way of approximately calculating the correlation characteristics of a wave field when there are multiple reflections from a statistically irregular surface. Examined is the case of high irregularities, for which the familiar Kirchhoff approximation is used (in the absence of shadowing). The correlation moment describing the frequency-space-time correlation of the wave field was calculated for the case of multiple reflections from an irregular boundary in a layer lying on a uniform half-space. The results show both exponential and power-law drops in frequency correlation. The scales of correlation with increase in the number of reflections from the irregular surface were observed to decrease for longitudinal as well as transverse correlations. Applicability of the results is limited due to transition from normal waves in a waveguide to rays with specific grazing angles; limitations also arise due to use of the Kirchhoff approximation and the approximate calculation of the integral by the stationary-phase method. In addition to other limitations, the results are inapplicable in describing correlation characteristics of a scattered field when there is a large number of reflections n , in which the angular "blurring" becomes comparable with the grazing angle specularly reflected from the middle plane. References 7: 6 Russian, 1 Western.

USSR

UDC 534.321.9:66.084

DISK-TYPE CONCENTRATORS OF RADIAL VIBRATIONS

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 6, Nov/Dec 76 pp 825-829
manuscript received 17 Jun 75

VASIL'YEV, P. YE., and KAZANTSEV, V. F., Acoustics Institute, Academy of Sciences USSR

[Abstract] Oscillatory systems relying on radio vibrations of disks or rings may be constructed with resonance concentrators strengthening the vibration amplitude. A stepped concentrator, a flat disk variable in thickness with an opening in its center, is the simplest type of disk concentrator of radial vibrations. From an examination of the equation of radial vibrations of a

disk with a central opening of constant and of variable thickness, working formulas were derived to find the resonance dimensions and gain of a stepped concentrator of radial vibrations, and a concentrator whose thickness depends linearly on radius. The calculations were experimentally checked on a number of concentrators of different shapes and dimensions. Excitation was by the Poisson effect through piezoelectric transducers. The transducers were pointed on the end supporting the concentrators to minimize the contact area and eliminate any influence of the transducers on the resonance parameters of the concentrators. The amplitude of radial vibrations was determined by a bimorph vibrometer. A microscope was used to measure the distribution of the amplitude of radial displacements on the flat end surface of the concentrators. Calculations of the resonance frequency and the radius of the nodal section agree with experimental results, but the calculated gains are about 20% too high. References 7: 6 Russian, 1 Western.

USSR

UDC 534.833

COMPENSATION OF THE RADIATION OF A FLEXURALLY VIBRATING PLATE WITH STIFFENERS

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 6, Nov/Dec 76 pp 830-837
manuscript received 17 Jul 75, after revision 5 Jul 76

VYALYSHEV, A. I., and TARTAKOVSKIY, B. D., Acoustics Institute, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] Attenuation of the sound power radiated by an infinite plate with thin stiffeners, acted on by an auxiliary linear force, is examined. The vibration field of the plate was investigated with consideration of the response of the medium; the dependence of power attenuation on the coordinates of application of the primary and compensating forces was determined. It was shown that the attenuation of the sound power achieved at subcritical frequencies depends on the contribution made by the stiffeners to the radiation field of the plate. The optimum distance between the coordinates of application of forces that correspond to the maximum attenuation of the radiated acoustic power was then determined. References 2 Russian.

USSR

UDC 534.26

DAMPING OF A FIELD EXCITED BY A PULSATING SPHERE IN A RECTANGULAR WAVEGUIDE

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 6, Nov/Dec 76 pp 818-824
manuscript received 13 Feb 75, after revision 1 Jun 76

BOYKO, A. I., and IVANOV, V. P., Acoustics Institute, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The stationary problem of damping of a field excited by a pulsating sphere in a rectangular, semi-infinite waveguide is examined: the waveguide is acoustically rigid on the side, end and lower walls and acoustically soft on the upper wall. Damping is effected by a field excited by a system of auxiliary spherical radiators arranged in some layer within the waveguide. The number of radiators, their amplitudes and phase is determined, as well as the distance from the waveguide end such that the total field of all radiators first falls below a prespecified small number. References 4 Russian.

USSR

UDC 534.23

SCATTERING OF AERODYNAMIC NOISE BY HARD AND SOFT SURFACES

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 6, Nov/Dec 76 pp 892-898
manuscript received 2 Apr 75, after revision 1 Dec 75

KRASIL'NIKOVA, T. N.

[Abstract] The author examines the influence of a number of surfaces on the intensity of different noise components: dipoles and quadrupoles in the main part of the flow, and viscous stresses on the surface itself. She uses the method of Green's functions and dimensional analysis. It is found that diffraction effects obviate amplification of the different noise components of a turbulent boundary layer on hard and soft infinite planes, on fairly smooth hard and soft surfaces of large wave number and on hard surfaces of small wave number. The intensity of the dipole component of the radiation generated by a shift in average frequency is proportional to U_0^6 (where U_0 is the characteristic velocity), and the intensity of the quadrupole component $\sim U_0^8$. At small Mach numbers, the dipole component predominates over the quadrupole component. Amplification of the acoustic field of turbulent sound sources due to conversion of the great part of the energy of the short-range field to acoustic energy takes place on the sharp edge of hard and soft half-planes and a wedge, and on a soft sphere of small wave number. The intensity of dipole and quadrupole components of noise from sources close to the sharp

edge of a hard or soft wedge with outside angle $\pi p/q$ conforms to the relations $I_{\text{dip}} \sim U_0^{4+2p/q}$ and $I_{\text{quad}} \sim U_0^{6+2q/p}$, while the intensities are proportional to the fourth and sixth powers of the characteristic velocity for dipole and quadrupole components respectively in the case of noise sources close to a small soft sphere. References 11: 5 Russian, 6 Western.

USSR

UDC 534.26

DIFFRACTION OF SOUND BY A WEDGE NEAR AN ELASTIC PLATE

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 6, Nov/Dec 76 pp 885-891
manuscript received 6 Sep 74, after revision 17 Mar 76

KOROVKIN, A. N.

[Abstract] The problem of the diffraction of a plane acoustic wave by a wedge with ideal faces near a thin elastic plate is examined. The acoustic pressure in the shadow zone beyond the wedge is determined. Each wedge face is assumed either ideally stiff or ideally compliant. The acoustic field is calculated for grazing angles of incidence. The solution is valid if the frequency of the incident wave is smaller than the frequency corresponding to the cutoff frequency for the plate. In this case, when the diffracted wave is reflected by the plate, surface waves are formed. But if the frequency of the incident wave is larger than the frequency corresponding to the cutoff frequency of the plate, when the diffracted wave is reflected by the plate, an exponentially damped wave will be radiated along the plate at an angle $\arcsin k/k_{f1}$ to the normal (where k_{f1} is the flexural wave number. This wave must be taken into consideration even at great distances from the plate. References 8: 5 Russian, 3 Western.

USSR

UDC 534.232.012.6

AMPLITUDE-PHASE DISPERSIONS OF ACOUSTIC TRANSDUCERS

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 6, Nov/Dec 76 pp 879-884
manuscript received 15 Apr 76, after revision 8 Apr 76

KOZYREV, V. A., and PAVLOV, R. P.

[Russian abstract provided by the source]

[Text] Experimental values of the standard deviations of sensitivity and phase are presented for a group of acoustic transducers over a wide frequency range. Ratios between these deviations are examined. It is shown that Hilbert transforms can be used to determine phase dispersions from amplitude dispersions. References 5 Russian.

USSR

UDC 534.833

VIBRATION-ISOLATION EFFICIENCY OF A SET OF GROUPS OF ARBITRARY DISCRETE
VIBRATION-ISOLATORS BENEATH A VIBROACTIVE BODY

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 6, Nov/Dec 76 pp 873-878
manuscript received 27 Oct 75

KLYUKIN, I. I., Leningrad Shipbuilding Institute

[Russian abstract provided by the source]

[Text] Expressions are derived for generalized parameters of a vibro-insulation mounting; the mounting is made up of an arbitrary number of groups of local vibration-isolators with different geometric and elastic-dissipative characteristics. Formulas are derived for transfer functions (with respect to oscillatory force and oscillatory velocity) and the vibration-isolation of a set of similar vibration-isolators arranged between a vibroactive body and a foundation with arbitrary impedance. An example of a calculation relying on these formulas is shown for vibration-isolators with longitudinal symmetry (elastic interlayers of regular shape); the calculation showed how the frequency dependence of the vibration-isolation changes with geometric parameters of the interlayers and the body placed on them, as well as the acoustic impedance of the interlayer material. References 6: 3 Russian, 3 Western.

USSR

UDC: 532.38:532.529.6

DYNAMICS OF A BUBBLE NEAR A SPHERICAL RADIATOR

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 6, Nov/Dec 76 pp 899-905
manuscript received 10 Feb 75, after revision 10 Nov 75

KUZNETSOV, G. N. and SHCHEKIN, I. YE., Acoustics Institute, Academy of Sciences USSR, Sukhumi Affiliate

[Abstract] The authors consider motion of a bubble close to a solid spherical surface that moves in accordance with a given law in an incompressible viscous liquid. This situation arises when a spherical radiator operates in an unbounded liquid. It is assumed that the radius of the radiator is much greater than that of the bubble, and the curvature of the spherical surface is accounted for in determining the velocity distribution and pressure field, but is disregarded in determining secondary effects -- the influence that the surface of the sphere has on parameters of bubble motion. A system of differential equations is derived for radial oscillations and translational motion of the bubble, and an expression is found for the force of hydrodynamic interaction between the bubble and the radiator surface. A solution is found for conditions of cavitation on the radiator surface. It is shown that the interaction of gas cavitation nuclei in a liquid with the pressure and velocity pulsations formed by the moving surface and with their gradients causes directed migration of the nuclei toward

the surface. For this reason there is an increase in concentration of the nuclei close to the surface, causing them to interact and coagulate. In addition, centripetal motion of nonlinearly pulsating nuclei toward the surface of the sphere leads to earlier excitation of cavitations than would be the case in a liquid with initial unperturbed parameters. Therefore in determining the conditions of onset of cavitation on radiators one must consider both the sound pressure gradients and the proximity of the pulsating interface. The significance of these factors will vary depending on the distance of the zone of interference maxima from the surface of the radiators. Under realistic conditions, when this distance is more than a few centimeters the influence of the interface can probably be disregarded and only the structure of the pressure field need be considered. Closer than this, the interface has a considerable effect and cavitation will arise directly on the radiators. References 9: 4 Russian, 5 Western.

USSR

UDC 534.2

CALCULATION OF AN ECHO SIGNAL FROM A NONCIRCULAR CYLINDRICAL SHELL

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 6, Nov/Dec 76 pp 906-913
manuscript received 27 Jan 75; after revision 18 Jun 76

METSAVEER, YA. A., Institute of Cybernetics, Estonian SSR Academy of Sciences

[Abstract] An algorithm is proposed for calculating the echo signal of a plane acoustic pulse from a thin, noncircular convex cylindrical shell in a liquid medium. Elastic waves in the shell can be described by the theory of Timoshenko type shells, and elastic waves in the medium surrounding these shells can be described by equations of motion of an ideal compressible liquid, given in the acoustic approximation. The algorithm is derived by generalizing formulas obtained for an echo signal from a circular cylindrical shell by the method of integral Fourier transformation with respect to time and Watson's lemma with respect to angular coordinate. The algorithm can be generalized to calculate echo signals from shells that have local inhomogeneities, for example, welds and so on. The simplest case occurs when the inhomogeneity in the shell can be allowed for only by means of coefficients of transmission and reflection of peripheral waves. References 6: 5 Russian, 1 Western.

USSR

UDC 534.873

PROPAGATION OF ACOUSTIC WAVES OF FINITE AMPLITUDE IN AN INHOMOGENEOUS MEDIUM
IN THE PRESENCE OF CAUSTIC SURFACES

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 6, Nov/Dec 76 pp 914-921

OSTROVSKIY, L. A., PELENOVSKIY, YE. N., and FRIDMAN, V. YE., Scientific
Research Radio Physics Institute, Gor'kiy

[Russian abstract provided by the source]

[Text] Propagation of intense acoustic waves was studied in a medium with a smoothly varying density and pressure. The method of nonlinear geometric acoustics was applied to describe the wave at a great distance from caustic surfaces. The field near these surfaces was pieced together by using formulas of linear theory (Hilbert transforms). The conditions of applicability of this approach are discussed. Transmission of Riemann and shock waves through a caustic surface were studied. It was shown that the diffraction transformation of the shape of the wave on a caustic surface increases the nonlinear attenuation of the reflected wave at large distances. By way of an example, propagation of an intense wave in a laminar medium with a given profile of the speed of sound is examined. References 18: 15 Russian, 3 Western.

USSR

UDC 534.232

MATRIX OF PARAMETERS OF EQUIVALENT SIX-POLE NETWORKS OF COMPLEX PRESSURE-SENSITIVE VIBRATIONAL SYSTEMS

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 6, Nov/Dec 76 pp 922-930
manuscript received 12 Jan 76

SNYTKO, A. YA. and CHERPAK, V. A.

[Abstract] Matrices of parameters of equivalent six-pole networks are convenient for calculating the electroacoustic parameters of complex vibrational systems of the rod type. The authors describe a method for obtaining such matrices for complex vibrational systems of both series and parallel mechanical coupling between links. Piezoelectric and magnetostriction systems are considered. The analysis consists in breaking down the initial system into unit composite Langevin transducers, and then computing the elements of the matrix for the entire system from the known elements of the matrices of the component links. Matrix parameters are tabulated for the pressure-sensitive elements of a system of two Langevin transducers in four basic arrangements of mechanical and electrical series and parallel connections. An example is given showing how the table can be applied for finding the matrix of active elements of a specific system. It is shown how matrices can be used to find the resonant frequencies of Langevin transducers. References 7: 6 Russian, 1 Western.

USSR

UDC 534.26:534.232

RADIATION BY AN INFINITE PERIODIC ARRAY OF OSCILLATING STRIPS IN A PLANE
ACOUSTICALLY COMPLIANT BAFFLE

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 6, Nov/Dec 76 pp 933-935
manuscript received 11 Jul 75, after revision 19 May 76

DOBROVOL'SKIY, YU. YU.

[Abstract] An infinite equidistant array of identical strips, of infinite length, is assumed to lie in the plane $Z = 0$ of a Cartesian coordinate system XYZ; the origin of coordinates coincides with some point on the midline of one of the strips, and the OY axis is oriented along it. The angle α that characterizes the direction of cophased emission is read out from the OZ axis in plane $Y=0$. Local dimensionless compliance is considered on the surface of the intermediate baffles that fill out the surfaces of the radiating strips to make an infinite continuous flat surface. Expressions are given for the acoustic pressure and emission impedance of the vibrating strips. Distributions of the amplitude of acoustic pressure at the surface of the radiating array with compliant baffle and with different strip sizes are shown. Also given are curves for the active and reactive components of the radiation impedance as functions of strip width for different baffle impedances. When the baffle has high compliance ($g=10$) and the ratio of strip width to the period of the array is less than 0.5, emission impedance changes only slightly with a considerable change in the angle α . When the width-to-period ratio is greater than 0.5 in a compliant baffle, the reactive component of the emission impedance increases with increasing compliance of the baffle. References 3: 2 Russian, 1 Western.

USSR

UDC 534.874.3

A MODEL OF ACOUSTIC RADIATION BY A TURBULENT BOUNDARY LAYER ABOVE AN
INHOMOGENEOUS BOUNDARY

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 6, Nov/Dec 76 pp 937-939
manuscript received 10 Feb 76

KASOYEV, S. G., Acoustics Institute, Academy of Sciences USSR

[Abstract] One mechanism of generating sound by a turbulent boundary layer at inhomogeneous boundaries and caused by the boundary layer interacting with inhomogeneities is examined. A plane statistical vortex model of a turbulent boundary layer is proposed: the layer consists of chains of identical linear vortices traveling at the same velocity over the boundary.

The distance between the vortices in the chain is a random variable, distributed exponentially. The distribution of parameters in the vortex layer is assumed to be as similar as possible to actual flows: the pattern of random fluctuations in velocity corresponds qualitatively to the concept of turbulent flow. References 8: 6 Russian, 3 Western.

USSR

UDC 534.2

CALCULATING THE ECHO SIGNAL OF A DIRECTED PROBING PULSE FROM A SPHERICAL SHELL

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 6, Nov/Dec 76 pp 939-941
manuscript received 6 Jun 74, after revision 18 Jun 76

METSAVEER, YA. A., Institute of Cybernetics, Academy of Sciences Estonian SSR

[Abstract] The problem of calculating an echo signal is described in dimensionless coordinates so that all linear dimensions are determined in units of the radius R of a shell. The dimensionless time τ is given by the formula ct/R , where t is time and c is the speed of sound in the medium. The source of the directed probing pulse is assumed to consist of a large number of elementary point sources located on a disk. An approximate expression is given for the probing pressure pulse from such a source, and it is shown how Fourier transformation with respect to time can be used to calculate the echo signal of this pulse upon arrival at a given point of the shell. The author examines the case where the point of observation is at the center of the source, and the source is located far from the shell compared with the dimensions of shell and source. Reference 1 Russian.

USSR

UDC 621.315.592-416:537

MANY-PHOTON STARK EFFECT IN A DIMENSIONALLY QUANTIZED SEMICONDUCTOR

Yerevan DOKLADY AKADEMII NAUK ARMYANSKOY SSR in Russian Vol 62, No 4, 1976
pp 222-227 manuscript received 3 Jan 76

ARUTYUNYAN, G. M., and NERKARARYAN, KH. V., Yerevan State University

[Abstract] Using a two-band model, a theoretical study is made of the influence of intraband movement of electrons and holes by a wave field on restructuring of the wave functions and energy spectrum of a semiconductor in the presence of the dimensional quantum effect (DQE). An earlier study has shown that the influence of an intense electromagnetic wave on semiconductors under conditions of saturation in the absorption process leads to the appearance of an extra gap in the quasi-particle spectrum. This effect has a number of distinctive features when the electron gas has a quasi-particle spectrum. This effect has a number of distinctive features when the electron gas has a quasidiscrete spectrum. Recently this effect has been of interest from the viewpoint of the feasibility of realizing the mechanism of high-temperature superconductivity in the presence of this physical situation. The model used here is that of a film described by a potential with infinitely high walls. It is demonstrated that taking intraband movement into account limits the size of the gap in the quasi-particle spectrum. At the same time, many-photon resonance becomes possible so that the wave induces not one, but an entire series of forbidden gaps in dimensionally quantized bands. Equations are given for the relationships between the width of the gap and various photon parameters. References 6 Russian.

USSR

UDC 535.343.2

ABSOLUTE QUANTUM YIELD OF LOW-INERTIA ENERGY TRANSFER IN ALKALI-HALIDE CRYSTALS

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR, SERIYA FIZICHESKIKH I TEKH-NICHESKIKH NAUK in Russian No 5, 1976 pp 70-74 manuscript received 14 May 76

NAGLI, L., Latvian SSR Academy of Sciences Institute of Physics

[Abstract] In earlier papers a rapid-response luminescent memory device was proposed, utilizing alkali-halide crystals. It operated on the basis of the phenomenon of low-inertia energy transfer from electron color centers excited by brief light pulses to hole activator centers and subsequent recombination luminescence of the activator. The absolute quantum yield of the low-inertia energy transfer process is important from the scientific viewpoint and its determination is the purpose of this paper. The object of

study was a KCl:In crystal with an In^+ ion concentration of $1.1 \times 10^{18} \text{ cm}^{-3}$, 1 mm thick. The method used was to compare the light sums emitted during phase excitation in the A In^+ -center absorption band (A scintillation) with the light sums omitted during pulse excitation in the F absorption band (F scintillation) of the crystal studied, x-rayed with different doses. It is possible to determine the absolute quantum yield of low-inertia energy transfer when the absolute quantum yield of In^+ ion emission during excitation in the A absorption band is known, which was determined earlier. Also found was the relationship between the absolute quantum yield of low-inertia energy transfer and the ionizing radiation dose used on the crystal. As the x-raying period increases from 5 to 40 min, the absolute quantum yield drops from 0.3 to 0.1. The value of the yield of the process leading to the origin of recombination activator luminescence pulses is close to unity. This fact proves the hypothesis that the process of low-inertia energy transfer from electron color centers of the base substance to hole activator centers takes place in genetic pairs. Figures 3; references 9 Russian.

USSR

UDC 537.226:537.311.322

THEORY OF NONLINEAR GALVANOMAGNETIC EFFECTS IN ANISOTROPIC MULTIVALLEY SEMI-CONDUCTORS IN AN ELECTRIC FIELD AND A QUANTIZING MAGNETIC FIELD BOTH PARALLEL

Makhach-Kala FIZIKA TVERDOVO TELA [Solid-State Physics, Collection of Articles] in Russian 1976 pp 54-58

[From REFERATIVNYY ZHURNAL, FIZIKA No 10 (II), 1976 Abstract No 10E954 by CHAYKOVSKIY, I. A.]

CHUYENKOV, V. A., and IDAYATOV, E. I.

[Text] The kinetic equation technique is used to derive corrections that are nonlinear with respect to electric field for longitudinal magnetoresistance in the case of quantizing magnetic fields. The corrections account for electron scattering on acoustic phonons, charged impurity centers and point lattice defects with δ -like potential.

USSR

UDC 621.382.3.001

NUMERICAL MODELING OF A ONE-DIMENSIONAL BIPOLAR TRANSISTOR STRUCTURE

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR, SERIYA FIZICHESKIKH I TEKH-NICHESKIKH NAUK in Russian No 5, 1976 pp 75-81 manuscript received 14 Jun 76

MARTUZANS, B., and POL'SKIY, B. S., Latvian State University imeni P. Stuchka Computing Center

[Abstract] In this paper an efficient iteration method is suggested for solving one-dimensional steady-state problems of semiconductor device theory. The problem is formulated proceeding from the system of steady-state equations describing the distribution of current carrier concentration and electric field potential in a semiconductor structure in a one-dimensional approximation. Boundary conditions are formulated for the concentration of electrons and holes and the electric field potential, drawing on methods suggested in earlier papers. The formulas used apply to an n-p-n transistor connected in a common base circuit. A finite difference approximation results in a system of nonlinear algebraic equations, for the solution of which an iteration process is suggested, resulting in an algorithm for computation. The iteration process used makes a more rapid rate of convergence possible, even in the case of heavily doped bipolar structures, where one of the iteration parameters, the time interval, is low and results ordinarily in a slow rate of convergence. The results are given of calculations for a specific bipolar silicon transistor structure. A particular calculation required six minutes of machine time, using the SYe-415 computer, the same calculation having taken 96 min of machine time before introducing the iteration parameters included here. An analysis of the choice of iteration parameters and the convergence of the iteration process is the subject of another paper. Figures 4; references 10: 3 Russian, 7 Western.

USSR

UDC 537.226:537.311.322

PRACTICAL USES FOR GALLIUM ARSENIDE CONTAINING DEEP CENTERS

Tomsk ARSENID GALLIYA [Gallium Arsenide, Collection of Articles] in Russian Izd-vo Tomsk. Univ., Vol 6, 1975 pp 161-178

[From REFERATIVNYY ZHURNAL, FIZIKA No 10 (II), 1976 Abstract No 10E862 by V.S.]

KHLUDKOV, S. S.

[Text] This is a survey of possible applications for GaAs containing impurities with deep energy levels, in such radioelectronic and optoelectronic devices as signal generators and amplifiers, microwave converters, switches, memory elements, temperature, pressure, or magnetic-field sensors, photo-receivers, light emitters, electro-optical modulators, and radiation detectors. References 105.

USSR

UDC 537.226:537.311.322

DETERMINATION OF THE ELECTROPHYSICAL PROPERTIES OF SEMICONDUCTOR STRUCTURES
ON THE BASIS OF MEASUREMENTS OF THEIR INTRINSIC THERMAL EMISSION

Saratov FIZIKA POLUPROVODNIKOV I POLUPROVODNIKOVAYA ELEKTRONIKA [Semi-conductor Physics and Electronics, Collection of Articles] in Russian, Izd-vo Saratovsk. Univ., Vol 6, 1974 pp 56-66

BILENKO, D. I., and TSIPORUKHA, V. D.

[From REFERATIVNYY ZHURNAL, FIZIKA No 10 (II), 1976 Abstract No 10E863 by the authors]

[Text] Results are shown of calculations and experimental studies concerning how the intrinsic thermal energy radiated by a GaAs single crystal depends on the concentration of charge carriers, and the problem of thermal emission from two-layer structures and diffusion layers is analyzed.

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UDC 537.226:537.311.322

ELECTRICAL PROPERTIES AND STRUCTURE OF ALUMINA FILMS PRODUCED BY OXIDATION
OF ALUMINUM TRIMETHYL

Voronezh NITEVIDNYYE KRISTALLY I TONKIYE PLENKI [Whiskers and Thin Films, Collection of Articles] in Russian, Part 2, 1975 pp 315-318

SHITOVA, E. V., GENKINA, N. A., and VODZINSKII, V. YU.

[From REFERATIVNYY ZHURNAL, FIZIKA No 10 (II), 1976 Abstract No 10E873]

[Text] A study was made of Al_2O_3 films 0.1-0.3 μm thick used in MOS and MOM structures. The loss tangent $\tan \delta$ was found to vary within the 0.005-0.01 range and to depend slightly on the frequency below 20 MHz. The dielectric constant ϵ was found to vary within the 7.5-8.6 range.

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UDC 537.226:537.311.322

RELATION BETWEEN THERMOELECTRIC AND MAGNETIC PROPERTIES OF CARBONACEOUS MATERIALS

Chelyabinsk VOPROSY FIZIKI TVERDOVO TELA [Problems in Solid-State Physics, Collection of Articles] in Russian Vol 6, 1976 pp 20-28

BAYTINGER, YE. M., KARASOV, V. YU., SHULEPOV, S. V., PEKIN, P. V., and PESIN, L. A.

[From REFERATIVNYY ZHURNAL, FIZIKA No 10 (II), 1976 Abstract No 10E947]

[Text] An expression is derived for the temperature characteristic of the thermoelectromotive force of carbonaceous materials, which qualitatively describes the approximate relation between the maximum on this characteristic and the Fermi energy at 0 K. The Fermi energy and the concentration of current carriers in carbonaceous materials are calculated over a wide range of heat treatment temperatures (1500-2500°C). The effective mass of charge carriers is then calculated from this temperature characteristic of the thermoelectromotive force and from the magnetic susceptibility of carbonaceous materials.

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UDC 537.226:537.311.322

ANALYSIS OF THE CONDUCTION AND THE HALL EFFECT IN SEMICONDUCTOR FILMS AND IN CRYSTALS WITH THE AID OF A SMALL COMPUTER

Kiev POLUCHENIYE I SVOYSTVA TONKIKH PLENOK [Production and Properties of Thin Films, Collection of Articles] in Russian 1976 pp 137-139

VETROV, A. P., ONIPKO, A. F., and YANCHUK, Z. Z.

[From REFERATIVNYY ZHURNAL, FIZIKA No 10 (II), 1976 Abstract No 10E941 by I. G.]

[Text] An apparatus is described which includes a model "PROMIN'-2" control computer for Hall effect and electrical conductivity (σ) measurements on semiconductor specimens. This computer is programmed for regulating the temperature of specimens in a cryostat, setting the current through the specimens, controlling the magnet performance, storing in its memory values of the Hall emf and the conductivity, and for calculating the Hall constant (R) as well as the carrier concentration and mobility. Both σ and R of various semiconductor materials were measured with this apparatus over the 100-400 K temperature range. The results agree closely with results obtained by other methods of measurement.

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UDC 537.226:537.311.322

ANALOG OF A MOTT JUNCTION IN COMPENSATED GALLIUM ARSENIDE

Tomsk ARSENID GALLIYA [Gallium Arsenide, Collection of Articles] in Russian
Izd-vo Tomsk Univ., Vol 6, 1975 pp 139-153

VUL, B. M., ZAVARITSKAYA, E. I., VORONOVA, I. D., and ROZHDESTVENSKAYA-
KOTEL'NIKOVA, N. V.

[From REFERATIVNYY ZHURNAL, FIZIKA No 10 (II), 1976 Abstract No 10E900 by
CHENSKIY, E. V.]

[Text] Temperature characteristics of the electrical resistance and of the Hall mobility were measured in GaAs with a compensation $K=N_aN_d=0.83-0.96$ at a donor concentration $N = 2.5 \cdot 10^{17} \text{ cm}^{-3}$. At a concentration of free electrons $n_0=N_d-N_a$ above $5 \cdot 10^{16} \text{ cm}^{-3}$ the resistance is slightly temperature dependent, corresponding to a degenerate state. At n_0 below $5 \cdot 10^{16} \text{ cm}^{-3}$ within the 10-1.0 K temperature range conduction is due to thermal activation of donors. This concentration corresponds to a transition from semiconductor to metallic properties. Measurements of the Hall mobility indicate that $\mu \sim T^{3/2}$ over the 20-100 K temperature range, which is characteristic of scattering by a charged impurity. The photoconductivity of a specimen with $n_0 \sim 10^{16} \text{ cm}^{-3}$ was measured at 1.6 K. The photocurrent has been found to increase jumpwise at a definite light intensity and this is attributed to a delocalization of electrons from potential wells, as a result of shielding of the fluctuation potential by photoelectrons and photoholes.

USSR

UDC 537.226:537.311.322

TEMPERATURE CHARACTERISTIC OF THE ELECTRICAL CONDUCTIVITY OF CARBONACEOUS MATERIALS

Moscow SBORNIK NAUCHNYKH TRUDOV PO PROBLEMAN MIKROELEKTRONIKI [Collected Scientific Papers on Microelectronics Problems] in Russian, Moscow Institute of Electronic Engineering, Vol 22, 1976 pp 90-91

SHERMERGOR, T. D., and AGRIKOV, YU. M.

[From REFERATIVNYY ZHURNAL, FIZIKA No 10 (II), 1976 Abstract No 10E898 by the authors]

[Text] The temperature characteristic of the electrical conductivity of graphitized carbon fibers was measured. The width of the forbidden band is estimated at 0.1 eV and the length of crystals along the fiber axis is estimated at 5400 nm.

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UDC 537.226:537.311.322

TEMPERATURE-FREQUENCY CHARACTERISTICS OF THE ELECTRICAL CONDUCTIVITY OF
CARBONACEOUS MATERIALS

Chelyabinsk VOPROSY FIZIKI TVERDOVO TELA [Problems in Solid-State Physics,
Collection of Articles] in Russian Vol 6, 1976 pp 48-55

SHUVALOV, V. I., PEKIN, P. V., and SHULEPOV, S. V.

[From REFERATIVNYY ZHURNAL, FIZIKA No 10 (II), 1976 Abstract No 10E897 by
the authors]

[Text] Temperature-frequency characteristics of the electrical conductivity
of carbonaceous materials were measured, after heat treatment at 200-600°C,
over the $3 \cdot 10^2$ - $2 \cdot 10^6$ Hz frequency range and from liquid-nitrogen temperatures
to 80-100°C below a given heat treatment temperature. Two mechanisms of
electrical conduction with a transition region are suggested, and their
respective temperature-frequency ranges of action are defined.

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UDC 537.226:537.311.322

TEMPERATURE-FREQUENCY CHARACTERISTICS OF THE DIELECTRIC PROPERTIES OF
CARBONACEOUS MATERIALS

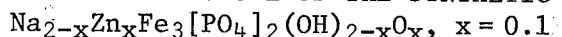
Chelyabinsk VOPROSY FIZIKI TVERDOVO TELA [Problems in Solid-State Physics,
Collection of Articles] in Russian Vol 6, 1976 pp 41-47

SHUVALOV, V. I., PEKIN, P. V., and SHULEPOV, S. V.

[From REFERATIVNYY ZHURNAL, FIZIKA No 10 (II), 1976 Abstract No 10E877 by
the authors]

[Text] A dispersion of the dielectric constant of calcined carbonaceous
materials has been established. The value of the loss tangent has been
found to depend on transmitted as well as polarization losses. The activa-
tion energy E of the polarization process is calculated from data covering
the 200-600°C range of heat treatment temperatures. This energy is found
to decrease with higher treatment temperatures.

CRYSTAL STRUCTURE OF THE SYNTHETIC SODIUM-IRON-ZINC ORTHOPHOSPHATE



Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 231, No 5, 11 Dec 76
pp 1119-1122 manuscript received 22 Jul 76

YAKUBOVICH, O. V., SIMONOV, M. A. and BELOV, N. V., academician

[Abstract] Crystals of synthetic sodium-iron-zinc orthophosphate were obtained at the Laboratory of Hydrothermal Synthesis of the Institute of Crystallography, Academy of Sciences USSR in a study of the $\text{NaCl-ZnO}-(\text{NH}_4)_2\text{-HPO}_4\text{-H}_2\text{O}$ system. With specific weight of 3.71 g/cc in the rhombic cell with lattice parameters $a = 8.429 \pm 0.002$, $b = 6.529 \pm 0.001$, $c = 14.605 \pm 0.003 \text{ \AA}$ there are two units of the approximate composition $\text{Na}_4\text{ZnFe}_5\text{P}_4\text{O}_{18} \cdot 1.5\text{H}_2\text{O}$. The experimental specimen was a spherical crystal 0.4 mm in diameter analyzed by the $2\theta\text{-}\theta$ method at a scanning rate of 6-24 deg/min on an autodiffractometer giving 1640 independent non-zero ($I \geq 3\sigma I$) reflections. Translation of intensities to $|F_{hkl}|$ with consideration of absorption ($\mu_r = 1.5$) and subsequent calculations were done in the "Kristall" complex of the BESM-4M computer. The decoded structure of $\text{Na}_{1.9}\text{Zn}_{0.1}\text{Fe}_3[\text{PO}_4]_2(\text{OH})_{1.9}\text{O}_{0.1}$ was similar to the structure of natural Mn,B,P-simanite $\text{Mn}_2^{2+}[\text{B}(\text{OH})_4][\text{PO}_4](\text{OH})_2$. The lattice constants are close for the two phosphates, both have a rhombic cell and triplets with $mm2$ symmetry consisting of three octahedra connected along the edges. References 6: 4 Russian, 2 Western.

Electricity and Magnetism

USSR

UDC 538.561

GENERATION OF CIRCULARLY POLARIZED ELECTROMAGNETIC RADIATION

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 46, No 11, Nov 76
pp 2392-2397 manuscript received 11 Aug 75

ALFEROV, D. F., BASHMAKOV, YU. A., and BESSONOV, YE. G., Physics Institute
imeni P. N. Lebedev, Academy of Sciences USSR, Moscow

[Russian abstract provided by the source]

[Text] Circular polarization of the radiation of particles traveling in a helical trajectory at relativistic longitudinal velocities is investigated. For an optimal transverse particle velocity, the radiation has high circular polarization. To generate circularly polarized radiation over a wide spectral range, a device shaping the transverse magnetic field in which charged particles move in a helical line is proposed. The device can also generate linearly polarized electromagnetic radiation. References 7 Russian.

USSR

UDC 537.226:537.311.322

RELAXATION OF THE SURFACE CHARGE ON ELECTRETS DURING PRESSURE CHANGES

Tomsk IZVESTIYA TOMSKOGO POLITEKHNIЧЕСКОГО INSTITUTA in Russian 1976,
8 pp manuscript filed 16 Jun 76 (VINITI No 2225-76)

LISITSYN, V. M., OLESHKO, V. I., and SELEZNEV, V. V.

[From REFERATIVNYY ZHURNAL, FIZIKA No 10 (II), Abstract No 10E881 DEP by the authors]

[Text] A study was made of the relaxation of the surface charge on corono-, tribo-, and radioelectrets during changes in the ambient gas pressure around these materials. It has been established that, regardless how such a relaxation is achieved, this process is a pulsating one and accompanied by electromagnetic radiation pulses within both the visible and the r-f range of the spectrum. The relaxation time τ is 500 ± 50 μ s for a light pulse and 200 ± 20 μ s for an r-f pulse.

USSR

UDC 537.52

INVESTIGATION OF CURRENT DISTRIBUTION IN A DISCHARGE GAP WITH SLIT DIAPHRAGM

Ryazan' ELEKTRONIKA. MEZHVUZOVSKIY SBORNIK STATEY. RYAZANSKIY RADIOTEKHNIЧЕСKIY INSTITUT [Electronics. Inter-Institutional Collection of Papers. Ryazan' Radio Engineering Institute] in Russian No 2, 1976 pp 141-145

SHADRIN, N. I.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G273 by the author]

[Text] An investigation was made of the principles that govern current distribution in the slit opening of a diaphragm in the pressure range of 0.05-0.6 mm Hg. It is shown that the maximum density of the discharge current at high pressures is localized in the middle sections of the diaphragm slit, while at low pressures the current alternates between opposite edges of the slit over the duration of the current pulse.

USSR

UDC 537.52

INVESTIGATION OF THE VOLTAGE DROP IN THE VICINITY OF A HIGH-FREQUENCY DISCHARGE ADJACENT TO POINTS OF APPLICATION OF EXTERNAL ELECTRODES

Ryazan' ELEKTRONIKA. MEZHVUZOVSKIY SBORNIK STATEY. RYAZANSKIY RADIOTEKHNIЧЕСKIY INSTITUT [Electronics. Inter-Institutional Collection of Papers. Ryazan' Radio Engineering Institute] in Russian No 2, 1976 pp 105-109

KOLGIN, YE. A. and POTSAR, A. A.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G282 by the authors]

[Text] The effective voltage drop in the edge regions of a radio-frequency discharge that are adjacent to a dielectric shell at points of application of external electrodes are experimentally and theoretically determined. The best agreement between the results of calculation and experiment for helium takes place at pressures above 1.5 mm Hg. It is pointed out that analogous results are observed for neon, argon and xenon as well.

USSR

UDC 533.95

RUNNING COMPUTATION SCHEMES FOR HYPERBOLIC SYMMETRIC SYSTEMS

Novosibirsk CHISLENNYYE METODY MEKHANIKI SPLOSHNOY SREDY [Numerical Methods in the Mechanics of Continuous Media, Collection of Works] in Russian Vol 7, No 1, 1976 pp 94-102

PINCHUKOV, V. I.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G163 by B. V. Yeliseyev]

[Text] Two two-step implicit absolutely stable difference schemes are constructed for hyperbolic symmetric systems of equations of first order. One of these difference schemes has second-order approximation with respect to all variables. The schemes can be realized by the multidimensional "running computation" method. The stability of the schemes is proved by the energy inequality method. One of them was applied to calculation of nonequilibrium two-dimensional flow of an ideal gas in a Laval nozzle for the case of oscillatory relaxation. The grids used were 8×32 and 16×64 (with respect to coordinate and time). On the first grid the deviation of enthalpy from the known constant value was no more than 0.5%, and on the second -- 0.2%. The difference between the maximum and minimum values of flowrate (which should be constant) did not exceed 4-6 and 3-4%. As a rule, the difference between solutions on different grids did not exceed 2-3%, and only close to a line, where the velocity is equal to the speed of sound, do additional first-order terms appear and the difference rises to 6-8%. The time for solution (80 time steps) on the BESM-6 computer is 16 minutes.

USSR

UDC 532.517.4:532.135

INFLUENCE OF POLYMER ADDITIONS ON REDUCTION OF FRICTION IN TURBULENT FLUID FLOWS

Minsk DOKLADY AKADEMII NAUK BSSR in Russian Vol 20, No 11, 1976 pp 1014-1017 manuscript received 3 Mar 76

STAROBINTSEV, G. L., associate member, Belorussian SSR Academy of Sciences, and STAROBINTSEV, G. G., Belorussian State University imeni V. I. Lenin

[Abstract] Excessively diluted solutions of polymer substances often possess eddy-viscosity resistance which is considerably lower than that of the pure solvent. Previous studies of the possible mechanism for this phenomenon have not paid attention to the energy expended by the normal component of the

turbulent flow in forming voids in the structure of the water or other solvent when hydrophobic chains of macromolecules move from the boundary adsorption phase near the rigid wall into the volume of the solution. The purpose of this paper is to demonstrate the interrelationship of two effects: Reduction of friction in solutions of polymers, and the energy expended to form a void in this solvent. A close relationship has been observed between the effect of reduction of friction in aqueous solutions of high-molecular substances and the adsorption of these substances at the rigid wall -- solution interface, for both effects pass through a maximum depending on the volume concentration of the high-molecular substance. Previous studies advanced the idea that the spontaneous occurrence of adsorption of organic substances at the phase interface is due to hydrophobic interaction, whose dominant component is the energy gain of the void, when hydrophobic parts of molecules pass from the volume of the diluted solution into the more concentrated boundary phase. A mechanism is suggested which explains well the experimental data thus far obtained and agrees well with an adsorption model from an earlier study. According to this mechanism the effect of reduction in friction will be most pronounced in the range of concentration of polymer solutions close to ideal when the polymer exists in the volume of the solution in the form of single molecules, and in the adsorption phase in the form of associates. With polymer concentrations exceeding the critical micelle-formation concentration association occurs in the volume of the solution almost as intensely as near the wall, the void energy becomes slight, and the polymer solution shows a negligible influence on friction. Reduction of friction is at a maximum with a polymer concentration less than the critical micelle-formation concentration. It is emphasized that the relationship between the effect of reduction in friction and concentration has not been explained in previous theories. References 13: 9 Russian, 4 Western.

USSR

UDC 532.528.135

EFFECT OF POLYMER ADDITIVES ON BUBBLE MOTION AND THE INTENSITY OF CAVITATION NOISE

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 6, Nov/Dec 76 pp 812-817
manuscript received 22 Sep 75

AVANESOV, A. M., AVETISYAN, I. A., and LISTROV, A. T., Acoustics Institute, Academy of Sciences USSR, Sukhumi Branch

[Russian abstract provided by the source]

[Text] Numerical calculations are made of the nonlinear motion of the boundary of a spherical bubble pulsating in an unbounded volume of incompressible viscoelastic liquid, acted on by a periodic pressure field

and dilatational field of specific extent. It was shown that in a viscoelastic medium, the bubble pulsates with smaller maximum velocities than in a Newtonian liquid. Amplitudes of bubble oscillation in the dilatational field and at certain frequencies in the periodic pressure field decrease. It was also found that the viscoelastic properties of polymer solutions reduce the natural frequency of bubble pulsation. A possible interpretation is given for experimental findings on the slowing down of the onset of cavitation and reduction in the intensity of cavitation noise when polymer additives are introduced into water. References 18: 13 Russian, 5 Western.

USSR

UDC 621.378.325

ON THE FEASIBILITY OF DEVELOPING SYSTEMS FOR AUTOMATIC ALIGNMENT OF LASERS WITH UNSTABLE CAVITIES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 9, Sep 76
pp 3-5 manuscript received 9 Feb 76

KUPRENYUK, V. I., RYBALKO, I. O., SHEBANOV, B. A. and SHERSTOBITOV, V. YE.

[Abstract] The mirrors of laser cavities get out of alignment during operation for various reasons. In this paper the authors discuss the possibility of making automatic alignment systems. Precision actuating devices are available for angular displacement of the mirrors, and therefore the problems reduces to generation of a control signal proportional to the amount of misalignment. This problem is examined from the standpoint of unstable cavities, which are in wide use in various types of gas lasers. The usual method of automatic alignment is based on the way that the symmetry of stimulated emission depends on the degree of misalignment, which is not applicable to the class of lasers considered. A way around the problem is to use an auxiliary laser with a wavelength that does not lie in the bands of absorption or amplification of the active medium. Ways to couple the auxiliary laser emission along the axis of the working laser are discussed. Parameters are determined for an automatic alignment system based on this principle. The "lock-in" range for the proposed system is within $2.04 \cdot 10^{-3}$ rad. Due to adverse experimental conditions, the noise level in the zero difference signal was about 50 mV, corresponding to a limiting precision of $4.85-5.82 \cdot 10^{-5}$, which can be improved to $2.42-2.91 \cdot 10^{-5}$ rad by mounting on rubber shock absorbers. In the unlikely event that even better precision is required, the influence of the unstable cavity on the cavity of the auxiliary laser can be eliminated by introducing a nonreciprocal device (quarter-wave plate and polarizer) into the gap between the cavities. The alignment system operates at a rate of $1.5 \cdot 10^{-3}$ rad/s. References 2 Russian.

USSR

UDC 535.247

RELATING AND OPTIMIZING THE PARAMETERS OF A NANOSECOND LASER-PULSE PHOTO-STIMULATION UNIT

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 9, Sep 76
pp 8-11 manuscript received 19 May 75

TIBILOV, S. S., candidate of sciences

[Abstract] Based on analysis of optical arrangements of the pumping system as well as the registration system in studying the method of nanosecond

laser-pulse photostimulation (NLPP) the author finds conditions of maximum sensitivity and maximum pumping (assuming constant pumping energy and linearity of the processes taking place in the system). It is shown that these conditions cannot be satisfied simultaneously. An optimum combination of such conditions is proposed. A general estimate is made of the sensitivity of the NLPP method based on the parameters of currently existing devices, and a value of 1.0% is found with respect to transmission for kinetic measurements, with a corresponding value of a few percent for spectral measurements. A number of expressions are found that relate the parameters of the substance investigated to the parameters of the equipment used in the NLPP installation with maximum permissible optical density of the induced absorption. References 11: 9 Russian, 2 Western.

USSR

UDC 621.375.826

INVESTIGATION OF THE CHARACTERISTICS OF A GAS DYNAMIC CO LASER

Moscow TEPILOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 14, No 6, Nov/Dec 76
pp 1281-1286 manuscript received 4 Feb 75

KUKHTO, A. N., Moscow

[Abstract] A method is proposed for calculating a multiple-frequency flat cavity for a gas dynamic CO laser. The computational procedure is based on energy balance equations with respect to all possible frequencies of stimulated emission. On the basis of this method and analytical calculations of kinetic processes in the nozzle the author examines the operation of a gas dynamic CO laser as a whole, reducing calculations to determination of output power. The calculated energy characteristics are compared with experimental data. The basic calculations were done for a conical axisymmetric nozzle with semivertex angle of 7.5° , diameter of the critical cross section of 0.884 cm, length of 73.4 cm and area ratio of $F/F_{cr} = 512$. The model of the optical cavity used is described for a resonator made up of two parallel flats separated by a distance d in a gas stream of extent l , one of the flats having a certain transmission factor. Assuming that the electromagnetic field distribution depends only on the z -coordinate along the mirrors, the problem is reduced to a one-dimensional case. Calculations showed that the proposed cavity can generate radiant energy even when the distance between mirrors is short and energy losses are high. For absorption losses of 4-8% in the mirrors the optimum output power with respect to transparency occurs in the range of a 10% transmission factor. Emission spectra are calculated for different Co:Ar gas mixtures. The results of comparison with experimental data show that the proposed model of kinetic processes in the cavity and the assumed particulars of the oscillatory kinetics in the nozzle with consideration of anharmonicity give a qualitatively correct description of the operation of a gas dynamic CO laser. References 10: 2 Russian, 8 Western.

USSR

UDC 621.375.82

INFLUENCE OF LASER EMISSION FIELD ON THE COLLISION-BROADENED SHAPE OF THE H_2O ABSORPTION LINE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 231, No 5, 11 Dec 76
pp 1106-1108 manuscript received 16 Aug 76

ZUYEV, V. YE., associate member of the Academy of Sciences USSR, LOPASOV, V. P. and PONOMAREV, YU. N., Institute of Optics of the Atmosphere, Siberian Department, Academy of Sciences USSR, Tomsk

[Abstract] A report on an experimental study of the contour of the H_2O absorption line with center at 694.38 nm (transition 4_3-5_4 of band 000-103) for the case of N_2 and CO_2 broadening as a function of the intensity of laser emission. The spectral coefficient of absorption $k(\nu)$ was measured on an acoustico-optic spectrometer including a spectrophone, a frequency-tunable monopulse ruby laser with emission line width of 0.04 cm^{-1} and a system for recording laser emission parameters. The H_2O absorption line contour was measured at laser emission intensities of 5 and 35 MW/cm^2 . In the case of nitrogen broadening, there is a reduction of absorption by a factor of about 1.5 in the line center with only slight reduction in absorption at the edges of the line. For intensity of 35 MW/cm^2 , carbon-dioxide broadening caused no reduction in absorption at the center of the line, and the reduction at the edges increased with distance from the center. The difference in behavior is attributed to the much lower probability of vibrational-vibrational energy exchange for the H_2O-N_2 system than for the H_2O-CO_2 system. References 7: 6 Russian, 1 Western.

USSR

UDC 535.374

INFLUENCE THAT NONEQUILIBRIUM CHEMICAL PUMPING HAS ON AMPLIFICATION OF EMISSION OF A CO_2 LASER IN PRODUCTS OF REACTION OF $CO+N_2O$

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 231, No 5, 11 Dec 76
pp 1113-1115 manuscript received 15 Jul 76

KUDRYAVTSEV, N. N., NOVIKOV, S. S. and SVETLICHNYY, I. B., Institute of Chemical Physics, Academy of Sciences USSR, Moscow

[Abstract] A systematic comparison is made of the amplification factor of monochromatic emission with wavelength $\lambda = 10.6\text{ }\mu\text{m}$ in a supersonic expanding flow of products of reaction of carbon monoxide with nitrous oxide for $5N_2O + 25CO + 70He$ (mixture 1) and $5CO_2 + 20CO + 5N_2 + 70He$ (mixture 2). The second mixture corresponds to the products of complete reaction of the first. An investigation was also made of the influence that partial replacement of the helium in the first mixture by nitrogen has on the way that gain depends on temperature preceding the nozzle. It was found that the gain for the

reacting first mixture at temperatures of 1500-2000 K considerably exceeds that for the final reaction products (mixture 2). Results of a study of spontaneous emission on the wavelength of fluorescence for recombination of $\text{CO} + \text{O}$ show intense recombination fluorescence in the flow of reacting products below 2200 K and none at all in the unreacting mixture. This is direct evidence of intermediate products of the reaction of $\text{CO} + \text{N}_2\text{O}$ in the expanding supersonic flow. A change in temperature dependence of gain when part of the helium is replaced by nitrogen can be explained by the particulars of the kinetics of vibrational relaxation in laser-active mixtures based on $\text{CO} \rightarrow \text{CO}_2$ oxidation. References 8: 5 Russian, 3 Western.

USSR

UDC 533.7

EMISSION OF AN OPTICALLY DENSE PLANE LAYER OF MOLECULAR GAS

Moscow TEPILOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 14, No 6, Nov/Dec 76
pp 1323-1326 manuscript received 24 Aug 75

SHLYAPNIKOV, G. V., Institute of Atomic Energy imeni I. V. Kurchatov

[Abstract] The coefficient of absorption of molecular gas in the infrared region consists of a large number of spectral lines, each of which corresponds to a certain vibrational-rotational transition. At high gas pressures the line width is large compared with the distance between adjacent lines, so that the coefficient of absorption is a continuous function of frequency. At low pressures the reverse is true and the frequency dependence of the coefficient of absorption becomes oscillatory. If this dependence is approximated by a rapidly oscillating function multiplied by a smooth frequency function, a relation can be found in the case of a lorentzian spectral line for the frequency-integrated flux of emission of a plane layer of gas of linear molecules as a function of a typical parameter of the problem -- the maximum value of the envelope traced through the minima of the optical thickness of the layer (the maximum optical thickness at the minimum).

An analogous calculation is given in this article for a spectral line of arbitrary shape. Simple expressions are found that relate the frequency-integrated flux of emission of a plane layer of gas to line shape for high values of the maximum optical thickness of the layer at the minimum. The results are tabulated for Doppler, lorentzian and power-law lines. The proposed formulas enable fairly easy calculation of the frequency-integrated emission flux for a plane layer, and they can be extended to the case of a layer of variable temperature. References 4 Russian.

SELECTION OF PUMPING MODE IN INJECTION LASER IN OPTICAL COMMUNICATION LINES

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 46, No 11, Nov 76
pp 2398-2402

ALFEROV, ZH. I., PORTNOY, YE. L., PRINTSEV, YE. V., and RUDOV, YU. K.,
Physicotechnical Institute imeni A. F. Ioffe, USSR Academy of Sciences,
Leningrad

[Abstract] Recommendations are worked out for determining the optimal pulsed pumping mode of an injection laser when the limitation of thermal power scattered in the laser body is the primary constraint. Also, the effect on choosing the regime of parameters such as threshold current, spontaneous lifetime of injected carriers and constant bias current, is estimated. A laser with plane geometry made by oxygen implantation based on the double heterostructure $\text{Al}_x\text{Ga}_{1-x}\text{As}$ was used. Laser operation in communication lines at these data transmission rates was analyzed: 8.448 mbits/sec, 120 telephone channel capacity, 34.816 mbits/sec, 480 telephone channel capacity and 114.048 mbits/sec, 1440 telephone channel capacity. An optimal pumping mode (ratio between duration of current pulse and its amplitude) was found at which the pulse energy of the semiconductor laser radiation is at a maximum for a given transmission rate. Semiconductor laser efficiency was found strongly affected by parameters such as series resistance and spontaneous lifetime of injected carriers. Applying a direct bias current may reduce the maximum radiation pulse energy, but reduces requirements for the source of pumping current pulses. References 6: 4 Russian, 2 Western.

USSR

UDC 539.9.01

INVESTIGATION OF ELECTRODE METHODS OF MEASURING THE ELECTRICAL CONDUCTIVITY OF COMBUSTION PRODUCTS

Moscow TEPILOFIZICHESKIYE SVOYSTVA NIZKOTEMPERATURNNOY PLAZMY [Thermophysical Properties of Low-Temperature Plasma, Collection of Works] in Russian, "Nauka," 1976 pp 62-65

ALEMASOV, V. YE., POTAPOV, G. P., ZIYATDINOV, R. KH., BUGAYENKO, A. G. and PETRIK, M. M.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G9 by the authors]

[Text] The paper presents the results of comparative measurements of the electrical conductivity of combustion products by an electrode method with respect to the alternating and direct components of currents when square-wave voltage pulses are applied to the electrodes. The range over which the measurement results coincide depends on the concentration of potassium in the additive solution. It is found that the pulse current shape depends on pulse amplitude.

USSR

UDC 539.9.01

INFLUENCE OF AN EXTERNAL ELECTRIC FIELD ON FORMATION OF FINELY DIVIDED CARBON IN THE PLASMA OF A HYDROCARBON FLAME

SBORNIK TRUDOV. NAUCHNO-ISSLEDOVATEL'SKIY ENERGETICHESKIY INSTITUT IMENI G. M. KRZHIZHANOVSKOGO [Collected Works. G. M. Krzhizhanovskiy Power Engineering Research Institute] in Russian No 36, 1975 pp 168-183

NESTERKO, N. A. and TARAN, E. N.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G11 by the authors]

[Text] The influence of an external electric field on the emission intensity of the carbon particle continuum is studied in a low-pressure colliding-jet acetylene-air flame. The mobility of electrons and positive ions in the flame is measured. The mobility of positive ions at 20 mm Hg and 1620 K is $565 \text{ cm}^2/\text{V}\cdot\text{s}$, while that of electrons is $1.4 \cdot 10^5 \text{ cm}^2/\text{V}\cdot\text{s}$. The mobility of positive ions dropped noticeably with the formation of solid carbon. The application of an external electric field to the flame led to an appreciable reduction of intensity of the continuum. The mechanism of formation of solid carbon in the flame is discussed on the assumption that complex $C_m H_n^+$ ions are centers of condensation of solid carbon.

USSR

UDC 621.313.12:538.4

SPATIAL STRUCTURE OF A SUPERSONIC ISOTHERMAL FLOW OF Ar-Cs PLASMA WITH STRONG MHD INTERACTION

Moscow TEPILOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 14, No 6, Nov/Dec 76
pp 1287-1295 manuscript received 24 Oct 74

BARANOV, V. YU., VEDENOV, A. A., KULESHOV, V. P., LYUBIMOV, B. YA., MALYUTA, D. D. and MEZHEVOV, V. S., Institute of Atomic Energy imeni I. V. Kurchatov

[Russian abstract provided by the source]

[Text] An investigation is made of the way that a hypersonic flow of argon-cesium plasma is slowed down by a magnetic field. The conditions of the experiment are such that a direct compression shock is set up in the channel. A detailed examination is made of the change in flow structure due to this compression shock. The authors find the change in Mach number in the channel due to electrodynamic deceleration with respect to the measured components of the currents, fields and pressure. Problems are discussed that are related to the existence of weak indirect shocks due to current concentration on the edges of the electrodes. An estimate is made of the influence that the degree of sectionalization has on flow perturbation in indirect shocks. References 5: 3 Russian, 2 Western.

USSR

UDC 537.52

INFLUENCE THAT A HIGH-FREQUENCY ELECTROMAGNETIC FIELD HAS ON THE DEVELOPMENT OF HOT-SPOT INSTABILITY IN A WEAKLY IONIZED GAS DISCHARGE PLASMA

Moscow TEPILOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 14, No 6, Nov/Dec 76
pp 1313-1315 manuscript received 14 Jan 75

RAKHIMOVA, T. V. and RAKHIMOV, A. T., Scientific Research Institute of Nuclear Physics, Moscow State University imeni M. V. Lomonosov

[Abstract] An examination is made of the effect that a radio-frequency electric field has on development of hot-spot instability in a weakly ionized plasma in a cavity discharge where the electron concentration is determined by ionization and recombination of charged particles in the plasma. The magnitude of the rf electromagnetic field relative to the gas discharge field strength is determined where the rf field begins to influence the increment of development of hot-spot instability. It is shown that the development of hot-spot instability is inhibited by the simultaneous action of rf and dc electric fields. The frequency of the alternating field must be greater than 10^3 - 10^4 Hz for gas pressure in the discharge of the order of 100 mm Hg and characteristic dimension of the plasma region of the order of 1 cm. References 3: 1 Russian, 2 Western.

INTERACTION OF PLASMA WITH SURFACE OF A SOLID. 1. IMPINGING OF A SUPER-SONIC FLOW ON BODIES OF DIFFERENT PROFILES

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 46, No 11, Nov 76
pp 2333-2338 manuscript received 8 Oct 73

DEMCHENKO, P. A., and KRUPNIK, L. I.

[Abstract] Characteristics of the glow induced around bodies of different profiles (plane, sphere, cone and others) when inserted in a supersonic plasma jet were investigated. The bodies were metallic. Residual gas pressure in the system was $5 \cdot 10^{-7}$ mm Hg. The plasma detector generated pulsed plasma flows with duration of 35-40 μ s. The flows were characterized by nonuniform lengthwise structure of particle density. In most injector operating modes several charged particle density maxima (bunches) were observed. Absolute particle velocity ranged from 0.3 to $1.0 \cdot 10^7$ cm/s; this corresponds to a mean energy of bombarding hydrogen ions $E_0 = 5-50$ eV. Density of the plasma striking the target varied in the range $5 \cdot 10^{12}-5 \cdot 10^{14}$ particles/cm³. At densities $n^+ < 10^{14}$ particles/cm³, the glow was concentrated at the body surface and existed only where direct incidence of particles on the target was observed. At higher densities, glow fronts formed, diverging from the bodies in the flow direction. The glow region about the flat target was found to be 2.5-3 cm. Two modes of interaction were recorded: when the wavelength of the ion mean-free path with respect to Coulomb collision processes was greater than the characteristic dimension D of the perturbing body, and when the mean-free path length was smaller than D. References 19: 17 Russian, 2 Western.

Nuclear Physics

USSR

UDC 533.92:621.039.61

A MIRROR TRAP WITH ROTATING PLASMA

Novosibirsk ZERKAL'NAYA LOVUSHKA S VRASHCHAYUSHCHEYSYA PLAZMOY in Russian, Institute of Nuclear Physics, Siberian Department of the [Academy of Sciences] USSR, preprint IYaF 76-28, 1976, 9 pp, mimeo.

PANASYUK, V. M. and TSEL'NIK, F. A.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G188]

[Text] The paper examines a version of a mirror trap with crossed fields in which plasma density increases weakly with radius. It is shown that this does not impair stability with respect to drift oscillations. In the proposed design the electric field intensity on the electrodes can be considerably reduced.

USSR

UDC 539.9.01

DIFFUSION OF A GLOW-DISCHARGE PLASMA

DIELEKTRIKI I POLUPROVODNIKI. MEZHVEDOMSTVENNYY NAUCHNYY SBORNIK [Dielectrics and Semiconductors. Interdepartmental Scientific Collection] in Russian No 10, 1976 pp 98-101

SHMYREVA, L. N.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G8 by the author]

[Text] Solutions are found for the problem of diffusion of plasma particles in cylindrical systems bounded by three kinds of walls -- dielectric, uninsulated metal and insulated metal. The theoretical curves match satisfactorily with experiment.

ELEMENTAL ANALYSIS OF VANADIUM AND TITANIUM PHOSPHATES BY THE METHOD OF ACTIVATION ANALYSIS WITH FAST NEUTRONS

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR, SERIYA FIZICHESKIKH I TEKH-NICHESKIKH NAUK in Russian No 5, 1976 pp 8-14 manuscript received 4 Jun 76

VAIVADS, J., GEDROVICS, J., KONSTANTS, Z., and PELEKIS, L., Latvian SSR Academy of Sciences Institute of Inorganic Chemistry and Institute of Physics

[Abstract] Wide use is being made of phosphate compounds of vanadium and titanium for the manufacture of materials such as inorganic ion exchangers, pigments, phosphate binders, and semiconductor oxide glass. But methods of chemically analyzing these compounds are complicated and labor intensive and require that most of these compounds be dissociated, and they are difficult to dissolve. Furthermore, these methods result in total destruction of the specimen and do not make it possible to determine the oxygen content, whose variation is used to describe the redox processes which occur in the synthesis of various phosphates. Here a study is made of the use of the neutron activation method of analysis as a nondestructive and convenient approach. Neutron generators have been little used hitherto in determining phosphorus, vanadium, and titanium, and there is no published data available on a complete analysis of a specific specimen for all its macrocomponents by the neutron activation analysis method. It is possible to make an elemental analysis of phosphate compounds of vanadium and titanium by using a fast-neutron generator operating at 14 MeV, resulting in a neutron flux density not exceeding 10^7 n/cm²/s. High-power neutron sources (nuclear reactors) are thus not required to determine macroquantities of titanium, phosphorus, oxygen, and vanadium. An analysis was made of vanadium and titanium phosphates synthesized by thermal interaction between ammonium dihydrophosphate and vanadium oxide or titanium oxide. The accuracy of the method depends to a considerable extent on how closely the neutron flux is monitored. Measurements were made with a Ge(Li) gamma spectrometer with a 1024-channel analyzer. All measurements were processed with a BESM-4 computer. A comparison is made between the analysis results obtained by chemical analysis and activation analysis with fast neutrons. Chemical analysis is certainly more precise (within one percent, as compared with four percent), but activation analysis is time-saving and provides satisfactory accuracy. This method is recommended both for analyzing some macrocomponents and for making a complete analysis. Figures 1; tables 2; references 23: 14 Russian, 9 Western.

USSR

EFFECT OF TRAPPED ELECTRONS ON ALFVEN WAVES IN A TOKAMAK

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 71
No 5(11), Nov 76 pp 1813-1825 manuscript received 26 Feb 76

MIKHAYLOVSKIY, A. B., and SHUKHMAN, I. G., Institute of Atomic Energy imeni
I. V. Kurchatov

[Russian abstract provided by the source]

[Text] The interaction between Alfvén waves and trapped electrons in a plasma in a toroidal magnetic field is investigated theoretically. For a finite ratio of plasma pressure to magnetic field pressure, there may be a buildup of waves by this interaction. The buildup increment is determined by the compressibility of the trapped electron gas and also by effects associated with the finite value of the longitudinal electric field of the perturbations. The phenomena studied are of interest for the problem of thermonuclear tokamak reactors and for the physics of the magnetospheric plasma. References 15: 9 Russian, 6 Western.

USSR

EXPERIMENTAL STUDY OF EXCITATION MECHANISMS OF PLASMA WAVES AND THE
GENERATION OF HARMONICS IN A PLASMA PRODUCED BY STRONG LASER PULSES

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 71,
No 5(11), Nov 76 pp 1826-1836 manuscript received 7 Apr 76

ALEKSANDROV, V. V., ANISIMOV, S. I., BRENNER, M. V., VELIKHOV, YE. P.,
VIKHAREV, V. D., ZOTOV, V. P., KOVAL'SKIY, N. G., PERGAMENT, M. I., and
YAROSLAVSKIY, A. I.

[Russian abstract provided by the source]

[Text] The mechanism of interaction between laser radiation ($\lambda = 1.06 \mu\text{m}$) and a high-temperature plasma was investigated, at light flux densities of 10^{12} to $4 \cdot 10^{14} \text{ W/cm}^2$. Comparison of results by different techniques showed that at light flux densities exceeding $\sim 10^{13} \text{ W/cm}^2$, the effective absorption of radiation is caused by the buildup of decay instabilities $t \rightarrow p + S$ and $t \rightarrow p + p$. Radiation from the plasma on a frequency of $3/2 \omega_0$ was found to stem from Raman scattering on plasma waves at frequencies close to $\omega_0/2$. Experimental values of threshold densities of the light flux obtained on targets of different materials agree closely with predictions from theory. References 20: 7 Russian, 13 Western.

USSR

HEATING OF IONS WHEN A RELATIVISTIC ELECTRON BEAM IS INJECTED INTO A PLASMA

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 71, No 5(ii), Nov 76 pp 1837-1848 manuscript received 3 May 76

KOYDAN, V. S., and ROGOZIN, A. I., Institute of Nuclear Physics, Siberian Division of the Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The distribution function and the number of heated ions occurring when a relativistic electron beam is injected into a plasma were experimentally studied. A ~ 1 MeV beam, current 7-10 kA, duration ~ 70 ns, was injected into a plasma with density $3 \cdot 10^{12}$ - $4 \cdot 10^{14}$ cm $^{-3}$, in a magnetic field of $(4.8-9.6) \cdot 10^5$ A/m. Ion heating was investigated by analyzing the fast neutral charge exchange particles escaping from the plasma across the magnetic field. The shape of the distribution function and the number of heated ions were found to depend heavily on the density of the initial plasma. At a plasma density $n > 10^{14}$ cm $^{-3}$, the distribution function of ions in the energy range studied is near-Maxwellian, and the density of heated ions is 10^{-3} - 10^{-4} of the total ion density. When the plasma concentration was lowered ($n < 10^{14}$ cm $^{-3}$), the distribution function begins to differ from the equilibrium value, and the number of heated ions increases and reaches 10-20 percent of the total number of ions. At reduced densities, the distribution function can be interpreted as a "two-temperature" function, but obviously the distribution of all plasma ions in all modes has a shape differing from the equilibrium shape. At high densities ($n > 10^{14}$ cm $^{-3}$), ion heating occurs in the space occupied by the electron beam. When the plasma density is lowered ($n < 5 \cdot 10^{14}$ cm $^{-3}$), ion heating is observed now throughout the plasma pinch. Possible mechanisms of ion heating are discussed. References 15: 9 Russian, 6 Western.

USSR

STUDY OF LASER-DRIVEN IMPLOSION OF HOLLOW MICROSPHERES

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 71, No 5(11), 1976 pp 1788-1798 manuscript received 17 May 76

BASOV, N. G., ZAKHARENKOV, YU. A., ZOREV, N. N., KOLOGRIVOV, A. A., KROKHIN, O. N., RUPASOV, A. A., SKLIZKOV, G. V., and SHIKANOV, A. S., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR

[Abstract] A nine-channel laser interacting with hollow microspheres was investigated. Laser energy reached 150 J, with light pulse duration of about 2.5 ns and rise time of the order of 0.5 ns or less. The assembly

had a spatial resolution of ~ 10 lines/mm. The electron temperature of the plasma was determined by the ratio of the number of x-ray quanta passing through beryllium filters of different thickness. Measurements showed that for solid glass microspheres 100–200 μm in diameter these ratios agree well with the ratios for an equilibrium plasma at an electron temperature $T_e \sim 250\text{--}350$ eV. But for hollow microspheres of the same diameter, the electron temperature usually was $T_e \sim 300$ eV, for filters 300 and 500 μm thick, and $T_e \sim 600\text{--}700$ eV for filters 300 and 700 μm thick. Estimates show that not less than $10^3\text{--}10^{-2}$ J was reradiated by the plasma in the X-ray range and evidently this value does not markedly influence the energy balance. References 29: 13 Russian, 16 Western.

USSR

UDC 621.384.66

EFFECT OF ELECTRON BEAM PARAMETERS ON PROPERTIES OF UNDULATOR RADIATION

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 46, No 11, Nov 76
pp 2386–2391 manuscript received 2 Jan 75, after revision 14 May 75

NIKITIN, M. M., and EPP, V. YA., Scientific Research Institute of Nuclear Physics at the Tomsk Polytechnic Institute imeni S. M. Kirov

[Abstract] The dependence of angular-spectral and angular-polarization characteristics of undulator radiation on the distribution of amplitudes and particle oscillation frequency in an accelerated bunch was studied. The undulator radiation was associated with the scatter of electrons with respect to directions of motion in the undulator caused by particle oscillations in the accelerator. The influence of betatron oscillations on the properties of undulator radiation is determined by the parameters

$\eta_y = \sigma_y / \sqrt{1 - \beta_0^2}$ and $\eta_z = \sigma_z / \sqrt{1 - \beta_0^2}$ (σ_y and σ_z are the variances of electron distribution with respect to directions of motion and $\beta_0 c$ is the electron drift velocity in the undulator). When $\eta_y \gg 1$ and $\eta_z \gg 1$, betatron oscillations of electrons strongly modify the spectral and angular-polarization distribution of radiation in a laminar particle beam. References 14 Russian.

USSR

UDC 621.384.6 : 621.3.038.624

EXPERIMENTAL STUDY OF SELF-ACCELERATION DURING INTERRUPTION OF AN INTENSE ELECTRON BEAM

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 46, No 11, Nov 76
pp 2371-2379 manuscript received 11 May 75

GRISHAYEV, I. A., ZAKUTIN, V. V., NASONOV, N. N., SHENDEROVICH, A. M., and RAKITYANSKIY, A. A., Physicotechnical Institute, Ukrainian SSR Academy of Sciences, Khar'kov

[Abstract] An experimental study was made of self-acceleration when the accelerating system is excited by the trailing edge of a current pulse from an intense electron beam, intended to more than double beam acceleration. An oscillatory circuit was used as the resonator. Self-acceleration of a beam with a current of 0.5-1 kA was achieved during beam interruption. The maximum energy of the accelerated beam (360 keV) was more than three times the maximum energy of the initial beam (110 keV). Registration of accelerated particles and their energy determination were made from the strength of the current of the beam passing through a foil. Foils were of aluminum, 100 and 200 μm in thickness. Most convenient was the 100 μm foil, virtually blocking a beam with an initial energy of 110-130 keV. Particles with smaller initial energy were intensified much more (up to eight times). An analysis was made of the way that the energy increment depends on time during a pulse. From 13 to 27% of the beam particles were accelerated in the experiments. The integral energy of all accelerated particles reached 25% of the total energy of the initial beam. A theoretical study was done on the self-consistent problem of interaction between the beam and the tank circuit. It was found that in this case the current is approximated with a high degree of accuracy even for considerable deceleration of particles. The measured amplitude and shape of the current pulse of the beam of accelerated particles passing through the foil, as well as the parameters of the accelerating voltage and the time dependence of the beam energy increment agree with the calculations. References 12: 9 Russian, 3 Western.

USSR

UDC 533.9.07

CHARACTERISTICS OF He^3 ISOTOPIC GAS PLASMA GENERATED BY PRODUCTS OF THE REACTION $\text{He}^3(n, p)\text{H}^3$ IN A NUCLEAR REACTOR

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 46, No 11, Nov 76 pp 2315-2317 manuscript received 18 Sep 75

BATYRBEKOV, G. S., KUZNETSOV, YU. D., PEL'MENSHTEYN, B. YA., and TAKIBAYEV, ZH. S.

[Abstract] Direct diagnostics of He^3 plasma formed by products of the reaction $\text{He}^3(n, p)\text{H}^3$ in a reactor was investigated in the pressure range of 25-300 mm Hg, with thermal neutron flux from 10^{13} to $2 \cdot 10^{14}$ neutrons/cm²·s. The gas samples was placed in a stainless steel ampule, with no uranium

layer on the walls. The ampule assembly was loaded into the central channel of the core of a VVR-K water-moderated water-cooled reactor. At helium pressures to 500 mm Hg, the rate of ion formation can be assumed constant throughout the cylinder (shielding by the flux of thermal neutrons was insignificant). Satisfactory agreement between calculated and experimental data suggests that the adopted calculation model, diffusion coefficients, shock-radiative recombination, especially coefficients of conversion and dissociative recombination, and their dependence on electron and gas temperatures corresponding to the He^4 isotope fairly well describe processes occurring in He^3 isotopic gas plasma. The electron temperature was found to rise faster than the gas temperature: this was due to the increase in the rate of ionization and thus a growing fraction of electrons with higher energy. References 11: 7 Russian, 4 Western.

USSR

STUDY OF VELOCITY DISTRIBUTIONS OF EXCITED HYDROGEN ATOMS FORMED WHEN HYDROGEN MOLECULES ARE DISSOCIATED BY ELECTRON BOMBARDMENT

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 71, No 5(11), Nov 76 pp 1755-1760 manuscript received 24 Apr 76

POLYAKOVA, G. N., YERKO, V. F., RANYUK, A. I., and PAVLICHENKO, O. S., Physicotechnical Institute, Academy of Sciences Ukrainian SSR

[Abstract] Velocity distributions of excited hydrogen atoms in states with principal quantum number $n = 3, 4$ and 5 formed when hydrogen molecules are dissociated upon electron bombardment at energies of 90, 130, 300 and 1000 eV were studied. The velocity distributions of the excited hydrogen atoms had two maxima: at velocities of $v \sim 0.6 \cdot 10^6$ cm/s and $v \sim 3.5 \cdot 10^6$ cm/s. These distributions show little change with electron energy. The group of "fast" hydrogen atoms is attributed to the process of dissociation when electron collision brings about transition of a hydrogen molecule from the ground state to auto-ionization repulsion states of the H_2^* molecule or molecular ion $(\text{H}_2^+)^*$. A possible cause of the group of "slow" excited hydrogen atoms with maximum at $v \sim 0.6 \cdot 10^6$ cm/s, may be the Franck-Condon transition to repulsion branches of bound electron states of H_2 molecules lying above the dissociation limit. Another process may be the transition of hydrogen molecules from their ground electron state to highly excited electron states, followed by predissociation to dissociable states of the H_2 molecule. The relative role of the predissociation process in formation of slow fragments might be decided by comparative experiments with deuterium. References 14: 2 Russian, 12 Western.

USSR

UDC 533.92:621.039.61

LASER-DRIVEN THERMONUCLEAR FUSION

Moscow PROBLEMY LAZERNOGO TERMOYADERNOGO SINTEZA [Problems of Laser-Driven Thermonuclear Fusion, Collection of Works] in Russian, Atomizdat, 1976 pp 58-80

BRYUKNER, K.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G228 by Ye. P. Potanin]

[Text] The paper discusses problems of using powerful laser pulses to solve the problem of controlled thermonuclear fusion. Assuming the use of DT fuel, estimates are given of the required dimensions of the system, the characteristic time of the process and the required laser energy for a given amplification level in thermonuclear fusion. An examination is made of problems of interaction of radiation with matter, plasma implosion and selecting the laser emission wavelength. It is noted that the feasibility of developing a laser-driven thermonuclear power plant depends more on the economics of the target and the laser than on problems of technology in making the reactor.

USSR

UDC 533.92:621.039.61

CONTROLLED LASER-DRIVEN FUSION

Moscow PROBLEMY LAZERNOGO TERMOYADERNOGO SINTEZA [Problems of Laser-Driven Thermonuclear Fusion, Collection of Works] in Russian, Atomizdat, 1976 pp 36-57

BRYUKNER, K.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G229 by Ye. P. Potanin]

[Text] The author discusses a number of problems that must be solved to achieve controlled laser-driven fusion. It is pointed out that in numerical modeling of a thermonuclear device, the following physical phenomena must be taken into consideration: interaction of the laser with plasma; electronic and ionic heat conduction; electron-ion energy exchange; hydrodynamic movement with shock wave formation; nuclear reactions and energy transfer by radiation, α -particles, neutrons, and also charged particles that have undergone collisions with neutrons. The paper examines schemes of energy conversion and hydrodynamic motion in the target under the action of laser light, ignition and propagation of combustion, and also tailoring of the laser pulse. Relations are given for the energy required for implosion and ignition as a function of the degree of compression, and a diagram is presented for the motion of shock waves and implosion by three shock waves.

USSR

UDC 533.92:621.039.61

SELF-SIMILAR MODES OF COMPRESSION OF A PLASMA OF FINITE MASS

Moscow PROBLEMY LAZERNOGO TERMOYADERNOGO SINTEZA [Problems of Laser-Driven Thermonuclear Fusion, Collection of Works] in Russian, Atomizdat, 1976 pp 279-294

ZMITRENKO, N. V. and KURDYUMOV, S. P.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G225 by Ye. P. Potanin]

[Text] The problem of piston compression of a plasma of finite mass for one-dimensional nonstationary equations of gasdynamics is amenable to a self-similar formulation that is based on separation of lagrangian time and mass variables. This paper demonstrates the feasibility of a solution with separation of variables where dissipative processes are considered in a piston-compressed plasma of finite mass with modeling of volumetric energy sources and drains (due to volumetric emission) typical for a completely ionized plasma. An examination is made of cases of adiabatic compression of a plasma of finite mass by a piston, and compression of a completely ionized plasma by a piston moving with fixed velocity. An analysis of the resultant self-similar solutions revealed the conditions under which plasma compression with monotonically increasing heat fluxes given on the piston leads to spatially nonequilibrium variation of quantities in the compressed plasma.

USSR

UDC 533.92:621.039.61

LASER-DRIVEN THERMONUCLEAR FUSION VIS-À-VIS DECISIVE EXPERIMENTS

Moscow PROBLEMY LAZERNOGO TERMOYADERNOGO SINTEZA [Problems of Laser-Driven Thermonuclear Fusion, Collection of Works] in Russian, Atomizdat, 1976 pp 81-107

BOYER, K.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G227 by Ye. P. Potanin]

[Text] The paper discusses the outlook for the laser method of mastering controlled thermonuclear fusion. A brief history of development of this method is outlined. The following questions are examined in detail: physics of thermonuclear combustion, absorption of laser emission, energy transfer, hydrodynamics of implosion, laser development. It is suggested that if success is achieved, laser implosion should result in small thermonuclear reactors as well as other devices similar to the jet engine.

USSR

UDC 533.92:621.039.61

FUSION WITH LASER-DRIVEN THERMONUCLEAR IGNITION IN SOLID DT TARGETS

Moscow PROBLEMY LAZERNOGO TERMOYADERNOGO SINTEZA [Problems of Laser-Driven Thermonuclear Fusion, Collection of Works] in Russian, Atomizdat, 1976 pp 155-171

BOBEN, ZH., KOLOMBA, D. and TONON, G.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G221 by Ye. P. Potanin]

[Text] An analysis is made of previously investigated approaches to the problem of using powerful lasers in controlled thermonuclear fusion, and a new method is proposed that utilizes plasma dispersion occurring when a solid DT target is exposed to a powerful laser beam with subsequent containment by a strong magnetic field. An examination is made of a vaporization model that satisfactorily describes the interaction of modern laser emission with a solid target. It is noted that the neutron yield predicted by this model is observed in experiments done with deuterated ice. The results are compared with other models and schemes.

USSR

UDC 533.92:621.039.61

IMPLOSION OF DT TARGETS BY A LASER PULSE UNTIL CONDITIONS OF THERMONUCLEAR FUSION ARE BROUGHT ABOUT

Moscow PROBLEMY LAZERNOGO TERMOYADERNOGO SINTEZA [Problems of Laser-Driven Thermonuclear Fusion, Collection of Works] in Russian, Atomizdat, 1976 pp 108-116

KLARK, DZH., FISHER, KH. and MEYSON, R.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G224 by Ye. P. Potanin]

[Text] The paper discusses the problem of implosion of spherical DT targets by a tailored laser pulse to densities that ensure efficient thermonuclear combustion. Phenomenological principles are given that govern the mutual relations between the target mass, the threshold energy investment and yield parameters $Y_R = E_{\text{Out}}/E_{\text{Inv}}$. It is shown that a yield parameter $Y_R = 4.7$ can be achieved when a hollow spherical DT target massing 3 μg is exposed to a CO_2 laser pulse with energy of 1.9 kJ. Results are compared for hollow and solid DT targets.

USSR

UDC 533.92:621.039.61

LASER-DRIVEN FUSION USING COMPLEX SPHERICAL SHELLS

Moscow PROBLEMY LAZERNOGO TERMOYADERNOGO SINTEZA [Problems of Laser-Driven Thermonuclear Fusion, Collection of Works] in Russian, Atomizdat, 1976 pp 117-134

AL'SHTROM, KH., SHTEYNKHAUER, L.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G219 by Ye. P. Potanin]

[Text] The paper discusses one of the possible methods of solving the problem of using lasers for controlled thermonuclear fusion based on the fact that moderate energy inputs are required for reaction in targets of small dimensions. The favorable circumstances for irradiating small targets consist in the simplicity of the equipment and the short time required for containment. An additional advantage of such a scheme is more energetic reaction as a consequence of the increase in target density. An examination of nonequilibrium implosion of DT targets showed that the minimum laser energy required for obtaining a positive yield is of the order of 100-1000 kJ.

USSR

UDC 533.92:621.039.61

INTERACTION OF HIGH-ENERGY PHOTON BEAMS WITH PLASMA

Moscow PROBLEMY LAZERNOGO TERMOYADERNOGO SINTEZA [Problems of Laser-Driven Thermonuclear Fusion, Collection of Works] in Russian, Atomizdat, 1976 pp 135-154

KIDDER, R.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G220 by Ye. P. Potanin]

[Text] The paper discusses problems of interaction of powerful laser emission with plasma from the standpoint of solution of the problem of controlled thermonuclear fusion. A brief overview is given on the properties of electromagnetic waves propagating in a completely ionized plasma, and examples are presented of the simplest hydrodynamic analysis of the influence that light pressure has on a plasma created by laser emission. Self-focusing of a light beam as a result of optical stresses in the plasma is considered. The authors discuss the scheme of distribution of the energy of a laser-driven thermonuclear reactor and the outlook of the laser method for solving the problem of controlled thermonuclear fusion.

USSR

UDC 533.92:621.039.61

PROBLEMS OF LASER-DRIVEN THERMONUCLEAR FUSION. COLLECTION OF PAPERS

Moscow PROBLEMY LAZERNOGO TERMOYADERNOGO SINTEZA. SBORNIK STATEY in Russian, Atomizdat, 1976, 295 pp

FILYUKOV, A. A. (translation editor)

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G216K by G. A. Yeliseyev]

[Text] The second collection of translated papers on laser-driven thermonuclear fusion and related problems, reflecting the state of the art as of 1972-1973. The first collection was put out by Atomizdat in 1973 (see RZh-Fizika, 1974, abstract No 2G403). The collection gives principal emphasis to papers dealing with the concept of ultra-strong adiabatic implosion of targets under the action of a powerful laser beam. The book contains 14 original papers examining the results of theoretical and experimental research on implosion of targets, and also evaluating the outlook for developing laser-driven thermonuclear power reactors.

USSR

UDC 533.92:621.039.61

COLLECTIVE PROCESSES WHEN NEUTRAL ATOMS ARE INJECTED INTO TOKAMAKS OF NON-CIRCULAR CROSS SECTION

Moscow KOLLEKTIVNYYE PROTSESSY PRI INZHEKTSII BYSTRYKH NEYTRAL'NYKH ATOMOV V TOKAMAK NEKRUGLOGO SECHENIYA in Russian, Institute of Atomic Energy imeni I. V. Kurchatov, IAE-2687, 1976, 16 pp, mimeo.

BARDAKOV, V. M., MIKHAYLOVSKIY, A. B.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G217]

[No text]

USSR

533.92:621.039.61

A NEW APPROACH TO THE USE OF LASERS FOR CONTROLLED THERMONUCLEAR FUSION

Moscow PROBLEMY LAZERNOGO TERMOYADERNOGO SINTEZA [Problems of Laser-Driven Thermonuclear Fusion, Collection of Works] in Russian, Atomizdat, 1976 pp 3-14

BELIKHOV, YE. P. and FILYUKOV, A. A.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G209 by G. A. Yeliseyev]

[Text] Preface to a collection of translations of papers on the problem of laser-driven thermonuclear fusion. The papers are the first original publications on the physics of laser-driven fusion using ultra-strong implosion printed chiefly in the United States. It is pointed out that modeling of laser-driven fusion on high-speed computers has already indicated possibilities for ultra-strong implosion of matter, which is cause for optimism among physicists working in this field. The short-range outlook for development of laser fusion systems will apparently involve using such systems as sources of fast neutrons, and in combination with a uranium blanket -- as power installations with concomitant breeding of fissile materials.

USSR

UDC 533.92:621.039.61

HIGH-POWER GAS LASERS FOR THERMONUCLEAR RESEARCH

Moscow TEKHNLOGIYA TERMOYADERNYKH REAKTOROV [Technology of Thermonuclear Reactors, Collection of Works] in Russian No 2, Atomizdat, 1976 pp 14-20

KOMPA, K. L.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G214 by G. A. Yeliseyev]

[Text] The paper presents the principles of operation of gas lasers and their analysis from the standpoint of prospective use in laser-driven thermonuclear fusion. As an example the author considers iodine vapor lasers, comparing them with solid-state lasers, CO₂ lasers and lasers on new gases. A description is given of HF and xenon lasers that may serve as a good model for demonstration of the distinguishing features of lasers with stimulation of the electron spectrum of molecules, although they are not suitable for laser-driven fusion.

USSR

UDC 533.951.7

INITIATION OF THERMONUCLEAR REACTIONS BY HIGH-CURRENT ELECTRON BEAMS

Moscow PROBLEMY LAZERNOGO TERMOYADERNOGO SINTEZA [Problems of Laser-Driven Theronuclear Fusion, Collection of Works] in Russian, Atomizdat, 1976 pp 172-190

VINTERBERG, F.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G125 by Ye. P. Potanin]

[Text] The paper discusses the problem of using high-current electron beams to make a thermonuclear reactor. A general description is given of the arrangement for initiating the reaction, and calculations of the electron beam parameters are presented. Problems of penetration of the magnetic field of the beam into the thermonuclear target and interaction of the beam with the plasma are discussed. Times are estimated over which the electron beam must be maintained to initiate thermonuclear combustion. The outlook for using gas targets is discussed. It is noted that a gas target scheme may be more economic since there would be no need for making solid targets; however, to all appearances thermonuclear ignition in a gas target will be difficult.

USSR

UDC 533.951.7

EXCITATION OF POTENTIAL SURFACE OSCILLATIONS OF A PLASMA BY A TUBULAR ELECTRON BEAM

BOLGARSKIY FIZICHESKIY ZHURNAL in Russian Vol 2, No 6, 1975(1976) pp 632-639

IVANOV, S. T.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G128 by V. N. Soshnikov]

[Text] By using the conventional equation for the potential of small perturbations that depend on time and coordinates as $f(r)\exp(-i\omega t + i l \phi + i k_z z)$ a dispersion equation is derived for longitudinal potential waves induced by a tubular non-relativistic electron beam with thin walls in a longitudinal magnetic field in a plasma with the same configuration and dimensions bounded by a vacuum. Only the case of rf oscillations is considered. Cases of development of beam and cyclotron instabilities are considered for long-wave and short-wave surface waves that can be induced only in an unmagnetized plasma (the long-wave oscillations -- in a rarefied plasma, and the short-wave oscillations -- in a dense plasma). The relation between increments of beam and cyclotron instabilities is discussed. The maximum amplitude of a steady-state monochromatic wave is estimated.

DAMPING OF COLLECTIVE OSCILLATIONS OF A BUNCHED PROTON BEAM

Novosibirsk DEMPFIROVANIYE KOLLEKTIVNYKH KOLEBANIY BUNCHIROVANNOGO PUCHKA PROTONOV in Russian, Institute of Nuclear Physics, Siberian Department of the Academy of Sciences USSR, preprint IYaF 76-40, 1976, 12 pp, mimeo.

DIKANSKIY, N. S. and PESTRIKOV, D. V.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V586 (résumé)]

[Text] The authors examine the problem of stability of a grouped beam of protons interacting with an electron flux. It is shown that when the mean velocities of the beams coincide exactly, interaction leads to development of "fast damping" of coherent oscillations of protons. This effect can be used for damping of coherent oscillations of beams in accumulators with electron cooling.

AN ACHROMATIC ANALYZING SYSTEM WITH SEVERAL OUTPUTS

Khar'kov VOPROSY ATOMNOY NAUKI I TEKHNIKI. SERIYA LINEYNYE USKORITELI [Problems of Nuclear Science and Technology. Linac Series] in Russian No 1(2), 1976 pp 36-37

MILLER, V. V. and OBOZNYI, V. A.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V594 by the authors]

[Text] A channel is proposed for transportation of a beam of π -mesons on the "Krasnaya Pakhra" meson factory. With the minimum number of identical magnets and quadrupole lenses the channel has satisfactory optical properties ($\Delta\Omega = 7$ msr, $(\Delta p/p)_{\max} = 8\%$, $(\Delta p/p)_{\min} = 0.2\%$). Adjustment of achromatic beams is possible in four directions.

SOFTWARE FOR AUTOMATING AN ACCELERATOR IN THE 'ADVISOR-COMPUTER' MODE

Riga SISTEMY AVTOMATIZATSII NAUCHNYKH ISSLEDOVANIY [Research Automation Systems, Collection of Works] in Russian No 1, "Zinatne," 1975 pp 156-161

ZAKHAROV, V. V., KOCHEGUROV, V. A., PRESLER, V. T. and ROGACHEVSKAYA, L. M.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V575 by Yu. Aleksandrov]

[Text] The authors consider a version of an algorithm for optimizing the operation of a synchrotron with respect to maximum intensity with manual adjustment of the installation and use of a computer as an "advisor" in a mode without direct connection. The paper discusses problems of connecting the computer into the control cycle with an open feedback loop, but with automatic data collection. The procedure is described along with the software for BESM-4 computer simulation of the control mode, enabling effective debugging of software and training of operators.

A HIGH-VOLTAGE NANOSECOND PULSE GENERATOR WITH SYMMETRIC OUTPUT

Khar'kov VOPROSY ATOMNOY NAUKI I TEKHNIKI. SERIYA LINEYNYE USKORITELI [Problems of Nuclear Science and Technology. Linac Series] in Russian No 1(2), 1976 pp 33-35

GRISHANOV, B. I., LYSENKO, A. P. and KHARITONOV, YE. N.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V581 by the authors]

[Text] The paper describes a simple high-voltage nanosecond square pulse generator with symmetric output and nanosecond synchronization. Output pulses with opposite polarity having an amplitude of up to 50 kV each are formed across a 50 Ω load by discharging a storage line precharged to +100 kV across two parallel cables with a helical cable inverter connected in a gap in one of them. The commutator is a three-electrode spark discharger in compressed gas triggered through a high-resistance helical line from a GMI-14B vacuum tube that can withstand a plate voltage of up to 36 kV and can handle a current pulse of up to 130 A. By using a high-voltage inverter at the output of the helical line in the trigger circuit, it was possible to create a simple heteropolar pulse generator on a single discharger triggered with nanosecond precision directly from the vacuum tube with commutation of voltage up to 100 kV.

USSR

UDC 539.1.08

INTERMEDIATE RING ACCELERATOR FOR THE INJECTION COMPLEX OF THE HIGH-ENERGY LABORATORY. (BASIC PROBLEMS AND CHOICE OF STRUCTURE)

Dubna PROMEZHUTOCHNYY KOL'TSEVOY USKORITEL' INZHEKTSIONNOGO KOMPLEKSA LVE. (OSNOVYYE ZADACHI I VYBOR STRUKTURY) in Russian, Joint Institute of Nuclear Research, report P9-9702, 1976, 18 pp, mimeo.

BALDIN, A. M., BELOV, V. P., VASILISHIN, B. V., DERYUGIN, G. M., ZINOV'YEV, L. P., ISSINSKIY, I. B., KULAKOVA, YE. M., MAKAROV, L. G., MIKHAYLOV, V. A., MONOSZON, N. A., NADGORNYY, V. P., SEMENYUSHKIN, I. N. and SHUKEYLO, I. A.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V563 (résumé)]

[Text] A plan is proposed for a synchrophasotron that accelerates nuclei to an energy of 0.5 GeV/nucleon. The installation can be used as an injector both for the superconductive accelerator (nucleotron) that is under development, and for the synchrophasotron at the Joint Institute of Nuclear Research. The magnetic structure with separated functions contains six periods, and the frequency of betatron oscillations is 2.25. An acceptance of $20 \pi \cdot \text{cm} \cdot \text{mrad}$ in the horizontal and vertical planes enables multiple-turn injection using coupling resonance.

USSR

UDC 539.1.08

INFLUENCE THAT NONLINEARITIES OF THE MAGNETIC FIELD HAVE ON PARTICLE DYNAMICS IN THE UPDATED PROTON SYNCHROTRON OF THE INSTITUTE OF THEORETICAL AND EXPERIMENTAL PHYSICS

Moscow VLIYANIYE NELINEYNOSTEY MAGNITNOGO POLYA NA DINAMIKU CHASTITS V REKONSTRUIROVANNOM PROTONNOM SINKHROTRONE ITEF in Russian, Institute of Theoretical and Experimental Physics, ITEF-53, 1976, 28 pp, mimeo.

ZENKEVICH, P. R., KOSHKAREV, D. G., TARASOV, YE. K. and VOROB'YEVA, YE. A.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V566 (résumé)]

[Text] Analytical and numerical calculations are done for a proton synchrotron on the way that frequencies of betatron oscillations depend on the amplitudes of free oscillations and pulse drift from the equilibrium value. These calculations showed that nonlinearities of the fields of magnet elements influence the frequencies of radial oscillations of particles. The total spread of frequencies of radial oscillations of particles in the beam at the beginning of an acceleration cycle is 0.2. This spread gradually decreases to a few hundredths in the process of particle acceleration due to attenuation of radial and radial-phase oscillations.

CRITERION AND PROCEDURE FOR DETERMINING THE TYPE AND PARAMETERS OF ELECTRON ACCELERATORS IN FLAW DETECTION

IZVESTIYA TOMSKOGO POLITEKHNICHESKOGO INSTITUTA in Russian Vol 269, 1976
pp 43-46

MOROZ, P. S. and POKROVSKIY, A. V.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V551 by P. S. Mikhalev]

[Text] Radiation flaw detection utilizes betatron, microtron and linac emission. The specific field of application requires emission with certain parameters. The method of mathematical modeling can be used to develop optimum emitters for these purposes. A quantitative estimate of effectiveness is presented that uses a complex criterion including both the expenditures for flaw detection work and the target efficiency expected when this method of inspection is put into practice. Computer calculations done over the entire range of variation in beam parameters give the required beam parameters, focal length, etc. as a function of inspection conditions. Algorithms and programs are developed for a type M-20 computer that enable determination of minimum expenditures to achieve optimum beam characteristics under specific inspection conditions. General computational formulas are presented for estimating the economy of using emitters in flaw detection.

CURRENT REVERSAL IN THE CORRECTING WINDINGS OF THE ISOCHRONOUS U-120M CYCLOTRON

Dubna REVERSIROVANIYE TOKA V KORREKTIRUYUSHCHIKH OBMOTKAKH IZOKHRONNOGO TSIKLOTRONA U-120M in Russian, Joint Institute of Nuclear Research, report 13-9624, 1976, 12 pp, mimeo.

DENISOV, YU. N., KALINICHENKO, V. V. and KRZHIVANEK, M.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V557 (résumé)]

[Text] The paper describes a thyristorized reversible DC commutator for the power supply of the correcting winding in a cyclotron. Diagrams are given of the principal components together with the results of an experimental study of a pilot model of the commutator. The rated working current is 600 A. The commutator can be controlled manually or by computer.

USSR

UDC 539.1.08

DESIGN OF A HIGH-CURRENT INJECTOR FOR A 300 MeV ELECTRON LINAC

Khar'kov VOPROSY ATOMNOY NAUKI I TEKHNIKI. SERIYA LINEYNYYE USKORITELI [Problems of Nuclear Science and Technology. Linac Series] in Russian No 1(2), 1976 pp 63-65

BATYGIN, YU. V., GRISHAYEV, I. A., DOBNYA, A. N., KOLOT, Z. M. and MAKHNENKO, L. A.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V542 by the authors]

[Text] The paper gives the calculation of a 300 MeV electron linac. It is shown that the proposed resonator beam shaping system has a waveguide section that gives electron bunches with phase extension of $\sim 70^\circ$, current of ~ 40 A, and energy spread over the pulse duration of $\sim 40\%$ at the input to the main part of the accelerator.

USSR

UDC 539.1.08

INCREASING THE INTENSITY OF ACCELERATED BEAMS OF NUCLEI IN PROTON LINACS

Dubna O POVYSHENII INTENSIVNOSTI USKORENNYKH PUCHKOV YADER V PROTONNYKH LINEY-NYKH USKORITELYAKH in Russian, Joint Institute of Nuclear Research, report 9-9592, 1976, 5 pp, mimeo.

BEZNOGIKH, YU. D., ZINOV'YEV, L. P., KARPOV, I. I., MONCHINSKIY, V. A. and POPOV, V. A.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V545 (résumé)]

[Text] The paper describes a method of increasing the intensity of accelerated beams of light nuclei in proton linacs. The method is realized in the LU-20 injector of the synchrophasotron at the Joint Institute of Nuclear Research. Experimental results are given.

A MICROWAVE POWER STABILIZATION SYSTEM

Khar'kov VOPROSY ATOMNOY NAUKI I TEKHNIKI. SERIYA LINEYNYYE USKORITELI [Problems of Nuclear Science and Technology. Linac Series] in Russian No 1(2), 1976
pp 29-30

BLAZHEVICH, S. V., ZLUNIT SIN, E. S., ZYKOV, A. I., KUSHNIR, V. A. and PLISKO, V. N.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V538 by the authors]

[Text] The paper describes an active regulating system for stabilizing rf power of a klystron in the 10 cm band. The activating element is an electrically tuned attenuator based on diodes with PIN structure. The system provides a stabilization coefficient of about 100 with a change in input power over a range of ± 5 dB. The passband is ~ 30 MHz and a speed of action of about 10^{-3} s. An evaluation of this method shows the feasibility of maintaining microwave power level within a precision to 10^{-5} .

A WAVEGUIDE CHANNEL PROTECTION CIRCUIT USING A MICROWAVE MODULATOR BASED ON SWITCH DIODES

Khar'kov VOPROSY ATOMNOY NAUKI I TEKHNIKI. SERIYA LINEYNYYE USKORITELI [Problems of Nuclear Science and Technology. Linac Series] in Russian No 1(2), 1976
pp 31-32

ALFEROV, V. N. and YAMPOL'SKIY, I. R.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V539 by the authors]

[Text] The paper gives the design and characteristics of a microwave modulator based on switching diodes, and also presents a scheme for using this modulator to protect high-power channels from breakdown. The modulator is two 1A504A diodes connected in parallel in a section of coaxial line with separation by a quarter wavelength. The controlling voltage is fed to the diodes through separate resistors. The modulator was tested in the frequency band of (2797 ± 10) megahertz at a continuous power of $(0.1-2)$ W. The VSWR of the modulator at output is about 1.2, transmission losses ~ 0.8 dB, maximum attenuation at least 50 dB. Microwave power activation and deactivation time does not exceed 60 ns.

A DEVICE FOR WIDE-RANGE MEASUREMENT OF ELECTRON-BEAM CHARGE AND CURRENT

Khar'kov VOPROSY ATOMNOY NAUKI I TEKHNIKI. SERIYA LINEYNYE USKORITELI [Problems of Nuclear Science and Technology. Linac Series] in Russian No 1(2), 1976
pp 43-45

BEKHTEV, B. V., BORODULIN, A. I. and RYBIN, V. M.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V540 by the authors]

[Text] The paper examines the operation of a magnetic induction current converter with low-frequency correction circuit. When low currents and charges are measured on charged-particle accelerators, the correction circuit appreciably improves the sensitivity of the converter for given distortions in the shape of the output voltage and measurement errors. This low-frequency correction circuit is an active integrator connected in a common feedback circuit, and is based on an opamp that works in a recurrent input signal mode. Theoretical and experimental characteristics are given for a converter with correction circuit, and the authors describe the operation of a device for measuring the current and charge of the beam from the U-31 electron linac at Moscow Engineering Physics Institute. The device measures beam current pulse amplitude in the range from $4 \cdot 10^{-5}$ to $4 \cdot 10^{-2}$ A, and charge per pulse in the range from $6 \cdot 10^{-12}$ to $6 \cdot 10^{-9}$ C with an error of less than 5%, and also reproduces the shape of beam current pulses lasting 0.2-0.3 μ s with an error of $\sim 10\%$.

SHAPING OF AN ELECTRON BEAM BY A SYSTEM OF RESONATORS

Khar'kov VOPROSY ATOMNOY NAUKI I TEKHNIKI. SERIYA LINEYNYE USKORITELI [Problems of Nuclear Science and Technology. Linac Series] in Russian No 1(2), 1976
pp 46-47

AFANAS'YEV, V. D., RUDYCHEV, V. G. and VISHNYAKOV, V. A.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V541 by the authors]

[Text] The paper examines grouping of an electron beam by two and three resonators working on a single frequency. Computer calculations show that for an arbitrarily assigned interval of input phases and fixed ratios of the field amplitudes in the resonators there are certain values of the grouping parameters for which the shaped beam has a minimum phase extension of an electron bunch. An investigation is made of the influence that the space charge has on the process of shaping of electron bunches.

USSR

UDC 539.1.08

USING A KLYSTRON SELF-EXCITED OSCILLATOR ON A TWO-SECTION ACCELERATOR

Khar'kov VOPROSY ATOMNOY NAUKI I TEKHNIKI. SERIYA LINEYNYYE USKORITELI [Problems of Nuclear Science and Technology. Linac Series] in Russian No 1(2), 1976
pp 18-19

BELOGLAZOV, V. I., VISHNYAKOV, V. A., GRISHAYEV, I. A., SDOBNOVA, L. N. and
FURSOV, G. L.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V536 by the authors]

[Text] An examination is made of the results of using a high-power klystron self-excited oscillator to feed an electron linac that boosts energy to 40 MeV. The KIU-12 klystron operating in the self-excited oscillator mode furnishes SHF power to the injector section and input circuit of a second klystron. The requirements for the stability of the frequency generated by the SHF power source are formulated on the basis of the theoretical and experimental characteristics of the accelerator.

USSR

UDC 539.1.08

WIDE-BAND MAGNETIC INDUCTION SENSORS

Khar'kov VOPROSY ATOMNOY NAUKI I TEKHNIKI. SERIYA LINEYNYYE USKORITELI [Problems of Nuclear Science and Technology. Linac Series] in Russian No 1(2), 1976
pp 25-26

KALININ, A. S.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V537 by the author]

[Text] A method is presented for eliminating the dependence of the signal of magnetic induction sensors on beam displacement along the sensor winding. Using this method enables one to measure the current and position of the beam over a time much shorter than the time of signal propagation along the line formed by the winding and shield. A description is given of a specific device that consists of the beam current sensor and position sensors for two coordinates that have a rise time of 4 ns and a decay time of the order of 1 ms.

USSR

UDC 539.1.08

CHARGE SENSORS FOR ISOLATED BUNCHES

Khar'kov VOPROSY ATOMNOY NAUKI I TEKHNIKI. SERIYA LINEYNYYE USKORITELI [Problems of Nuclear Science and Technology. Linac Series] in Russian No 1(2), 1976
pp 23-24

KALININ, A. S.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V534 by the author]

[Text] Two types of sensors for the charge of isolated bunches of charged particles are considered: a current transformer loaded by capacitance, and an original sensor in which the main element is a coaxial line formed by the walls of a chamber. It is shown that these sensors can be used to measure the charge of nanosecond bunches.

USSR

UDC 539.1.08

A COMPACT ELECTRON LINAC WITH BEAM CIRCULATION

Khar'kov VOPROSY ATOMNOY NAUKI I TEKHNIKI. SERIYA LINEYNYYE USKORITELI [Problems of Nuclear Science and Technology. Linac Series] in Russian No 1(2), 1976

MUNTYAN, V. I., RUMYANTSEV, V. V., RYABTSOV, A. V., SMIRNOV, V. L. and SEVERGIN, YU. P.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V535 by the authors]

[Text] The paper points out the feasibility of using repeated acceleration of electrons in the accelerating system of accelerators for applied purposes to increase the energy buildup per unit of length as well as the electronic efficiency. Theoretical parameters are given for an accelerator with double passage of the beam through the accelerating section, and results are presented from a study of the accelerating system. The unit was designed and built at the All-Union Institute of Experimental Physics Equipment.

IMPACT ACCELERATION OF CHARGED PARTICLES

Moscow UDARNOYE USKORENIYE ZARYAZHENNYKH CHASTITS in Russian, Physics Institute of the Academy of Sciences USSR. High-Energy and Cosmic-Ray Physics. Photomeson Process Laboratory preprint No 53, 1976, 14 pp, mimeo.

BESSONOV, YE. G., KURAKIN, V. G. and SEROV, A. V.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V489 (résumé)]

[Text] An investigation is made of the salient features of impact acceleration of charged particles. Particulars are pointed out that distinguish this method from other acceleration techniques from the standpoint of formation of mono-energetic beams and beams of relativistic particles of short duration. A fairly detailed scheme is worked out for impact acceleration of charged particles by an electromagnetic field excited in the accelerating structures. The possibilities for realization of such a scheme are analyzed.

RESTRICTIONS ON THE SPECIFIC POWER OF AN ION SOURCE THAT ARE RELATED TO HEATING AND CATHODE SPUTTERING OF ELECTRODES

Moscow OGRANICHENIYA UDEL'NOY MOSHCHNOSTI IONNOGO ISTOCHNIKA, SVYAZANNYYE S NAGREVOM I KATODNYM RASPYLENIYEM ELEKTRODOV in Russian, Institute of Atomic Energy imeni I. V. Kurchatov, IAE-2628, 1976, 16 pp, mimeo.

GAMIL'TON, G. U. and SEMASHKO, N. N.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V529 (résumé)]

[Text] The authors calculate the possibilities and limitations of the water-cooled ion-optical system of an ion source necessary for continuous operation of a high-power neutral beam injector. The following problems are considered: thermal expansion and warping of electrodes, sputtering of electrodes under the action of bombardment, heat removal by the turbulent flow of water.

USSR

UDC 539.1.08

ON STABILITY DIAGRAMS FOR SOME FORMS OF SUPPLY VOLTAGES FOR THE SENSOR OF A
THREE-DIMENSIONAL QUADRUPOLE MASS SPECTROMETER

Ryazan' ELEKTRONIKA. MEZHVUZOVSKIY SBORNIK STATEY. RYAZANSKIY RADIOTEKHNIЧЕСKIY
INSTITUT [Electronics. Inter-Institutional Collection of Papers. Ryazan' Radio
Engineering Institute] in Russian No 2, 1976 pp 41-43

TERENT'YEV, V. I.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V476 by the author]

[Text] The paper gives the results of calculations of the coordinates of
vertices of common zones of stability for a three-dimensional quadrupole mass
spectrometer assuming certain shapes of the sensor supply voltage.

USSR

UDC 539.1.08

ON A METHOD OF CALCULATING BOUNDARIES OF ZONES OF STABILITY FOR THE MATHIEU
FUNCTION

Ryazan' ELEKTRONIKA. MEZHVUZOVSKIY SBORNIK STATEY. RYAZANSKIY RADIOTEKHNIЧЕСKIY
INSTITUT [Electronics. Inter-Institutional Collection of Papers. Ryazan' Radio
Engineering Institute] in Russian No 2, 1976 pp 43-45

SHERETOV, E. P., SAFONOV, M. P. and MZHEL'SKAYA, L. A.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V477 by the authors]

[Text] The paper gives a form of the solution of the Mathieu equation that is
convenient for the theory of quadrupole mass spectrometers. On the basis of
this solution, relations are found that are suitable for calculating the
boundaries of the first zone of the stability diagram.

USSR

UDC 539.12.04

INVESTIGATION OF ASYMMETRY OF THE ANGULAR DISTRIBUTION OF PROTONS SCATTERED BY
TUNGSTEN SINGLE CRYSTALS

Moscow TRUDY SED'MOGO VSESOYUZNOGO SOVESHCHANIYA PO FIZIKE VZAIMODEYSTVIYA
ZARYAZHENNYKH CHASTITS S MONOKRISTALLAMI [Works of the Seventh All-Union Con-
ference on the Physics of Interaction of Charged Particles with Single Crystals]
in Russian, Moscow University, 1976 pp 155-158

GRIGOR'YEV, YU. A., YEREMIN, N. V., KAZAK, L. A. and PUZANOV, A. A.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V464 by I. N.
Yevdokimov]

[Text] The topology of regions of overlapping of axial and planar shadows is
studied in experiments on scattering of protons with energy of 620 keV. Regions
are found that have the highest sensitivity to displacement of a source of
particles from a crystal lattice site. It is suggested that investigation of
these regions in determining the lifetime τ of composite nuclei by the shadow
effect method could reduce the threshold of fixation of τ to $2 \cdot 10^{-19}$ s.

USSR

UDC 539.1.08

PRINCIPLES OF THE THEORY OF INJECTION OF IONS INTO THE SENSOR OF A THREE-
DIMENSIONAL QUADRUPOLE MASS SPECTROMETER

Ryazan' ELEKTRONIKA. MEZVUZOVSKIY SBORNIK STATEY. RYAZANSKIY RADIOTEKHNICHESKIY
INSTITUT [Inter-Institutional Collection of Papers. Ryazan' Radio Engineering
Institute] in Russian No 2, 1976 pp 37-41

SHERETOV, E. P., SAFONOV, M. P., KOLOTILIN, B. I.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V475 by the authors]

[Text] A general theory is developed for the injection of ions from without
into the sensor of a three-dimensional quadrupole mass spectrometer. Principal
relations are presented that define the one-dimensional ion injection mode.
On the basis of the resultant relations, recommendations are made on choosing
the working conditions of the mass spectrometer. References 5.

USSR

UDC 539.12.04

CALCULATION OF YIELDS AND ANGULAR DISTRIBUTIONS OF BREMSSTRAHLUNG OF A THICK TARGET

Obninsk RASCHET VYKHODOV I UGLOVYKH RASPREDELENIY TORMOZNOGO IZLUCHENIYA TOLSTOY MISHENI in Russian, Power Engineering Physics Institute, FEI-700, 1976, 11 pp, mimeo.

KITAYEV, V. YA., ABRAMOV, A. I., ROGOV, A. V. and YUTKIN, M. G.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V451]

[Text] A comparatively simple analytical formula is derived for numerical calculation of the spectral distribution of bremsstrahlung at different angles from a tungsten target with a thickness of 870 mg/cm^2 exposed to electrons with energies of 10-15 MeV. The results are compared with experimental and theoretical data of other authors.

USSR

UDC 539.12.04

CONCERNING THE WAY THAT DIFFERENT PARAMETERS OF THE AXIAL SHADOW DEPEND ON THE MAGNITUDE AND DIRECTION OF DISPLACEMENT OF A COMPOSITE NUCLEUS FROM A CRYSTAL LATTICE SITE

Moscow TRUDY SED'MOGO VSESOYUZNOGO SOVESHCHANIYA PO FIZIKE VZAIMODEYSTVIYA ZARYAZHENNYKH CHASTITS S MONOKRISTALLAMI [Works of the Seventh All-Union Conference on the Physics of Interaction of Charged Particles with Single Crystals] in Russian, Moscow University, 1976 pp 138-141

MELIKOV, YU. V., OTSTAVNOV, YU. D., TULINOV, A. F. and CHECHENIN, N. G.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V463 by I. N. Yevdokimov]

[Text] In most instances the measurement of lifetimes of excited nuclei by the method of shadows presupposes machine modeling based on the Lindhard concept of an isolated chain of atoms. Experiments done on fissioning of ^{235}U and ^{238}U by neutrons with an energy of 1 MeV have shown that the depth of the shadow is not very sensitive to lifetime, so that additional confirmation of the validity of the chain model is required. This confirmation is obtained by studying another shadow parameter -- the total number of particles thrown out beyond the limits of the shadow angle as a result of interaction with the atomic chain.

USSR

UDC 539.12.04

INFLUENCE OF AXIAL AND PLANAR CHANNELING ON 1 GeV ELECTRON AND POSITRON BREMS-
STRAHLUNG SPECTRA IN SILICON AND GERMANIUM CRYSTALS

Moscow TRUDY SED'MOGO VSESOYUZNOGO SOVESHCHANIYA PO FIZIKE VZAIMODEYSTVIYA
ZARYAZHENNYKH CHASTITS S MONOKRISTALLAMI [Works of the Seventh All-Union Con-
ference on the Physics of Interaction of Charged Particles with Single Crystals]
in Russian, Moscow University, 1976 pp 195-203

BOCHEK, G. L., GRISHAYEV, I. A., KOVALENKO, G. D. and SHRAMENKO, B. I.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V448 by G. S.
Pashchenko]

[Text] The paper presents bremsstrahlung spectra measured for secondary elec-
trons (positrons) in the photon energy range of $0.2 < X < 0.8$, where X is the
photon energy in units of the initial electron (positron) energy. The Si and
Ge crystals had thicknesses of 640 and 165 μm respectively. Measurement errors
did not exceed 10%. The influence of channeling was determined by comparing
the experimental spectra with those calculated in the Born approximation; the
correctness of the calculations was checked by measuring the bremsstrahlung
spectra of electrons and positrons from an amorphous 0.5 mm aluminum target.
The authors discuss the experimental results and compare them with theory.

USSR

UDC 539.12.04

INVESTIGATION OF COHERENT BREMSSTRAHLUNG OF ELECTRONS ON THIN SINGLE CRYSTALS
OF DIAMOND

Moscow TRUDY SED'MOGO VSESOYUZNOGO SOVESHCHANIYA PO FIZIKE VZAIMODEYSTVIYA
ZARYAZHENNYKH CHASTITS S MONOKRISTALLAMI [Works of the Seventh All-Union Con-
ference on the Physics of Interaction of Charged Particles with Single Crystals]
in Russian, Moscow University, 1976 pp 190-194

GANENKO, V. B., GORBENKO, V. G., ZHEBROVSKIY, YU. V., KOVALENKO, N. A., KOLESNI-
KOV, L. YA., KRIVETS, A. G., MIROSHNICHENKO, I. I., RUBASHKIN, A. L., SANIN,
V. M., SHALATSKIY, S. V. and SOROKIN, P. V.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V449 by G. S.
Pashchenko]

[Text] An experimental study was done on coherent bremsstrahlung of electrons
with energy $E_0 = 1.3$ GeV from diamond single crystals 2, 0.3 and 0.08 mm thick.
Registration was from recoil protons detected after analysis by momenta using
scintillation counter telescopes. The telescopes had an energy resolution of
0.05 [sic]. Curves are given showing the way that the intensity of gamma
quanta depends on the angles of orientation of the diamond single crystals for
gamma quanta energy of 330 MeV.

USSR

UDC 539.14+539.16

CROSS SECTION OF THE DOUBLE CHARGE EXCHANGE $\pi^+ + {}^4\text{He} \rightarrow \pi^- + 4p$ AT PION ENERGIES OF 98, 135, 145 AND 156 MeV

Dubna SECHENIYE DVOYNOY PEREZARYADKI $\pi^+ + {}^4\text{He} \rightarrow \pi^- + 4p$ PRI ENERGIYAKH PIONOV 98, 135, 145 I 156 MeV in Russian, Joint Institute of Nuclear Research report Pl-9591, 16 pp, mimeo.

LYASHENKO, V. I., PONTEKORVO, D. B., FALOMKIN, I. V., SHCHERBAKOV, YU. A., AL'BU, M., ANZHELESKU, T., BALEA, O., MIKHUL, A., NIKITIU, F., SERARU, A., BALESTRA, F., GARFAN'INI, R., PIRADZHINO, G., GUARAL'DO, K. and SKRIMAL'O, R.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V410]

[Text] The cross section of double charge exchange of positive pions on helium nuclei is measured at different energies. The experimentally determined energy dependence of the cross sections is compared with predictions of different theoretical models.

USSR

UDC 539.14+539.16

NUCLEAR DIFFRACTION PROCESSES WITH THE PARTICIPATION OF LIGHT NUCLEI

Tashkent MNOZHESTVENNYYE PROTSESSY PRI VYSOKIKH ENERGIYAKH [Multiple Processes at High Energies, Collection of Works] in Russian, "Fan," 1976 pp 55-77

ISMATOV, YE. I.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V411]

[Text] The author considers the interaction of mesons, nucleons, deuterons and other complex particles with nuclei. The amplitudes and cross sections are calculated for different diffraction processes when nucleons and complex particles interact with nuclei as a function of the smearing of the boundaries of the nucleus, and also with consideration of the interaction of nucleons within the target nucleus. A survey is given of the literature for the past few years on the diffraction method of calculating nuclear interactions.

USSR

UDC 539.14+539.16

YIELD OF FAST PROTONS AND THEIR ASYMMETRY IN NUCLEAR μ -CAPTURE

Dubna VYKHOD BYSTRYKH PROTONOV I IKH ASIMMETRIYA V YADERNOM μ -ZAKHVATE in Russian, Joint Institute of Nuclear Research report P29753, 1976, 10 pp, mimeo.

DOGOTAR', G. YE., SAKAYEV, R. A. and SALGANIK, YU. A.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V390]

[Text] The authors consider the yield of fast protons when muons are absorbed by the ^{16}O nucleus. The process was studied in the weak interaction momentum approximation using the traditional effective muon-nucleon hamiltonian.

USSR

UDC 539.14+539.16

RADIATION CAPTURE OF π -MESONS BY THE ^6Li NUCLEUS

Dubna RADIATIONNYY ZAKHVAT π -MEZONOV YADROM ^6Li in Russian, Joint Institute of Nuclear Research report P2-9610, 1976, 23 pp, mimeo.

SAKAYEV, R. A. and ERMAZHYAN, R. A.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V392]

[Text] The process of radiative capture of π -mesons by the ^6Li nucleus is examined within the framework of the shell model. Transitions to bound states and to states of giant resonance are considered. The gross structure of the spectrum of hard gamma quanta agrees well with measurement results.

USSR

UDC 539.14+539.16

INVESTIGATION OF GAMMA EMISSION FROM THE REACTION $^{12}\text{C}(p, \gamma p)^{12}\text{C}$

Dubna ISSLEDOVANIYE GAMMA-IZLUCHENIYA IZ REAKTSII $^{12}\text{C}(p, \gamma p)^{12}\text{C}$ in Russian, Joint Institute of Nuclear Research, report P15-9649, 1976, 10 pp, mimeo.

PARZHITSKIY, S. S., POPOV, YU. P., POYARKOV, V. A., SALEKH, Z. A., SIZOV, I. V. and STRIZHAK, V. I.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V291 (résumé)]

[Text] A germanium-lithium detector is used to measure gamma emission due to capture of protons with energy of 1.2 and 1.6 MeV to the ground state and the first excited state (2366 keV) of the ^{13}N nucleus. Information is obtained on the width and position of the 2366 keV level ($\Gamma = 34.6 \pm 1$ keV, $E_{\text{res}} = 2366 \pm 1$ keV). The particulars of the gamma spectrum from the reaction $^{12}\text{C}(p, \gamma p)^{12}\text{C}$ are discussed and compared with theoretical calculations.

USSR

UDC 539.14+539.16

USING THRESHOLD NUCLEAR REACTIONS WITH NEUTRON YIELD IN EXPERIMENTS WITH HIGH-CURRENT ELECTRON BEAMS

Moscow ISPOL'ZOVANIYE POROGOVYKH YADERNYKH REAKTSIY S VYKHODOM NEYTRONOV V EKSPERIMENTAKH S SIL'NOTOCHNYMI ELEKTRONNYMI PUCHKAMI in Russian, Physics Institute, Academy of Sciences USSR, Plasma Physics Preprint No 68, 1976 11 pp, mimeo.

VOLOBUYEV, I. V., GRANATKIN, B. V., IVANOV, V. N., ISAKOV, A. I., KOLOMENSKIY, A. A., LIKHACHEV, V. I., SINIL'SHCHIKOVA, I. V. and SMIT, O. A.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V309 by I. P.]

[Text] The reaction $^{12}\text{C}(d, n)^{13}\text{N}$ with threshold of ~ 0.3 MeV was used to study the process of deuterium acceleration at low pressure by an intense electron beam. Experiments were done at an electron energy of 600 keV, current of 15-20 kA and pulse duration of ~ 50 ns. An investigation is made of the way that the neutron yield depends on deuterium pressure in the range of $0.08 \leq P \leq 0.2$ mm Hg. Maximum neutron yield corresponds to a pressure of 0.15 mm Hg. The energy of the accelerated deuterons was determined by three independent methods: from the time of flight, from absorption by foils, and by a magnetic spectrograph. It was found that the energy of the deuterons is strongly dependent on the operating stability of the accelerator, and amounts to from 1 to 4 MeV.

USSR

UDC 539.16+539.14

STATE OF THE ART IN MEASUREMENT OF FISSION CROSS SECTIONS OF THE PRINCIPAL FISSION ISOTOPES IN THE NEUTRON ENERGY RANGE OF $1-10^5$ eV. (A SURVEY)

Moscow SOVREMENNOYE SOSTOYANIYE V IZMERENII SECHENIY DELENIYA OSNOVNYKH DELYASHCHIKHSYA IZOTOPOV V OBLASTI ENERGIY NEYTRONOV $1-10^5$ eV. (OBZOR) in Russian, Institute of Atomic Energy imeni I. V. Kurchatov, IAE-2637, 1976, 40 pp, mimeo.

BIRYUKOV, S. A. and GERASIMOV, V. F.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V191]

[Text] A survey of data on fission cross sections for ^{233}U , ^{235}U , ^{239}Pu and ^{241}Pu . The main emphasis is given to theoretical problems associated with parametrization of these cross sections, measurement techniques and verification of the accuracy of estimated microscopic data in integrated experiments.

USSR

UDC 539.16+539.14

CURRENT STATE AND OUTLOOK FOR RESEARCH ON NUCLEAR AND HYPERNUCLEAR PHYSICS ON ACCELERATORS

Moscow SOSTOYANIYE I PERSPEKTIVY ISSLEDOVANIY PO YADERNOY I GIPERYADERNOY FIZIKE NA ELEKTRONNYKH USKORITEL'YAKH in Russian, report delivered to the Ninth All-Union Conference on Development and Practical Application of Electron Accelerators, Tomsk, 3-5 Sep 75, Physics Institute, Academy of Sciences USSR, Preprint No 168, 1975, 63 pp, mimeo.

SOKOL, G. A. and FETISOV, V. N.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V261 by E. Ye. Sapershteyn]

[Text] A discussion of various aspects of the use of high-energy electrons (200-1000 MeV) in nuclear physics. In studying the properties of the ground states of nuclei and their first excitations, high resolution of the electron beam is a necessary condition for obtaining valuable information on the structure of nuclei. When this condition is met, data on elastic and inelastic scattering enable determination of the detailed behavior of form factors in the case of large transferred momenta, and thus give important information on the nature of nucleonic correlations at short distances. A new area of nuclear physics is research on electro- and photoproduction of mesons on nuclei, giving a great deal of information on the mesonic degrees of freedom in nuclei. An examination is also made of the possibilities for studying the properties of hypernuclei by using electrons and gamma quanta.

USSR

UDC 539.14+539.16

INVESTIGATION OF CONVERSION ELECTRONS WHEN ^{235}U IS FISSIONED BY THERMAL NEUTRONS

Leningrad ISSLEDOVANIYE KONVERSIONNYYKH ELEKTRONOV PRI DELENII ^{235}U TEПЛОВЫМИ НЕЙТРОНАМИ in Russian, Leningrad Institute of Nuclear Physics, Preprint No 210, 1976, 14 pp, mimeo.

POPEKO, L. A., RUDNEV, YU. P., PETROV, G. A. and KOCHUBEY, YE. F.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976, Abstract No 11V188]

[Text] An investigation is made of electron spectra in the energy region of 150-1500 keV when ^{235}U is fissioned by thermal neutrons. The delayed electron emission shows a line with energy of 843 ± 3 keV, period of 65 ± 10 ns and intensity of $(2.5 \pm 0.5) \cdot 10^{-4}$ electron/fission. This line can be attributed to an isomeric $E0$ transition in one of the light fragments with charge $Z = 40 \pm 1$. It is shown that the yield of electrons associated with the fluctuation electromagnetic field of the fissile nucleus is $\leq 10^{-4}$ electron per fission. It is confirmed that the predominant contribution to the prompt gamma spectrum of the fragment nuclei is from $E2$ transitions.

USSR

UDC 539.14+539.16

MEASUREMENT OF THE RATIO α OF CAPTURE TO FISSION CROSS SECTIONS IN THE NEUTRON ENERGY RANGE FROM 0.007 eV to 12 keV

Moscow IZMERENIYE OTNOSHENIYA SECHENIY ZAKHVATA I DELENIYA (α) V OBLASTI ENERGIY NEYTRONOV OT 0.007 eV DO 12 keV in Russian, Institute of Nuclear Research, Academy of Sciences USSR, P-0031, 1976, 11 pp, mimeo.

RYABOV, YU. V.

From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V190]

[Text] The radiative capture to fission cross section ratio α is measured for ^{239}Pu with expansion $\Delta t/L = 0.23$ $\mu\text{s}/\text{m}$. The experimental procedure consisted in comparing the count of gamma quanta and prompt fission neutrons from the specimen by means of a scintillation detector with pulse division with respect to de-excitation time. Values of $\alpha(E)$ are given for ^{239}Pu in the region of interacting neutron energies from 0.007 eV to 12 keV.

USSR

UDC 539.125.5.173.162.3

INVESTIGATION OF RESONANT ABSORPTION OF NEUTRONS IN A LATTICE OF THE RBM-K TYPE

Moscow ATOMNAYA ENERGIYA in Russian Vol 41, No 6, Dec 76 pp 387-391 manuscript received 16 Jul 75, revised 30 Apr 76

YUROVA, L. N., BUSHUYEV, A. V., KOZHIN, A. F., YEGIAZAROV, M. B. and KAMANIN, P. M.

[Abstract] The paper gives experimental data characterizing the absorption of resonance neutrons in lattices of the RBM-K type at Leningrad Nuclear Electric Power Plant. Calculation of neutron absorption in these heterogeneous lattices involves difficulties due to the need for considering both the energy and spatial distribution of the moderated neutron flux. Strong intrachannel moderation causes appreciable spatial nonhomogeneity of the field of resonance neutrons in a cell. One way to solve the problem is experimental measurements on reactor core models. A change in concentration of hydrogen in the heterogeneous water film may influence physical processes in the intermediate-thermal neutron energy region. Therefore the integral parameters sensitive to this region of the neutron spectrum were measured -- ρ^{28} , $\langle \sigma_c^{28} \rangle / \langle \sigma_f^{25} \rangle$ and the effective resonant integral of absorption I_{eff}^{28} . The measurements were done on critical and sub-critical assemblies, with and without water in the fuel channels. Coefficients of self-locking are found for isolated fuel elements, and coefficients of mutual shielding are determined for elements in a cluster. It was found that filling the fuel channels with water has little effect on the effective resonant integral of absorption, but reduces the other two parameters (especially ρ^{28}) due to softening of the neutron spectrum. References 9: 6 Russian, 3 Western.

USSR

UDC 621.039.584:621.039.538.7

START-UP TESTS OF THE EFFECTIVENESS OF BIOLOGICAL SHIELDING OF A NUCLEAR ELECTRIC POWER PLANT WITH WATER-MODERATED WATER-COOLED POWER REACTOR

Moscow ATOMNAYA ENERGIYA in Russian Vol 41, No 6, Dec 76 pp 395-399 manuscript received 7 Jan 76

IZ'YUROV, A. S., KUZHIL', A. S., MIRONOV, V. N., RYMARENKO, A. I. and TSYPIN, S. G.

[Russian abstract provided by the source]

[Text] Experiments gave detailed information on the main source of ionizing radiation -- the reactor itself. In addition, a more detailed investigation was done on the gamma radiation of equipment in the in-pile loop. Specific radioactivity of the coolant in the in-pile loop of the VVER-440 reactor was determined. The experimental data can be used to improve the design of

biological shielding and to develop computational techniques. A safety caisson for inspecting a reactor vessel is described. Use of such a caisson for a single inspection has saved 600,000 rubles. References 6 Russian.

USSR

UDC 621.384.612

COHERENT INSTABILITY OF THE BEAM ON THE ACCELERATOR AT THE INSTITUTE OF HIGH-ENERGY PHYSICS

Moscow ATOMNAYA ENERGIYA in Russian Vol 41, No 6, Dec 76 pp 408-412 manuscript received 23 Dec 75

BALBEKOV, V. I. and GERTSEV, K. F.

[English abstract provided by the source]

[Text] The results of experimental investigation of coherent instability of vertical and radial betatron oscillations in the IHEP accelerator are reported. It is shown that the instability is due to the interaction of the beam with the walls of the vacuum chamber. Positive ions formed during ionization of residual gas by the beam produce a small stabilizing effect. Experimental data and calculations are in agreement within about 30%. References 5: 2 Russian, 3 Western.

USSR

UDC 533.92:621.039.61

THE 'DOLPHIN' HIGH-POWER 12-CHANNEL LASER UNIT FOR SPHERICAL HEATING OF THERMONUCLEAR TARGETS

Moscow MOSHCHNAYA 12-KANAL'NAYA LAZERNAYA USTANOVKA 'DEL'FIN' DLYA SFERICHESKOGO NAGREVA TERMOYADERNYKH MISHENEY in Russian, Physics Institute of the Academy of Sciences USSR, Quantum Radiophysics, preprint No 74, 1976, 67 pp, mimeo.

BASOV, N. G., DANILOV, A. YE., KROKHIN, O. N., KRUGLOV, B. V., MIKHAYLOV, YU. A., SKLIZKOV, G. V., FEDOTOV, S. I. and FEDOROV, A. N.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G239]

[Text] The paper describes the powerful "Dolphin" 12-channel laser unit designed for high-temperature heating of thermonuclear targets in spherical irradiation geometry. The installation includes a neodymium laser with maximum emission

energy of ~ 10 kJ, light pulse duration of $\sim 10^{-10}$ – 10^{-9} s and emission divergence of $5 \cdot 10^{-4}$ rad, a vacuum chamber in which the laser emission is interacted with the plasma, and a complex of facilities for diagnosing laser and plasma parameters. The optical arrangement and design particulars of the laser system are considered. An analysis is made of schemes for focusing emission onto the target, and the focusing system of the "Dolphin" installation is described. This system gives a high degree of symmetry of target irradiation with a maximum density of the flux at the target surface of $\sim 10^{15}$ W/cm². The authors examine the main problems of physical research on a laser plasma and the principal diagnostic facilities for solving them.

USSR

UDC 533.92:621.039.61

PROBLEMS OF TRITIUM PRODUCTION, RADIATION DAMAGE AND NEUTRON ACTIVATION OF MATERIALS IN THE BLANKET OF PULSED THERMONUCLEAR REACTORS

Moscow TEKHNLOGIYA TERMOYADERNYKH REAKTOROV [Technology of Thermonuclear Reactors, Collection of Works] in Russian No 2, Atomizdat, 1976 pp 3-13

DÄNNER, W.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G245 by V. L. Blinkin]

[Text] An examination is made of three blanket designs for pulsed thermonuclear reactors that are intended for a reactor of the theta-pinch type (RTPR) and for the LFPP and "Saturn" laser-driven reactors. The designs are considered from the viewpoint of tritium production, and activation and radiation damage of structural materials. Different methods of regenerating tritium from the reactor blanket material are discussed. Consideration is given to the need for ensuring a low level of tritium accumulation in the blanket to achieve a fairly short doubling time. It is noted that existing data on radiation damage of possible structural materials for thermonuclear reactors are not adequate for drawing reliable conclusions on the suitability of a given material. An examination is made of the particulars of radiation damage to insulators that lead to a reduction in their electrical resistance and permittivity. Considerations are presented in support of the view that some types of radiation damage will be annealed in the time between neutron pulses. It is asserted that neutron activation of structural materials in thermonuclear reactors is not as serious a problem as the formation of fission products in nuclear reactors since the probability of massive accidents is considerably lower in this case. Estimates are made of the biological hazard of installations with thermonuclear reactors, as well as the magnitude of residual heat release in activated structural elements.

USSR

UDC 533.92:621.039.61

PLAN OF THE 'SATURN' LASER-DRIVEN THERMONUCLEAR INSTALLATION

Moscow TEKHNLOGIYA TERMOYADERNYKH REAKTOROV [Technology of Thermonuclear Reactors, Collection of Works] in Russian No 2, Atomizdat, 1976 pp 39-55

FOERSTER, S., BOHN, F. H., CONRADS, H., DARVAS, J. and SACH, B.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G238 by N. G. Koval'skiy]

[Text] The paper gives the plan of the chamber of the "Saturn" thermonuclear reactor designed for 5000 MW of thermal power. The construction and type of laser system are not discussed. The proposed interaction chamber, including blanket, devices for conversion of the energy released, mechanism for insertion of LiD and LiT targets and vacuum chamber is based on criteria of reliability, servicing safety, the possibility for using existing hardware, and also considerations of economic nature. The proposed number of laser beams is 60, frequency of reactor ignition 100 Hz, laser beam energy per pulse 0.6 MJ. The most specific features of the proposed version of the reactor are complete mechanical separation of the system of fuel injection and ignition and the system of energy regeneration and conversion, use of several energy conversion modules and several vacuum modules connected directly to the blanket, provision for removing and repairing blanket modules under load, and finally, an original system for using helium to inject the fuel pellets. A detailed analysis is made of the energy distribution in the reactor, wall effects caused by thermonuclear reaction products, problems relating to protection of optical elements that focus the laser beams onto the target. The energy balance of the entire installation gives a pure efficiency of about 30%.

USSR

UDC 533.92:621.039.61

A TOROIDAL REACTOR OF THE THETA-PINCH TYPE

Moscow TEKHNLOGIYA TERMOYADERNYKH REAKTOROV [Technology of Thermonuclear Reactors, Collection of Works] in Russian No 2, Atomizdat, 1976 pp 25-38

RIBE, F. L.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G247 by G. A. Yeliseyev]

[Text] The paper discusses the principles of operation, parameters and design of a thermonuclear reactor of the theta-pinch type (RTPR) developed jointly by the Los Alamos and Argonne laboratories (United States). The total thermal power of the RTPR reactor is 3600 MW at electric power production efficiency of 49% using a potassium heat-removal cycle. The reactor is made up of 100

separate modules 2 m in length with 50 cm radius of the plasma chamber. The compressive magnetic field is 11 T, and the magnetic field for impact heating of the plasma is 1.38 T. The ratio of the plasma pressure to the magnetic field pressure $\beta \sim 1$. The energy balance in the system and the dynamics of the DT-reaction are considered. The characteristics of the blanket are estimated when different systems of heat removal and levels of thermal and radiation loads on the first wall are used.

USSR

UDC 533.92:621.039.61

REACTORS FOR LASER-DRIVEN THERMONUCLEAR FUSION

Moscow PROBLEMY LAZERNOGO TERMOYADERNOGO SINTEZA [Problems of Laser-Driven Thermonuclear Fusion, Collection of Works] in Russian, Atomizdat, 1976 pp 191-205

KHENKOKS, R. and SPOLDING, I.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G254 by Ye. P. Potanin]

[Text] The paper examines the technical and economic characteristics of laser-driven thermonuclear reactors with superdense plasma. It is noted that from the economic standpoint efforts should be made to reduce energy expenditures on internal needs, using lasers with high efficiency and ensuring a high degree of burn-up in the imploded core. An estimate is made of the typical cost of a DT system that can compete with a nuclear fast-neutron breeder reactor. The authors discuss factors that could affect thermonuclear yield and that have not been considered in numerical experiments. It is pointed out that inertial thermonuclear reactors have the following potential advantages over reactors with magnetic containment: a) simplicity of operation; b) simplicity of design and low capital investment; c) elimination of the need to maintain a high vacuum; d) automatic handling of facilities for ignition, fuel feed and removal of fusion products; e) simplicity of monitoring the average output power of the reactor. The following problems are noted as specific to laser-driven synthesis: a) development of a high-efficiency laser with tailored pulse; b) development of pumping systems with high recurrence rate and long service life; c) development of combustion chambers with high recurrence rate that can withstand heavy energy loads.

A LAYER OF NEUTRAL GAS FOR HEAT REMOVAL

Moscow TEKHNLOGIYA TERMOYADERNYKH REAKTOROV [Technology of Thermonuclear Reactors, Collection of Works] in Russian No 2, Atomizdat, 1976 pp 21-24

BRANDT, B.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G246 by V. L. Blinkin]

[Text] The paper examines different aspects of the use of a gas blanket placed between the plasma and the first wall of a thermonuclear reactor. Such a blanket serves to prevent the chamber wall from vaporizing under the action of charged particles, transfers heat into the reaction zone and promotes cleaning of the reaction zone as a consequence of gas diffusion. The gas blanket can also be used to remove impurities from the plasma before they reach the hot core. In pulsed reactors a gas blanket could be used to control temperature and density profiles in the vacuum chamber, and to regulate the development of these profiles with time. The author discusses the feasibility of forming a gas blanket in a pulsed reactor at the instant of cessation of the thermonuclear reaction to increase heat transfer from the plasma to the wall of the chamber or to absorb plasma energy. Calculated parameters of the plasma and gas blanket of a pulsed reactor are presented. It is shown that the gas blanket solves the problem of heat removal from the plasma and protection of the chamber wall; however, there are certain difficulties in the formation of such a blanket and in pumping out the gas at the end of a cycle. It is noted that the possibilities and advantages of the gas blanket are of particular moment for pulsed reactors.

EAST GERMANY

CALCULATION AND EXPERIMENTAL VERIFICATION OF NEUTRON FLUENCES WITHIN BODY PHANTOMS UNDER IRRADIATION IN VARIOUS NEUTRON FIELDS

East Berlin KERNENERGIE in German Vol 19 No 8, Aug 76 pp 253-258 manuscript received 15 Oct 75

DOERSCHHEL, B., and PROKERT, K., Dresden Technical University, Physics Section, No. 3 Experimental Physics Group

[Abstract] The fluence distributions in a body phantom were calculated by means of the SPECT4 Monte Carlo program. The phantom was a water-filled elliptical cylinder with half axes of 18 and 12 cm, and a height of 60 cm. The calculations were carried out for primary reactor, cyclotron, and 14 MeV neutrons, with the assumption of a 10 cm diameter beam of primary neutrons. The total fluence was measured on the basis of the readout of a single detector, using information about the percentage of thermal, intermediate, and fast neutrons. The results are presented in graphic form. The calculated fluence distributions of the various neutrons exhibited the typical form of water moderation. There was exponential decrease of fluence of fast neutrons with increasing penetration depth, and there were maximums for the fluence of thermal and intermediate neutrons. The fluence profile perpendicular to the irradiation direction corresponded to a fanning of the primary neutron beam. There was good agreement between calculated and measured values. Figures 12; references 5: 1 Western and 4 German.

EAST GERMANY

ABSOLUTE DIFFERENTIAL NEUTRON-EMISSION CROSS SECTIONS FOR Ga, Se, Br, Zr, Nb, Cd, In, Sn, Sb, I, Ta, W, Au, Hg, Pb, AND Bi AT 14 MeV INCIDENCE ENERGY

East Berlin KERNENERGIE in German Vol 19 No 8, Aug 76 pp 241-253 manuscript received 26 Nov 75

HERMSDORF, D., MEISTER, A., SASSONOFF, S., SEELIGER, D., and SEIDEL, K., Physics Section, Dresden Technical University

[Abstract] This article, the last of a series of four, presents absolute differential neutron-emission cross sections for the elements listed in the title as determined by time-of-flight spectrometry for five scatter angles between

40 and 150° in the emission-energy range between 2 and 14 MeV. The information is presented in diagrams. The results presented were compared to corresponding data published in the literature. Only in the case of Zr and Bi were there differences beyond what may be judged experimental deviations. There is good agreement between the neutron-emission cross sections determined on the basis of the integral non-elastic cross section and measured directly by emission spectrometry, except for Se and Zr (in which the deviations exceeded 10 percent). Tables 3; figures 33; references 28: 8 German, 3 Russian, and 17 Western.

EAST GERMANY

STUDIES ON THE OPTIMIZATION OF THE COIL CONFIGURATION IN INDUCTION ACCELERATORS FOR ELECTRONS IN IRON-FREE DESIGN

East Berlin KERNENERGIE in German Vol 19 No 10, Oct 76 pp 311-318 manuscript received 10 Feb 76

UNVERRICHT, A., Friedrich Schiller University, Radiological Clinic, Betatron Department, Jena

[Abstract] Studies were carried out to establish the relationship between the coil configuration (cross section, number of windings, air gap size) in induction accelerators for electrons and the attainable electron intensity, and to find out whether the calculated results of these studies can be confirmed by experiments on actual magnet systems. By using the stabilizing potential it is possible to determine and optimize the size of the stabilizing range as a function of coil configuration. A toroidal cross section should be well adapted to the configuration of the stable range and the shape of the core, and the latter should match well the course of the equipotential surfaces. There was good agreement between calculated and experimentally determined values. Low-iron or no-iron designs reduce the size of the betatron, make it lighter in weight, reduce its cost, and permit the coil configuration to be optimized. The results contribute to the development of high-performance small betatrons with energies of up to 5 MeV. Figures 10; references 17: 11 German, 3 Russian, and 3 Western.

EAST GERMANY

STUDIES ON THE ACCURACY OF THE CALCULATION OF THE GAMMA SPECTRUM OF FISSION PRODUCTS

East Berlin KERNENERGIE in German Vol 19 No 10, Oct 76 pp 299-306 manuscript received 25 Feb 76

PULZ, E., and KRUEGER, F. W., Power Plant Construction Combine State Enterprise, Berlin-Pankow, and State Bureau of Nuclear Safety and Radiation Protection in the German Democratic Republic, East Berlin

[Abstract] Gamma spectra of momentarily generated mixtures of fission products were calculated as a function of decay time. The calculations were carried out with the aid of the AKTIVIST III program, and the fission process was the fission of ^{235}U by thermal neutrons. The computed results were compared with experimentally obtained data as published in the literature. Comparisons were also made between the data calculated with the AKTIVIST III program and other published methods. The differences in data obtained by different methods of calculation were relatively small; their interpretation was discussed. But certain simplifications in the procedures of calculation or measurement may increase the differential. Figures 6; tables 3; references 16: 6 German and 10 Western.

Optics and Spectroscopy

USSR

UDC 537.52

INVESTIGATION OF AN ARC PLASMA OF INERT GASES AT HIGH PRESSURE

Moscow TEPILOFIZICHESKIYE SVOYSTVA NIZKOTEMPERATURNNOY PLAZMY [Thermophysical Properties of Low-Temperature Plasma, Collection of Works] in Russian, "Nauka," 1976 pp 42-46

NESTEROV, YE. V.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G271 by the author]

[Text] A plasma of inert gas (helium, neon) is created in an electric arc of miniature dimensions at pressures of 30-500 atmospheres with optical thickness $\tau \leq 1$. Optical methods were used to measure temperature, line broadening and emission intensity in the continuous spectrum in the wavelength range of 5000-7000 Å. Broadening of spectral lines is several times greater than the theoretical value at pressures above 100 atmospheres. The coefficient of emission is also considerably higher than the calculated value. The optical reduction in the ionization potential is compared with results of other authors.

USSR

UDC 621.397.68

OPTIMIZING THE PARAMETERS OF AN OPTO-ELECTRONIC SYSTEM IN THE SEARCH MODE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 9, Sep 76
pp 6-8 manuscript received 21 Mar 75

MISHCHENKO, N. I., PUSTYNSKIY, I. N., and SUVOROV, B. I.

[Abstract] The tracking accuracy of an opto-electronic system for location of point objects can be improved with a concomitant reduction in the search time by preliminary (coarse) determination of the coordinates of the object in conjunction with the narrow-angle (fine) system of search and tracking. In this case the probability density of the coordinates in the search field of the system is close to gaussian with near-zero mathematical expectation, whereas the probability density is usually taken as uniform, and the probability of the object being found in the search field is assumed known, and most often equal to unity. The authors determine the optimum dimensions of the search field, scanning rate and other parameters of an opto-electronic system that maximize sensitivity for a given probability of detection of a point object, which depends on the probability that the object will be in the search field, the probability that it will be moving at a given speed, and the probability of signal detection. It is shown that the probability of a false alarm has practically no effect on the optimum values of the size of the search field and scanning parameters.

USSR

A CRITERION FOR THE BREAKDOWN OF DIELECTRICS INDUCED BY STRONG OPTICAL RADIATION PULSES

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 71, No 5(11), Nov 76 pp 1863-1872 manuscript received 19 Nov 75

ZAKHAROV, S. I., All-Union Scientific Research Institute of Physical-Optical Measurements

[Russian abstract provided by the source]

[Text] A phenomenological criterion for the breakdown of dielectrics induced by light monopulses is proposed. The distribution of the increase in the density of internal energy in the optical radiation absorption region with respect to electron and phonon subsystems is investigated; limits of the applicability of the von Hippel criterion to the optical breakdown problem are examined. The validity of the Seitz criterion is examined from the standpoint of the criterion proposed by the author. The temperature criterion for breakdown of dielectrics in this category is also discussed. Expressions are derived for the coefficient of absorption of strong optical radiation in dielectrics. References 17: 13 Russian, 4 Western.

USSR

STIMULATED RAMAN SCATTERING AND SELF-FOCUSING OF LIGHT IN SUBSTANCES WITH DIFFERENT EFFECTIVE CROSS SECTION OF RAMAN SCATTERING OF LIGHT

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 71, No 5(11), Nov 76 pp 1738-1754 manuscript received 20 Apr 76

GAZENDEL, J., and RIVOIRE, G., Technological Institute, Angers, France, KUDRYAVTSEVA, A. D., and SOKOLOVSKAYA, A. I., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR

[Abstract] Self-focusing of the first Stokes component of stimulated Raman scattering and laser light was investigated for a large number of substances that have different optical characteristics. The substances were chosen so that the Kerr constant and the effective cross section of Raman scattering were sensibly different. Raman scattering was stimulated by giant pulses of a single-mode ruby laser. Variables characterizing the buildup of stimulated Raman scattering and self-focusing of light in these substances were compared (Kerr constant, gain factors of transformation of laser light into stimulated Raman scattering power density at the points of

minimum-diameter self-focusing and others). These substances were investigated: CS_2 , $\text{C}_6\text{H}_5\text{NO}_2$, C_6H_6 , CHCl_3 , N_2 , CaCO_3 , C_6H_{12} , CCl_4 and CH_3COCH_3 . Factors leading to common properties and differences in the buildup of self-focusing in substances with widely varying Kerr constants are discussed. References 29: 16 Russian, 13 Western.

Superconductivity

USSR

MAGNETIC FORCES ON THE SURFACE OF A SUPERCONDUCTOR

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 71, No 5(11), Nov 76 pp 1893-1904 manuscript received 5 Mar 76

SHIKINA, N. I., Institute of Solid State Physics, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The theory of ponderomotive phenomena at the surface of a superconductor of arbitrary size is derived, valid within the limits of applicability of the London equations or the Ginzburg-Landau equations. The formalism that results serves to describe several effects observed: the influence of magnetic forces on the law of dispersion of flexural oscillations of a plate of arbitrary thickness in a parallel magnetic field, the appearance of an electric quadrupole moment on a superconducting sphere in a uniform magnetic field and so on. The existence of a potential difference between the equator and the poles of this sphere in a magnetic field is confirmed experimentally. A consistent theory of perturbations is proposed for solving the Ginzburg-Landau equation under given conditions with respect to calculating magnetic forces on the surface of a thin plate of a type I superconductor.

USSR

UDC 537.52

ON THE FEASIBILITY OF DETERMINING THE PROPERTIES OF A MEDIUM FROM THE RESPONSE OF A DIFFUSE DISCHARGE TO AN INERTIAL EFFECT

Moscow TEPILOFIZICHESKIYE SVOYSTVA NIZKOTEMPERATURNNOY PLAZMY [Thermophysical Properties of Low-Temperature Plasma, Collection of Works] in Russian, "Nauka," 1976 pp 65-69

SHMIGEL', A. I.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G269 by the author]

[Text] An examination is made of diffuse discharge under conditions of transverse convection caused by the action of forces of inertia or gravitation on the discharge. The author studies the behavior of the discharge as a function of the thermophysical properties of the gas-discharge medium for both steady and periodic action. The theoretical results concerning the influence that these properties have on displacement as well as on the amplitude and phase characteristics of the discharge are confirmed by experimental data.

USSR

UDC 539.9.01

DETERMINATION OF THE ELECTRON CONCENTRATION IN A TWO-TEMPERATURE SYSTEM MADE UP OF A GAS AND HIGHLY DISPERSED NEGATIVELY THERMIONIC PARTICLES

Moscow TERMOFIZICHESKIYE SVOYSTVA NIZKOTEMPERATURNNOY PLAZMY [Thermophysical Properties of Low-Temperature Plasma, Collection of Works] in Russian, "Nauka," 1976 pp 10-14

SAMUYLOV, YE. V. and GORBATOV, A. V.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G6 by the authors]

[Text] The distribution of electron concentration and temperature is found in a two-temperature system where the temperature of the particles exceeds the temperature of the ambient gas. The problem is solved in the quasi-steady state approximation. Due to the difficulties that arise in solving the self-consistent equation in the thermodynamic-equilibrium case, the authors examine two limiting potential distributions for which electron temperature and concentration profiles are found in the vicinity of a spherical thermionic particle.

CALCULATING THE COMPOSITION OF DENSE MULTICOMPONENT PLASMAS

Moscow TEPILOFIZICHESKIYE SVOYSTVA NIZKOTEMPERATURNNOY PLAZMY [Thermophysical Properties of Low-Temperature Plasma, Collection of Works] in Russian, "Nauka," 1976 pp 35-38

ABLEKOV, V. K., KASHNIKOV, G. N., KOZLOV, N. P., LESKOV, L. V., MALASHCHENKO, V. A., PROTASOV, YU. S. and SAVICHEV, V. V.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G1 by the authors]

[Text] The composition of various plasmas is calculated over a range of 5000-90 000 K in temperature and 10^{16} - 10^{19} cm⁻³ in electron concentration, assuming local thermodynamic equilibrium. The existence of local thermodynamic equilibrium in the plasma focus of a magnetoplasma compressor of erosion type has been proved by comparing the results of investigations of plasma parameters (n_e , n_i , T_e , T_i) using independent methods, and by checking compliance with criteria of existence of local thermodynamic equilibrium in the plasma. The missing values of statistical sums for the first to fifth ions of the plasma forming elements were calculated by an approximate method. The paper presents the technique and results of digital computer calculation of the composition of fluorine-carbon and structurally similar multicomponent dielectric plasmas, and also plasmas of a number of metals that are working fluids in magnetoplasma compressors of erosion type.

SOME PROBLEMS OF THERMODYNAMIC CALCULATION OF A MULTICOMPONENT NON-IDEAL PLASMA

Moscow TEPILOFIZICHESKIYE SVOYSTVA NIZKOTEMPERATURNNOY PLAZMY [Thermophysical Properties of Low-Temperature Plasma, Collection of Works] in Russian, "Nauka," 1976 pp 25-30

GRYAZNOV, V. K. and IOSILEVSKIY, I. L.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G2 by the authors]

[Text] The paper describes a program for thermodynamic calculation of a multicomponent plasma. A number of the particulars of such a calculation are discussed. Truncation of statistical sums leads to additional dependence on thermodynamic parameters. This dependence shows up in the region of appreciable non-ideality, and is closely related to the latter. For successful description of strong non-ideality it is essential to comply with general relations that are not related to the smallness of the parameter of interaction. Use of these relations to correct a number of known approximations noticeably improves their extrapolation properties.

USSR

UDC 539.9.01

SHOCK-WAVE COMPRESSION OF A NON-IDEAL PLASMA

Moscow TEPILOFIZICHESKIYE SVOYSTVA NIZKOTEMPERATURNNOY PLAZMY [Thermophysical Properties of Low-Temperature Plasma, Collection of Works] in Russian, "Nauka," 1976 pp 39-42

FORTOV, V. YE., DREMIN, A. N., LEONT'YEV, A. A., LOMAKIN, B. N. and GRYAZNOV, V. K.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G4 by the authors]

[Text] The paper examines a dynamic method of creating and studying a non-ideal plasma that is based on compression and heating of gases on a strong shock wave front. An explosive shock wave generator is described. The caloric equation of state of a non-ideal argon and xenon plasma was determined by using conservation laws through registration of the kinematic parameters of shock wave propagation.

USSR

UDC 539.9.01

INVESTIGATION OF THE PROPERTIES OF A FLAME PLASMA BASED ON EXPERIMENTAL DATA ON THE ELECTRON ENERGY DISTRIBUTION FUNCTION

Moscow TEPILOFIZICHESKIYE SVOYSTVA NIZKOTEMPERATURNNOY PLAZMY [Thermophysical Properties of Low-Temperature Plasma, Collection of Works] in Russian, "Nauka," 1976 pp 60-62

ZAYTSEV, A. S., KITOVA, S. V., TVERDOKHLEBOV, V. I., TVERDOKHLEBOVA, L. S.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G5 by the authors]

[Text] Studies were done on the flame plasma of an oxyacetylene torch at a pressure of 2 mm Hg. In all zones of the flame measured with respect to the second derivative of the probe current the energy spectrum of electrons differs from maxwellian. In the experimentally found spectrum there is a deficit of both high-energy electrons and those with very low energy. An estimate is made of the rate of ionization of the mixture.

CSO: 1862

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