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No. 32

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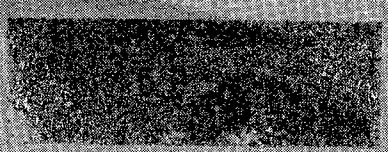

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PHYSICS AND MATHEMATICS

No. 32

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CONTENTS PAGE

USSR

UDC 513.6

ON QUASI-LOCAL 'FIELDS OF CLASSES' OF ELLIPTICAL CURVES. I

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA MATEMATICHESKAYA in Russian Vol 40, No 5, Sep/Oct 76 pp 969-992 manuscript received 22 May 74, after revision 1 Mar 76

VVEDENSKIY, O. N.

[Russian abstract provided by the source]

[Text] The author examines elliptical curves defined over a quasi-local field such that their finite Galois cohomologies are finite. The main result of the work is that Shafarevich-Ogg pairing in curves of the given class is extended with conservation of nondegeneracy to paired-group components that correspond to the characteristic of the field of residues. References 32: 10 Russian, 22 Western.

USSR

UDC 513.88

DISCRETE SYMMETRY OPERATORS FOR REDUCTIVE LIE GROUPS

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA MATEMATICHESKAYA in Russian Vol 40, No 5, Sep/Oct 76 pp 1055-1083 manuscript received 14 Oct 75

ZHELOBENKO, D. P.

[Abstract] For every reductive connected linear Lie group G the author considers a family of elementary G-modules (which can be characterized as Gording spaces of representations of a basic non-unitary series). In the class of these modules there is an analytical family of homomorphisms (interlacing operators) related to orbits of the Weyl group of the symmetric subspace G/K, where K is the maximum compact subgroup in G. There also exists a discrete family of homomorphisms related to orbits of the Weyl group of the pair (g^c, h^c), where g^c is the complexification of the Lie algebra of group G, and h^c is a Cartan subalgebra in g^c. The author calls these homomorphisms discrete symmetry operators, and in this article they are described and classified in detail. Operators of rank 1 are distinguished which are induced by simple normally imbedded subgroups of rank 1. Analogy with the complex case shows that these operators together with Schifmann's interlacing integrals generate the entire family of interlacing operators in the class of elementary G-modules. At the same time, reduction to rank 1 appreciably simplifies the investigation of these operators.

The article is divided into three chapters. The first chapter is introductory and contains the definition of discrete symmetry operators. The second chapter studies operators of rank 1 and their images in the "K-realization." In the third chapter the kernels of these operators are calculated in terms of contraction to the subgroup K for cases of a simple K-spectrum (unitary and orthogonal Lie algebras). In all other cases (simplex Lie algebras and F_4) the proposed method is applicable but leads to more complicated calculations. The author's intention is to study these cases separately.

The author's results enable description of all sub-modules of elementary G-modules in the cases $G = SU(n,1)$, $SO(n,1)$, which in turn provides the basis for a similar description of unitary and orthogonal groups of arbitrary rank. References 13: 7 Russian, 6 Western.

USSR

UDC 519.4

THE SERRE PROBLEM ON PROJECTIVE MODULES OVER RINGS OF POLYNOMIALS, AND THE ALGEBRAIC K-THEORY

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA MATEMATICHESKAYA in Russian Vol 40, No 5, Sep/Oct 76 pp 993-1054 manuscript received 4 Apr 75

VASERSHTEYN, L. N. and SUSLIN, A. A.

[Abstract] Let F be a field, and let $A = F[x_1, \ldots, x_n]$ be a (commutative) ring of polynomials in n variables with coefficients from F. A problem formulated by J.-P. Serre asks whether every projective A-module is free. The problem has been solved with positive results in the following cases: $n = 3$ and either F is perfect or $\mathrm{char}(F) \neq 2$; $n = 4$ and $\mathrm{char}(F) \neq 2$; $n = 5$ and F is aogebraic over the finite field of a characteristic other than 2. Developing their methods further, the authors get the following result: Theorem 1. Let F be a field, n be a natural number and $A = F[x_1, \ldots, x_n]$. Let us assume that either $n \leqslant 5$ or $n = 6$ and the field F is algebraic over a finite field. Then every projective A-module is free. In this article the authors prove the following theorem: Theorem 2. Let C be the domain of principal ideals, $A = C[x_1, \ldots, x_n]$ with natural $n \leqslant 4$. Then every projective A-module is free.

The results are summarized at the end of the article, where a number of other results on the freedom of projective and stably free modules over rings of polynomials are obtained in addition to theorems 1 and 2. For instance the following theorem is true: Theorem 3. Let C be the principal ideal domain, n and r be natural numbers, and $A = C[x_1, \ldots, x_n]$. Let us assume that either $r \geqslant (n+5)/3$ or $r \geqslant \max(4, (n+4)/3)$ and C is a finitely spanned ring. Then every projective A-module of rank r is free. References 46: 18 Russian, 28 Western.

USSR

UDC 534.8

ACOUSTICAL RELAXATION IN SOLUTIONS OF CELLULOSE ESTERS

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA, FIZIKA KHIMIYA in Russian
Vol 16 No 3, Aug 76 pp 53-58 manuscript received 21 Apr 76

GRIGOR'YEV, S. B., KITSENKO, L. A., and MIKHAYLOV, I. G.

[Abstract] A report is presented on a continuing study of the mechanical relaxation properties of polymer molecules with high chain rigidity. The objects of the study were solutions of cellulose esters, namely methyl-, ethyl- and oxyethyl celluloses. Measurements of the acoustical absorption factor were performed in the frequency range of 0.1-1000 MHz at 20°C. The frequency dependences of acoustical absorption for all of the solutions studied are relaxation curves with a broad time spectrum. For other solutions, these dependences can be described by a set of two wide relaxation time spectra. The single broad relaxation time spectra observed in MC and OEC can apparently be explained by keeping in mind the specifics of water as a solvent. MC and OEC are quite similar in their conformation properties and in aqueous solutions form the most extended conformation due to the strong solvation of the polymer chain via hydrogen bonds. The presence of solvation layers should change the intramolecular mobility and, consequently, the nature of large- and small-scale movements, apparently greatly increasing the rigidity of the polymer chain, shifting the LF relaxation spectrum into an area of still lower frequencies. References 11: 10 Russian, 1 Western.

USSR

ON A POSSIBLE NEW TYPE OF PHOTOCONDUCTIVITY IN DISORDERED SEMICONDUCTORS WITH A RANDOM FIELD

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian
Vol 24, No 9, 5 Nov 76 pp 507-509 manuscript received 30 Sep 76

BONCH-BRUYEVICH. V. L., Moscow State University imeni M. V. Lomonosov

[Abstract] In random fields of a fairly general type, all discrete (fluctuation) levels above the Fermi level F are unsteady even at the absolute zero of temperature. Due to spontaneous emission of phonons and/or photons, etc. (magnons as well in magnetic materials) transitions may take place from these levels to lower-lying states. It is shown that the density of states in the energy region $E > F$ is non-zero and continuous even at $T = 0$. Thus the electrons that enter this energy region make a finite contribution to the static electrical conductivity at $T = 0$. An estimate is made of the mobility of electrons injected into the given region by exposure to light with the proper frequency. It is shown that the photon contribution to line width may be comparable to the phonon contribution for sufficient luminous intensity. Under these conditions at low temperatures, disordered semiconductors should show superlinear photoconductivity: the light not only injects electrons into the appropriate levels, but also widens these levels as a result of stimulated emission. References 4: 3 Russian, 1 Western.

USSR UDC 621.315.592

A PHOTORECEIVER BASED ON THE EFFECT OF LUMINOUS PRESSURE ON FREE CARRIERS WITH PLASMA REFLECTION FROM SEMICONDUCTORS

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 10, No 11, Nov 76 pp 2031-2038 manuscript received 30 Mar 76

KURBATOV, L. N., ROMANOV, G. N. and SHAKHIDZHANOV, S. S.

[Abstract] An investigation is made of the normal and tangential effect of photon entrainment of free carriers under conditions of plasma reflection for the case of normal and oblique incidence of light on the surface of a semiconductor, and the parameters of a photoreceiver based on this effect are estimated. The effect of entrainment of free carriers is explained in classical terms of the Lorentz force that arises due to electron motion caused by the electric field of the light wave in the magnetic field of the same wave, and an electrodynamic theory is outlined on the basis of the wave equation in a conductive medium. Using solutions of this equation and the relation between the electric and magnetic field components for plane waves, the authors find an expression for the time-averaged force acting on a free charge carrier as a function of the energy flux density in the semiconductor. It is shown that the voltage sensitivity close to the plasma resonance frequency is $2.7 \cdot 10^{-4}$ V/W·cm^{-2} when the distance between contacts is 1 cm and angle of incidence is about 33°, the time resolution being of the order of 10^{-11} s. For a flux density of luminous energy equal to 1 W/cm^2 and oblique incidence, the efficiency of conversion of luminous power to DC power is about 10^{-8}. The value for normal incidence under the same conditions is 10^{-7} if the current density is limited by contact resistance, and $3 \cdot 10^{-4}$ if the frequency of light modulation lies in the range of tens of GHz so that the current sensitivity reaches its maximum of about 600 A/W. References 8 Russian.

USSR UDC 621.382.2

POLARIZATION PROPERTIES OF $CdSnP_2$ DIODES

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 10, No 11, Nov 76 pp 2081-2084 manuscript received 31 May 76

MEDVEDKIN, G. A., OVEZOV, K., RUD', YU. V. and SOKOLOVA, V. I., Physico-technical Institute imeni A. F. Ioffe, Academy of Sciences USSR, Leningrad

[Russian abstract provided by the source]

[Text] Diode structures are made on the basis of copper-doped $CdSnP_2$ crystals (Cu-$CdSnP_2$ Schottky barriers and alloy-junction diodes). For the best diodes rectification reached 10^3 at a voltage of 1 V and reverse current of

USSR

MEDVEDKIN, G. A. et al., FIZIKA I TEKHNIKA POLUPROVODNIKOV, Vol 10, No 11, Nov 76 pp 2081-2084

$\simeq 3 \cdot 10^{-8}$ A, open-circuit photoelectromotive force of $\simeq$0.3-0.4 V at 300 K. It is found that the photosensitivity of the diodes and the optical absorption of their base are a periodic function of the angle between the tetragonal axis of the crystal and the electric vector of the light wave. The photosensitivity spectra of the diodes as a function of polarization and excitation geometry are analyzed on the basis of the energy model and selection rules for optical transitions. An analysis of pleochroism spectra reveals that $CdSnP_2$ diodes can be used for analyzing polarized emission in the spectral region of 1-1.5 eV at T = 300 K. References 10: 5 Russian, 5 Western.

USSR UDC 621.315.592

ALUMINUM NITRIDE FILMS ON SILICON AND GERMANIUM

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 10, No 11, Nov 76 pp 2123-2126 manuscript received 22 Jun 76

KUZNETSOV, O. N., LEZHEYKO, L. V., LYUBOPYTOVA, YE. V., SMIRNOV, L. S., SHVARTSEV, YU. V. and EDEL'MAN, F. L., Institute of Physics of Semiconductors, Siberian Department of the Academy of Sciences USSR, Novosibirsk, Physicotechnical Institute imeni A. F. Ioffe, Academy of Sciences USSR, Leningrad

[Abstract] A new method is described for growing aluminum nitride films, and an investigation is made of the cathodoluminescence spectra of the resultant films for stimulating electron energies of 6-29 keV. A study is done on the capacitance-voltage characteristics of Al-AlN-Si-Al structures at high frequency (1 MHz). An aluminum layer was sputtered on surface (111) of a silicon crystal and then exposed to nitrogen ions with energy of 40 keV. The maximum dose of implanted ions was $1.5 \cdot 10^{18}$ cm^{-2}, giving a film up to 1200 Å thick with an area of about 0.5 cm^2. Electron microscope studies showed that the film structure improves with increasing target temperature and increasing thickness of the Al sublayer. The capacitance-voltage characteristics show that the density of surface states on the AlN-Si interface is $2 \cdot 10^{11}$ cm^{-2}. The breakdown electric field strength is at least 10^6 V/cm, and the permittivity of the AlN film is of the order of 10. The cathodoluminescence spectra are complex and highly dependent on the energy of the stimulating electrons. References 9: 5 Russian, 4 Western.

USSR UDC 621.315.522

METAL—p-SEMICONDUCTOR — METAL (MSM) STRUCTURE BASED ON CdTe AS A SPECTROMETRIC DETECTOR OF NUCLEAR RADIATION

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 10, No 11, Nov 76 pp 2127-2132 manuscript received 22 Jun 76

AKOBIROVA, A. T., MATVEYEV, O. A., RYVKIN, S. M. and KHUSAINOV, A. KH., Physicotechnical Institute imeni A. F. Ioffe, Academy of Sciences USSR, Leningrad

[Russian abstract provided by the source]

[Text] In a metal—p-type semiconductor—metal structure produced by the application of metal to an etched surface it is typical for the current to depend linearly on voltage over a wide voltage range; this linear dependence corresponds to the resistance of the semiconductor. Beyond the linear section is an abrupt rise in current, corresponding to a transition to complete filling of traps. The results show that such a structure carries a space charge limited hole current set up by holes localized on deep capture centers. The specific distribution of electric field due to the space charge limited current results in a carrier transit time in the MSM structure appreciably greater than that in a solid ionization chamber (p-i-n structure) with analogous parameters. Experimental results are given for a gold—(p_i-CdTe)—gold structure. References 10: 6 Russian, 4 Western.

USSR UDC 621.315.592

INTRINSIC PHOTOCONDUCTIVITY OF INDIUM ANTIMONIDE CRYSTALS WITH PROTECTIVE FILMS

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 10, No 11, Nov 76 pp 2138-2144 manuscript received 29 Mar 76

KOVALEVSKIY, V. V., PLOTNIKOV, A. F. and PODLESNYKH, L. S., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR, Moscow

[Abstract] Protective dielectric films on the surface of semiconductors may alter the physical processes that take place in these materials, and thus influence the characteristics of devices based on them. The authors study the inherent photoconductivity of indium antimonide single crystals with surfaces coated with thin oxide films, which were anodized from 300 to 1000 Å in thickness. It is found that the protective oxide layer has an appreciable effect on electron lifetime. Coated specimens show an increase in photoconductivity with decreasing wavelength in the spectral region from 2.9 to 2.0 μm, indicating electron transitions that increase the lifetime of nonequilibrium charge carriers, e. g. transition of some of the carriers

generated by exposure to light from the semiconductor into the oxide, resulting in a change in filling of oxide traps by electrons, and in particular the recombination surface levels. The capacitance-voltage characteristics show absence of electric charge in the oxide layers. Exposure to a wavelength shorter than 1.9 μm induces a negative charge in the oxide layer that is steady at nitrogen temperatures, depleting the majority carriers from the semiconductor surface layer. Under these conditions the surface photoemf with zero biasing is determined only by the negative charge localized in the oxide layer. An analytical expression is found for the carrier lifetime as a function of the excitation level. The concentration of recombination centers is found to be of the order of 10^{12} cm^{-3}, which agrees with the density of surface states in these crystals. An energy diagram is proposed for the semiconductor-oxide interface. References 12: 8 Russian, 4 Western.

USSR UDC 621.382.2

DETERMINATION OF THE CONCENTRATION PROFILE OF A DEEP IMPURITY IN A DIFFUSION pn-JUNCTION

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 10, No 11, Nov 76 pp 2157-2159 manuscript received 6 Feb 76

BERMAN, L. S., Physicotechnical Institute imeni A. F. Ioffe, Academy of Sciences USSR, Leningrad

[Abstract] A method is proposed for determining the concentration profile of an electrically active deep impurity $N_d(x)$ in a diffusion junction for the case of a two-charge impurity with donor level E_d in the lower half of the forbidden band and acceptor level E_a in the upper half, where the relaxation times for filling of these levels differ by several orders of magnitude. The method can be extended to other multiply charged impurities. It is shown how $N_d(x)$ can be determined from the increase in capacitance as charge exchange takes place between impurity levels at two temperatures (for the case $N_d(x) \ll N_s(x)$), and from the values of dC/dV at three temperatures (for the case where $N_d(x) < N_s(x)$ but the concentrations are comparable in order of magnitude). The resultant expressions for concentration profile are applicable in particular to gold in a diffusion silicon junction. References 6: 1 Russian, 5 Western.

USSR

MAGNETIC ORDERING OF Mn^{2+} AND Cr^{3+} IONS IN $Mn_3Cr_2Ge_3O_{12}$ GARNET

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHSKOY FIZIKI in Russian Vol 24 No 8, 20 Oct 76 pp 461-464 manuscript received 25 Aug 76

GOLOSOVSKIY, I. V., PLAKHSHIY, V. P., SMIRNOV, O. P., CHERNENKOV, YU. P., KOVALEV, A. V. and BEDRIZOVA, M. N., Institute of Nuclear Physics imeni B. P. Konstantinov, Academy of Sciences USSR

[Abstract] The neutron-diffraction method is used to determine the magnetic structure of spins of Mn^{2+} ions in dodecahedral sites and Cr^{3+} ions in octahedral sites of $Mn_3Cr_2Ge_3O_{12}$ garnet. A polycrystalline specimen of the compound was studied in the temperature range of 2-300 K. It is found that magnetic order arises in the chromium sublattice below 5.1 K, and in the manganese sublattice below 3.9 K. The ordering of spins is independent for the Cr^{3+} and Mn^{2+} ions. The bond between the octahedral and dodecahedral sublattices is weak and only reduces the intrasublattice interaction as compared with garnets that contain one of these ions. References 6: 3 Russian, 3 Western.

USSR

UDC 535.37

INFLUENCE OF UNIAXIAL DEFORMATION ON POLARIZED LUMINESCENCE OF ISOTROPIC SEMICONDUCTORS

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian Vol 40, No 11, Nov 76 pp 2346-2349

BERKOVITS, V. L., SAFAROV, V. I. and TITKOV, A. N., Physicotechnical Institute imeni A. F. Ioffe, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] Comparatively small deformations (of the order of 10 kg/mm^2 or more) may cause appreciable changes in the state of polarization in GaSb crystals: an abrupt increase may take place in the degree of polarization (by a maximum factor of 2.5), spectral dependence of the degree of polarization occurs, which is absent at zero deformation, and in the case of longitudinal deformation there is a change in the sign of polarization. References 7: 5 Russian, 2 Western.

USSR

ON ONE POSSIBILITY FOR RF HEATING OF THE PLASMA IN TOKAMAKS

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian
Vol 24 No 8, 20 Oct 76 pp 457-461 manuscript received 23 Aug 76

LONGINOV, A. V. and STEPANOV, K. N., Physicotechnical Institute of the Academy of Sciences UkrSSR

[Abstract] An examination is made of the feasibility of using fast modes of magnetoacoustic waves (H-waves) stimulated on the inside of the torus in tokamaks for rf heating of the plasma. As the fast mode propagates down into the plasma, it reaches a critical point where it is transformed into a slow mode that propagates in the opposite direction, reaching a point of lower hybrid resonance where it is converted to a plasma wave. If the plasma is sufficiently dense, the fast mode may penetrate directly to conditions of lower hybrid resonance. The feasibility of rf heating by this technique is due to the toroidal effect that leads to a change in direction of the long radius of the longitudinal component of the wave vector and the magnetic field. Conditions of wave propagation are analyzed, and it is shown that the action of parametric instabilities may be strongly attenuated for fast modes in the low-density region, and also that the angle between the group velocity and magnetic field may be greater than for slow modes. References 11: 6 Russian, 5 Western.
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USSR

INVESTIGATION OF NONADIABATIC EFFECTS OF THE MOTION OF CHARGED PARTICLES IN A DIPOLE TRAP WITH ADIABATIC PERTURBATIONS

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 70, No 4, Apr 76 pp 1269-1273 manuscript received 3 Jul 75

IL'IN, V. D. and IL'INA, A. N., Scientific Research Institute of Nuclear Physics, Moscow State University imeni M. V. Lomonosov

[Russian abstract provided by the source]

[Text] A change is observed in the number of captured particles in a dipole trap acted on by a reversible adiabatic magnetic perturbation. The critical adiabaticity parameter for the perturbed field is found that defines the boundary between reversible and irreversible changes of particle fluxes. The pitch-angle dependence is given for the critical adiabaticity parameter for a static field. The law of change in particle density in the trap is determined as a function of the amplitude and duration of the perturbation. References 4 Russian.

USSR UDC 621.384.6.01

LONGITUDINAL STABILITY OF A CHARGED BEAM IN A PERIODIC METAL-DIELECTRIC SYSTEM

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 46 No 10, Oct 76 pp 2108-2111 manuscript received 16 Apr 75

RESHETNIKOVA, K. A., Joint Institute of Nuclear Research, Dubna

[Abstract] An increasing intensity of particles in an accelerator may lead to various dangerous instabilities, as a result of interaction between these particles and the system. This study is concerned with the longitudinal stability of a magnetized electron beam with respect to axisymmetric waved in a periodic metal-dielectric channel structure. The analysis is based on the hydrodynamic flow and continuity equations for the electron beam as well as on Maxwell's field equations. The beam is transversely focused by a constant magnetic field, all fields are axisymmetric, and all quantities vary sinusoidally in space and time. In the linear approximation, furthermore, the longitudinal component of the current density is proportional to the longitudinal component of the electric field intensity. The boundary conditions assume continuity of the tangential field components when a metal-dielectric interface is crossed. The solvability condition leads to a dispersion equation relating the frequency and the phase velocity of a wave to the system parameters. It leads in this case to the conclusion that an electron beam will remain stable with respect to long-wave perturbations, but may become unstable with respect to pertubations of a wavelength within the dielectric which is comparable to or shorter than the period of the structure. References 4: 2 Russian, 2 Western.

USSR UDC 532.46:533.6

FLAME PROPAGATION IN A TURBULENT FLOW OF FUEL MIXTURE

Moscow IZVESTIYA AKADEMII NAUK SSSR, MEKHANIKA ZHIDKOSTI I GAZA in Russian
No 5, Sep/Oct 76 pp 3-15 manuscript received 26 Jan 76

KUZNETSOV, V. R., Moscow

[Abstract] The flame propagation in a turbulent flow of fuel mixture is theoretically investigated in a study of "surface" burning, where the thickness of the normal flame front usually is of the order of 0.1 mm; considered is the average motion of a plane stationary flame front propagating with the velocity u_t, which is the burning rate. From correlations of analyzed formulas an expression for u_t results; it indicates that the velocity of flame propagation increases indefinitely with unlimited decrease of the flame front thickness in laminar flow, that the scale of turbulence has little effect on the propagation rate of the flame and that the flame temperature is a weak function of the initial temperature. The comparison of absolute values of u_t and experimental data of a stoichiometric gasoline-air fuel mixture at normal pressure and at the initial temperature of 440°K in a 5x5 cm square pipe at the speed of 50 m/s results in u_t=5 m/s; this is in good correlation with the measured value of u_t=6.8 m/s. Formulas 45; references 20: 7 Western, 13 Russian.

USSR UDC 532.5.013.4:538.4

TAYLOR INSTABILITY OF THE INTERFACE OF TWO LIQUIDS IN AN ELECTROMAGNETIC FIELD

Moscow IZVESTIYA AKADEMII NAUK SSSR, MEKHANIKA ZHIDKOSTI I GAZA in Russian
No 5, Sep/Oct 76 pp 24-27 manuscript received 16 Jan 76

SHCHELKACHEV, M. V., Moscow

[Abstract] The gravitational instability of the interface of two compressible or of two incompressible liquids is analyzed. The liquids are in an electromagnetic field, one is nonconducting the other possesses a limited conductivity and the magnetic Reynolds number is considered low. It is demonstrated that in contrast to investigations by other authors (infinitely conductive compressible liquids on both sides of the surface of discontinuity) the interface cannot be stabilized by the electromagnetic field. At the same time, there may exist stable directions of the propagation of disturbances. The presence of walls decreases the growth of disturbances but their conductivity does not affect the instability of the interface. A comparison of derived dispersion functions for compressible and incompressible liquids shows that the maximum growth of instability arises in waves propagating along the magnetic field in the liquids. In the case of incompressible liquids, the

electromagnetic field does not influence the growth of disturbances, whereas it affects the growth in the case of compressible liquids by increasing or decreasing the growth of unstable disturbances. Formulas 13; references 5 (Russian).

USSR UDC 532.516

ON THE INSTABILITY TOWARD THREE-DIMENSIONAL DISTURBANCES

Moscow IZVESTIYA AKADEMII NAUK SSSR, MEKHANIKA ZHIDKOSTI I GAZA in Russian No 5, Sep/Oct 76 pp 29-34 manuscript received 4 Jan 76

SHTERN, V. N., Novosibirsk, Institute of Thermophysics of the Siberian Department of the Academy of Sciences, USSR

[Abstract] The analysis of parallel flows of a viscous fluid shows that at high values of the critical Reynolds number R the range of the zone of the generation of turbulence in the initial stage of its development is formed by three-dimensional perturbations. This applies both to the generation range of wave numbers and to the size of the boundary layer of the flow in which the pulsation energy is generated. The consequences arising from Squire transforms for parallel flows are analyzed. They include one-to-one correspondence between one-parameter families of three-dimensional problems and solutions of two-dimensional problems, finiteness of the instability range of wave numbers and the existence of a unique dispersion dependence of the phase velocity of three-dimensional neutral oscillations on the modulus of the wave vector for any Reynolds numbers. The role of resonant nonlinear three-harmonic interaction in rapid rise of pulsation energy is studied for the case of explosive instability of an extended laminar flow. It is shown that the rate of generation of turbulent energy is due to nonlinear three-harmonic interactions of neutral and rising perturbations whose spatial properties play an appreciable part, rather than to decrements according to the linear theory. References 15: 10 Russian, 5 Western.

USSR UDC 532.516

THE STABILITY OF SECONDARY FLOWS OF A VISCOUS LIQUID IN AN UNLIMITED SPACE

Moscow PRIKLADNAYA MATEMATIKA I MEKHANIKA in Russian Vol 40 No 5, 1976 pp 886-891 manuscript received 27 Dec 74

NEPOMNYASHCHIY, A. A., Perm'

[Abstract] A study is made of secondary motions arising as a result of instability of plane-parallel flow of a viscous incompressible fluid in an unlimited space with a sinusoidal velocity profile with slight excess over the threshold Reynolds number throughout the entire interval of wave numbers between zero and the wave number d_m of neutral perturbation of plane-parallel motion. The stability of secondary motions is studied in relationship to perturbations disrupting the periodicity of the motion. The author employs the method of expansion with respect to d_m used periodically to study the stability of wave modes in a film of a viscous fluid flowing down an inclined plane. It is shown that all of the spatially periodic secondary motions are unstable. References 8: 6 Russian, 2 Western.

USSR UDC 532.252.2

ON THE CALCULATION OF OSCILLATORY NONEQUILIBRIUM IN FLAT SUPERSONIC NOZZLES

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 14 No 5, Sep/Oct 76 pp 954-990 mnauscript received 13 Jan 75

ANAN'KIN, A. I., KHAYLOV, V. M. and SHIKHMAN, YU. M., Moscow

[Russian abstract provided by the source]

[Text] Theoretical calculations are done on two-dimensional flow of an oscillatory-nonequilibrium gas mixture of CO_2-N_2-H_2O in a flat Laval nozzle with a corner point. The analysis is based on the example of a nozzle with throat height of 1 mm in which the contour of the supersonic flow section is designed to give a parallel flow with $M = 4$. The parameters of flow stagnation were varied over a range of $T_0 = 1700$-2000 K and $p_0 = 5$-10 atmospheres. Nozzles with different configurations of the subsonic sections were calculated: a smooth aerodynamic configuration giving uniform flow in the throat, and with rectilinear walls in the subsonic section making an angle of 45° with the axis of the nozzle. An estimate is made of the influence that the two-dimensional nature of the flow has on the amplification factor on the 001-100 transition of the CO_2 molecule and on the distribution of gasdynamic parameters in the investigated nozzles. References 14: 11 Russian, 3 Western.

USSR UDC 532.542.1

CALCULATION OF THE VELOCITY PROFILE IN A TWO-PHASE FLOW IN THE CASE OF A DISPERSED RING FLOW REGIME

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 14 No 5, Sep/Oct 76 pp 1015-1021 manuscript received 10 Jul 74

KASHCHEYEV, V. M. and MURANOV, YU. V., Power Engineering Physics Institute

[Russian abstract provided by the source]

[Text] An expression is derived for the longitudinal velocity of steam in a steam-water flow in the dispersed ring regime by substituting homogeneous flow for the two-phase stream, using basic principles of semi-empirical theories of turbulence. The validity of the formula is verified in a comparison of the theoretical results with experimental data. Satisfactory agreement is observed between the results of calculation and experiment. References 13: 10 Russian, 3 Western.

USSR UDC 532.517.4

APPLICABILITY OF THE BOUNDARY LAYER APPROXIMATION TO CALCULATION OF A PLANE TURBULENT MIXING LAYER

Moscow IZVESTIYA AKADEMII NAUK SSSR, MEKHANIKA ZHIDKOSTI I GAZA in Russian No 5, Sep/Oct 76 pp 35-42 manuscript received 6 Feb 76

RASSHCHUPKIN, V. I. and SEKUNDOV, A. N., Moscow

[Abstract] The calculation of the mixing layer is a classical problem of the theory of jet flows and it is usually carried out in the boundary layer approximation. At low velocity of one of the flows, the angle of flare of the mixing layer amounts to 20% in the case of an incompressible liquid and it proves to be even more when flows of different densities are mixed. Therefore, doubts arise concerning the smallness of rejected terms that include differentiation in the direction of discharge of the flows. The problem of mixing of two semi-infinite flows is solved in the boundary layer approximation and by applying an entire system of Reynolds equations, assuming the molecular viscosity is low compared with the turbulent viscosity which corresponds to $Re \to \infty$. Formulas 25; figures 5; table 1; references 19: 12 Western, 7 Russian.

USSR UDC 532.59

WAVES IN AN INHOMOGENEOUS LIQUID FROM PERIODIC PRESSURES IN THE PRESENCE OF A THIN PLATE

Moscow IZVESTIYA AKADEMII NAUK SSSR, MEKHANIKA ZHIDKOSTI I GAZA in Russian No 5, Sep/Oct 76 pp 91-96 manuscript received 12 Oct 75

KLAD'KO, S. R., Odessa

[Abstract] The problem of the motion of a two-layer liquid of finite depth under the action of a pressure applied to its surface in presence of a semi= infinite plate is analyzed in the linear approximation. Derived expressions define the form of the surface and internal waves that arise. Presented results of numerical calculations of the rise in the free surface and the interface caused by the applied pressure indicate that waves originating on the interface differ from the respective waves on the free surface only in their amplitudes. The thin plate exerts an appreciable influence on the oscillations of the liquid caused by the pressure applied to its surface. The elevation of the free surface and of the interface in the zone between the plate and the pressure system is considerably lower than the rise in the corresponding points of the area located behind the zone of pressure application. Formulas 11; references 4 (Russian).

USSR UDC 532.529.5-1

THE MOTION OF A MIXTURE OF LIQUID AND GAS BUBBLES IN THE FIRST STAGE OF CAVITATION

Moscow IZVESTIYA AKADEMII NAUK SSSR, MEKHANIKA ZHIDKOSTI I GAZA in Russian No 5, Sep/Oct 76 pp 151-153 manuscript received 15 Dec 75

BISHAY KHANNA, S. S., Moscow

[Abstract] On the basis of the B. S. Kogarko model (B. S. Kogarko: Doklady Akademii Nauk SSSR 1961, v 137, No 6) of the motion of a cavitating liquid described by a system of equations of motion, continuity and state, solutions in first and second approximations were derived for non-stationary motion of a mixture of an ideal incompressible liquid with gas bubbles in the starting stage of a developing cavitation. The cases of the motion in a pipe behind a moving piston, in a pipe with an immovable bottom and a free surface and the case of pulsating pressure on the free surface of a pipe are analyzed. An expression is derived for the velocity field of a piston moving with a given speed. Formulas 16; references 2 (Russian).

USSR UDC 533.6.01.5

NONSTATIONARY HYPERSONIC STREAMLINE FLOW OVER SPIKE-NOSED BODIES

Moscow IZVESTIYA AKADEMII NAUK SSSR, MEKHANIKA ZHIDKOSTI I GAZA in Russian
No 5, Sep/Oct 76 pp 118-124 manuscript received 18 Nov 75

ANTONOV, A. N., GRETSOV, V. K. and SHALAYEV, S. P., Moscow

[Abstract] The occurrence of nonstationary conditions in longitudinal hypersonic flow around a cylinder with spiked nose is experimentally investigated in a wind tunnel with the help of a high-speed motion picture camera at Mach numbers M=2.1-6.0 and Re varying from $7 \cdot 10^4$ to $1.6 \cdot 10^6$. The results of filming of the changing flow picture in the vicinity of the spike are discussed on the basis of photographs and diagrams. The dependence of the ripple frequency on Mach and Reynolds numbers of the undisturbed flow and also on the relative diameter and on the angle of taper of the spike are systematically investigated by reference to illustrated results of measurements. Particular attention is paid to the study of the influence of dimensionless parameters on the Strouhal number Sh of vibrations of the separation zone on the spike in front of the cylinder face. Calculated values of Sh numbers are in good correlation with experimental data derived at various Mach numbers of the incident flow and under turbulent flow conditions in the separation zone. Formulas 10; figures 5; references 7: 3 Western, 4 Russian.

USSR UDC 621.387.325

STABILIZATION OF THE OUTPUT RADIATION FROM A MODE-LOCKED YAG:Nd LASER

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 46 No 10, Oct 76 pp 2198-2200 manuscript received 3 Nov 75

KOVALENKO, YE. S. and MANDEL', A. YE., Institute of Radioelectronics and Automated Control Systems, Tomsk

[Abstract] It is shown that stabilization of solid-state lasers is possible by resonant modulation of resonator losses. In a YAG:Nd laser the transition of axial mode locking is accompanied by a simultaneous vanishing of radiation spikes. A YAG:Nd rod with coated end faces was placed inside a cylindrical illuminator and pumped by a cw krypton-arc lamp. The resonator was formed by two mirrors with dielectric coatings deposited on wedgelike substrates. A diaphragm served to suppress the transverse modes. The losses were modulated by an acousto-optic cell with a $LiNbO_3$ crystal. It was possible to attain 25% modulation, as a result of diffraction of light by the standing acoustic waves in the lithium niobate, with the frequency of intermodal beats about 188 MHz. A photomultiplier was used as the receiver. References 4 (Russian).

USSR UDC 621.378.33

PARAMETRIC ANALYSIS OF A PULSED H_2-F_2 LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3, No 9(51), Sep 76 pp 1932-1940 manuscript received 16 Jan 76

AGROSKIN, V. YA., VASIL'YEV, G. K., KIR'YANOV, V. I. and TAL'ROZE, V. L., Institute of Chemical Physics, Academy of Sciences USSR, Moscow

[Abstract] An analysis is made of a hydrogen-fluorine laser on the basis of a simplified model in which the chemical reaction kinetics are described by a two-parameter scheme, while the main processes of stimulated emission within the framework of the simplest two-level model are described by certain effective constants selected from comparison with experiment. The degree of dissociation of F_2 molecules was experimentally determined in a conventional installation used for studying pulsed chemical lasers. The experiments were done at an initial temperature of 300 K; the variables were the composition of the mixture, the degree of dissociation of fluorine molecules ($\alpha = 0$-2%) and the initial pressure of the mixture ($P_0 = 0$-3 at). Curves are given for these variables as functions of the specific power output ε of the stimulated emission. The behavior of $\varepsilon(\alpha)$ has a threshold at $\alpha = 0.15\%$ and increases monotonically with α. When the partial composition of the mixture is held constant, $\varepsilon(P)$ has a maximum with approximately linear change in specific

power output with pressure on each side. This maximum shifts toward lower pressures with richer mixtures or with increasing characteristic time ω^{-1} of the initiating pulse. Increasing the pressure by adding helium has about the same effect on power reduction as an increase in pressure while the partial composition is held constant. The curve for $\varepsilon([H_2]/[F_2])$ is approximately hyperbolic. Agreement between experimental and theoretical results is observed only for hydrogen:fluorine ratios of the order of 0.3 or greater. The absence of agreement for values of $[H_2]/[F_2]$ of less than 0.3 can be attributed to incompleteness of the assumed kinetic scheme:

$$F_2 \xrightarrow{h\nu} 2F,$$
$$F + H_2 \rightarrow HF + H,$$
$$H + F_2 \rightarrow HF + F,$$
$$H + O_2 + M \rightarrow HO_2 + M.$$

It is shown that stimulated emission reaches maximum efficiency when the characteristic reaction time is of the same order as the characteristic time of initiation. References 28: 10 Russian, 18 Western.

USSR

UDC 621.375.826

AMPLIFICATION OF EMISSION ON THE FUNDAMENTAL FREQUENCY AND HARMONICS DURING A CHEMICAL REACTION

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3, No 9(51), Sep 76 pp 1967-1979
manuscript received 8 Feb 76

BASOV, N. G., BASHKIN, A. S., IGOSHIN, V. I. and ORAYEVSKIY, A. N., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR, Moscow

[Abstract] An analysis is done on the problem of amplification of emission on the fundamental frequency and harmonics in the case of chemical pumping under conditions of rotational equilibrium. An expression is derived for the power density of the stimulating emission on harmonics, and a criterion of suitability is formulated for selecting a transition in making an amplifier. Application of the proposed theory to the reaction $H_2 + F_2$ shows that this reaction can be used in principle as a basis for developing efficient amplifiers on the fundamental frequency ($\lambda = 2.7$ μm) and the first harmonic ($\lambda = 1.3$ μm). An examination is made of some of the unsolved problems that still block the way to creation of amplifiers with chemical pumping: development of a multifrequency master laser with low divergence and fairly high emission intensity; development of a more detailed mathematical model of the amplifier that would enable calculations of emission intensity not only in the direction of propagation of the amplified signal but also in the reverse direction and across the axis of the amplifier; finding ways to reduct the intensity of the reverse wave. When these problems have been solved it should be feasible to make fluorine-hydrogen lasers that emit in the range of 1.3-1.8 and 2.7-3.7 μm. References 13: 5 Russian, 8 Western.

USSR

LASER DETECTION OF LOW CONCENTRATIONS OF URANIUM ATOMS FORMED IN A CHEMICAL REACTION

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 24 No 8, 20 Oct 76 pp 475-478 manuscript received 21 Sep 76

BALYKIN, V. I., LETOKHOV, V. S., MISHIN, V. I. and SEMCHISHEN, V. A., Institute of Spectroscopy, Academy of Sciences USSR

[Abstract] A report on experimental observation of small numbers of uranium atoms (1000 atoms per cc) by the method of stimulation of fluorescence by the emission from a tunable cw dye laser. The technique was used for studying the reactions $(NH_4)_2UF_6 \rightarrow 2(NH_4)F + UF_4$ and $UF_4 + 2Ba \rightarrow U + 2BaF_2$. The reaction products escaped from the crucible through a small opening in the cover and the vapor jet was probed by a transverse laser beam tuned to the wavelength of the uranium absorption line. The fluorescence signal was registered by synchronous detection. The absolute concentration of uranium atoms was determined by comparing the fluorescence signals with Rayleigh scattering in air or argon. The minimum number of individual atoms that can be detected in the proposed method is of the order of ten. The technique is applicable to laser spectroscopy of trace amounts of transuranium and radioactive elements and determination of temperature dependence of the vapor pressure of these elements. References 6: 3 Russian, 3 Western.

USSR UDC 621.375

CONCERNING THE INFLUENCE THAT ADDITIVES OF MOLECULAR HYDROGEN HAVE ON THE LASER EMISSION AMPLIFICATION FACTOR OF A CO_2 LASER WITH EXPANSION FLOW OF A MIXTURE OF CARBON DIOXIDE AND NITROGEN

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 12 No 5, Sep/Oct 76 pp 729-735 manuscript received 6 Jan 76

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

[Russian abstract provided by the source]

[Text] A shock tube with nozzle is used in an experimental study of the effect that additives of molecular hydrogen have on the coefficient of amplification of monochromatic radiation in an expanding flow of a CO_2+N_2 with change in temperature and pressure preceding the nozzle. It is shown that when T_o = 800-1700 K the behavior of the amplification factor as a function of the percent concentration of hydrogen in the mixture can be explained by the influence of molecular hydrogen on the kinetics of vibrational relaxation, but when $T_o > 1700$ K consideration must be taken of water formation in the chemical reaction of carbon dioxide and hydrogen. References 15: 11 Russian, 4 Western.

USSR UDC 621.3.038.8

ELECTRON BEAM INITIATION OF A HYDROGEN FLUORIDE CHEMICAL LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3 No 9, 1976 pp 2072-2074
manuscript received 2 Mar 76

IGOSHIN, V. I., NIKITIN, V. YU., and ORAYEVSKIY, A. N., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR, Moscow

[Abstract] The laser efficiency η, the chemical efficiency η_c, and the emission time t were calculated for an electron-beam initiated H_2-F_2 laser by using the following reactions of the slow and fast (e_s and e_f) electrons of the beam with fluorine: $F_2 + e_f \rightarrow F_2^+ + e_s + e_f$, $F_2 + e_s \rightarrow F + F^-$, and $F^- + F_2^+ \rightarrow 3F$. Calculations were performed for $t = \tau$ (where τ is the duration of the initiating pulse) for beam currents J = 0.1-1,000 A/cm^2 for a laser with a 1 atm. mixture of F_2:H_2:O_2:He = 0.526:0.131:0.053:0.029. The maximum value of η = 817% was obtained for J = 10 A/cm^2, for which η_c = 11.5% and τ = t = 2.11 μs. For J = 1 A/cm^2, t = τ = 8.1 μs, η_c = 4.4%, η = 811%. For J = 10 A/cm^2 and τ = 1 μs: η = 1050%, η_c + 7%, and t = 2.4 μs. Since electron-beam accelerators can have efficiencies as high as 60%, total system efficiencies of 600% are attainable. Values of J ≳ 1 A/cm^2 are desirable, since heating problems in the foil separating the accelerator chamber from the laser chamber are reduced, and industrially produced equipment can be used. References 7: 2 Russian, 5 Western.

USSR UDC 621.378.8

DF-CO_2 CHEMICAL QUANTUM AMPLIFIER WITH HIGH SPECIFIC PARAMETERS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3 No 9, 1976 pp 2067-2070
manuscript received 15 Feb 76

BASOV, N. G., BASHKIN, A. S., GRIGOR'YEV, P. G., ORAYEVSKIY, A. N., and PORODNIKOV, O. YE., Physics Institute imeni P. N. Lebedev, Academy of Sciences, Moscow

[Abstract] The DF-CO_2 chemical light amplifier was constructed in a 100 cm long, 30 ℓ steel chamber. The working gas contained a 1:1:4:5:0.05 1 atm. mixture of D_2:F_2:CO_2:He:O_2. The amplifier aperture was 5.5 cm diameter, with its axis 6 cm from the aperture of the chamber. The amplifier was driven either by a DF-CO_2 laser in the same working chamber parallel to the amplifier or by an 0.8 ℓ, 17 J, 40 μs CO_2-N_2 laser that had a CO_2, N_2, D_2, and He mixture with (D_2 + N_2)/CO_2 > 15/1. The unsaturated amplification coefficient was determined to be 0.07 cm^{-1} for the P(20) transition and was independent of the driving laser for a driving power of < 0.05 W/cm^2. With the DF-CO_2

driver, which was initiated by a > 500 J, 1us electrical traveling discharge from a 5 μF capacitor, a 150 J/ℓ output was obtained from the amplifier for a chemical efficiency of 7% for the P(20) plus P(22) transitions. Here the yield of the driver was ≤ 70 J/ℓ, which still was not enough to saturate the amplifier. The inversion time of the amplifier was 8-12 μs. Figures 3; references 6 (Russian).

USSR UDC 621.373.826.038.823+546.02

USE OF A TUNABLE RAMAN COMPRESSED HYDROGEN LASER FOR ISOTOPE SEPARATION

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3 No 9, 1976 pp 2059-2061
manuscript received 3 Feb 76

AMBARTSUMYAN, R. V., GOROKHOV, YU. A., GRASYUK, A. Z., ZUBAREV, I. G., KOTOV, A. V., and PURETSKIY, A. A., Physics Institute imeni P. N. Lebedev and the Institute of Spectroscopy, Academy of Sciences USSR, Moscow

[Abstract] The SF_6 molecule is used as an example to show that a tunable Raman laser in the far IR region offers promise for separating isotopes by selective non-collisional dissociation in the high-intensity IR field. The Raman laser was tuned to the compound vibration of $\nu_4 + \nu_5 = 1138$ cm^{-1} of the $^{32}SF_6$ molecule, which was in a 1:10 and 1:4 mixture with $^{34}SF_6$ in two tubes irradiated by a maximum intensity of 10 GW/cm^2 and 25 J of the laser. The tube lengths were 10 and 20 cm, and the gas pressure was 0.13 mm Hg. The ^{34}S enrichment in the residual gas was 1.06 ± 0.02 and 1.09 ± 02 times in the two tubes. The ^{32}S enrichment in the dissociation products was 1.25 in the first tube. The dissociation rate in the two tubes was 0.0014 and 0.0021. Figures 1; references 5 (Russian).

USSR UDC 551.551.2:535.311

LASER MEASUREMENT OF THE ALTITUDE DEPENDENCE OF THE ATMOSPHERIC STRUCTURAL PARAMETER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3 No 9, 1976 pp 2051-2054
manuscript received 14 Jan 76

BELEN'KIY, M. S., MAKAROV, A. A., MIRONOV, V. L., and POKASOV, V. V., Institute of the Optics of the Atmosphere, Siberian Department of the Academy of Sciences USSR, Tomsk

[Abstract] Values of the refractive index C_n^2 were measured as a function of the altitude h by mounting photomultipliers at h = 4, 7.5, 15, 37.5 and 72.5 m on a 72.5 m meteorological tower near Tsimlyansk and illuminating them with a 1 mm diameter He-Ne laser beam from the ground. The laser was mechanically modulated with a 10 kHz modulator that gave 5 flashes of identical intensity per pulse train. An integral equation was used to find $C_n^2(h)$ from the measured dispersion $\sigma^2(h)$ and the altitude angle $\phi(h)$. Measured values of $C_n^2(2.5\ m)$ are $4 \cdot 10^{-14} cm^{-2/3}$ at 1100-1530 hrs, $1.8 \cdot 10^{-14}$ at 0700-1100 hrs, $4.3 \cdot 10^{-15} cm^{-2/3}$ at 1600-1900 hrs, and $3 \cdot 10^{-16} cm^{-2/3}$ at 1800-1930 hrs. $C_n^2(h) \propto h^{-1/3}$ to $h^{-2/3}$ for $h < 30$ m. At 30 m there is a break, above which $C_n^2(h) \propto h^{-4/3}$, which is characteristic of free convection. The slant measurements are in good agreement with direct horizontal measurements made at the same location. Figures 3; references 10: 8 Russian, 2 Western.

USSR UDC 551.508.9

LIDAR FOR ATMOSPHERIC INVESTIGATIONS BY VARIOUS METHODS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3 No 9, 1976 pp 2029-2034
manuscript received 11 Mar 76

VANIN, N. V., MIGULIN, A. V., and RYBAKOV, S. YU., Moscow State University imeni M. V. Lomonosov

[Abstract] The design of a laser radar is described for investigating various atmospheric characteristics. The system is based on a special Cassegrain telescope with a 30 cm diameter mirror and a 1:5 relative aperture. The telescope can be pointed in any direction. Laser light can be directed out either parallel to or directly along the telescope axis. The return signals can be split by a prism, detected by one or two photomultipliers, digitized, and analyzed. The operation of the digitizer is controlled by a strobe and digitizer can be operated from 0.2 to 10 μs from the time of the laser pulse (10 kW for 100 ns). The wavelength of the laser light varies from 350 to 600 nm. A lidar of this type was built and operated on the ship "Moskovskiy universitet." The scattered signal could be reliably detected from a 4 km

range. The total weight of the system is 100 kg. The system can be used to study NO_2 concentrations and air sounding by the methods of comparative absorption, spontaneous Raman scattering, resonance fluorescence, etc. Figures 2; references 3: 2 Russian, 1 Western.

USSR UDC 621.378.33

ON THE EFFICIENCY OF THE DIFFUSION-TYPE CW CHEMICAL AMPLIFIER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3 No 9, 1976 pp 1896-1902
manuscript received 26 Dec 75

ORAYEVSKIY, A. N., PIMENOV, V. P., STEPANOV, A. A., and SHCHEGLOV, V. A., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR, Moscow

[Abstract] A flame-front model, based on the model of H. Mirels, R. Hofland, and W. S. King [AIAA J., Vol 11, 1973, p 156; AIAA Paper 72-145], is used to analyze a CW HF chemical amplifier operating under saturation conditions. The molecules are assumed to have a Boltzmann distribution with respect to vibrational level. It is assumed that the rotational number, the intensity, and the gain are the same for all vibrational-level transitions $m \rightarrow m-1$. The mixing of the H and F reagents is assumed to be laminar. However, more than one vibrational level is allowed, and the ratio of population densities n_m/n_{m-1} is not required to be unity. The expressions derived can be used to estimate the ultimate power and the chemical efficiency of the amplifier. They can also be used for more exact numerical calculations that account for the mixing effect both for the isothermal approximation and for accounting for thermal and gas dynamic effects. It is shown that the chemical efficiency can be increased by 2.0-2.5 times by increasing the rotational level from $j=4$ to $j=8$. References 11: 6 Russian, 5 Western.

USSR

UDC 553.92+621.378.8

STUDY OF IODINE LASER OPTICALLY EXCITED BY HIGH-CURRENT PLASMODYNAMIC DISCHARGES

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3 No 9, 1976 pp 2023-2028
manuscript received 29 Mar 76

KAMRUKOV, A. S., KASHNIKOV, G. N., KOZLOV, N. P., MALASHCHENKO, V. A., ORLOV, V. K., and PROTASOV, YU. S., Moscow Higher Technical College imeni E. N. Bauman

[Abstract] Studies were done on a C_3F_7I gas laser at an optimum pressure of 150 mm Hg, driven by a "plasma focus" erosion-type magnetoplasma compressor with electrodes 50 and 16 mm in diameter separated by a quartz tube 50 mm in diameter and 150-200 mm long. The plasma was formed from a polyfluoroethylene washer. The discharge was initiated by a Bostik-type plasma injector in the central electrode of the compressor. Electrical energy (8 kJ) came from a low-inductance, 756 μF capacitor bank that produced a maximum current of 460 kA in a strongly damped pulse with a 17 μs half period. The plasma generator operated at a pressure of 10^{-5} mm Hg. The illumination from the plasma discharge was a pulse with half-amplitude duration of 28 μs containing 5-7% of the capacitor energy and an intensity of $(4-6)\cdot10^4$ W/cm^2 at a wavelength λ = 200-290 nm. The resonator was 10 mm i.d. and 150-250 mm long with dielectrically coated flat mirrors with reflectivities of 72 and 99.5% at λ = 1.3 μm. The resonator axis was 55 mm from the plasma tube axis. The stimulated emission energy density was 0.1 J/cm^3 with an emission power of 0.2 MW. The laser efficiency was estimated to be 0.35-0.44% in experiments without an aluminum-foil illuminator. A xenon lamp pump under similar conditions gave an emission energy density of 1.2-1.5 mJ/cm^3 and 0.7 kW. High current plasmodynamic discharges are felt to offer promise for the optical excitation of photodissociation laser media. Figures 4; references 12: 10 Russian, 2 Western.

USSR UDC 621.378.826.038.823

NUMERICAL ANALYSIS OF A CW DIFFUSION-TYPE CHEMICAL LASER WITH AN ARBITRARY DEGREE OF MOLECULAR FLUORINE DISSOCIATION

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3 No 9, Sep 76 pp 1919-1931
manuscript received 14 Jan 76

KRUTOVA, V. G., ORAYEVSKIY, A. N., STEPANOV, A. A., and SHCHEGLOV, V. A., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR, Moscow

[Abstract] Results are presented of numerical calculations of a CW diffusion-type HF chemical laser using a flame-front model with laminar flow of a quasi-homogeneous mixture of fuel and oxidant. The HF molecule was assumed harmonic with a Boltzmann distribution over rotational levels; 8 vibrational levels were considered. The reactions $F + H_2 \rightarrow HF + H$ and $F_2 + H \rightarrow HF + F$ were considered in the gas-generator chamber, which was at a pressure of 2 atm. and a temperature T_c of 800-2,000°K, with a helium dilution factor of n_{He}/n_F = 10-30.

It is shown that for a chain excitation mechanism, the total efficiency η_0 of the CW laser can be a few times higher than that of a laser using a cold $F + H_2 \rightarrow HF + H$ type reaction. For a total intensity I = 20 kW/cm^2 per vibrational transition, η_0 reaches a maximum of 0.04 for T = 900°K, and then drops to 0.02 at 1,400°K. At low laser pressures $p < ^c$ 4 mm Hg, the chemical efficiency varies from 0.30 to 0.20 as n_{He}/n_F varies from 30 to 10. Variations of other laser parameters are given with temperature and pressure. Figures 5; references 25: 6 Russian, 5 Western.

USSR UDC 621.378.33+535.89

STUDY OF THE GAS DYNAMIC PROCESSES AND THE RECOIL IMPULSE FOR THE OPTICAL BREAKDOWN OF AIR NEAR THE SURFACE OF A TARGET ON EXPOSURE TO ELECTRON-BEAM-CONTROLLED CO_2 LASER RADIATION

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3 No 9, 1976 pp 1955-1961
manuscript received 2 Feb 76

PROKHOROV, A. M., SPIKHAL'SKIY, A. A., SYCHUGOV, V. A., and SHIPULO, G. P., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR, Moscow

[Abstract] An experimental study was made of the gas dynamic processes associated with the exposure of an aluminum target to the 10.6 μm radiation of a 10^9 W electron-beam-controlled CO_2 laser that had a 10 liter working volume with a 10x10 cm aperture and flat gold-coated and NaCl mirrors, a 4:1:8 mixture of CO_2, N_2, and He gases and a 1.5 atm. operating pressure. The laser pulse had an energy E as high as 100 J with a 75 ns rise time, a half-amplitude duration of 120 ns and a 1-2 μs tail, which was 1/15 to 1/20

the height of the peak and contained 15-20% of the total pulse energy. Beam areas S ranged from 0.5-27 cm^2.

Air breakdown occured at a threshold of $(1.4\text{-}2.1)\cdot 10^7$ W/cm^2 or when $E/S \geq$ 2-3 J/cm^2. The breakdown and shielding of the target was slightly delayed from the start of the laser pulse. The delay increased as the laser energy increased. For E/S = 50-100 J/cm^2, 3% of the energy is reflected from the target; at 2-3 J/cm^2, 20% was reflected. The "plasma torch" formed in front of the target was 5-10 mm thick and lasted about 4 μs for E/S = 12 J/cm^2 and S = 0.3 cm^2. The thickness of the plasma torch decreased for S = 2 cm^2 and E/S = 40 J/cm^2. For S = 1 cm^2 and E/S = 120 J/cm^2, local air breakdowns formed up to 6 cm from the target surface.

The recoil impulse had a threshold of E/S = 2.3 J/cm^2 and reached values as high as 12.7 dyne-s/J for a spot size of 18 cm^2 and E = 90 J, 12 dyne-s/J for S = 8.3 cm^2 and E = 83 J, and 9 dyne-s/J for S = 6.5 cm^2 and E = 85 J. For S = 0.5 cm^2, the impulse leveled off at 5 dyne-s/J for $E/S \geq 5$ J/cm^2 because of the air-breakdown formation at large distances from the aluminum target. Figures 8; references 22: 11 Russian, 11 Western.

USSR UDC 621.373.826.038.823

ON THE INFLUENCE OF THE SPATIAL GAIN INHOMOGENEITY ON THE PROPERTIES OF A LASER WITH AN UNSTABLE RESONATOR

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3 No 9, 1976 pp 1962-1967
manuscript received 2 Feb 76

KUPRENYUK, V. I., SERGEYEV, V. V., and SHERSTOBITOV, V. YE.

[Abstract] The effect of the cross-sectional inhomogeneity of the spatial gain of an unstable air-CO_2 laser on the radiation efficiency η and the beam divergence was studied for a laser with a 30:1 air:CO_2 mixture at a CO_2 flow rate of 25 m/s and a total pressure of 30 mm Hg. The laser was excited by electrical discharge. The resonator was formed by two spherical mirrors with curvature radii of R_1 = 9.23 m and R_2 = -6.38 m with a gain of $M \doteq 1.45$. The aperture diameter was 2 a = 18 mm. The efficiency was found to be 8, 7, 4.5 and 3.5% as the distance Δ between the resonator axis and the CO_2 inlet was 7, 12, 17, and 22 mm. The beam divergence at Δ = 19 mm was about 1 mrad. The effect of optical inhomogeneities on the measurements was 0.1λ. The maximum laser output was 0.7 kW. Although the unfocused laser beam had a C-shaped or half-moon character, depending on Δ, the focused beam was almost homogeneous, with a radial dependence close to the theoretical value. The behavior was to be expected, since the effective Fresnel number of the resonator $N_{eff} = a^2/|R_2|\lambda \doteq 1$. In this case, divergence would result mainly from phase effects caused by inhomogeneities resulting from non-uniform thermal expansion of the optics. Figures 5; references 4: 3 Russian, 1 Western.

USSR

ELECTRON GUN WITH BEAM SHAPING IN A HIGH-VOLTAGE GLOW DISCHARGE

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 46 No 10, Oct 76 pp 2195-2196 manuscript received 7 Aug 75

BALTAKOV, F. N., BOSAMYKIN, V. S., KORNILOV, V. G., KUDRYAVKIN, E. V., PAVLOVSKIY, A. I., SELYAVSKIY, V. T., SUKHANOV, L. V., and CHELPANOV, V. I.

[Abstract] Devices which shape electron beams in low-pressure high-voltage glow discharges are useful for exciting homogeneous discharges in CO_2 lasers. They are also simple in construction and reliable in operation, thus competitive with thermoelectron or autoelectron emitters. Such an electron gun is described here which yields a beam with a cross section of about 200 cm^2, an electron energy within 120-150 keV, a current density of about 10 mA/cm^2, and pulse durations up to 50 μs. It has a hollow steel cathode with a brass grid 20 mm away. It has a ring anode with a brass grid supporting a 25 μm Mylar film through which the electrode beam is coupled out. Cathode and anode are separated by an insulator sleeve of acrylic plastic. Negative voltage pulses 140-170 kV in amplitude are applied to the cathode through limiting resistors. The starting potential of the cathode grid is set by a resistive voltage divider. The anode is grounded through a low-inductance coaxial shunt that also measures the current. Purified gas is pumped through the active zone. Similar beams can be obtained with helium, hydrogen, and residual gas. Figures 3; references 3 Western.

USSR UDC 621.373.21

BUILDUP DYNAMICS AND SELF-STABILIZATION OF THE CHARACTERISTICS OF ULTRASHORT LASER PULSES IN SELF-MODE LOCKING OPERATION

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 25 No 4, Oct 76 pp 618-624 manuscript received 5 Aug 75

MILINKEVICH, A. V., SAVVA, V. A., and SAMSON, A. M.

[Abstract] The efficiency of a laser with self-mode locking depends mainly on the light filter. According to the fluctuation mechanism of ultrashort-pulse generation, radiation at the beginning of the nonlinear buildup stage constitutes a quasiperiodic noise pattern with random amplitude spikes per resonator period. The buildup of ultrashort pulses in a solid-state laser with a light filter is analyzed here on the basis of numerically integrated differential-difference equations, with a Gaussian initial distribution of radiation density. These equations describe three modes of emission: 1) with separate stages of absorption saturation and gain saturation, 2) with simultaneous saturation of both, yielding a more effective amplitude discrimination and a sharper contrast, 3) with self-stabilization by transition

from peaks to a single giant pulse. A remarkable feature of this last mode is that a single pulse from various spurts is formed from a field profile of the same contrast. In order to attain this mode, it is necessary that the radiation density of free emission never fall below the noise level, lest new peaks arise from each new fluctuation pattern between peaks. This can be achieved with high-power pumping lamps and by using active media which operate in the four-level mode. A high degree of reproducibility of ultrashort pulse with self-stabilization can be maintained without narrowing the emission spectrum, so that a high stability will be ensured, while the contrast can be regulated by defocusing the radiation in the filter or by changing the length of the resonator. Figures 3; references 12: 9 Russian, 3 Western.

USSR UDC 621.373:535(206.2)

SPATIAL COHERENCE OF RHODAMINE 6G LASERS WITH FLASH-TUBE PUMPING

Moscow OPTIKA I SPEKTROSKOPIYA in Russian Vol 41 No 4, Oct 76 pp 674-677
manuscript received 20 Aug 75

ARISTOV, A. V., KOZLOVSKIY, D. A., STASEL'KO, D. I., STRIGUN, V. L., and CHERKASOV, A. S.

[Abstract] A study was made on how to improve the spatial coherence of dye lasers with flash tube pumping, by the use of aqueous solutions with a small temperature coefficient of the refractive index at room temperatures and by ensuring an excitation more uniformly distributed over the cross section. For this purpose, a cylindrical vessel 130 mm long and with an inside diameter of 7.0 mm was placed inside a four-lamp illuminator with a diffusely reflecting surface. Rhodamine 6G was used as the active substance, on account of its high photochemical stability, low quantum yield in the triplet state, and high solubility in ordinary and heavy water. The vessel was thermostatically controlled with a stream of aqueous $NaNO_2$ + K_2CrO_4 through a surrounding jacket. Pumping pulse energy was 575 J, with a risetime of 4 μs and a half-width of 6 μs. The results indicate that the use of aqueous rather than alcohol solutions of dyes yields a better spatial coherence and thus a higher efficiency, comparable to that of solid-state ruby lasers. Figures 2; references 16: 12 Russian, 4 Western.

USSR UDC 621.378.325.2

ANALYSIS OF A RING LASER WITH AMPLITUDE ANISOTROPY, A FARADAY CELL, AND A NATURAL OPTICAL ROTATOR

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 25 No 4, Oct 76 pp 610-617

SARDYKO, V. I.

[Abstract] In a four-mirror resonator of a ring laser containing a Faraday rotator and a natural optical rotator, each of which rotates the polarization planes through 90°, emission can be stimulated in a mode where the frequencies of opposed waves are separated by half the intermodal interval. Such devices are useful for a broader study of physical processes in traveling-wave lasers and also for some practical purposes. A circular-phase plate or two linear-phase half-wave plates or, in a three-mirror resonator, a half-wave plate together with one of the mirrors can serve as the natural rotator. In any case these elements produce an anisotropy. Furthermore, the magnetic field intensity at the Faraday cell deviates from its nominal level. All this, as well as manufacturing and assembly imprecision, gives rise to ellipticity and affects the frequency separation. Here the effect of anisotropy is analyzed for the case of a circular-phase plate, by the method of Jones' vectors and matrices. Theoretical results are compared with test data. Instability of the magnetic field and its effect on the polarization-frequency characteristic of such a laser are also estimated. Figures 3; references 7 (Russian).

USSR UDC 533.9.15

ON THE EFFECT THAT THE REACTION OF CARBON COMBUSTION HAS ON EXCITATION OF VIBRATIONAL LEVELS IN THE DISCHARGE PLASMA OF A CO LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3 No 10(52), Oct 76 pp 2156-2160
manuscript received 12 Dec 75

VOLCHENOK, V. I., YEGOROV, N. P., KOMAROV, V. N., KUPRIYANOV, S. YE., OCHKIN, V. N., SOBOLEV, N. N., and TRUBACHEYEV, E. A., Physics Institute imeni P. N. Lebedev, Moscow

[Russian abstract provided by the source]

[Text] An estimate is made of the contribution of the fast exothermal reaction $C + O_2 \rightarrow CO + O + \Delta E$ to the stimulation of vibrations of CO molecules under conditions of the gas discharge used in CO lasers. The rate of excitation of oscillations resulting from this reaction may be comparable with the rate of excitation by direct electron impact, which provides a qualitative explanation for the increase in emission power with small admixtures of oxygen. When large amounts of O_2 are added, quenching of CO vibrations occurs due to the collisions with the CO_2 molecules formed in plasma chemical reactions. References 15: 8 Russian, 7 Western.

USSR UDC 621.375.82

INFLUENCE OF CHLORINE ON THE GAIN OF A CO_2 GAS DYNAMIC LASER BASED ON COMBUSTION PRODUCTS OF METHANE MIXTURES

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3 No 10(52), Oct 76 pp 2171-2175 manuscript received 23 Dec 75

VASILIK, N. YA., SHMELEV, V. M. and MARGOLIN, A. D., Institute of Chemical Physics, Academy of Sciences USSR, Moscow

[Russian abstract provided by the source]

[Text] An experimental investigation is made of the change in characteristics of the working fluid of a gas dynamic laser that operates on the products of combustion of hydrocarbon fuel when chlorine is added. It is shown that adding chlorine increases the gain of the working medium and that this method can be used to improve the energy characteristics of the laser. A technique is proposed for evaluating the change in the rate of deactivation of the upper laser level in the critical section of the nozzle when various additives are introduced into the gasdynamic laser medium. References 7: 2 Russian, 5 Western.

USSR UDC 621.375.826:541.127:546

ON THE RELATION BETWEEN STIMULATED EMISSION AND THE MECHANISM OF REACTIONS IN CHEMICAL LASERS ON MIXTURES OF CHLORINE FLUORIDES AND HYDROGEN

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3, No 10(52), Oct 76 pp 2232-2237 manuscript received 12 Mar 76

CHEBOTAREV, N. F. and PSHEZHETSKIY, S. YA.

[Russian abstract provided by the source]

[Text] An analysis is made of fundamental elementary processes leading to stimulated laser emission on the systems $ClF_3 + H_2$ and $ClF_5 + H_2$. A study of emission pulses on HF and HCl in these mixtures with the addition of HCl, Cl_2 and ClF revealed that ClF, an intermediate product, is a determining factor in the laser chain. The process $H + Cl \rightarrow H^{*+} + F$ proceeds much faster than $H + ClF_3$ and $H + ClF_5$. It is established that in the $ClF_5 + H_2$ system there may be "autocatalysis" by HCl molecules which are also an intermediate product of the reaction. References 8: 4 Russian, 4 Western.

USSR UDC 621.371.24

FLUCTUATIONS IN THE INTENSITY OF LASER EMISSION WITH REFLECTION IN A TURBULENT ATMOSPHERE

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3 No 10(52), Oct 76 pp 2156-2160
manuscript received 9 Jan 76

AKSENOV, V. P., BANAKH, V. A., and MIRONOV, V. L., Institute of Optics of the Atmosphere, Siberian Department of the Academy of Sciences USSR, Tomsk

[Russian abstract provided by the source]

[Text] The Huygens-Fresnel principle generalized to the case of continuously nonhomogeneous media is used to solve the problem of diffraction of a laser beam by a reflector of finite dimensions. A numerical study is done on the influence that atmospheric turbulence has on the variance and the spatial correlation function of fluctuation in the intensities of the diffracted field. It is shown that the main phenomena of fluctuations in the intensity of a reflected beam remain qualitatively the same as for direct propagation. References 14 Russian.

USSR UDC 771.448.6

THROWAWAY FLASHBULB AS AN OPTICAL PUMPING SOURCE FOR LASERS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3 No 10(52), Oct 76 pp 2300-2301
manuscript received 13 Apr 76

MAKHROV, YE. T., CHERPOV, N. I., and YAZEV, I. I.

[Russian abstract provided by the source]

[Text] The paper describes a throwaway flashbulb with emission energy of 200 J used for optical pumping of lasers. The source of energy in the bulb is the reaction of combustion of zirconium foil in oxygen. Stimulated emission with energy of 1.2 J is achieved on a YAG:Nd^{3+} crystal and it is shown that a miniature laser can be made with energy of the order of a few joules. References 7: 4 Russian, 3 Western.

USSR UDC 621.375.826

EXCITATION OF THE SECOND HARMONIC BY RADIATION OF A TUNABLE DYE LASER OPERATING AT A HIGH REPETITION FREQUENCY

Yerevan DOKLADY AKADEMII NAUK ARMYANSKOY SSR in Russian Vol 62, No 5, 1976 pp 293-294

ISAYEV, A. A., KAZARYAN, M. A., MOVSESYAN, M. YE., PETRASH, G. G., SAAKYAN, A. K., and KHANBEKYAN, A. M., Institute of Physical Studies, Academy of Sciences Armenian SSR, Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR

[Abstract] This article presents a report on the production of a tunable laser operating at high repetition frequency based on an organic dye with a freely emitted stream and the use of the radiation of this laser for the production of a second harmonic in KDP and $LiIO_3$ crystals. Pulse lasers with high repetition frequency combine the advantages of continuous lasers with the high powers of pulsed lasers, which is particularly important in the study of nonlinear high order processes. The dye is pumped using the radiation of a copper vapor laser. References 3.

USSR UDC 533.952

HEATING OF PLASMA IONS DURING PARAMETRIC RESONANCE AT THE LOWER-HYBRID FREQUENCY

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 46 No 10, Oct 76 pp 2051-2056 manuscript received 3 Mar 75

BAYKOV, I. S., P. N. Lebedev Institute of Physics, Academy of Sciences USSR

[Abstract] Plasma heating by anomalous absorption of electromagnetic radiation is analyzed on the basis of the quasilinear approximation, applicable to the initial stage of turbulence in a parametrically unstable plasma during which changes in the form of the particle distribution function are still insignificant for the spectra of plasma perturbations. The rates of ion heating are calculated for a plasma in a constant magnetic field and in a variable electric field, the latter alternating at the lower-hybrid frequency where aperiodic or oscillatory instability arises. The analysis is based on the dispersion equation for low-frequency long-wave oscillations, with the amplitude decrement being due to collisions and Landau attenuation. Two extreme situations are considered, namely the pumping electric field either perpendicular or parallel to the magnetic field, with the initial ion temperature assumed isotropic. It is found that under conditions where electrons are magnetized and ions are unmagnetized the distribution of ion energy relative to the direction of the magnetic field becomes anisotropic during parametric excitation of the lower hybrid resonance, owing to the faster buildup of the transverse energy component. Ions are heated faster by the same pumping power in the case of transverse orientation of fields. References 8: 4 Russian, 4 Western.

USSR UDC 537.529

MECHANISM OF CURRENT-PULSE EXPLOSION OF WIRES

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 46 No 10, Oct 76 pp 2081-2087 manuscript received 3 Mar 75

KRIVITSKIY, YE. V. and LITVINENKO, V. P., Electrohydraulic Planning and Design Office, Nikolayev

[Abstract] Explosion of wires by large current pulses is studied for the case where the conductor is heated for a period of time shorter than the time within which an MHD instability can develop, or the energy is supplied at a rate $dw/dt > 10^{10}$ J/g·s. Several mechanisms are likely to operate here: 1) evaporation from the conductor surface, 2) formation of metal bond interfaces in the liquid conductor, 3) fast transition from a metastable superheated liquid to a two-phase system, owing to an avalanche increase in the number of homogeneous vapor nuclei and a rapid increase in the volume of the entire specimen. The analysis is based on the van-der-Waals equation for the speed of

sound in a two-phase medium near the stability curve for the liquid phase, with the electrical resistance assumed a linear function of the specific energy. It is shown that the initial point of the explosion can be determined from the behavior of superimposed oscillograms of voltage across study specimens. It is found that the time constant (characteristic time of the explosion) depends on the properties of the conductor, the rate of energy supply and the hydrodynamic characteristics of the ambient medium. It is experimentally confirmed that loss of metallic conductivity should be attributed to processes that take place simultaneously throughout the entire volume of the wire. References 21: 19 Russian, 2 Western.

USSR UDC 539.95

THE CONSTRUCTION OF PLANE STATIONARY SOLUTIONS OF THE EQUATIONS OF A NON-EQUILIBRIUM MAGNETIZED PLASMA

Moscow PRIKLADNAYA MATEMATIKA I MEKHANIKA in Russian Vol 40 No 5, 1976 pp 813-822 manuscript received 14 Jan 76

ARTEMOV, V. I., and SINKEVICH, O. A., Moscow

[Russian abstract provided by the source]

[Text] A method is developed of constructing stationary two-dimensional distributions of electric current and electron temperature in a nonequilibrium magnetized plasma considering heat conductivity and convection. The solution is presented in the form of asymptotic expansions with respect to a small parameter. A study is made of the construction of the zero approximation for external and internal expansions. As an example, the problem of distribution of current in a channel with infinite electrodes is studied. References 19: 11 Russian, 8 Western.

USSR UDC 533.951

INVESTIGATION OF ELECTRON CONCENTRATION AND MOBILITY IN A PLASMA OF COMBUSTION PRODUCTS BY MEANS OF A SUBMILLIMETER INTERFEROMETER WITH HCN LASER

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 14 No 5, Sep/Oct 76 pp 1055-1060 manuscript received 9 Apr 76

VASIL'YEVA, I. A., GOLUBKOVA, A. S., SHUMYATSKIY, B. YA. and YUNDEV, D. N., Institute of High Temperatures, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The paper gives the results of an experimental study of the concentration and mobility of electrons in a plasma of combustion products with various alkaline additives. Electron concentration and mobility are measured by a hydrogen cyanide laser and submillimeter interferometer (λ = 0.337 mm). The temperature and concentration of free atoms of alkali metals are determined by optical methods. The amount of alkali metal introduced into the combustion products is established by chemical analysis. The measurements were made at 2200-2600 K in the region of electron concentrations above 10^{19} m^{-3}, which is of the greatest interest for MHD generators. References 25: 17 Russian, 2 Polish, 6 Western.

USSR UDC 621.313.12:538.4

AN EXPERIMENTAL INSTALLATION WITH PULSED ISOTHERMAL PLASMA GENERATOR FOR INVESTIGATION OF MHD FLOWS

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 14 No 5, Sep/Oct 76 pp 1061-1069 manuscript received 8 Jul 75

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

[Russian abstract provided by the source]

[Text] The paper describes a pulsed installation ($t \sim 10^{-2}$ s) for experiments on MHD-deceleration of plasma. A plasma of inert gas with alkaline additive is created by an arc plasmotron that provides a high degree of spatial homogeneity and a stagnation temperature of 6000-7000 K. The special design of the plasmotron gives a homogeneous plasma flow, which is theoretically and experimentally demonstrated. The technique for measuring plasma flow parameters is described. References 12: 11 Russian, 1 Western.

USSR UDC 533.7

THE EQUILIBRIUM CONSTANT AND PARAMETERS OF POTENTIAL INTERACTION OF ATOMIC PARTICLES

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 14 No 5, Sep/Oct 76 pp 943-947 manuscript received 28 Nov 74

SMIRNOV, B. M., and SHCHEGOL'KOV, S. G., Institute of Atomic Energy imeni I. V. Kurchatov

[Abstract] The equilibrium constant is calculated for the process $A \leftrightharpoons AB$, where A, B specify an atom, ion or molecule. One way to find the energy of dissociation of molecular and complex ions is to measure the temperature derivative of the equilibrium constant. Relations are found for determining the parameters of the potential of interaction of atomic particles from the absolute value of the equilibrium constant. The analysis is based on the kinetic theory of gases. Numerical results are given for the processes $O_2^+ + O_2 \leftrightharpoons O_4^+$ and $O_4^+ + O_2 \leftrightharpoons O_6^+$. References 7: 4 Russian, 3 Western.

USSR

EFFECTIVE MASS OF ELECTRONS LOCALIZED OVER THE SURFACE OF LIQUID HELIUM

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 24, No 9, 5 Nov 76 pp 510-513 manuscript received 30 Sep 76

EDEL'MAN, V. S., Institute of Physics Problems, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The effective mass m and relaxation time of electrons localized over the surface of liquid helium 4 are measured at a temperature of ~0.4 K by the method of cyclotron resonance. It was found that the effective mass in a compressing field of $\leqslant$15 V/cm is 1.0005 ± 0.0004 times the mass of a free electron, and decreases linearly with increasing field strength at a rate of $\sim 2 \cdot 10^{-5}$ $V^{-1} \cdot cm$ when the electron density is $3 \cdot 10^{8}$ cm^{-2}. Electron mobility in weak fields is $(1.15 \pm 0.15) \cdot 10^{7}$ $cm^2/V \cdot s$ and falls off with increasing compressing field strength. References 10: 5 Russian, 5 Western.

USSR UDC 539.12.08

USING SEMICONDUCTOR DETECTORS FOR RADIATION MONITORING IN INTENSE GAMMA-NEUTRON FIELDS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 76 pp 56-57 manuscript received 21 Jul 75

KRAMER-AGEYEV, YE. A. and PARKHOMOV, A. G., Moscow Engineering Physics Institute

[Russian abstract provided by the source]

[Text] An investigation is made of the way that short-circuit current of a number of semiconductor detectors depends on fluence in the range of 10^{10}-10^{14} neutrons/cm^2 with irradiation in a field of mixed n-γ emission. The results suggest a technique for using silicon detectors with a pn junction as monitors for high dose rates. The procedure is based on pre-exposing the detectors to fast neutrons at a fluence of ~10^{12} neutrons/cm^2. References 4: 2 Russian, 2 Western.

USSR

UDC 621.384.633

COMPUTER MODELING OF TRANSITION THROUGH WHOLE-NUMBER RESONANCES ON A CYCLOTRON KAON FACTORY

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA III, FIZIKA, ASTRONOMIYA in Russian Vol 17, No 3, May/Jun 76 pp 282-286 manuscript received 24 Feb 75

SARKISYAN, L. A., Scientific Research Institute of Nuclear Physics

[Abstract] Transition through the whole-number resonance $Q_r = 2$ in the cyclotron is studied by numerical modeling based on complete equations of motion for frequencies of radial betatron oscillations of $2 \leqslant Q_r \leqslant 2.28$. It is shown that passage through the whole-number resonance $Q_r = 2$ takes place in the cyclotron with subsequent acceleration, and an interpretation is suggested for the mechanism of passage through whole-number resonances ($Q_r = 2, 3, 4...$). The mechanism of conservation of radial stability of a perturbed orbit with appreciable displacement as passage through a whole-number resonance takes place in a cyclotron in the case of moderate energy buildup per revolution and a fairly high margin for the lower harmonic of the field of the index $S = Q_r$ can be attributed to two causes. In the first place the perturbed orbit oscillates with adiabatically damped amplitude relative to the ideal orbit as the velocity on the mean radius increases; secondly, the required magnetic field of the cyclotron is formed over a wide radius range (the vacuum chamber has large radial dimensions) that considerably exceeds the amplitude of radial fluctuations of the perturbed orbit. An asymptotic formula is derived that approximates the deviation of a perturbed orbit from the ideal orbit when a whole-number resonance is crossed. On the second stage of a K-meson factory based on a cyclotron, transition through whole-number resonances can be achieved with an energy buildup of 3 MeV per revolution and a margin of 40 A/m on lower harmonics of the magnetic field in whole-number resonance zones, assuming a proton injection energy of 500-840 MeV. The number of spiral resonators in the second stage should be greater than the value of Q_r on the final radius. The maximum buildup of energy upon passage through a resonator is $\leqslant$600 keV. It is shown that the periodicity of the magnetic field structure in the first stage should be increased from 8 to 10 or 12, which will increase proton acceleration in the pi-meson factory to an energy of ~1.3 GeV. This will permit production of secondary K^+-mesons (production threshold on nuclei 1.1 GeV). In this case the range of frequencies of radial betatron oscillations in the second high-energy stage will be $\sim 2.5 \leqslant Q_r \leqslant 6$ and $\sim 3 \leqslant Q_r \leqslant 6$, i. e. transition through the most dangerous whole-number resonance $Q_r = 2$ will be avoided. The studies show that in addition to accelerating partons to an energy beyond E^0, electrons can be accelerated as well. In 1973 the author proposed a high-current electron cyclotron (average current of tens of mA) for an energy of ~2 MeV. Displacement of the perturbed orbit is 1.3 cm with transition through whole-number resonance $Q_r = 2$ on a radius of 169 cm when energy buildup is 8 keV per revolution and the margin for the second harmonic of the magnetic field is 1.6 A/m (depth of the harmonic of the vertical field component is 0.0013). The efficiency of such a cyclotron is of the order of 70%. References 12: 9 Russian, 3 Western.

USSR UDC 539.172.4

INFLUENCE THAT ENRICHMENT OF NUCLEAR FUEL HAS ON THE FORMATION OF TRANSURANIUM ISOTOPES IN POWER REACTORS

Moscow ATOMNAYA ENERGIYA in Russian Vol 41, No 5, Nov 76 pp 321-325 manuscript received 3 Feb 76

ZARITSKAYA, T. S., KRUGLOV, A. K. and RUDIK, A. P.

[Abstract] An investigation is made of the way that formation of transuranium isotopes in a power reactor with given physical characteristics changes with enrichment of the ^{235}U in the initial fuel. The analysis is based on a gas-cooled heavy-water reactor that uses unenriched natural uranium. It is assumed that the geometry of the fuel elements remains constant and that each element contains an identical amount of ^{235}U. It is also assumed that the power of the fuel element remains constant and independent of enrichment. The concentrations of transuranium isotopes were calculated as a function of power output per metric ton of initial fuel for ^{235}U, ^{236}U, ^{237}Np, ^{238}Pu, ^{238}U, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, ^{243}Am and ^{244}Cm. Tables are given summarizing the physical constants of the reactor, the characteristics of the fuel burn-up process, the concentration of transuranium isotopes in kilograms per metric ton, the yield of isotopes. ^{235}U enrichment was taken as 7.14, 16, 24 and 36 kg per metric ton, and the calculations were done for power outputs of 0, 5, 10, 15, 20, 25 and 30×10^3 MW-days per metric ton. References 5: 4 Russian, 1 Czech.

USSR UDC 539.122.164

MEASUREMENT OF THE INTRAREACTOR GAMMA SPECTRUM

Moscow ATOMNAYA ENERGIYA in Russian Vol 41, No 5, Nov 76 pp 325-329 manuscript received 21 Jan 76

BRISKMAN, B. A., BONDAREV, V. D., TARASKO, M. Z. and NOVGORODTSEV, R. B.

[Abstract] An experimental technique is developed for measuring the spectrum of intrareactor gamma-radiation by using the spectral dependence of the ratios of heat release in materials with different atomic numbers. The basis of the method is the "outpacing" effect that permits precision determination of heat release ratios within 1% under reactor conditions. A system comprising an absorber and closed shell is placed in a radiation field so that the temperature of the shell exceeds that of the absorber for a time τ^* (the "outpacing" time) when the condition $P_1/P_2 < c_1/c_2$ is met, where P is the absorbed dose rate, c is the specific heat, and the subscripts 1 and 2 refer to the absorber and shell respectively. The quantity τ^* is a pronounced single-valued function of the heat release ratio of the elements in the system, and the sensitivity of the method improves with increasing difference

BRISKMAN, B. A. et al., ATOMNAYA ENERGIYA, Vol 41, No 5, Nov 76 pp 325-329

between the dose rate ratio and the specific heat ratio. A calorimetric spectrometer for gamma measurements based on this principle is described. The gamma radiation spectrum remains constant heightwise of the reactor core, and becomes softer with a transition to the reflector. The ratio P_{Pb}/P_{Mg} changes from 1.84 to 2.60. This result agrees with Monte Carlo calculation. The results show that the absorbed dose can be recalculated from a model material (graphite) to any given material within 10%. Coefficients $(P_i/P_C)^{\gamma}$ are tabulated for 27 elements and $(CH_2)_n$. References 4: 3 Russian, 1 Western.

 UDC 539.173.8:539.122.164

KX EMISSION SPECTRA OF FRAGMENTS WHEN ^{235}U IS FISSIONED BY NEUTRONS, AND THE ENERGY DEPENDENCE OF ν IN THE THERMAL BALANCE METHOD

Moscow ATOMNAYA ENERGIYA in Russian Vol 41, No 5, Nov 76 pp 329-332 manuscript received 3 Feb 76

DONICHKIN, A. G., SMIRNOV, A. N. and EYSMONT, V. P.

[Russian abstract provided by the source]

[Text] A semiconductor spectrometer of soft electromagnetic radiation is used to measure the spectra and yields of KX-radiation of fragments when U^{235} is fissioned by neutrons with energy of 0.7, 1.2 and 3.5 MeV. The spectra and yields of x-radiation on thermal neutrons are measured under analogous conditions. The results of comparison of spectra at different neutron energies are used to obtain data on the temperature stability of charge distributions of the fragments that are necessary for determining the energy dependence of the number of prompt fission neutrons ν by the thermal balance method. References 10: 5 Russian, 5 Western.

USSR UDC 539.125.4.164

MEASUREMENT OF THE SPECTRA OF HIGH-ENERGY PROTONS ESCAPING FROM THE SHIELD OF A 680-MeV SYNCHROCYCLOTRON

Moscow ATOMNAYA ENERGIYA in Russian Vol 41, No 5, Nov 76 pp 332-334 manuscript received 5 Jan 76

ALEYNIKOV, V. YE., GERDT, V. P. and TIMOSHENKO, G. N.

[Abstract] A spectrometer similar to that used by Gibson et al. (W. Gibson, W. Burrus, J. Wachter, "Nuclear Instruments and Methods," 1967, v. 46, p 29) was used to measure the spectra of protons escaping from the shield of the synchrocyclotron at the Nuclear Devices Laboratory of the Joint Institute for Nuclear Research in Dubna. The spectra were measured for protons traveling normal to the shield surface. In the working range of proton energies from 55 to 500 MeV the amplitude resolution of the spectrometer was 11 and 27% respectively. The angular resolution of the spectrometer for a path length of 1030 mm was 3°30'. The solid angle for registration of protons was $2 \cdot 10^{-3}$ sr. Spectral distributions of protons are given behind thick and thin shields. Behind the thin iron shield (156 g/cm^2) the secondary protons show the typical falling spectrum of formation in a thick target. Behind a thick shield (~3000 g/cm^2 Fe) the proton distribution function shows a low derivative for energy below about 200 MeV due to two competing effects -- production of low-energy protons in nucleon-nuclear interactions, and reduction of the probability of escape of charged particles from the shield with decreasing energy, as well as accumulation of protons with energy of 60-200 MeV formed when neutrons of the equilibrium spectrum enriched by particles with energy of 150-200 MeV interact with iron nuclei. References 11: 9 Russian, 2 Western.

USSR UDC 539.164.3

EXPERIMENTAL INVESTIGATION OF ALPHA-DECAY OF ACTINIDES (STATUS OF DATA ON ALPHA-DECAY)

Moscow ATOMNAYA ENERGIYA in Russian Vol 41, No 5, Nov 76 pp 342-348 manuscript received 19 May 76

BARANOV, S. A., ZELENKOV, A. G. and KULAKOV, V. M.

[Russian abstract provided by the source]

[Text] An examination is made of the current state of data on the half-life of actinide elements, energy, and the intensity of groups of the fine structure of alpha emission. The authors discuss the precision attained up to the present in estimating these quantities, and error requirements in measurements of the half-life and intensity of the basic alpha groups of actinides used in nuclear engineering. References 31: 11 Russian, 20 Western.

USSR UDC 621.039.562:621.039.517

INTRAREACTOR POWER DISTRIBUTION MONITORING SYSTEM IN REACTORS OF THE BILIBINSKAYA NUCLEAR ELECTRIC POWER PLANT

Moscow ATOMNAYA ENERGIYA in Russian Vol 41, No 5, Nov 76 pp 354-355 manuscript received 2 Apr 75

ANDREYEV, L. G., DUBOVSKIY, B. G., ZAGADKIN, V. A., KORYAGIN, YE. V., LYUBCHENKO, V. F., MITEL'MAN, M. G., MOKHNATKIN, K. N., POCHIVALIN, G. P., ROZENBLYUM, N. D., SOLDATOV, G. YE. and SUKHOVERKO, V. B.

[Abstract] The paper describes a system for monitoring intrareactor distribution of power with respect to the radius of the core in reactors of the Bilibinskaya Nuclear Electric Power Plant. The system is made up of direct charge detectors type DPZ-7b and "Prokhlada" (VET-01) electronic equipment. The detectors are installed in openings in the graphite brickwork of the reactor. The length of the sensing section is equal to the height of the reactor core. Technical specifications of the detectors and electronic equipment are summarized. It is shown that the error in determination of the power in a fuel channel by DPZ detectors is no more than +6%(±3%) when the power output of the channel is 200 MW-days. References 3 Russian.

USSR UDC 621.039.548

INFLUENCE THAT AN ADMIXTURE OF BERYLLIUM IN URANIUM DIOXIDE HAS ON THE ERROR OF MONITORING PLUTONIUM CONVERSION

Moscow ATOMNAYA ENERGIYA in Russian Vol 41, No 5, Nov 76 pp 356-357 manuscript received 10 Sep 75

BULANENKO, V. I. and FROLOV, V. V.

[Abstract] Among the systematic errors that determine the selectivity and sensitivity of the method of checking plutonium accumulation in irradiated uranium dioxide is that due to the presence of beryllium in the fuel or in the construction materials of the fuel elements. The presence of beryllium leads to photoneutrons due to the (γ,n) reaction from fission products. Thus there is an additional neutron component due to fuel burn-up rather than the conversion of heavy nuclei. Estimates are made of the contribution of photoneutrons to the intrinsic neutron emission of irradiated fuel. It is concluded from the results that the content of beryllium as an impurity in uranium dioxide should not exceed 10^{-4} mass %. References 9: 4 Russian, 5 Western.

USSR UDC 621.039.58

SOME PROBLEMS OF RADIATION SAFETY OF NUCLEAR ELECTRIC POWER PLANTS WITH VVER-440 WATER-MODERATED WATER-COOLED POWER REACTORS

Moscow ATOMNAYA ENERGIYA in Russian Vol 41, No 4, Oct 76 pp 235-238 manuscript received 29 Mar 76

VORONIN, L. M., VOLKOV, A. P. and KOZLOV, V. F.

[Russian abstract provided by the source]

[Text] Radiation safety studies of series nuclear electric power plants with VVER-440 water-moderated water-cooled power reactors show that the level of penetrating radiation does not exceed the permissible limits; the exposure of personnel does not exceed 5% of the maximum permissible dose in a year. Slight emission of radioactive gases (3-30 c per day) and iodine ($>10^{-4}$ c per day) shows the low concentration of fission products in the coolant and adequate gas-tightness of the technological equipment. Emissions are so low that there is no detectable elevation of radionuclide content over the background level in air, water, soil or vegetation or radioiodine in milk. Calculations show that external exposure of the populace can be no more than 1-2% of the background level. References 5: 3 Russian, 2 Western.

USSR UDC 621.3.038.625

ION ACCELERATION BY THE QUASISTATIC FIELD OF AN ELECTRON BEAM

Moscow ATOMNAYA ENERGIYA in Russian Vol 41, No 4, Oct 76 pp 244-247 manuscript received 22 Dec 75

LEBEDEV, A. N. and PAZIN, K. N.

[Russian abstract provided by the source]

[Text] An examination is made of a scheme for ion acceleration in which the accelerating field is set up by injecting an electron beam into a corrugated tube with low-frequency modulation of the beam current at the input. The purpose of the paper is to make a rough estimate of the requirements for the electron beam and the parameters of the system. Two electron beam models are considered (a continuous ultrarelativistic beam and an infinitely thin tubular beam), and the relations between current, boundary depth and longitudinal field are determined for these models. Analysis showed that efficient operation of the proposed scheme for ion acceleration requires electron beams with current of several kA and particle energy of several MeV. References 6 Russian.

USSR UDC 621.039.58.68+541.15

ENSURING RADIATION SAFETY IN OPERATION OF HIGH-POWER RADIATION INSTALLATIONS

Moscow ATOMNAYA ENERGIYA in Russian Vol 41, No 4, Oct 76 pp 260-263 manuscript received 6 Jul 76

CHISTOV, YE. D.

[Abstract] A review of some of the papers delivered at the Third All-Union Scientific-Practice Conference on Radiation Safety. Research results are presented on accident prevention when using powerful sources of ionizing emissions to carry out various radiation processes. Regulations are proposed for using radioisotopic sources in water with consideration of the specifics of the radiation-chemical processes carried out. The temperature behavior of the coefficient of dissolution of ^{60}Co in water is given, annual doses for exposure of personnel are analyzed, and the necessary and sufficient volume of individual radiation monitoring is suggested. The authors and titles of the six papers covered in the survey are listed at the end of the article.

USSR UDC 621.039.58,68

RELATIVE SAFETY OF NUCLEAR AND FOSSIL-FUEL ELECTRIC POWER PLANTS FOR THE ENVIRONMENT

Moscow ATOMNAYA ENERGIYA in Russian Vol 41, No 4, Oct 76 pp 263-267 manuscript received 20 Jul 76

SIVINTSEV, YU. V. and TEVEROVSKIY, YE. N.

[Abstract] A comparative analysis is made of the environmental impact of fossil-fuel (coal, oil and gas) and nuclear (PWR and BWR) electric power plants. It is concluded that atmospheric emissions from fossil-fuel plants are a greater hazard than the radionuclide emissions of nuclear power plants. The maximum annual dose of exposure to the populace from a nuclear plant is one-third of the radiation effect sustained by a person on the average jet flight. While the thermal pollution of nuclear power plants is much higher than for fossil-fuel plants at present, the thermal economy of nuclear plants has not yet reached its limit. References 3: 1 Russian, 2 Western.

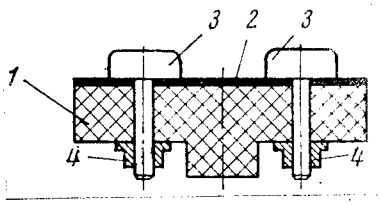
USSR UDC 621.3.038.612:533.9.12

A PULSED PLASMA SOURCE OF ELECTRONS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 76 pp 30-32
manuscript received 4 Feb 75

DEMIDOV, F. P. and CHESTNOV, A. M.

[Abstract] The paper describes a spark plasma source of electrons with gas-containing electrodes having a discharge ignition voltage of less than 1 kV, prf of 100 Hz and service life of up to 10^6 operations. A diagram of the device is given in the figure. The surface of ceramic insulator 1 is covered in the interelectrode space with a conductive film 2. The insulator carries gas-saturated electrodes 3 held in place by sleeves 4. The electrodes are made from zirconium and saturated with hydrogen. Interelectrode spacing is 1.5 ± 0.2 mm. The boundary of the plasma formed as a result of arc discharge between the electrodes is an intense emitter of electrons. A power supply for the source is described that permits regulation of pulse duration from 0.2 to 5 μs. References 6: 5 Russian, 1 Western.



USSR UDC 621.384:537.533

MEASUREMENTS OF THE ENERGY SPECTRUM OF HIGH-CURRENT ELECTRON BEAMS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 76 pp 39-41
manuscript received 16 Sep 75

KRASTELEV, YE. G., MESKHI, G. O. and YABLOKOV, B. N., Physics Institute of the Academy of Sciences USSR, Moscow

[Abstract] The energy spectrum of high-current electron beams in experiments on the "Impul's" accelerator (electron energy $\leqslant$800 keV, maximum current 30 kA in a pulse with half-width of $\simeq$40 ns) was measured on a 180° magnetic analyzer, by the method of partial absorption, and by plotting curves for total absorption in aluminum foil. The magnetic analyzer and measurement set-up are described. It is shown that the results of measurements on the magnetic analyzer at the output of the diode of the "Impul's" accelerator agree within the limits of experimental error with measurements by the method of partial absorption. Discrepancy is no greater than 10-15%. References 8: 3 Russian, 5 Western.

USSR UDC 631.384.66

ACCELERATING RESONATORS FOR PROTON SYNCHROTRONS WITH SHORT ACCELERATION TIME

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 76 pp 24-26
manuscript received 25 Nov 74

ABDUL'MANOV, V. G., AUSLENDER, V. L. and PANFILOV, A. D., Institute of Nuclear Physics, Siberian Department of the Academy of Sciences USSR, Novosibirsk

[Russian abstract provided by the source]

[Text] The article describes two types of accelerating resonators with a wide range of frequency tuning designed for use in proton synchrotrons with short acceleration time. The construction of the resonators provides for complete decoupling of the high-frequency circuits from the ferrite magnetizing circuit. Experimental curves are given for the resonator frequency as a function of the magnetizing current plotted for a frequency variation rate of (0.5-2) 10 MHz/s. References 16: 13 Russian, 3 Western.

USSR UDC 621.376

A THYRISTORIZED MODULATOR FOR AN ARC-TYPE CYCLOTRON ION SOURCE

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 76 pp 27-28
manuscript received 2 Oct 75

LATUSHKIN, S. T., REZVOV, V. A., TRET'YAK, V. A. and YUDIN, L. I., Institute of Atomic Energy, Moscow

[Russian abstract provided by the source]

[Text] The article describes a current modulator for an arc-type source of cyclotron ions that gives pulse currents up to 100 A at a voltage up to 1.5 kV. Pulse duration is controllable from 0.2 to 20 ms, and the duty factor is 0.5 or less. The upper limit of the prf is 300 Hz. The modulator is based on a symmetric flip-flop circuit using TCh-63 thyristors. References 2 Russian.

USSR UDC 621.384.668.83

MEASUREMENT OF THE EQUILIBRIUM BEAM ORBIT ON THE NAP-M ACCUMULATOR

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep/Oct 76 pp 33-35
manuscript received 15 Nov 75

ZAGORODNIKOV, YE. I., KALININ, A. S., and MEDREDKO, A. S., Institute of Nuclear Physics, Siberian Affiliate of the Academy of Sciences USSR, Novosibirsk

[Abstract] The equilibrium orbit of the beam in the NAP-M proton storage device is measured using electrostatic beam position sensors. The sensor signals are processed on the first harmonic of beam reversal frequency which varies over the range 0.36-2.5 MHz. The apparatus developed is described. The system operates with a number of particles in the beam of over $1\text{-}2\cdot10^8$. At the present time, the system is operating on an installation with $1\text{-}2\cdot10^9$ particles in orbit and has a resolution of about 0.5-1 mm of beam displacement. References 3: 2 Russian, 1 Western.

USSR UDC 621.384.633

AUTOMATIC MEASUREMENT OF BEAM TRANSIT PHASE IN A CYCLOTRON

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep/Oct 76 pp 35-38
manuscript received 16 Sep 75

DENISOV, YU. N., LYUBENKO, A. N., and CHIGAK, M., Nuclear Process Laboratory, Joint Institute for Nuclear Research, Dubna

[Abstract] Two methods are described for measurement of the phase in a cyclotron--by points of intersection and by the second harmonic. When the recurrence rate of clusters of charged particles of about 40 MHz, the calculated accuracy of phase determination is about 0.1°, the mean square measurement error about 2°. All software for the calculations was written in FORTRAN, with the exception of some short subroutines written in a mnemonic code for nonstandard I/O devices. The M-6000 computer was used, its structure, accuracy and speed making it convenient for solution of problems of this type. References 9: 4 Russian, 5 Western.

USSR UDC Δ539.1.073/.074

DOUBLE EXTRACTION OF PROTONS FOR BOMBARDMENT OF BUBBLE CHAMBERS IN THE HIGH ENERGY PHYSICS INSTITUTE ACCELERATOR

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep/Oct 76 pp 38-41
manuscript received 27 Dec 75

AKIMTSEV, A. I., ASEYEV, A. A., GERTSEV, K. F., KOMAROV, V. V., KURNAYEV, O. V., KUTVINOV, A. V., MOYZHES, L. M., MYZNIKOV, K. P., and TATARENKO, V. M., Institute of High-Energy Physics, Serpukhov

[Abstract] A mode of double extraction of protons to an external target for bombardment of the "Mirabel" and "Lyudmila" bubble chambers is described. The minimum time resolution between successive expansions is about one second for these chambers. Protons with the maximum energy are extracted in the flat portion of the magnetic cycle, the first extraction being performed at the beginning of the plateau on the bunched beam, the second--at the end on the de-bunched beam remaining after interaction with the internal targets. A description is presented of the equipment developed and modernized for the purpose of double beam extraction. A block diagram is presented of the intensity stabilization system for the second extraction, as well as a schematic diagram of the pulsed power supply for the lenses of the transport system. The reproducibility of beam position is within 0.1 mm in the horizontal and vertical planes in continuous-duty operation. The results of the experiment show that the system developed can be successfully used for double beam bombardment of bubble chambers. References 3 (Russian).

USSR UDC 539.107.5

TAGGED PHOTON SYSTEM ON THE TOMSK SYNCHROTRON

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 5, Sep/Oct 76 pp 41-42
manuscript received 18 Dec 75

KALININ, B. N., SARUYEV, G. A., PETLIN, G. N., and TOMCHAKOV, V. K., Scientific Research Institute of Nuclear Physics, Tomsk Polytechnical Institute

[Russian abstract provided by the source]

[Text] A tagged photon system has been created on the extracted electron beam of the Tomsk synchrotron. Recoil electrons, the energy of which is determined by a magnetic analyzer, are recorded by 10-channel FEU-87 scintillation counters. The system produces photons with energies from 200 to 850 MeV with an energy resolution of 2%. Some $5 \cdot 10^4$ tagged quanta are produced per channel when the extracted beam intensity is 10^{10}/cycle. References 9: 1 Russian, 8 Western.

USSR

SEARCH FOR ASSOCIATIVE PRODUCTION OF CHARMED PARTICLES IN π^-p COLLISIONS AT A MOMENTUM OF 40 GeV/c

Moscow YADERNAYA FIZIKA in Russian Vol 24, No 5(11), Nov 76 pp 969-975
manuscript received 30 Jun 76

APEL, W. D., MÜLLER, H., SCHNEIDER, H., Institute of Experimental Nuclear Physics, University and Nuclear Research Center, Karlsruhe, West Germany, BERTOLUCCI, E., VINCELLI, M. L., MANNELLI, I., PIERAZZINI, G. M., SERGIAMPIETRI, F., SCRIBANO, A., Institute of Physics, University and INFN, Pisa, Italy, VIKTOROV, V. A., DONSKOV, F. V., INYAKIN, A. V., KACHANOV, V. A., KRASNOKUTSKIY, R. N., LEDNEV, A. A., MIKHAYLOV, YU. V., PROKOSHKIN, YU. D., PROKHOROV, A. N., SHUVALOV, R. S., Institute of High-Energy Physics, Serpukhov, USSR, LEDER, G., PERNIKA, M., Institute of High-Energy Physics and AAN, Vienna, Austria, and SIGURDSSON, G., CERN, Geneva, Switzerland

[Russian abstract provided by the source]

[Text] A report on research done on the 70 GeV accelerator at the Institute of High-Energy Physics in Serpukhov to detect associative production of particles with the new hadron quantum number charm in reaction $\pi^-p \to D^0\bar{D}^0n$ at a pion momentum of 40 GeV/c. To identify $\bar{D}^0 \to \bar{K}^0\pi^0$ decays the authors used spark and proportional chambers and hodoscopes registering the decay $K_S^0 \to \pi^+\pi^-$, and a 648-channel hodoscopic spectrometer on-line with a computer for registration of γ-quanta from decay of π^0-mesons. References 13: 6 Russian, 7 Western.

USSR

RELATION BETWEEN DOORWAY STATES AND THE OPTICAL MODEL

Moscow YADERNAYA FIZIKA in Russian Vol 24 No 5(11), Nov 76 pp 945-952
manuscript received 31 Oct 75

NEMIROVSKIY, P. E. and MANEVICH, L. G., Institute of Atomic Energy imeni I. V. Kurchatov

[Russian abstract provided by the source]

[Text] Doorway states of a small number of quasi-particles should play the principal part in processes of interaction between neutron and nucleus in nuclei with closed shells and in their neighbors. Eitehr three-quasi-particle or five-quasi-particle states may predominate in different energy ranges, depending on parity; the five-quasi-particle states are produced via virtual three-quasi-particle states. In this paper the mean width of doorway states is found by setting the sticking probability found from experiment or from the optical model equal to that calculated in terms of doorway states. On the other hand $\langle \Gamma^{\uparrow}_{d} \rangle$ is calculated in terms of the potential of paired correlations. Experimental data on the sticking probability enable determination of this potential. Specifically, if this probability is taken as $u\delta(r_i r_k)$, the value of u is found to be 400 MeV·fm^3. The distribution of widths $\Gamma^{\uparrow}_{d}$ of three-quasi-particle states is found on the basis of the pairing potential. References 12: 3 Russian, 9 Western.

USSR

ESTIMATES OF THE CROSS SECTION OF TWO-POMERON PROCESS IN π^-p INTERACTIONS AT 40 GeV/c

Moscow YADERNAYA FIZIKA in Russian Vol 24 No 5(11), Nov 76 pp 1058-1064
manuscript received 14 Oct 75

DIDENKO, L. A., MURZIN, V. S. and SARYCHEVA, L. I., Institute of Nuclear Physics, Moscow State University

[Abstract] An attempt is made to distinguish two-pomeron inclusive processes in reactions of the type $\pi^-p \to \pi^-+p+$ ..., and to estimate the cross section of these processes. The work is based on analysis of materials from the two-meter propane bubble chamber at the High-Energy Laboratory of the Joint Institute for Nuclear Research with exposure to a beam of π^- mesons with momentum of 40 GeV/c. The analysis included 5062 completely measured π^-p interactions consisting of interactions between pions and free protons (56%) and interactions between pions and quasi-free nucleons of carbon nuclei (44%). The lower limit of the reaction cross section is estimated at 5-10 μb. References 12: 5 Russian, 7 Western.

USSR

CHARGE ASYMMETRY IN NEUTRINO EXPERIMENTS ABOVE THE CHARMED PARTICLE PRODUCTION THRESHOLD

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian
Vol 24, No 9, 5 Nov 76 pp 521-524 manuscript received 28 Jul 76

GERSHTEYN, S. S. and FOLOMESHKIN, V. N., Institute of High-Energy Physics, Academy of Sciences USSR

[Abstract] An analysis is made within the Glashow-Iliopoulos-Maiani model of the scattering of neutrinos and antineutrinos by the quarks and antiquarks of a nucleon above the threshold of charmed particle production, and it is shown that $F_1^{\nu p} = F_1^{\bar{\nu} n}$, $F_1^{\nu n} = F_1^{\bar{\nu} p}$. With regard to F_3 functions, under realistic conditions the suppression of the sea of C-quarks as compared with the sea of s-quarks makes them charge-asymmetric: $F_3^{\nu p} \neq F_3^{\bar{\nu} n}$, $F_3^{\nu n} \neq F_3^{\bar{\nu} p}$. The violation of charge symmetry occurs only in the interference structure functions F_3, and only beyond the threshold of charmed particle production. It is concluded from the analysis that all experimental data on $\nu N(\bar{\nu} N)$ scattering are satisfactorily explained by the Glashow-Iliopoulos-Maiani theory (assuming that the percentage of sea quarks increases with energy) without recourse to multiple-quark schemes or right-hand hadronic currents. References 13 Western.

USSR

CONCERNING THE QUESTION OF THE POSSIBILITY OF RADIATION DECAY OF COLLECTIVE LEVELS OF THE ARGON ATOM

Moscow PIS'MA ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian
Vol 24 No 8, 20 Oct 76 pp 464-467 manuscript received 6 Sep 76

VERKHOVTSEVA, E. T., POGREBNYAK, P. S., and FOGEL', YA. M., Physicotechnical Institute of Low Temperatures, Academy of Sciences UkrSSR

[Russian abstract provided by the source]

[Text] The x-ray spectrum of argon is studied in the range of 15-200 Å in an effort to find emission of collective vibrations of the electron shell of atoms. No such emission is detected, which can be attributed either to an insufficient number of electrons in the shell of the argon atom or to the low probability of the process of radiation decay of the collective levels of the atom. References 10: 6 Russian, 4 Western.

USSR UDC 621.384.612.22

INVESTIGATION OF COHERENT SYNCHROBETATRON BEAM OSCILLATIONS IN THE YEREVAN SYNCHROTRON WHEN PARTICLES ARE ACCELERATED TO AN ENERGY OF 2-3 GeV

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR, FIZIKA in Russian Vol 11, No 4, 1976 pp 280-287 manuscript received 18 Jun 75

AYRAPETYAN, B. B., BARYSHEV, A. I., NIKOGOSYAN, V. TS. and TUMANYAN, A. R., Yerevan Physics Institute

[Russian abstract provided by the source]

[Text] The paper describes the results of an investigation of coherent phase oscillations of the beam in an electron synchrotron, and the effect that "passive" resonators have on the parameters of these oscillations. Recommendations are made on eliminating loss of particles in the acceleration cycle, as well as the results of experimental verification of some theoretical points. It is experimentally confirmed that components with combination frequencies show up in betatron oscillations in the presence of coherent beam oscillations. It is shown that the frequency of coherent phase oscillations of the beam can be determined by measuring these components of betatron oscillations. References 4 Russian.

USSR UDC 531.1.07

POLARIZATION OF μ^+-MESONS IN THE FIELD OF A MAGNETIC TRAP OF THE MIRROR TYPE

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 46 No 10, Oct 76 pp 2130-2135 manuscript received 20 May 75

SERDYUK, O. V., Institute of Nuclear Research, Academy of Sciences USSR, Moscow

[Abstract] A magnetic mirror trap has been proposed for confinement of μ^+-mesons with a mean energy of approximately 150 MeV. Preliminary calculations indicate that a planarly focused neutron flux with a mean energy of approximately 100 MeV will then result. Since the lifetime of μ^+-mesons is equal to 10^3-10^4 Larmor precessions in the trap, anomalous ("small") spin oscillations contribute largely to the polarization dynamics. This situation is analyzed according to the classical Bargmann-Michel-Telegdi equation of motion for the spin of a relativistic particle in an electromagnetic field. In the case of μ^+-mesons this equation is characterized by the presence of the small parameter $\varepsilon = 1/274\pi$. It is set up here for the spin of a charged particle: first in a uniform magnetic field and then in the axisymmetrically gradiental field of a magnetic mirror trap, where the muon trajectories are found. It is shown that in the case of coaxial resonance the motion of spin in a trap in the zero approximation with respect to ε corresponds to solution of the Bloch equation by the method of averaging with respect to the fast component due to Larmor precession with simultaneous isolation of the adiabatic component due to motion between

the magnetic mirrors. In the nonresonant case, in contrast to motion in a uniform magnetic field the axis of anomalous precessions of spin in the magnetic trap coincides with the axis of its Larmor precessions, the frequency of anomalous precessions being maximum when the particle momentum is perpendicular to the field. References 8: 5 Russian, 3 Western.

USSR UDC 621.378.32:537.22

OPTICAL BREAKDOWN OF TRANSPARENT DIELECTRICS IN CONSTANT EXTERNAL ELECTRIC FIELDS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 25 No 3, Sep 76 pp 500-503 manuscript received 12 Aug 75

VLASOV, R. A. and ZHVAVYY, S. P.

[Abstract] The avalanche ionization during optical breakdown of transparent dielectrics is influenced by the presence of constant electric fields which localize, for instance, near defects. The effect of such fields on the functional relation between breakdown threshold and other parameters is analyzed here on the basis of the kinetic equation, assuming the electric field to be uniform in space and the n ($\mathcal{E}$,t) distribution to be isotropic in the energy domain $\mathcal{E}$. The four terms in this equation represent respectively: the energy imparted to electrons by the optical field, the energy imparted to electrons by the electric field, the energy lost by electrons during collisions with the lattice, and the energy of the impact ionization process. This equation has been solved by the moments method, and numerical results have been obtained for the specific case of a leucosapphire crystal, with the "forty ionizations (θt_{thr}= 40)" criterion of breakdown. It appears that the electron-phonon interaction constant hardly affects the threshold flux in the absence of a constant electric field, but does so rather strongly in such a field, or if the acoustic branch is also considered. Generally, also the lifetime of electrons must be taken into account, inasmuch as it is not negligibly shorter than the drift time out of the breakdown region. Figures 1; references 6 (Russian).

USSR UDC 533.9:621.375.826

LASER METHODS OF PLASMA INTERFEROMETRY

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 25 No 3, Sep 76 pp 379-407 manuscript received 10 Nov 75

DUSHIN, L. A., PRIVEZENTSEV, V. I., and TARAN, V. S.

[Abstract] This survey of laser interferometers for contactless plasma measurements covers the principles of operation, major types of instruments, and methods of interferogram recording and evaluation. First the basic relations are established between electron density, gas density, refractive index, and phase shift and attenuation of an electromagnetic wave. The object is to determine the variation of plasma distribution in space and time. The interference field is recorded photographically by any of the three methods: single-frame, photography with time sweep, and holography--each characterized by its sensitivity, space resolution, and time resolution. The interferograms are then evaluated with a high degree of automation, by photometry, by filtering, by

means of a memory device, by phase shift measurements, or by mathematical transformations (Abel, Fourier) or by computer decoding. A higher sensitivity of interference measurements requires longer waves, at which photographic recording is not feasible and must be replaced by photoelectric recording. The major types of laser interferometers operate with coupled resonators, with open resonators, or with compensation. Special-purpose interferometers have been designed for infrared measurements. Figures 16; references 132: 69 Russian, 1 Yugoslav, 62 Western.

USSR

SUPERCONDUCTIVE CONTACTS WITH NONEQUILIBRIUM ELECTRON DISTRIBUTION FUNCTION

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 70, No 4, Apr 76 pp 1340-1349 manuscript received 1 Sep 75

ASLAMAZOV, L. G. and LARKIN, A. I., Institute of Theoretical Physics imeni L. D. Landau, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The authors determine the influence that nonequilibrium electrons have on the current-voltage characteristics of superconductor contacts. In the case of massive superconductors where the length of the contact is $a \gg \xi\tau^{-\frac{1}{4}}$ [here ξ is a dimension of the superconducting pair, $\tau = (T - T_c)/T_c$, T_c is the critical temperature], stimulation of superconductivity arises in the contact, and the current through the contact rises appreciably at low voltage. In film contacts the nonequilibrium effects lead to suppression of superconductivity. In this connection the current-voltage characteristic has a section with negative resistance, leading to the voltage jumps observed in the experiment. References 5: 3 Russian, 2 Western.

USSR

PHOTOELECTRIC AND ACOUSTICOELECTRIC FIELDS IN SUPERCONDUCTORS

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 70, No 4, Apr 76 pp 1477-1489 manuscript received 3 Nov 75

ARONOV, A. G., Leningrad Institute of Nuclear Physics imeni B. P. Konstantinov, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] When a superconductor is radiated with microwaves or sound passes through it, steady-state electric fields arise in such a superconductor that fall off with increasing distance from the boundary. Equations are derived that describe the distribution of these fields and their boundary conditions. Methods of observation are discussed and a correction is found for the Josephson emission frequency if a superconductor is exposed to microwave emission or sound. References 8: 6 Russian, 2 Western.

USSR UDC 532.132

SUPERFLUIDITY OF HELIUM II NEAR THE λ-POINT

Moscow USPEKHI FIZICHESKIKH NAUK in Russian Vol 120 No 2, Oct 76 pp 153-216

GINZBURG, V. L., P. N. Lebedev Institute of Physics, Academy of Sciences USSR
SOBYANIN, A. A., All-Union Scientific-Research Institute of the Metrological Service, Government Standards USSR

[Abstract] Since helium was first liquefied in 1908, the λ-transition from helium I to helium II and the accompanying anomaly in the temperature characteristic of its density along with the phenomenon of superfluidity were discovered in 1911. The Landau theory of superfluidity, which approaches this phenomenon in terms of the quasimicroscopic theory as well as two-fluid hydrodynamics, fails near the λ-point because of not having the order parameter included in its formulation. The problem of the velocity jump at a solid wall, moreover, requires that this theory be further extended. Accordingly, the fundamental equation for the effective wave function Ψ (order parameter) is derived here for helium II in the states of complete or incomplete thermodynamic equilibrium, which cover stand-still as well as steady superfluid flow. The boundary conditions for this equation are also established, namely at the solid wall, whereupon the accuracy of this Ψ-theory is analyzed with fluctuations of both the modulus and the phase of the Ψ-function taken into account. While this theory is still severely limited and applicable only under various assumptions, it is regarded valid enough for solving some specific problems such as the four ones considered here. The first problem concerns the size effect in films, capillaries, and pores with a resulting shift of the λ-point, decrease in the superfluid density, and change in the specific heat. The second problem concerns the density distribution when the superfluid is affected by external fields (gravitational, electric and magneto-striction forces, van der Waals forces) slowly or rapidly varying in space. The third problem concerns the surface tension and the boundary conditions at the free surface, with the helium II liquid-vapor interface treated as an analogy to a "superconductor-normal metal" interface. The fourth problem concerns the critical velocity of superfluid flow and the formation of a vortex filament. The study continues with the development of a general Ψ-theory of superfluidity near the λ-point. The complete flow equations for the superfluid and the normal component are derived, covering also the condition of nonsteady flow and accounting for dissipation as well as for relaxation of the order parameter. This system of equations can be used for solving the important problem of sound and heat propagation through stationary helium II, with the medium first assumed homogeneous and then considering the much more complex nonhomogeneous case. Figures 5; references 180: 55 Russian, 125 Western.

USSR

COOLING A SUBSTANCE BY A HIGH-FREQUENCY RESONANCE FIELD

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 70, No 4, Apr 76 pp 1463-1476 manuscript received 31 Oct 75

SHAPIRO, V. YE., Institute of Physics, Siberian Department of the Academy of Sciences USSR

[Abstract] This paper continues the discussion of the feasibility of using rf resonance fields in the cw mode for cooling that was begun in 1975 (V. Ye. Shapiro, "On the Possibility of Using High-Frequency Forces to Control the State of a System," Preprint IFSO-25F, Krasnoyarsk, 1975). It is shown that cooling can be achieved by a source of monochromatic forces with frequency appreciably higher than the characteristic frequencies of thermal fluctuations in the system, but close to the frequencies of resonances that interact nonlinearly with these fluctuations. In this situation, when energy is pumped from the source to a fast vibrational subsystem in resonance, energy exchange between fast and slow motions becomes noticeably unilateral: in operation on one slope of the resonance curve the energy of the fluctuations passes only from the fast system to the slow one, and when the sign is reversed the flux of energy is opposite. This principle is general and dissipative. A number of examples of the application of this principle for cooling are examined, and it is shown in particular that strongly scattering but weakly absorbing media in a multimode optical cavity can be appreciably cooled by a light beam (efficiency comparable with unity). References 8: 7 Russian, 1 Western.

USSR

INFLUENCE OF REFLECTION AT BOUNDARIES AND SELECTIVITY OF THE OPTICAL CHARACTERISTICS OF THE MEDIUM ON RADIATION-CONDUCTIVE HEAT TRANSFER IN A FLAT LAYER

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 14 No 5, Sep/Oct 76 pp 957-964 manuscript received 28 Apr 75

PETROV, V. A. and STEPANOV, S. V., Institute of High Temperatures, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] A new numerical method is used as the basis for studying heat transfer in a flat layer in the case of mirror reflection at boundaries over a wide region of values of optical thickness and dimensionless coefficient of thermal conductivity. An investigation is made of the influence that the angle dependence of reflectivity has on the temperature differential in the layer. Quartz glass is examined by way of an example showing the way that accuracy of the calculation depends on the nature of approximation of the spectrum. The part played by "water" bands in the processes of heat transfer is demonstrated for this glass. References 14: 7 Russian, 7 Western.

USSR UDC 532.542.4:536.24

HEAT EXCHANGE IN PIPES OF ANNULAR CROSS SECTION ASSUMING CONSTANT THERMOPHYSICAL PROPERTIES AND BOUNDARY CONDITIONS q_{st} = const

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 14 No 5, Sep/Oct 76 pp 991-997 manuscript received 7 Feb 75

GALIN, N. M. and YESIN, V. M., Moscow Power Engineering Institute

[Russian abstract provided by the source]

[Text] Numerical calculations are done on heat transfer for turbulent flow of fluids with constant thermophysical properties in channels of annular cross section in the region of stabilized heat exchange. The calculations are done over a wide range of Reynolds and Prandtl numbers and dimensionless number r_1/r_2. For $Pr \geqslant 0.7$ The results of the calculations are described by interpolation formulas that satisfy requirements of limiting transition with a change in the parameter r_1/r_2 from 0 to 1. References 21: 1 Russian, 10 Western.

USSR UDC 533.951.2

INTERFEROMETRIC INVESTIGATION OF A THERMAL ARGON PLASMA

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 14 No 5, Sep/Oct 76 pp 937-942 manuscript received 4 Apr 75

KON'KOV, A. A. and SOKOLOV, A. I., Institute of High Temperatures, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The paper presents the results of an investigation of the distribution of density and electron concentrations behind incident and reflected shock waves in argon at Mach numbers of 8-23. A comparison of experimental and theoretical data showed that the experimental values of density and electron concentrations directly behind the shock waves correspond to the values calculated by laws of conservation. Analysis of experimental data shows that radiation is the determining factor responsible for cooling of the argon plasma under the conditions of this research. References 13: 11 Russian, 2 Western.

USSR UDC 532.5+536.25

INFLUENCE OF THERMODYNAMIC FORCES ON TRANSPORT PROCESSES ON THE FREE SURFACE OF A LIQUID IN A HORIZONTAL LAYER IN THE CASE OF TURBULENT THERMAL GRAVITATIONAL CONVECTION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 231, No 2, 11 Nov 76 pp 309-311 manuscript received 3 Nov 75

KUTATELADZE, S. S., associate member of the Academy of Sciences USSR, KIRDYASHKIN, A. G. and BERDNIKOV, V. S., Institute of Thermal Physics, Siberian Department, Academy of Sciences USSR, Novosibirsk

[Abstract] Small-scale currents commensurate with the thickness of the thermal boundary layer can be observed close to the free cooled surface of a liquid. It has been suggested that these are thermogravitation currents. This paper gives the results of an experimental study of the thermal and hydrodynamic scales of flow close to a free cooled surface and the mechanism of transport processes. The research object was a layer of ethyl alcohol uniformly heated from below and thermally insulated around the perimeter. The free surface was cooled by a transparent heat exchanger via an air-vapor layer. The horizontal dimensions of the layer were 390 x 400 mm, and the liquid height was 29-44 mm. The mean temperature profile $\overline{T}(y)$ was measured by a platinum resistance thermometer within 0.01°C. The results show large-scale cellular flow commensurate with the height of the layer. Flow visualization by fine aluminum powder showed quasi-two-dimensional small-scale cellular currents close to the heat-exchange surface against a background of large-scale currents commensurate with the thickness of the layer. The transport processes in the small-scale cells are determined by the combined action of thermocapillary and thermogravitational forces. For this reason, considerable differences are observed in the intensity of transfer close to the free and solid heat-exchange surfaces. The influence of thermocapillary forces on processes of heat and mass exchange on the free surface must be accounted for independently of the scales of volumes of liquid being cooled. References 3: 1 Russian, 2 Western.

USSR

UDC 533.7

EFFECTIVE TRANSPORT COEFFICIENTS IN PLASMA IN THE LOCAL THERMODYNAMIC EQUILIBRIUM APPROXIMATION

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 14 No 5, Sep/Oct 76 pp 921-926 manuscript received 20 Jun 75

KUCHERENKO, V. I., PAVLOV, G. A., and SON, E. YE., Moscow Physicotechnical Institute

[Russian abstract provided by the source]

[Text] The paper introduces effective transport coefficients that define the mass flux of a chemical element and heat flux in plasma in the local thermodynamic equilibrium approximation. The effective coefficients simplify accounting for multicomponent diffusion if the number of components is greater than the number of chemical elements comprising the plasma. The authors discuss an example of calculation of the effective coefficients of a mixture of hydrogen and helium assuming parameters typical of entry of space vehicles into the atmosphere of Jupiter. References 17: 9 Russian, 8 Western.

USSR

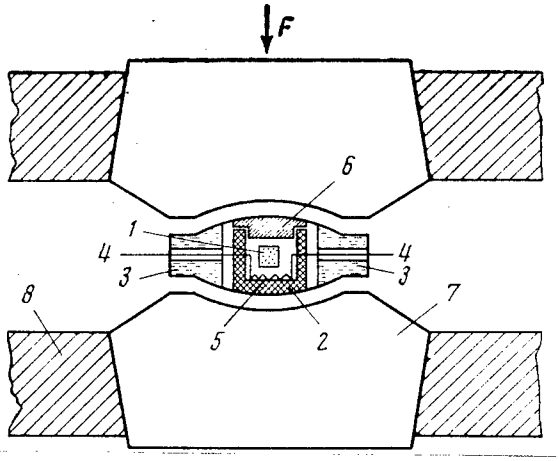
UDC 539.172.3:539.2

A HIGH-PRESSURE CHAMBER FOR STUDYING MÖSSBAUER SPECTRA UNDER HYDROSTATIC PRESSURE UP TO 50 kbar

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 76 pp 203-204
manuscript received 22 Jul 75

KAPITANOV, YE. V. and PANYUSHKIN, V. N., Institute of High-Pressure Physics, Academy of Sciences USSR

[Abstract] The paper describes a high-pressure chamber for Mössbauer research. The figure shows a cross section of the chamber through the plane containing the study specimen. Teflon ampule 2 is held in a container of a molded mixture of boron and epoxy resin. Annealed steel wire leads pass through openings in the container into the ampule. The leads are connected to a wire coil that is the pressure sensor. The specimen is then placed in the ampule and the working fluid (B70 gasoline) is poured in, after which the ampule is closed with annealed copper cover 6. The ampule is squeezed between the faces of VK6 alloy dies 7 held in a system of steel rings 8. The dies are brought together by force F from a press. A diagram is given showing the relative placement of the source of Mössbauer emission, the study specimen, collimator, detector and pressure sensor. Pressures up to 50 kbar can be produced in the proposed chamber. The installation was used to study the effect of hydrostatic pressure on Mg_2Sn by the Mössbauer and electric resistance method. References 3 Russian.



1--study specimen; 2--Teflon ampule; 3--container of a pressed mixture of boron and epoxy resin; 4--electrical leads; 5--manganin wire coil; 6--annealed copper cover; 7--hard-alloy die; 8--steel holding rings (45KhMNFA steel, HRC 50).

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