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USSR REPORT

PHYSICS AND MATHEMATICS

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UDC: 621.373.826

EXCITATION OF SUPERSHORT DEFORMATION PULSES DURING ABSORPTION OF STRONG OPTICAL RADIATION

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84
(manuscript received 19 Mar 84) pp 2197-2209

GUSEV, V. E., Moscow State University imeni M. V. Lomonosov

[Abstract] The possibility of implementing a laser picosecond acoustic pulse generator is analyzed theoretically. Processes occurring in the system when a metal film is applied to the surface of the dielectric are investigated in detail. The generation and propagation of acoustic phonons and deformation waves are investigated using a model of an isotropic solid body disregarding acoustic mismatch at the film-crystal boundary and assuming that the system generates only longitudinal phonons. Formulas are derived for the energy density balance in the film. The model demonstrates effective excitation of deformation waves by the moving front of the heat pulse. It is found that the main contribution to the deformation pulse comes from synchronous excitation of acoustic waves in the region associated with the front of the nonequilibrium flux.
References 29: 24 Russian, 5 Western.
[178-6900/12947]

FOCUSING REFLECTORS FOR SURFACE ACOUSTIC WAVES

Leningrad PISMA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 11, No 5,
12 Mar 85 (manuscript received 5 Nov 84) pp 305-308

BORODIY, Yu. N., GRANKIN, I. M. and KOLOMENKO, A. V., Kiev Polytechnical Institute

[Abstract] A focusing periodic reflector for surface acoustic waves that can be used in SAW resonators and acoustic radio signal processors is investigated. The focusing reflector (mirror) is a periodic structure of reflecting strips whose curvature allows for the acoustic anisotropy of the piezoelectric crystal. Focusing reflectors based on Y-cut $LiNbO_3$ crystals focusing along

the Z axis are investigated experimentally. A reflector with a 15.5-mm aperture and f = 24 mm consisting of a periodic structure of 20 reflecting strips is studied. The shape of the experimental distribution is found to be close to that calculated, while the width of the main lobe is 125 μ m, as compared with an experimental value of 130 μ m. The size of the focal point is practically equal to its diffraction limit.
References 5: 4 Russian, 1 Western.
[374-6900/12947]

UDC: 621.373.826

TEMPERATURE-INDUCED OPTICAL DAMAGE TO $LiNbO_3$:Nd

Moscow KVANTOVAYA ELEKTRONIKA in Russian, Vol 12, No 2, Feb 85 (manuscript received 1 Nov 84) pp 246-247

BARDASAROV, Kh. S., BOGDANOV, N. Ya. and Uyukin, Ye. M., Institute of Crystallography imeni Shubnikov, USSR Academy of Sciences

[Abstract] An $LiNbO_3$:Nd crystal (with Nd content of 1.0% by weight) with a length of 8.3 mm in the direction perpendicular to the Y-cut is investigated. The intensity of the light beam from an argon laser (P = 700 mW) is measured before and after passing through the crystal. The temperature-induced light scattering when the specimen is pre-heated to approximately 150°C disappears at approximately 120 - 130°C, and occurs in the 85 - 95°C region as the temperature drops. Local 'bleaching' of the crystal by laser radiation is observed. No temperature-induced optical damage was observed in undoped $LiNbO_3$ specimens, or in crystals doped with transition metals (Fe, Mn, Ni). References 3 Russian.
[340-6900/12947]

PHOTOELECTRIC DOMAIN STRUCTURE IN RUBY CRYSTALS

Moscow ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian Vol 87, No 12, Dec 84 (manuscript received 17 Apr 84) pp 2047-2061

BASUN, S. A., KAPLYANSKIY, A. A. and FEOFILOV, S. P., Physical-Technical Institute imeni A. F. Ioffe, USSR Academy of Sciences

[Abstract] It is shown experimentally that concentrated ruby crystals subjected to laser radiation enter a steady spatially inhomogeneous state with regions (domains) in which the internal electrical field directed along the C axis has the same absolute value but opposite sign. The characteristic restructuring of the domain structure that is accompanied by hysteresis is observed when the crystals are irradiated in an external electrical field. The phenomenon of photo-induced electrical domains in ruby is explained qualitatively by a phenomenological theory that associates the phenomenon with electrical instability of the crystal during irradiation. The

instability is caused by the fact that the photovoltaic current arising in a centrally symmetrical ruby in the presence of a field is directed against the field. The photocurrent flowing in the crystal against the applied external electrical field is observed directly by measuring the voltage-current characteristics of optically excited ruby. Reversible 'phase' transitions are detected between homogeneous and inhomogeneous (domain) states of optically excited ruby that occur when external conditions change. Characteristic critical behavior of these transitions is established.
References 16: 8 Russian, 8 Western.
[204-6900/12947]

PHOTOELECTRIC DOMAIN STRUCTURE. THEORY

Moscow ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian Vol 87, No 12, Dec 84 (manuscript received 17 Apr 84) pp 2063-2074

DYAKONOV, M. I. and FURMAN, A. S., Physical-Technical Institute imeni A. F. Ioffe, USSR Academy of Sciences

[Abstract] A phenomenological theory of photoelectric instability is constructed that explains the occurrence of a stationary electrical domain structure in ruby crystals subjected to strong laser radiation. The theory is based on a mechanism proposed in another study to underlie the occurrence of photovoltaic current in an axisymmetrical crystal in the presence of an electrical field directed against the field. The resistance of the specimen in the zero-order field is negative, which results in the development of instability and the spontaneous occurrence of an electrical field in the crystal. Different types of steady field distributions resulting in the application of fields with different strengths are investigated. The occurrence of a reverse photovoltaic current in an electrical field during two-quantum excitation is analyzed. The theory of photoelectric domain instability is in complete accord with the experimental findings: the occurrence of current in ruby crystals directed against the electrical field is firmly established.
[204-6900/12947]

UDC: 621.315.592

INFLUENCE OF GAMMA-RADIATION ON ACOUSTIC WAVE ABSORPTION IN YTTRIUM-ALUMINUM GARNET

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 27, No 3, Mar 85 (manuscript received 26 Mar 84) pp 902-904

IVANOV, S. N., MEDVED, V. V. and RAKHMANOV, A. B., Institute of Electrical Engineering and Electronics, USSR Academy of Sciences

[Abstract] The influence of gamma-radiation on the absorption of acoustic waves in YAG, including those containing rare earth metal impurities, is

investigated. YAG specimens and YAG doped with Yb^{1} and Lu were irradiated by gamma-quanta from a Co^{60} source up to a dose of 10^{8}R. After irradiation, the coloration of the crystals remained unchanged, suggesting that the excess absorption observed in the crystals is not associated with color centers. The absorption of longitudinal acoustic waves propagating along the [110] crystallographic axis was measured by the pulse echo method. The parameters of the paramagnetic level on which wave absorption occurs are found to be Δ = 150 K and $\tau_0 \sim 1.5 \cdot 10^{13}$ sec. An additional experiment of absorption in YAG doped with scandium confirms that the proposed model of absorption centers in gamma-irradiated YAG is valid. References 7: 5 Russian, 2 Western.
[366-6900/12947]

GAS DYNAMICS

UDC: 621.373.826.038.823

FORMATION OF SPATIALLY HOMOGENEOUS DISCHARGE IN LARGE VOLUME CO_2 - N_2 -He GAS MIXTURES

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84 (manuscript received 11 Jul 84) pp 2149-2150

APOLLONOV, V. V., BUSH, G. V., MINENKOV, V. R., PROKHOROV, A. M., SEMKIN, B. V., SOBOLEV, V. M., FIRSOV, K. N., SHUBIN, B. G. and YUSHIN, A. V., Institute of General Physics, USSR Academy of Sciences, Scientific Research Institute for High Voltages, Tomsk Polytechnical Institute

[Abstract] The characteristics of a volumetric self-sustained discharge in a device with discharge intervals of up to 0.4 m and discharge volume of up to 100 l are investigated. The discharge was produced in a mixture of CO_2 -N_2-He at atmospheric pressure by means of electrodes designed for a discharge interval of 0.25 m; the discharge interval was varied from 0.2 to 0.4 m in the experiments. It was found that by using an elongated voltage front in conjunction with easily ionized substances makes it possible to produce stable discharges in devices with the electrodes spaced far apart using significantly lower voltages from the pre-ionization sources and pulse voltage generator. References 8: 7 Russian, 1 Western. [178-6900/12947]

UDC: 533.951.8

INTERACTION OF CHARGED PARTICLE BEAMS WITH ACTIVE PLASMA MEDIUM

Gorky IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 11, Nov 84 (manuscript received 15 Jul 83) pp 1382-1387

BONDARENKO, M. B., KONDRATENKO, A. N. and TKACHENKO, V. I., Kharkov State University

[Abstract] This study investigates the interaction of a low-density beam of charged particles with a weakly ionized plasma whose neutral component contains active molecules. The latter are modeled by a nonlinear 2-level system. The effects of the collective interaction between the oscillations

excited by the beam and the active medium are taken into account. The amplitude of the oscillations excited in the plasma is assumed to be low, and the beam particles are assumed not to be trapped by the field of these oscillations, i.e., a linear approximation is satisfactory. Periodic pumping of the plasma oscillation energy to active medium energy is observed in a plasma containing active molecules in the absence of a beam. The introduction of a beam of charged particles with comparatively low density into the medium causes additional phase discrepancy between the field of the oscillations and the polarization of the medium. This distorts the regular nature of the energy pumping from the active component to the plasma oscillations and back. For high beam densities the influence of active molecules is significant only in the initial stage of the instability. The parameters of the medium for which the subject interaction can occur are estimated for the example of an ammonia molecule. References 8 Russian.
[205-6900/12947]

UDC: 533.9.01

KINETIC INVESTIGATION OF SAUSAGE-TYPE RESISTIVE INSTABILITY OF RELATIVISTIC ELECTRON BEAM

Moscow FIZIKA PLAZMY in Russian Vol 10, No 6, Nov-Dec 84
(manuscript received 28 Feb 84 after revision) pp 1167-1171

GUREYEV, K. G., ZOLOTAREV, V. O. and STOLBETSOV, S. D., Moscow Physical-Technical Institute

[Abstract] The nonlinear problem of the development of sausage-type resistive instability of a relativistic electron beam propagating without collisions in a rarified conducting plasma is solved. The investigation assumes that the beam has equilibrium distribution and its perturbation is axisymmetrical, that beam scattering in the plasma can be disregarded, that the transverse component of the beam particle velocity is much smaller than the axial component and that the beam is entirely charge-neutral. The kinetic equation representing the distribution function of the beam is solved by the large-particle method. It is shown that sausage-type instability is among the most troublesome resistive instability modes. Calculations with different perturbation frequencies indicate that phase mixing completely suppresses resistive instability with mode m=0 in the case of a 'warm' beam with Bennett density distribution. References 6: 2 Russian, 4 Western.
[202-6900/12947]

UDC 533.933

SECONDARY ELECTRON TEMPERATURE IN CHARGED PARTICLE BEAM

Moscow FIZIKA PLAZMY in Russian Vol 11, No 3, Mar 85
(manuscript received 29 May 84 after revision) pp 314-319

A. V. ZHARINOV, G. A. TOSUNYAN, and A. S. CHIKHACHYEV, All Union Electrotechnical Institute imeni V. I. Lenin

[Abstract] The temperature of trapped δ-electrons and the depth of the potential barrier at the beam boundary are determined for a wide range of gas pressures. A homogeneous axisymmetrical infinitely long charged particle beam completely filling a tube is examined. An expression for approximating the distribution function of the δ-electrons generated is presented. Two different relaxation modes are identified for secondary electrons. The secondary electrons in the beam are found to be trapped and to relax to a Maxwellian distribution with temperature on the order of several volts. References 6: 4 Russian, 2 Western.
[351-6900/12947]

UDC 533.6.011.72

SHOCK WAVE PROPAGATION THROUGH GAS MIXTURE

Moscow VESTNIK MOSKOVOSKOGO UNIVERSITETA Seriya 3: FIZIKA ASTRONOMIYA in Russian Vol 26, No 1, Jan-Feb 85 (manuscript received 29 Feb 84 after revision) pp 56-63

F. V. SHUGAYEV, A. Ye. KONDRASHOV, and Ye. N. FOMENKO, Department of Molecular Physics

[Abstract] The interaction of a shock wave with small perturbations is examined theoretically, and the special case of the incidence of a shock wave on an inhomogeneous region of a quiescent gas is studied experimentally. The reflection of a plane acoustic wave from a shock wave, and the incidence of a plane shock wave on an inhomogeneous region of a quiescent gas, are analyzed. Head-on interaction between shock and acoustic waves is studied. Experiments on the transmission of a shock wave through a gas mixture are carried out in a horizontal shock tube with a near-two-dimensional inhomogeneity created in the cross section by diffusion of helium or freon-14 in the air filling the low pressure chamber of the tube. Interferograms of shock wave propagation through air-helium and air-Freon 14 mixtures are presented. References 10: 8 Russian, 2 Western.
[358-6900/12947]

UDC 621.373

ONSET AND EVOLUTION OF CHAOS IN DISTRIBUTED OSCILLATOR WITH DELAYED FEEDBACK

Gorky IZVESTIYA VYSSKIKH UCHEBNYKH ZAVEDENIY. RADIOFIZIKA in Russian Vol 28, No 2, Feb 85 (manuscript received 17 July 84 after revision) pp 161-176

V. A. KATS, Saratov State University

[Abstract] Different types of transition from harmonic self-sustained oscillation to autostochastic oscillations (chaos) and the evolution of the properties of chaos, in a distributed oscillator with delayed feedback are investigated experimentally. The distributed system in question consists of a delayed-feedback oscillator with an active element consisting of a non-equilibrium medium formed by an electron beam and a traveling electromagnetic wave. The experimental prototype delayed-feedback oscillator employed is described. The oscillator model is interpreted as a distributed dynamic system. The intrinsic modes of the oscillator are described. Different routes to chaos are found experimentally for simple dynamic systems: successive period-bifurcations, disruption of quasiperiodic motion with three different frequencies, "hard" occurrence of chaos, transition through alternation, and successive torus-doubling bifurcations. A limiting stochastic set that represents the image of "developed" randomness is found to occur in the space of the distributed system far from the equilibrium state; this set can be viewed as a "gas" made up of stochastic sets with initially small dimensionality that are characteristic for simple dynamic systems. References 30: 26 Russian, 4 Western.
[359-6900/12947]

UDC 517.946

INVESTIGATION OF A MODEL OF FLOW OF STREAM OF STRATIFIED FLUID ABOUT A BODY

Moscow DOKLADY AKADEMII NAUK SSR in Russian Vol 279, No 6, Dec 84 (manuscript received 5 Apr 84) pp 1345-1348

BEZHANOV, K. A. and TER-KRIKOROV, A. M., Moscow Physical-Technical Institute

[Abstract] The plane problem of the flow of a steady-state stream of stratified fluid about a body is investigated. The number of layers if finite, the bottom is horizontal, and the upper bound is free. The density and tangential component of the velocity vector are discontinuous at the boundaries of the layers, while the pressure and normal component of the velocity vector are continuous. The ox axis runs along the horizontal bottom of the channel, and the oy axis is vertical. The velocity field at the boundary of the bodies is approximated by the velocity field corresponding to flow about the body by a stream of weightless homogeneous fluid. The boundary problem for the multiply-connected region G is transformed to a linear integrodifferential equation that is solved with the help of an auxiliary Fredholm equation with symmetrized kernel. The latter equation is shown to have no more than a finite number of positive characteristic numbers. References 5: 4 Russian, 1 Western.
[203-6900/12947]

GENERATION OF HARMONICS WITHOUT SPATIAL SYNCHRONISM

Moscow PISMA V ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian Vol 40, No 9, 10 Nov 84 (manuscript received 10 Aug 84) pp 369-371

BELENOV, E. M. and NAZARKIN, A. V., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] The generation of harmonics in nonlinear media is examined for the case in which the index of refraction of the medium at the pumping frequency differs from the index of refraction of the field generated. A problem is examined in which the discrepancy between the group velocities of the pumping pulses and the harmonic is such that the pumping pulse is separated from the generated harmonic pulse more than usual, such that there

can be no reverse conversion from the harmonic to the pumping. It is shown that the introduction of impurities that resonantly retard the ultrashort pumping pulse makes possible efficient harmonic conversion. It is easiest to achieve this conversion mode in liquid and gas media by mixing the basic nonlinear medium with a relatively low concentration of a resonant 'retarder' and in optical waveguides by using nonlinear materials coated with thin resonant films. References 5 Russian.
[210-6900/12947]

UDC 621.373.826

THE MECHANISM UNDERLYING DESTRUCTION OF POLYMERS BY RADIATION FROM PULSE-PERIODIC CO_2 LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84
(manuscript received 10 Jan 84) pp 2294-2300

GLADUSH, G. G., LEVCHENKO, Ye. B., NIZEV, V. G. and SEYDGAZOV, R. D.,
Scientific Research Center for Technological Lasers, USSR Academy of Sciences

[Abstract] This study investigates the principles underlying the formation of deep ($h/d > 1$) craters in polymethylmethacrylate specimens caused by focused radiation from a pulse periodic CO_2 laser. An LGI-50 CO_2 laser with pulse length of 100 μsec, repetition frequency of 380 Hz and pulse energy of less than 0.05 J was employed. The parameters of the craters formed were analyzed photographically. Analysis of the cratering indicates that, in addition to waveguide processes, gas-phase processes (absorption in vapors and excitation of acoustic oscillations within the crater cavity) are significant. The acoustic currents increase the heat flux on the walls of the crater, causing local expansion; these processes restrict the possibility of achieving large crater depth-to-diameter ratios. References 12: 9 Russian, 3 Western.
[178-6900]

UDC 621.375.82

THEORY OF FORMATION OF 'NORMAL' AND 'ANOMALOUS' LATTICES ON SURFACE OF ABSORBING CONDENSED MEDIA DUE TO LASER RADIATION

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84
(manuscript received 5 Jan 84) pp 2283-2293

YEMELYANOV, V. I., ZEMSKOV, Ye. M. and SEMINOGOV, V. N.

[Abstract] This study presents a theory of modulation of the surface relief of metals, semiconductors and dielectrics during laser evaporation. The formation of 'normal' and 'anomalous' (not explainable by surface electromagnetic wave excitation) lattices is analyzed. Electromagnetic wave

diffraction on surface roughness; and the heating, evaporation and temporal evolution of surface relief are investigated. The increment, orientation and period of dominant lattices are analyzed as a function of ε for an s-polarized pumping wave. The periods and orientations of the dominant lattices are shown to depend strongly upon the permittivity of the medium. The nature of the lattices formed by laser evaporation can serve as an indicator of the local nonequilibrium value of permittivity on the surface of the irradiated medium. References 18: 10 Russian, 8 Western.
[178-6900/12947]

UDC 533.932

BREAKDOWN OF MOLECULAR GASES BY LASER RADIATION NEAR A METAL SURFACE

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84
(manuscript received 8 Dec 83) pp 2221-2226

VOROBEV, V. S. and KHOMKIN, A. L., Institute of High Temperatures, USSR Academy of Sciences

[Abstract] The 'low-threshold' breakdown of molecular gases caused by laser radiation near the surface of a metal is investigated. The threshold lasing power at which breakdown occurs is defined. The process is interpreted as a crudely defined transition from a state in which the electrons in the surrounding gas are formed by diffusion from the heated surface to a state in which bulk ionization of the target vapors is the main electron source. The breakdown power is investigated as a function of surface temperature for Mb and Mo, Ta and W. The experimental values are found to agree well with the predicted figures. References 12: 11 Russian, 1 Western.
[178-6900/12947]

FINDING AND DEVELOPING GALLIUM-GARNET ACTIVE LASER MEDIA

Moscow AKADEMIYA NAUK SSSR, INSTITUT OBSHCHEY FIZIKI, FIZIKA TVERDOGO TELA, LABORATORIYA FIZIKI TVERDOGO TELA, Preprint No 135 in Russian (signed to press 12 Jun 84) pp 1-28

ZHARIKOV, Ye. V., KALITIN, S. P., LAPTEV, V. V., MAYER, A. A. and OSIKO, V. V., Institute of General Physics, USSR Academy of Sciences

[Abstract] Rare-earth gallium-garnet crystals containing a chromium ion as the activator or sensitizer are developed. An integrated approach is described for developing laser materials that is based on crystallochemical construction, including spectroscopic and technological aspects. The proposed class of laser materials meets all of the basic spectral and lasing requirements, and can be used to develop a number of solid state lasers operating at various wavelengths in the near-IR region of the spectrum. Certain of the physical properties and lasing characteristics of crystals obtained by Chokhralskiy's method are presented. References 45: 16 Russian, 29 Western.
[322-6900/12947]

UDC 621.373

MODEL OF OPERATION OF HYBRID CO_2 LASER WORKING ON TWO ROTATIONAL LINES CONSIDERING ADDITIONAL AMPLIFICATION IN "HOT ZONES"

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 55, No 3, Mar 85 (manuscript received 7 May 84) pp 550-558

V. V. BULANIN, V. Yu. NEZHENTSEV, and S. N. USHKOV, Leningrad Polytechnical Institute imeni M. I. Kalinin

[Abstract] Emission of a CO_2 hybrid laser on several rotational lines is examined, as well as the kinetics of the lower vibrational levels of CO_2 molecules and overlap of the contours of the $P_{20}(00^01\text{-}10^00)$ and $R_{23}(01^11\text{-}11^10)$ lines. The behavior of the system of lower vibrational levels of CO_2 and N_2 molecules is examined. The temporal behavior of the intensity of radiation on two lines, one of them being $P_{20}(00^01\text{-}10^00)$, is described by solving the proposed system of velocity equations numerically. References 19: 9 Russian, 9 Western.
[365-6900/12947]

UDC 535.375+621.373

EXPERIMENTAL STUDY OF STIMULATED MANDELSHTAM-BRILLOUIN SCATTERING OF FOCUSED BEAMS IN THE REPETITIVE-PULSE MODE

Vilnius LITOVSKIY FIZICHESKIY SBORNIK in Russian Vol 25, No 1, Jan-Feb 85 (manuscript received 2 Feb 84) pp 68-79

BUZYALIS, R. R., DEMENTYEV, A. S., and KOSENKO, E. K., Institute of Physics, Lithuanian SSR Academy of Sciences

[Abstract] A YAG:Nd^{3+} laser operating in a repetitive-pulse mode with pulse repetition frequencies less than 30 Hz was used to study stimulated Mandelshtam-Brillouin scattering (SMBS) of the YAG-laser radiation from CCl_4, acetone, and other organic liquids. In CCl_4, which absorbs the YAG radiation weakly, the coefficient of reflection R increased with the laser pulse energy, both for single pulses and in the repetitive-pulse mode, in which the reflection coefficient depended only on the pulse energy. Intense 1-nsec Stokes pulses and an angular divergence of less than 1 mrad were obtained. In acetone it was found that for pulse repetition frequencies less than 5 Hz there is an optimum pumping energy above which R decreases and SMBS is disrupted. As the pulse repetition frequency was increased, R approached zero within several pulses. Observations of transient effects in SMBS showed that this difference in the behavior of SMBS is linked to the absorption of the pumping radiation in the medium. The subsequent heating of the medium caused strong thermal defocusing of the pumping beam which made it impossible to achieve the intensity threshold required for SMBS scattering. Elucidation of this phenomenon is important because SMBS is used in phase-front reversal as a means for decreasing beam divergence of ruby and neodymium glass lasers operating in the single-pulse mode. Figures 8; references 22: 16 Russian, 6 Western.
[390-9638/12947]

UDC 621.373.826.038.824

GENERATION OF PICOSECOND PULSES BY DYES IN SELF-Q MODULATION MODE

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA: SERIYA 3 FIZIKA, ASTRONOMIYA in Russian Vol 25, No 6, Nov-Dec, 1984 (manuscript received 4 Nov 83) pp 54-56

PETNIKOVA, V. M., PLESHANOV, S. A. and SHUVALOV, V. V., Department of General Physics and Wave Processes

[Abstract] The generation of picosecond pulses of tunable dye laser radiation in the monopulse mode is investigated experimentally. Second-harmonic pulses from a passive mode-locked YAG picosecond laser were employed for pumping. A threshold pumping power is shown to exist at which the cuvette containing the dye switches from nanosecond luminescence to lasing, and a powerful fully polarized picosecond pulse is generated. Spectrally limited pulses up to 3.5 ps are obtained. References 7: 2 Russian, 5 Western.
[183-6900/12947]

UDC 621.373.826.038.823

LASING IN $He:Kr:F_2$ MIXTURE PUMPED BY ION BEAM

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA in Russian Vol 48, No 12, Dec 84, pp 2321-2324

ARTEYEV, M. S., BUNKIN, F. V., DERZHIYEV, V. I., SULAKSHIN, S. S., SYSHCHKO, Yu. I., YUROVSKIY, V. A. and YAKOVLENKO, S. I., Institute of General Physics, USSR Academy of Sciences

[Abstract] Lasing characteristics in an $He:Kr:F_2$ mixture, as well as a binary mixture, are investigated experimentally. A pumping beam with $E = 0.9 - 1$ MeV, $j = 30$ A $\cdot$ cm^2 and half-height pulse duration $\tau_{0.5} = 50$ nsec was employed. This proton beam was followed by an electron beam with energy of 100 - 200 keV. Energy release of 40 $J \cdot l^{-1}$ with 8.5% efficiency was obtained for an optimum $He:Kr:F_2$ composition of 230:66:1. Similar efficiency was achieved in the binary mixture. Because the cavity was not optimized, these efficiencies are not the best achievable. References 6 Russian.
[193-6900]

FREQUENCY STABILIZATION OF YAG:Nd LASER AT 127_{J2} ABSORPTION LINES

Leningrad PISMA V ZHURNAL TEKNICHESKOY FIZIKI in Russian Vol 11, No 5, 12 Mar 85 (manuscript received 2 Nov 84) pp 270-274

KRUZHALOV, S. V., PARFENOV, V. A., PAKHOMOV, L. N. and PETRUNKIN, V. Yu., Leningrad Polytechnical Institute imeni M. I. Kalinin

[Abstract] Stabilization of the parameters of a YAG:Nd laser is investigated. The spectrum of the superfine structure of the 127_{J2} absorption lines is recorded. Experiments are described to reference the frequency of the YAG:Nd laser to the permitted spectral components. The data indicate that a YAG:Nd laser can serve as a monochromatic radiation source with reproducable lasing frequency. References 4: 3 Russian, 1 Western.
[374-6900/12947]

UDC 621.373.826.038.823

INVESTIGATION OF AMPLIFICATION AND LASING SPECTRUM OF TEA-LASER EMPLOYING MIXTURE OF ISOTOPE-SUBSTITUTED CARBON DIOXIDE MOLECULES

Moscow KVANTOVAYA ELEKTRONIKA in Russian, Vol 12, No 2, Feb 85
(manuscript received 12 May 84) pp 416-419

PETUKHOV, V. O., SAZHINA, N. N., STAROVOYTOV, V. S., TRUSHIN, S. A., CHEBURKIN, N. V., CHEKIN, S. K. and CHURAKOV, V. V., Institute of Physics, Belorussian SSR Academy of Sciences

[Abstract] The amplification and lasing spectra in a nonselective cavity of a TEA-laser employing $^{12}CO_2$ and $^{13}CO_2$ isotope mixtures are investigated experimentally as a function of the degree of excitation of molecular oscillations, the gas pressure, and the content of isotopically substituted molecules. The radiation spectrum of the laser is assumed to be determined uniquely by the amplification spectrum at the maximum of the lasing pulse. A system with a nonselective cavity is shown to lase on one or several lines at wavelengths ranging from 11.11 to 11.22 μm for a wide range of active medium pressures (100 - 3500 mm Hg) and excitation levels when a gas mixture is used in which the ratio of $^{13}CO_2$ (x_{13}) and $^{12}CO_2$ (x_{12}) molecules is $x_{13}/(x_{13} + x_{12}) \geqslant 0.35 - 0.45$. The experimental results confirm the analytical findings regarding the lasing spectrum, indicating that the effectiveness of exciting asymmetrical oscillations of the CO_2 and N_2 molecules in the electrical discharge is independent of the isotope content. References 14: 8 Russian, 6 Western.
[340-6900/12947]

UDC 621.373.826.038.823

MODULATION OF ARGON LASER DUE TO BROADENING OF EXCITON LEVEL IN CdS CRYSTAL

Moscow KVANTOVAYA ELEKTRONIKA in Russian, Vol 12, No 2, Feb 85
(manuscript received 14 May 84) pp 419-422

VELIKOVICH, A. L., GARKAVENKO, A. S., GOLUBEV, G. P., KALENDIN, V. V. and LEVINSKIY, V. N., All-Union Scientific Research Center for the Study of Surface and Vacuum Properties

[Abstract] Modulation of the blue line of an argon laser due to broadening of the N = 1 level of the A-exciton in a CdS crystal pumped by a 30 - 50 keV electron beam is investigated. Modulation of the radiation due to electron pumping of a λ = 488 nm argon laser near the exciton peak is observed; no modulation was detected when the laser was tuned to other lasing lines (476.5 and 514.5 nm). The modulation of the radiation is associated with broadening of the exciton level of the CdS crystal caused by electron pumping. The theoretical model developed for exciton level broadening provides a qualitatively correct description of the observed modulation, and agrees quantitatively with the experimental findings. It is found possible, in

principle, to increase the depth of modulation to 80 - 90% by using thinner crystals (about 1 μm thick); the modulation effect detected can be exploited in developing high speed laser scanning systems. References 14: 9 Russian, 5 Western.
[340-6900/12947]

UDC 621.373.826.038.825.3

CHARACTERISTICS OF NEODYMIUM LASING KINETICS EMPLOYING SELECTIVE PULSED PUMPING

Moscow KVANTOVAYA ELEKTRONIKA in Russian, Vol 12, No 2, Feb 85 (manuscript received 14 May 84) pp 422-425

BYKOVSKIY, N. Ye., IVANOV, V. V. and SENATSKIY, Yu. V., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] The influence of excitation energy relaxation in the glass of a neodymium laser on the lasing pulse shape and duration is investigated. A numerical model is developed to describe the lasing kinetics of selectively pumped neodymium lasers. Two stages are identified in the development of lasing that differ in the cavity photon density. It is found that pulse length, delay, and shape depend strongly upon the rate of relaxation of excited particles from the pumping level to the metastable level. The lasing kinetics may also be influenced by the rate of 'depopulation' of the lower level of the working transition. These characteristics must be taken into account in developing pumped minilasers. References 15: 12 Russian, 3 Western.
[340-6900/12947]

UDC 621.373.826.038.825

SOLID STATE MINILASERS PUMPED BY MINIATURE FLASHLAMPS

Moscow KVANTOVAYA ELEKTRONIKA in Russian, Vol 12, No 2, Feb 85 (manuscript received 23 May 84) pp 375-377

BERENBERG, V. A., BOLDYREV, S. A., LEONOV, G. S., NESTERENKO, V. F., PAVLYUK, A. A. and TERPUGOV, V. S.

[Abstract] High-efficiency miniature neodymium flashlamp-pumped lasers were investigated. Potassium-gadolinium tungstate crystals activated with neodymium ions were employed as the active element. The operating efficiency of the minilasers was estimated by the emitted energy in the free-lasing mode, where values of 2% were achieved; 1.3% efficiency was achieved in the Q-modulation mode with emitted pulse lengths of 2 nsec. The change in efficiency as the dimensions of the pumping lamps are reduced is identified, making it possible to establish the limits for laser minaturization. References 9: 7 Russian, 2 Western.
[340-6900/12947]

UDC 535.211:536.4

INFLUENCE OF PHASE TRANSITIONS ON PHOTOACOUSTIC EFFECT DURING LASER IRRADIATION OF CONDENSED MEDIA

Moscow KVANTOVAYA ELEKTRONIKA in Russian, Vol 12, No 2, Feb 85
(manuscript received 7 Jun 84) pp 381-382

VESELOVSKIY, I. A., ZHIRYAKOV, B. M., KOROTCHENKO, A. I. and SAMOKHIN, A. A., Institute of General Physics, USSR Academy of Sciences

[Abstract] The acoustic perturbations occurring in absorbing condensed media subjected to pulses from a Q-modulated laser are investigated experimentally. The changes in the form of the photoacoustic pressure signal that may be associated with melting of the irradiated material are registered. Neodymium and ruby lasers producing 1 J with pulse lengths of 30 - 40 nsec were used to irradiate silicon and germanium specimens. The pressure was recorded by means of a thin-film transducer with time resolution of about 5 nsec placed on the rear, unexposed surface of the specimens. The maximum pressures in the positive- and negative-glowing parts of the pulse vary linearly as the energy density; the signal changes as the energy density increases further: a narrow pressure peak occurs on the leading edge of the positive-glowing part of the pulse. As the intensity continues to increase, the maximum pressure in the positive part of the acoustic pulse begins to drop. References 9: 5 Russian, 4 Western.
[340-6900/12947]

UDC 621.373.826.038.825.4

INFLUENCE OF EXTERNAL MIRROR ON RADIATION CHARACTERISTICS OF SOLID STATE LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian, Vol 12, No 2, Feb 85
(manuscript received 10 Dec 84) pp 397-400

GONCHAROV, I. G., GRACHEV, A. P., DEDUSHENKO, A. P., ZVERKOV, M. V. and MAMAYEV, A. N., Moscow Engineering-Physics Institute

[Abstract] The radiation characteristics of solid state lasers are investigated for different levels of optical coupling with the external mirror that forms the external cavity. Ga-Al-As dual heterostructure lasers were investigated. The wavelength and power of the radiation are modulated as the optical length of the laser or external cavity change. The power modulation is complex for single cavity lengths and strong coupling, and is determined by two components: fast and slow. An additional component appears when the external mirror is displaced angularly. References 12: 5 Russian, 7 Western.
[340-6900/12947]

UDC 621.373.826.038.824

SUBMICROSECOND FLASHLAMP-PUMPED DYE LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian, Vol 12, No 2, Feb 85
(manuscript received 8 Aug 84) pp 405-407

TRUSOV, A. K. and TRUSOV, K. K., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] A rhodamine 6G flashlamp-pumped laser is developed and tested in which energy of 1.1 J is achieved in a pulse 0.23 msec long without Q-modulating the cavity. The efficiency of the laser, the divergence angle of the radiation and the photoresistivity of the dye are determined. The laser is competitive in terms of space-energy parameters with existing single-module submicrosecond lasers. References 10: 1 Russian, 9 Western.
[340-6900/12947]

UDC 621.373.826.038.823

INFLUENCE OF SPECTRUM WIDTH ON INJECTION LASER POWER FLUCTUATION

Moscow KVANTOVAYA ELEKTRONIKA in Russian, Vol 12, No 2, Feb 85
(manuscript received 8 May 84) pp 347-350

BESSONOV, Yu. L., KURLENKOV, S. S., MOROZOV, V. N., SAPOZHNIKOV, S. M., CHAN MIN TKHAY and SHIDLOVSKIY, V. R., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] The influence of the radiation spectrum width on the intrinsic amplitude noise level of A1GaAs dual heterostructure injection lasers with a narrow strip contact, and transverse p-n-junction lasers, is investigated experimentally. Lasers operating in the CW mode at room temperature at 830 - 850 nm on the same transverse radiation mode are investigated. It is found in the steady-state lasing mode that the radiation power fluctuation level depends strongly upon the spectrum width of the radiation; however, the relative spectral density of the fluctuations increases significantly in the nonstationary lasing mode, even at intermediate frequencies lower than the frequency of the pulsations. References 7: 3 Russian, 4 Western.
[340-6900/12947]

UDC 621.373.826.038.824

TUNABLE LASERS WITH IN-CAVITY LASING LINE SEPARATION

Moscow KVANTOVAYA ELEKTRONIKA in Russian, Vol 12, No 2, Feb 85
(manuscript received 6 Jun 84) pp 351-354

YAKOBI, Yu. A., GRIGORYEV, P. V., MALOV, A. N., RUDNITSKIY, A. L., SOLOUKHIN, R. I., STUDENIKIN, Yu. Ye. and FEDOROV, S. Yu., Institute of Heat- and Mass-Exchange, Belorussian SSR Academy of Sciences

[Abstract] Expansion of the spectral range and operating mode of tunable lasers with emission lines separated within the cavity, and improvement of the output characteristics of the radiation, are investigated. Tunable laser schemes are devised, and their operating characteristics in the visible and IR regions of the spectrum are discussed. Schemes with in-cavity selection are shown to be suitable for use in TEA CO_2 lasers and dye lasers. Argon and CO_2 laser line selection is achieved in the CW mode, with frequency stabilized by the maxima of the power of the lasing lines, thus stabilizing the output power. Frequency tuning of various types of lasers without mechanical movement of the basic elements of the cavity is shown to be effective over a wide spectral range in both the pulse and CW modes; the radiation quality is improved significantly by using an afc system. References 5 Russian.
[340-6900/12947]

UDC 621.373.826.038.823

FLUCTUATIONS IN STATE OF POLARIZATION OF CO_2 LASER RADIATION

Moscow KVANTOVAYA ELEKTRONIKA in Russian, Vol 12, No 2, Feb 85
(manuscript received 26 Mar 84) pp 306-310

DYMSHAKOV, V. A., LEBEDEV, F. V. and RYAZANOV, A. V.

[Abstract] The radiation polarization state of a quasisteady state CO_2 laser with an unstable cavity containing no strobing elements is investigated. It is found that focusing asymmetry has a strong influence on radiation transmission at different polarization states. Even linearly polarized radiation may exhibit different transmission coefficients, depending upon the orientation of the polarization vector. The influence of these effects on laser radiation penetration into long metal seams for deep laser welding is demonstrated. The findings indicate that allowance must be made for random changes in the polarization state of laser radiation. References 10: 8 Russian, 2 Western.
[340-6900/12947]

UDC 621.373.826.038.823

NEW MECHANISM UNDERLYING OUTPUT RADIATION MODULATION IN A LASER WITH UNSTABLE CAVITY

Moscow KVANTOVAYA ELEKTRONIKA in Russian, Vol 12, No 2, Feb 85
(manuscript received 29 Mar 84) pp 311-314

DERYUGIN, A. A., LIKHANSKIY, V. V. and NAPARTOVICH, A. P.

[Abstract] Continuous-flow lasers incorporating unstable cavities are investigated. It is shown that instability associated with the development of optical inhomogeneities within an unstable cavity can cause radiation intensity modulation with the period of the oscillations governed by the transmit time of the active medium. Expressions are obtained for the characteristic frequencies of perturbations and for the instability increment. The influence of pumping the active medium in the CO_2 laser cavity, the exchange of excitation among molecules, and the relaxation process on the growth rate of optical inhomogeneities is analyzed. It is estimated that optical inhomogeneities can occur in such lasers within approximately 10 msec, with characteristic radiation modulation frequencies ranging from 1 - 10 KHz. References 8: 6 Russian, 2 Western.
[340-6900/12947]

UDC 621.373.826.038.823

INVESTIGATION OF DYNAMICS OF ANGULAR DIVERGENCE OF RADIATION FROM PULSED ELECTRONIONIZATION CO LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian, Vol 12, No 2, Feb 85
(manuscript received 9 Apr 84) pp 315-324

DROZHBIN, Yu. A., ZVORYKIN, V. D., KOVSH, I. V., TROFIMENKO, V. V. and YAROVA, A. G., Physics Institute imeni P. N. Lebedev, USSR Adademy of Sciences

[Abstract] A photographic method is devised for measuring the radiation divergence dynamics of pulsed lasers operating in the mid-IR region of the spectrum. The method is used to investigate the output characteristics of a CO-electroionization laser employing different types of cavities. The influence of initial temperature irregularities of the active medium on the quality of the laser radiation is determined. It is found that irregular cooling of the working mixture is the most important factor limiting the angular directivity of the radiation from a cooled electroionization CO laser. When the gas is cooled uniformly without self-interaction of the laser radiation with the active medium, the density disturbance in the compression and rarefaction waves is the fundamental cause of degraded divergence. References 22: 11 Russian, 9 Western.
[340-6900/12947]

UDC 621.375.8.038.825.3

POSSIBILITY OF INCREASING EFFICIENCY OF NEODYMIUM GLASS LASER AMPLIFIERS WITH DISK FINAL STAGES

Moscow KVANTOVAYA ELEKTRONIKA in Russian, Vol 12, No 2, Feb 85
(manuscript received 10 Apr 84) pp 325-330

ALEKSEYEV, V. N., GOLOVIN, S. V., KOSTOMETOV, G. P., MIRONOV, Ye. P., STARIKOV, A. D. and CHERNOV, V. N.

[Abstract] The energy characteristics of a disk stage 15 cm in diameter employing a transverse pumping system are modeled numerically; the parameters of a multistage amplifier in which such a disk stage is employed as the final stage are estimated. A Monte Carlo-based modeling method is employed that provides good agreement between the analytical and experimental data. The influence of the various physical factors on the efficiency of the amplifier is investigated; among others, the role of the 0.35 μm absorption band of neodymium is determined. Efficiency of approximately 0.15%, with final stage efficiency of approximately 0.3%, can be achieved for laser pulse lengths of 1 nsec; increasing the pulse length to 5 - 10 nsec and optimizing the laser circuit can provide efficiency of approximately 0.5%, with energy of approximately 3 KJ. References 16: 10 Russian, 6 Western.
[340-6900/12947]

UDC 621.373.826.038.823

POSSIBILITY OF OBTAINING INVERSION IN UV REGION WITH OPTICAL PUMPING

Moscow KVANTOVAYA ELEKTRONIKA in Russian, Vol 12, No 2, Feb 85
(manuscript received 18 Jul 84) pp 248-258

BASOV, N. G., VERGUNOVA, G. A. and ROZANOV, V. B., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] The possibility of obtaining inversion on the $1s2p^3P \rightarrow 1s^2$ transition in He-like ions is investigated. The accumulation of ions in the upper state of $1s2p^3P$ during optical pumping of the working medium by laser plasma radiation, followed by spontaneous transition to the fundamental state, is examined. The possibility of increasing the gain by compressing the active medium is investigated, and found to provide no apparent increase in gain. Compression of the active medium can increase gain significantly in other schemes where the ratio of the relaxation time to the hydrodynamic compression is more favorable. References 17: 14 Russian, 3 Western.
[340-6900/12947]

UDC 621.373.826.038.823

58.3 NM PENNING-CLEANING PLASMA LASER EMPLOYING ELECTRON-BEAM-EXCITED DENSE NEON MIXTURES

Moscow KVANTOVAYA ELEKTRONIKA in Russian, Vol 12, No 2, Feb 85
(manuscript received 30 Oct 84) pp 245-246

BUNKIN, F. V., DERZHIYEV, V. I., MESYATS, G. A., SKAKUN, V. S., TARASENKO, V. F. and YAKOVLENKO, S. I., Institute of General Physics, USSR Academy of Sciences

[Abstract] A plasma laser employed Penning cleaning is implemented on a neon transition (λ = 585.3 mm) in dense Ne-H_2 and Ne-Ar mixtures pumped by an electron beam. Lasing occurred during afterglow, as well as while the pumping beam was present. Inversion is found to be caused by cleaning of the lower working state by Penning reactions with H_2 and Ar. The findings indicate that a dense Ne-H_2 mixture is one of the most effective media for visible-band lasers employing gas mixtures. References 7: 4 Russian, 3 Western.
[340-6900/12947]

UDC 621.378.33

ELECTRIC DISCHARGE HF LASER PRODUCING ABOVE 20 J WITH GOOD TECHNICAL EFFICIENCY

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84
(manuscript received 5 Feb 84) pp 2381-2383

VELIKANOV, S. D., ZAPOLSKIY, A. F., SINITSIN, N. V. and SHEREMETEV, Yu. N.

[Abstract] An F_2-H_2-O_2-SF_6 chemical laser with active volume of 8 is investigated in order to determine the possibility of obtaining high radiation energy and good physical and technical efficiency. An experimental setup incorporating the laser, an IKT-1m energy meter, a lasing power meter and an energy distribution meter is described. The working mixture was compounded in a 3:1:3:1 ratio. The voltage applied to the electrodes in the working chamber, the discharge current, the time parameters of the lasing pulse, the lasing energy and lasing energy distribution in the near zone were recorded. The lasing signal duration was found to decrease as the pressure of the working mixture increases, with fixed pulse voltage generator discharge output varying from 30 to 50 kV, and as the initiation level increases with the mixture pressure fixed. The lasing energy is found first to increase as the pressure of the working mixture, reaching a maximum, and then to decrease. Maximum output energy of approximately 23 J was obtained at a pressure of 28 mm Hg and discharge voltage of 50 kV; however, maximum technical efficiency of 63% was achieved with discharge voltage of 40 kV, and the physical efficiency of the laser was 120% with respect to the ratio of the energy input to the discharge. References 5: 3 Russian, 2 Western.
[178-6900/12947]

ELECTRIC DISCHARGE XeCl LASER WITH 1 μs PULSE LENGTH

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84 p 2384

MELCHENKO, S. V., PANCHENKO, A. N. and TARASENKO, V. F.

[Abstract] This item presents a correction to an article published in KVANTOVAYA ELEKTRONIKA, Vol 11, No 7, pp 1490-1492. The pulse length units on the horizontal scale in Figure 2a (page 1491), beginning at the intersection of the coordinate axes, should read 0.2, 0.4, 0.6, 0.8 and 1.0s.
[178-6900/12947]

UDC 621.378.33

NUMERICAL MULTIPARAMETRIC OPTIMIZATION OF D_2-F_2-CO_2 PULSED CHEMICAL LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84
(manuscript received 27 Jan 84) pp 2336-2348

BAYKOV, E. U., BASHKIN, A. S., GAMZATOV, N. M., ORAYEVSKIY, A. N. and PORODINKOV, O. Ye., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] This study addresses the multiparameter problem of investigating the potential capabilities of D_2-F_2-CO_2 lasers. A model is developed that makes it possible to describe the basic characteristics of D_2-F_2-CO_2 pulsed lasers for a wide range of initial conditions. The analysis confirms the known basic operating principles of the system in question, and also discloses discrepancies with some existing viewpoints regarding the behavior of the energy characteristics of the D_2-F_2-CO_2 laser. It is found that the power profile of the laser is degraded when the mixture is cooled because of oxygen in the lasing mixture. Increased mixture pressure in mixtures containing oxygen increases the power profile of the laser over a limited range of pressures, depending upon the initiation level. The role of carbon dioxide gas in increasing the power profile is found to depend upon its concentration in the mixture. Optimum lasing mixture compositions are determined for different initiation levels. the theoretical findings agree well with existing experimental data. References 22: 20 Russian, 2 Western.
[178-6900/12947]

UDC 621.375.8.038.825.3

MULTIPASS NEODYMIUM GLASS LASER AMPLIFIER WITH SBS MIRROR

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84
(manuscript received 26 Apr 84) pp 2359-2361

VASILEV, Yu. P., PASHININ, P. P., SEROV, R. V. and SHKLOVSKII, Ye. I., Institute of General Physics, USSR Academy of Sciences

[Abstract] A multipass neodymium glass laser amplifier with a single active element is described that amplifies weak white beams efficiently and outputs radiation with near-diffraction divergence. The laser beam in the SBS medium was focused by a spherical mirror through the active element of the amplifier. Gain of up to $3 \cdot 10^5$ is obtained in an 8-pass arrangement for nanosecond light pulses, with output signal energy of approximately 10 μJ. The high gain achieved makes possible, using a comparatively compact setup, to model a self-tuned laser-target system excited by a weak optical signal by employing SBS wavefront conjugation. References 5: 4 Russian, 1 Western.
[178-6900/12947]

UDC 535.417.2.261.373.8.038.8

SELECTIVE PROPERTIES OF LASER CAVITIES EMPLOYING DIFFRACTION GRATINGS IN AUTOCOLLIMATION MODE

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84
(manuscript received 3 Jan 84) pp 2272-2282

BELTYUGOV, V. N., OCHKIN, V. N., SOBOLEV, N. N., TROITSKIY, Yu. V. and UDALOV, Yu. B., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] An open stable laser cavity incorporating a diffraction grating in an autocollimation arrangement is investigated experimentally and theoretically in order to find the selective properties of such cavities for developing single-frequency tunable molecular Co_2 and CO lasers. Generalized scales are employed, making it possible to employ the findings directly to estimate the selectivity of lasers operating in the mid-IR band. CO_2 laser experiments confirm the analytical results in a number of cases. The influence of radial inhomogeneity of the active medium is assessed, and is found to consist mostly of changes in nonselective losses as compared with a hollow cavity. Calculations and experiments on CO_2 laser continuous frequency tuning considering competition between vibrational-rotational transitions and axial modes showed that cavities with diffraction gratings are not always selective enough to facilitate tuning throughout the entire amplification zone above the threshold. References 20: 13 Russian, 7 Western.
[178-6900/12947]

UDC 621.373.826.038.823

RELAXATION OF METASTABLE $4s^2\ ^2D_{5/2}$ LEVEL OF COPPER ATOM IN PULSE DISCHARGE AFTERGLOW OF COPPER-VAPOR LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84
(manuscript received 29 Nov 83) pp 2191-2196

KELMAN, V. A., KLIMOVSKIY, I. I., KONOPLEV, A. N., OPACHKO, I. I., SELEZNEVA, L. A. and FUCHKO, V. Yu., Institute of High Temperatures, USSR Academy of Sciences

[Abstract] Absorption of the 510.6 mm line in the active element of a copper-vapor laser was measured in order to identify the mechanisms underlying the relaxation kinetics of the metastable states of copper atoms. The absolute concentrations of the metastable copper atoms were obtained by calculating their absorption cross section for the 510.6 mm line using the known atomic constants of copper. The population of the metastable $4s^2\ ^2D_{5/2}$ state of copper is plotted as a function of the time elapsed from the end of the current pulse for various neon pressures. The temporal behavior of the metastable copper atom concentration is nonexponential; for neon pressures exceeding 10 kPa, the populations drop off rapidly and then begin to increase 5 - 10 μs after the pulse; for lower pressures the populations drop off monotonically. The complex nature of the population variation is interpreted as resulting from the combined operation of several processes, including restoration of the initial state of the copper atom concentration and relaxation of the electron temperature and concentration. References 17: 14 Russian, 3 Western.
[178-6900/12947]

DYNAMIC CHARACTERISTICS OF ADAPTIVE OPTICS SYSTEMS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 9(159), Sep 85 pp 1959-1961

[Article by V. P. Lukin and V. L. Mironov]

[Text] The Strehl ratio for an optical system with correction for distortion is examined as a function of time lag. Two adaptive optics systems are compared for effectiveness: a system with continuous lag and a system using the function as well as its derivative for correction. The required bandwidth for an adaptive optics system is determined.

Let us examine the effect of time delay on the effectiveness of an adaptive system. We use Strehl's coefficient (relative change of axial intensity) to evaluate correction quality. We assume that the optical radiation field is formed using adaptive correction. Radiation from a point source is used as a reference and a phase-conjugate algorithm is implemented [1].

We assume the time it takes to record data in the reference signal circuit and to control the adaptive aperture to be sufficiently small. Therefore, the time delay in the feedback circuit is determined by the time it takes to translate the optical measurements into commands. With this approach, an adaptive system can be viewed as a discrete control system. At the same time, if the transients in the system are disregarded and attention is paid only to the mean characteristics of the system, which are obtained by averaging over a long interval of time, then the system can be described on the basis of a constant delay.

Using the Huygens-Kirchoff method of phase approximation [2,3], we write the mean axial intensity of a corrected field:

$$\langle I(0)\rangle = \frac{1}{\lambda^2 l^2}\iint d^4\rho_{1,2} A(\rho_1) A(\rho_2) \exp\left\{-ik\frac{(\rho_1^2-\rho_2^2)}{2l}\right\}\times$$
$$\times\langle\exp\{i[S(0,\rho_1;l,0;t+\tau)-S(0,\rho_2;l,0;t+\tau)]-$$
$$-i[S(l,0;0,\rho_1;t)-S(l,0;0,\rho_2;t)]\}\rangle. \qquad (1)$$

Here $A(\rho)$ is field distribution at the source; l is the distance travelled by an optical wave (wavelength λ) in a random-heterogeneous medium; French quotes

indicate ensemble averaging of achieved values in a random-heterogeneous medium; t represents current time and τ is a constant time delay.

The delay τ can be interpreted as the adaptive circuit's response time. This means that due to the delay the adaptive system is controlled on the basis of previous phase measurements of the reference source's field. Thus, the problem arises of determining the allowable delay τ and the corresponding bandwidth Δf for the entire adaptive system's feedback circuit.

To determine the averages in (1), we assume that the phase fluctuations are distributed normally; thus, the term in French quotes is written in the form:

$$\langle\cdots\rangle=\exp\{-1/2\langle\{[S(\rho_1, t+\tau)-S(\rho_2, t+\tau)]-[S(\rho_1, t)-S(\rho_2, t)]\}^2\rangle\}, \quad (2)$$

where $S(\rho, t)$ is used as shorthand for spherical wave phase fluctuations $S(0, \rho; l, 0; t)$ at time t. We employ the hypothesis of "time frozen" for the phase fluctuations:

$$S(\rho_1, t+\tau)=S(\rho_1+v\tau, t), \quad (3)$$

where $\underline{v}$ is the wind velocity vector. If an expansion of the function $S(\rho+v\tau, t)$ into a Taylor series is used:

$$S(\rho_1+v\tau, t)=S(\rho_1, t)+\nabla_{\rho_1}S(\rho_1, t)\,v\tau, \quad (4)$$

we obtain in (2):

$$\langle\cdots\rangle=\tau^2v^2\left[\langle|\nabla_{\rho_1}S(\rho_1, t)|^2\rangle+\langle|\nabla_{\rho_2}S(\rho_2, t)|^2\rangle-2\langle\nabla_{\rho_1}S(\rho_1, t)\nabla_{\rho_2}S(\rho_2, t)\rangle\right], \quad (5)$$

where $\nabla_\rho S(\rho, t)$ is the phase gradient.

For the rest of the calculations, we use a phase representation in the form of an expansion by Zernike orthogonal polynomials in a circle of radius R [4,5]:

$$S(\rho_1)=\sum_{j=1}^{\infty}a_jF_j(\rho_1, R). \quad (6)$$

where the coefficients of the expansion are:

$$a_j=R^{-2}\iint d^2\rho F_j(\rho/R)S(\rho)W(\rho); \quad (7)$$

and $W(\rho)=\begin{cases}1, \rho<R,\\ 0, \rho>R\end{cases}$ is the aperture function for the circle described by the expansion. If the phase gradient is calculated using representation (6),

$$\nabla_\rho S(\rho)=\sum_{j=2}^{\infty}a_j\nabla_\rho F_j(\rho/R),$$

it is easy to see that the piston modal value (where j = 1) of expansion (6) is missing. Thus, the unknowns in (5) are the dispersion and the phase gradient spatial correlation function. These functions exist and can be calculated even for Kolmogrorov's spectrum model of turbulence, when the structural function of phase takes the form:

$$D_S(|\rho_1-\rho_2|)=6{,}88\,(|\rho_1-\rho_2|/r_0)^{5/3}, \tag{8}$$

where r_0 is the coherence redius of a layer of the random-heterogeneous medium.

By limiting ourselves in the phase gradient expansion to the first six modal values of the expansion and taking the orthagonality of the modal values into consideration, we obtain:

$$\langle(\nabla_{\rho_1}S(\rho_1))^2\rangle=(\langle a_2^2\rangle+\langle a_3^2\rangle)/R^2+16(x_1^2+y_1^2)\langle a_4^2\rangle/R^4+4(x_1^2+y_1^2)\langle a_5^2\rangle/R^4+$$
$$+4(x_1^2+y_1^2)\langle a_6^2\rangle/R^4, \tag{9}$$

$$\langle\nabla_{\rho_1}S(\rho_1)\nabla_{\rho_2}S(\rho_2)\rangle=(\langle a_2^2\rangle+\langle a_3^2\rangle)/R^2+16(x_1x_2+y_1y_2)\langle a_4^2\rangle/R^4+$$
$$+4(x_1x_2+y_1y_2)(\langle a_5^2\rangle+\langle a_6^2\rangle)/R^4. \tag{10}$$

Summing (2), (5), (9), and (10), we have:

$$\langle\ldots\rangle=\exp\{-12\langle a_4^2\rangle\tau^2v^2(\rho_1-\rho_2)^2/R^4\}, \tag{11}$$

where for structural function type (8) $\langle a_4^2\rangle = 0.0736\,(R/r_0)^{5/3}$.

Substituting (11) into (1), we obtain:

$$\langle I(0)\rangle=\frac{1}{\lambda^2l^2}\int\int d^4\rho_{1,2}A(\rho_1)A^*(\rho_2)\exp\left\{-ik\frac{(\rho_1^2-\rho_2^2)}{2l}-\right.$$
$$\left.-12\langle a_4^2\rangle\frac{\tau^2v^2}{R^4}(\rho_1-\rho_2)^2\right\}, \tag{12}$$

where R is the radius of the phase expansion circle. In general, R is determined by the type of problem being solved: beam forming or optical image forming. If an image is being formed, $\langle a_4^2\rangle$ is determined as for a plane wave (then R equals the radius of the receiving aperture and l the focal length of the receiving system); in beam forming $\langle a_4^2\rangle$ is determined for a spherical wave and R depends on optical beam parameters.

It is not difficult to show that, for a focused Gaussian beam of effective size $\underline{a}$, we obtain from (12):

$$\langle I(0)\rangle=\frac{2\pi^2a^2}{\lambda^2l^2}\int_0^\infty d\rho\rho\exp\left(-\frac{\rho^2}{4a^2}-0{,}88\frac{\tau^2v^2}{r_0^{5/3}R^{7/3}}\rho^2\right).$$

If we take R = a, we then emphasize the action of the term dependent on τ, so that

$$\langle I(0)\rangle\approx\Omega^2/\left[1+3{,}52\tau^2v^2/r_0^{5/3}a^{1/3}\right]. \tag{13}$$

Thus the condition for effective correction is the inequality:

$$\tau\ll(r_0/v)(a/r_0)^{1/6}, \tag{14}$$

where r is the radius of coherence for a spherical wave on a path of length l and $\Omega = ka^2/l$.

Thus, for effective correction (axial intensity equals undistorted intensity), delay τ must be significantly less than transfer time by an optical beam of the coherence radius at average wind velocity. The frequency spectrum $\sin(\pi f\tau)/(\pi f\tau)$ corresponds to a discrete control function with time interval τ. Therefore, if we interpret the bandwidth as the first zero of the function sin x/x, we get a corresponding bandwidth for the adaptive system's feedback circuit:

$$\Delta f = 1/\tau \geqslant (v/r_0)(r_0/a)^{1/6}. \tag{15}$$

Note that an adaptive system with a constant delay τ is a system in which the optical measurements made at time t are used to predict the phase at time $t+\tau$. The correcting phase at time $t+\tau$ can be written as a prediction in the form:

$$S(\rho, t+\tau) = S(\rho, t) + \nabla_\rho S(\rho)\, v\tau, \tag{16}$$

where phase $S(\rho,t)$ and its gradient are measured at time t within aperture $A(\rho)$.

The average axial intensity is given by the expression:

$$\langle I(0)\rangle = \frac{1}{\lambda^2 l^2}\int\int d^2\rho_1\, {}_2A(\rho_1)\, A^*(\rho_2)\exp\left\{-ik\frac{(\vec{\rho}_1^{\,2}-\vec{\rho}_2^{\,2})}{2l}\right\}\langle\exp\{i[S(\rho_1+v\tau)- \\ -S(\rho_1)-\nabla_{\rho_1}S(\rho_1)\,v\tau]-i[S(\rho_2+v\tau)-S(\rho_2)-\nabla_{\rho_2}S(\rho_2)\,v\tau]\}\rangle. \tag{17}$$

To compute the function in (17) which depends on random phase $S(\rho)$, we calculate the second derivative of S, since in (17)

$$\langle\ldots\rangle = \exp\left\{-\frac{1}{2}\langle[\nabla^2_{\rho_1}S(\rho_1)-\nabla^2_{\rho_2}S(\rho_2)]^2\rangle\,\frac{v^4\tau^4}{4}\right\}. \tag{18}$$

Repeating the same operations as in formulas (6)-(18) using the first ten modal values, we arrive at the following expression for (18):

$$\langle\ldots\rangle = \exp\left\{-8{,}48\,\frac{\tau^4 v^4}{r_0^{5/3}R^{13/3}}(\rho_1-\rho_2)^2\right\}. \tag{19}$$

For the problem of focusing a Gaussian beam (of size a) with correction (16), the allowable delay is:

$$\tau_{\text{уск}} \ll (r_0/v)(a/r_0)^{7/12}. \tag{20}$$

Comparing (14) and (20), we see that if we use for the correction not only the measurements of phase $S(\rho,t)$, but also its derivative

$$S'_\tau = \left(\frac{\partial S}{\partial x}v_x + \frac{\partial S}{\partial y}v_y\right) = \nabla_\rho S(\rho)\,v,$$

then the allowable delay τ (with which effective correction is achieved) significantly increases:

$$\tau_{\text{уск}}/\tau = (a/r_0)^{5/12}. \tag{21}$$

From (21) it is easy to see that adaptation with prediction (16) allows much greater time delays. The gain in time when compared with traditional adaptation increases with the strength of phase distortions (as a/r_0 increases).

However, it should be remembered that a gain in time (increase in allowable time delays) and, consequently, a decrease in bandwidth ($\Delta f = 1/\tau$) of the feedback circuit, require a corresponding increase in the volume of phase measurements to estimate the phase gradient [7].

To assess correction quality in the configuration with a constant delay, 6 modal values of the expansion were used in phase expansion (6), while in the configuration using the phase gradient, 10 modal values were used. However, as shown in [4,6], the same degree of accuracy is ensured for evaluating remaining phase distortions. In both cases, while calculating the corrected intensity, the main term which describes the remaining distortions is retained.

The suggested correction scheme (16) is sufficiently easy to implement, since in phase meters [7] the wave phase itself is not measured, but rather its change (derivative) or the phase difference by which the mean phase gradient can be estimated.

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Manuscript submitted 2 September 1984

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CSO: 1862/62

UDC 530.182:621.373.826

NONLINEAR ATTENUATION OF PULSED LASER RADIATION ALONG A NEAR-SURFACE ATMOSPHERIC PATH

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 10, Oct 85 (signed to press 15 Jan 85) pp 2147-2149

[Article by N. A. Blinov, I. A. Leontyev, Ye. G. Ryzhkov, V. L. Semenov, V. P. Sinelnikov, S. S. Fillippov, N. V. Cherburkin of the USSR Academy of Sciences, Institute of Applied Mathematics imeni M. V. Keldysh]

[Text] The propagation of intensive pulsed CO_2 laser radiation along a near-surface atmospheric path is examined. A mechanism is suggested which explains the anomalous radiation attenuation during a pulse.

Much attention is now given to the problem of laser radiation propagation in the atmosphere and, in particular, to its nonlinear attenuation. In [1], nonlinear energy (integrated over the pulse duration) attentation of CO_2 laser radiation with duration of 2 microseconds and energy density up to 10 J/cm^2 was studied in experiment during its propagation at the near surface layer of the atmosphere. The authors explain the attained results by the medium's nonlinearity which arose due to points of low-threshold optical break-down at hard aerosol particles.

Examined in this work is the propagation of a collimated beam of pulse laser radiation with 40 μs duration and energy density of up to 10 J/cm^2 along a near-surface atmospheric path for 40 m at a level 2 m above the earth's surface. In accordance with [3], radiation was not intense enough to cause points of low-threshold optical breakdown; nevertheless, nonlinear attenuation was observed in this case also. An electroionization CO_2 laser with a telescopic unstable resonator served as radiation source. The radiation energy attenuation (integrated over the pulse duration) as a function of the energy density, the transmission dynamics during a pulse, the radiation channel glow dynamics in the 0.3 - 0.7 μm spectral region and the backscatter radiation were all studied.

The methodology for determining transmission dynamics during a pulse is based on comparing the temporal pulse shapes at the input and output of the atmospheric path. The pulse shape is checked by Ge-Au based detectors with a time

resolution of 0.1 μs. A Cd-Hg-Te-based detector mounted at the beginning of the optical path was used to record backscatter radiation having λ =10.6μm.

Transmission of radiated energy was studied using transmission grating bolometers (TGB) consisting of a grid of two rows of wire thermistors. The vertical and horizontal dimensions of the TGBs exceeded those of the light beam by factors of 3 and 2, respectively. The geometric transmission of the TGBs was 98%. Preliminary calibration of the TGBs was done using a type TPI-2-5 calorimeter and the mean-square error in determining the radiation energy in a series of 10 start-ups with identical energy is estimated to be 3%.

After the measurements were taken, the TGB readings were repeatedly compared to check the stability of the bolometers' sensitivities. The radiation energy transmission was $T=\langle E_\ell \rangle / \langle E_0 \rangle$, where $\langle E_\ell \rangle$ and $\langle E_0 \rangle$ are the average energies of radiation pulses at the input and output of the atmospheric path averaged over a group of start-ups with a fixed pulse energy.

The standard meteorological parameters: meteorological visibility range, aerosol composition (aerosol particle concentration graded according to size) and atmosphere transparency for low intensity beams at wavelengths of 0.63 and 10.6 μm were monitored while the measurements were taken.

The dependencies of the transmission of radiated energy along the near-surface atmospheric path are given in fig. 1 as a function of the energy density at the path input. The dynamics of radiation transmission during a pulse, whose shape is given in fig. 2, a, is shown in fig. 2, b. It can be seen that the radiation pulse energy attenuation is ~15 and 30% for low and high radiation energy densities, respectively.

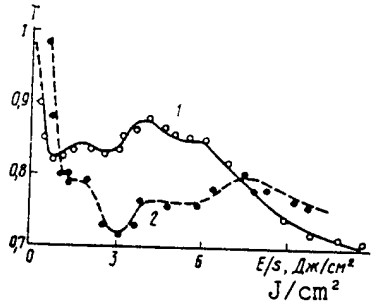


Fig 1. Relationship between energy transmission and radiation energy density in December (1) and March (2) of 1983.

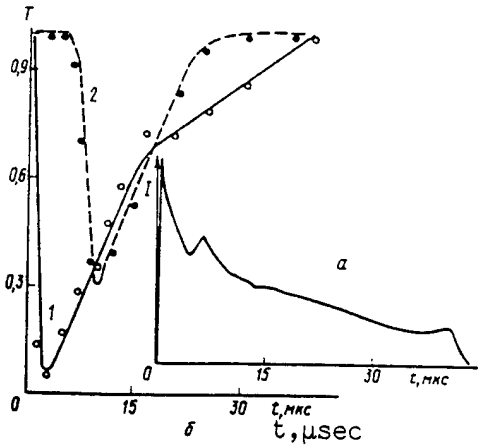


Fig 2. Typical shape of a radiation pulse at path input (a) and radiation transmission dynamics (b) having energy density of 10 (1) and 2.5 J/cm² (2) in August, 1983.

The dynamics of radiation scattering obtained by normalizing the temporal shape of the scattered radiation to the temporal shape of a powerful radiation pulse is illustrated in Fig. 3. The time coincidence between the first scattering peak and the time of maximum atmospheric disturbance caused by laser radiation draws one's attention.

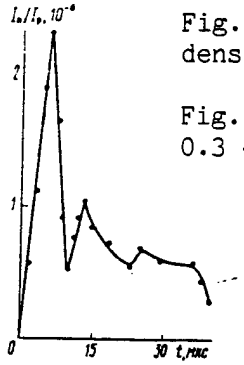
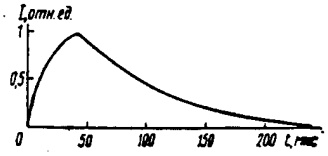


Fig. 3. Dynamics of backscattering radiation having energy density of 10 J/cm² in August, 1983.

Fig. 4. Dynamics of intensive radiation channel glow in the 0.3 - 0.7 μm spectral region in August, 1983.

relative units



The radiation channel glow dynamics in the 0.3 - 0.7 μm spectral region given in Fig. 4, was recorded at night using a pulsed FIM photometer which was located directly beneath the channel and viewed it from below. The photometer's field of view was limited by the diaphragm. The photometer reading of the radiation channel showed the presence in it of glowing features with sizes from 1 - 10 mm.

These results cannot be explained from the standpoint of linear molecular and aerosol absorption and scattering. For this reason, the following mechanism of nonlinear radiation attenuation is proposed. For a certain time (dependent on intensity), numerous finely dispersed aerosol particles are heated uniformly throughout, up to the boiling temperature. Next, an explosion occurs with gas-dynamic expansion of these vaporized aerosol particles. The density, and, consequently, the refractive index of the medium decreases sharply in the entropy traces of the expanding spherical shock waves. After explosion of the finely dispersed aerosol fraction, the atmospheric medium in the channel, which is now occupied by the radiation, becomes optically nonuniform. The sizes of the inhomogeneities formed may be significantly larger than the sizes of the aerosol particles prior to the explosion, while their number is equal to the number of exploded particles.

As previously demonstrated [2], the difference between the refractive indexes of the scatterer and the medium enters into the description of the multiple scattering as a parameter which defines effectiveness of radiation attenuation. We estimate the sizes of the inhomogeneities formed after the explosion by assuming that the density perturbations are dispersed at a velocity which is determined by thermal conductivity. It follows from Fig. 2 that the inhomogeneities are dispersed in ~ 40 μs, so that the characteristic inhomogeneity size $r \sim (4\chi t)^{1/2}$, where χ is the coefficient of thermal diffusivity. For air

at normal conditions $\chi \approx 0.3$ cm^2/s, and so $r \approx 70$ μm. The distance between inhomogeneities is $l_0 \sim N^{-1/3}$, where N is the concentration of scatterers. For N=300 cm^{-3} l_0 0,1 cm; consequently the condition of applicability $\lambda \ll r \ll l_0$ for Mi's scattering theory is satisfied.

Radiation attenuation due to scattering by the inhomogeneities is described by the equation [2]: $I = I_0 \exp(-NL\pi r^2 Q_{sc})$, where N is the concentration of scatterers; L is the propagation path length; r is the radius of a spherical scatterer and Q_{sc} is the scattering efficiency factor. For small $B = 4\pi r|n-1|/\lambda$, we have $Q_{sc} \sim B$, as $n \to 1$. For air $|n-1| = 3 \cdot 10^{-4}$; consequently $Q_{sc} \sim B \approx 2.4 \cdot 10^2$. For N = 300 cm^{-3} and L = 40 m, we can estimate the exponent in Bouguer's law to be $NL\pi r^2 Q_{sc} \approx 3.9$. Therefore, at the time of maximum attentuation of radiation due to scattering by the inhomogeneities (which were formed as a result of the aerosol explosion), the path transmission T = exp(-3.9) = 0.02 is in satisfactory agreement with the experimental results. This argues in favor of the proposed mechanism of powerful pulse radiation attenuation along a near-surface atmospheric path in the presence of an aerosol.

We note that, in addition to scattering by thermal inhomogeneities of the medium, absorption and scattering by expanding plasma structures (as they arise at the aerosol particles), can also contribute to the radiation attenuation.

Thus, the radiation transmission dynamics can be described as follows. At the start of a pulse, after rapid heating of aerosol particles, one of the chemical fractions of a finely dispersed aerosol explodes, forming thermal inhomogeneities of the medium which results in radiation scattering. Then, the medium's optical density is restored and the path transmission increases, owing to thermal conductivity.

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CSO: 1862/63

UDC 621.9.01

COLLECTIVE EFFECTS DURING INDUCED RADIATION OF ELECTRON BEAM IN WIGGLER WITH AXIAL MAGNETIC FIELD

Moscow FIZIKA PLAZMY in Russian Vol 10, No 6, Nov-Dec 84
(manuscript received 4 Jan 84 after revision) pp 1275-1279

KOLOMENSKIY, A. A. and PAKHOMOV, I. I., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] Hydrodynamic approximation is employed to investigate the dispersion properties of free-electron lasers resulting from the combined operation of collective effects and the magnetic field H corresponding to actual experiments. Two magnetic field configurations are investigated: combination of the spiral field and longitudinal field, and an azimuthally-symmetrical field modulated along the z axis. It is found that, all other conditions being equal, the increment in the instability for the spiral field is somewhat greater than that of the azimuthally-symmetrical field. The increment is found to fall in both cases as the kinetic electron energy and radiation frequency increase. The combination of the wiggler field and a strong focusing longitudinal field changes the nature of the transverse movement of the electrons, and also has a strong influence on their longitudinal movement. References 10: 5 Russian, 5 Western.
[202-6900/12947]

MOLECULAR PHYSICS

UDC 621.373.826.038.824

LASING PROPERTIES OF TWO-COMPONENT DYE SOLUTION EMPLOYING FLASHLAMP PUMPING IN DIFFERENT SOLVENTS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 2, Feb 85
(manuscript received 19 Mar 84) pp 294-305

SALETSKIY, A. M. and YUZHAKOV, V. I., Moscow State University imeni M. V. Lomonosov

[Abstract] This study investigates the influence of the solvent on lasing properties in a system of rhodamine 6G and oxazine 17, which exhibits a wide frequency tuning range when flashlamp pumping is employed. It is found that the energy and spectral characteristics of the two-component system are improved by the participation of both components, as well as by donor-to-acceptor transfer of the excitation energy. The increase in 017 lasing efficiency resulting from transfer of the excitation energy from R6G molecules is insignificant, and no change in the solvent to influence the transfer rate of the excitation energy causes any significant change in the lasing efficiency of the two-component system. The lasing characteristics of the multicomponent system is influenced by the solvent chiefly due to modification of the spectral-luminescent properties of the components; the lasing energy of the dye mixture is increased mainly by the gain associated with the direct involvement of donor as well as acceptor molecules. References 17: 13 Russian, 4 Western.
[340-6900/12947]

UDC 621.384.633

BEAM EXTRACTION FROM HIGH ENERGY CYCLOTRONS BASED ON INTEGER RESONANCE

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA: SERIYA 3 FIZIKA, ASTRONOMIYA in Russian Vol 25, No 6, Nov-Dec 1984 (manuscript received 20 Feb 84) pp 59-61

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

[Abstract] Beam extraction from strong-current kaon-neutron cyclotrons with proton energy of several GeV is analyzed. In contrast to earlier models, it is found that integer resonance $Q_r = 2$ followed by acceleration does not occur, but that the beam was extracted on the basis of integer resonance rather than fourth-order nonlinear resonance. It is found that proton extraction on the basis of integer resonance can also be employed in cyclotron pion factories with low energy accumulation per revolution (approximately 400 keV). References 12: 3 Russian, 9 Western.
[183-6900/12947]

UDC 621.039.524.2.034.3:001.57

MATHEMATICAL MODEL OF BEHAVIOR OF MINIATURE OXIDE FUEL CELLS IN HIGH-TEMPERATURE GAS-COOLED REACTOR

Moscow ATOMNAYA ENERGIYA in Russian Vol 58, No 2, Feb 85
(manuscript received 10 Jan 83) pp 101-104

S. A. BALANKIN and Ye. A. RYBAKOVA

[Abstract] The amoeba effect in miniature fuel rods with uranium, thorium, and mixed uranium-thorium oxide and carbide kernels is investigated. The change in the shape of the fuel kernel due to diffusion of splitting atoms within the buffer coating is analyzed. A primary mathematical model is developed for the amoeba behavior of an oxide miniature fuel rod in a reactor at temperatures ranging from 1273 to 1523 K, and of the depletion of 0.5-5% of the initial number of metal atoms. References 20: 5 Russian, 15 Western.
[361-6900/12947]

UDC 621.373.826

DEGREE OF COMPRESSION OF SPHERICAL TARGET AS FUNCTION OF TEMPORAL FORM AND DURATION OF LASER PULSE

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 2, Feb 85
(manuscript received 10 May 84) pp 410-413

GUSKOV, S. Yu. and ROZANOV, V. B., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] This study investigates the compression of two-layer and gas-filled shell targets caused by a shaped laser pulse in which the radiated power increases stepwise over time. The situation examined is for optimum power, in which the laser pulse duration is shorter than the amount of time required for the shell to collapse to the center. The entropy introduced into the target by the shockwave decreases as the shell moves while the exponent in the expression for the power build-up of the laser pulse, so that the final density of the plasma increases. References 5 Russian.
[340-6900/12947]

INITIAL EXPERIMENTS ON HIGH FREQUENCY PLASMA HEATING AT TUMAN-3 TOKAMAK

Leningrad PISMA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 11, No 5, 12 Mar 85 (manuscript received 23 Nov 84) pp 315-318

ASKINAZI, L. G., GOLANT, V. Ye., GONCHAROV, S. G., GRYAZNEVICH, M. P., LUSEV, V. K., DYACHENKO, V. V., IZVOZCHIKOV, A. B., KISLYAKOV, A. I., KRIKUNOV, S. V., LEBEDEV, S. V., LIPIN, B. M., PAVLOV, I. P., PAZDOBARIN, G. T., POZHDESTVENSKIY, V. V., SAKHAROV, N. V., KHALILOV, M. A., CHERNYCHEV, F. V., CHAKHOVETS, K. G., CHERBININ, O. N., BELYAKOV, V. A., BENDER, S. Ye., KOSTSOV, Yu. A., LITUNOVSKIY, R. N., MINYAYEV, O. A., NAUMCHIN, Yu. Ye. and CHVERSKIY, L. G.

[Abstract] The conditions for injecting hf power at the ion cyclotron resonance frequency are investigated and optimized experimentally with the help of a high-power generator loaded to a metal antenna. The power input to the plasma was 50 - 150 kW. The absorption efficiency was investigated as a function of the longitudinal magnetic field size and the amount of hydrogen added to the deuterium plasma. The replacement of deuterium by hydrogen is found not to change the parameters of the ohmic heating mode significantly. Experiments on ion cyclotron heating are described in which a single antenna contained in a 72 x 330 mm^2 tube is employed. The hf power is found to be contained in the stationary stage of the discharge, 25 - 35 msec after initiation. Oscillograms are presented of the discharge parameters in which the main working gas is deuterium. The increase in deuteron and proton temperature measured spectrally is analyzed as a function of the concentration of added hydrogen. Significant electron heating in modes was noted with a strong longitudinal field. References 3 Russian.
[374-6900/12947]

NUCLEAR RESEARCH INSTITUTE'S ACTIVITIES AND EQUIPMENT

Kiev PRAVDA UKRAINY in Russian 21 Apr 85 p 4

[Excerpt] In recent years, the scientists at Ukrainian Academy of Sciences' Institute of Nuclear Research have carried out a number of major studies aimed at increasing the economy, reliability and safety of nuclear power stations. These developments are being used at the Armenian, Novovoronezh, Chernobyl, Kola and Rovno nuclear power stations. Scientists at the institute are working productively also on the problem of 'harnessing' high-temperature nuclear plasma. An experimental unit which will make it possible to study the behavior and controllability of hot plasma is being built jointly with the Ukrainian academy's Institute of Cybernetics.

The researchers have at their disposal a modern cyclotron of large capacity, the U-240, a nuclear reactor, an electrostatic generator, and other equipment for modern experiments.

An inter-agency commission which has been created under the institute is engaged in expanding scientific-technical ties, organizing scientific conferences and exchanging information.

FTD/SNAP
/12947
CSO: 1862/414

UDC 517.946+535.42

UNIQUENESS THEOREMS FOR THE PHASE PROBLEM IN OPTICS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 279, No 6, Dec 84 (manuscript received 26 Mar 84) pp 1348-1351

KLIBANOV, M. V., VOLOSTNIKOV, V. G. and KOTLYAR, V. V., Kuybyshev State University

[Abstract] The phase problem in optics - that of finding the phase distribution of a light wave (or the wavefront form of coherent monochromatic light) from intensity measurements - is stated mathematically as

$$(1) \quad g(x) = \left| \int_{\Omega} f(\xi) e^{ix\xi} d\xi \right|^2, \quad x \in R^n, \quad x\xi = \sum_{k=1}^{n} x_k \xi_k.$$

Uniqueness theorems for problem (1) are obtained in the class $fEC^{\infty}(\bar{\Omega})$, as well as uniqueness theorems for the inverse scattering problems in the Fresnel and Fraunhofer zones. References 14: 9 Russian, 5 Western. [203-6900/12947]

UDC 538.81; 535.8

RECOVERY OF CHARACTERISTIC FUNCTION OF RANDOM PHASE TRANSPARENCY FROM INTENSITY MEASUREMENTS OF SCATTERED LIGHT

Gorky IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 11, Nov 84 (manuscript received 29 Nov 83) pp 1484-1486

VOLOSTIKOV, V. G., KOTLYAR, V. V. and MALOV, A. N., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] This study addresses the conditions under which intensity measurements can be made other than on some observation plane perpendicular to the direction of propagation of a light field: either on a straight line lying in that plane, or a straight line perpendicular to that plane. The condition is identified under which the characteristic function of a random screen can be recovered uniquely for isotropic scatterers from measurements of the average intensity on a straight line lying in the observation plane, or on a straight

line running in the direction of propagation of the light field. It is shown that the statistical characteristics of a random transparency can be recovered uniquely from measurements of the average intensity of the speckle field in the near zone along a straight line lying in the observation plane, or perpendicular to the observation plane. References 8: 5 Russian, 3 Western.
[205-6900/12947]

UDC 538.56:519.25

ESTIMATION OF MINIMUM LIGHT FLUX DETERMINED BY PHOTON NOISE FOR ADAPTIVE IMAGE "VIBRATION" COMPENSATION SYSTEM

Gorky IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 11, Nov 84 (manuscript received 4 May 84 after revision) pp 1410-1418

BOGATUROV, A. N., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] This study investigates a field measuring system incorporating a single Hartman sensor to directly extract the photon noise influence. An adaptive system for compensating image vibration incorporating a slope corrector is examined. Expressions are derived for the minimum average number of optical samples for different gains in the corrector circuit based on a correction effectiveness criterion proposed by the authors. When few photons are recorded, a nonoptimum choice of gain in the corrector circuit can increase the image vibration, or make the requirements for the received flux more stringent. The minimum flux, expressed in the average number of recorded samples, is determined for different gains. Numerical estimates show that the maximum astronomical quantity for which compensation remains effective does not exceed m = 9 when the diameter of the receiving aperture is equal to the radius of the spatial coherents of the field. References 10: 7 Russian, 3 Western.
[205-6900/12947]

UDC 621.384

NATURAL BACKGROUND INTERFERENCE IN ATMOSPHERIC WINDOWS (A REVIEW)

Gorky IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 11, Nov 84 (manuscript received 26 Dec 83) pp 1355-1381

FIRAGO, V. A., KHANOKH, B. Yu. and DOLININ, V. V., Belorussian State University

[Abstract] This review attempts to integrate information available in scattered publications regarding background interference in atmospheric windows, and to analyze the problems involved in describing, modeling and defining its basic statistical characteristics. Studies on the nature of

fluctuations and the power of optical radiation from natural backgrounds is discussed. The description and representation of the basic characteristics of optical background radiation are reviewed. Models of spatial fluctuations in the brightness of natural backgrounds are analyzed. Research on the statistical characteristics of natural background interference is outlined. The scientific literature is found to provide incomplete data on the statistical characteristics of spatial fluctuations in the radiation of certain types of brightness backgrounds; natural brightness backgrounds have been found to be inhomogeneous and unsteady; however, most analyses of statistical characteristics have employed methods suitable only for studying steady random processes. For this reason, the information available on the statistical characteristics of fine-structural fluctuations needed for designing optical and electronic systems is masked by strong large-scale components. References 109: 86 Russian, 23 Western.
[205-6900/12947]

UDC 621.373.826

WAVEFRONT DISTORTIONS OF LASER RADIATION CAUSED BY THERMAL SELF-STRESS AND ADAPTIVE COMPENSATION FOR THEM

Moscow IZVESTIYA AKADEMII NAUK SSR: SERIYA FIZICHESKAYA in Russian Vol 48, No 12, Dec 84, pp 2299-2303

BELOUSOVA, I. M., VYSOTINA, N. V., GRIGOREV, V. A., ROZANOV, N. N., SEMENOV, V. Ye. and SMIRNOV, V. A.

[Abstract] Wavefront distortions of quasicontinuous laser radiation caused by thermal self-stress are investigated theoretically. The problem of quasi-steady modes (in terms of heat) of radiation propagation is reduced to the solution of a steady-state quasi-optical (parabolic) equation for the slowly changing complex amplitude of the field and a steady-state heat conductivity equation for the temperature. Nonlinear distortions of the laser beam in a gas medium with convective heat release, in which the coefficient of nonlinearity is large, are examined. The characteristics of a beam passing through a layer of gas are calculated as an example: the beam divergence is assigned by phase distortions alone. Severe distortions noted in the beam profile, as well as nonlinear effects, are caused by linear diffraction of relatively small inhomogeneities of the beam. The possibility of adaptive compensation for nonlinear distortions by phase conjugation are investigated. References 6 Russian.
[193-6900/12947]

UDC 537.533

INVESTIGATION OF RELATIVE CURRENT DENSITY DISTRIBUTION IN POWERFUL PULSE ELECTRON BEAM BY PHOTOMETER REGISTRATION OF X-RAY BREMSSTRAHLUNG

Moscow RADIOELEKRONIKA USKORITELEY I FIZICHESKOGO EKSPERIMENTA in Russian 1982 (signed to press 6 Jul 82) (manuscript received 11 Jan 82) pp 11-21

GOLUBEV, A. A., KADYMOV, A. Kh. and RADKEVICH, O. I.

[Abstract] A pulse electron beam with E = 400 keV, I = 25 A and rectangular pulse shape is investigated photographically with allowance for the influence of the finite dimensions of the aperture of the camera. The electron beam was received in a vacuum by a flat tantalum target set at 45° to the axis of the beam 2 meters from the accelerator. The resulting X-ray bremsstrahlung (gamma radiation) exits the camera chamber and is recorded on film. The picture of the density distribution of the gamma radiation sources at the target corresponds to the distribution density of the current across the cross section of the electron beam. The optical density curves were recorded photometrically as a function of the radius on an automatic MF-431 microphotometer. This method is found to provide acceptable accuracy even under the unfavorable sensitivity conditions of the experiment. The use of high sensitivity film in conjunction with amplifying luminescent screen film makes it possible to enhance the accuracy of the method by placing the films farther from the aperture. This reduces the error in the mathematical allowance for the influence of the aperture, improves the photometry accuracy and makes it possible to operate in the linear section of the film characteristic. References 3 Russian.
[188-6900/12947]

UDC 621.3.038.616.621.317.085.5

FILTERING OF WIGGLER RADIATION AGAINST BACKGROUND OF RECEIVING EQUIPMENT NOISE

Moscow RADIOELEKRONIKA USKORITELEY I FIZICHESKOGO EKSPERIMENTA in Russian 1982 (signed to press 6 Jul 82) (manuscript received 15 Jan 82) pp 22-27

AKSENOV, O. Yu.

[Abstract] This study investigates the filtering of a weak wiggler radiation signal against the background of internal receiving equipment noise by distinguishing the statistical characteristics of the valid signal from the statistical characteristics of the noise. The analysis is performed in a device for diagnosing a charged-particle beam incorporating an input optical system, an electron-optical converter and a television camera. The conditions are defined under which the valid wiggler radiation signal can be extracted against the background of internal receiver noise in the optical band with the required time resolution. An expression is derived for the minimum number

of particles in a beam for which it is possible to extract the wiggler radiation of the beam against the background of receiver noise. The proton beam diagnostic system for the accelerator-accumulator complex proposed for construction at Serpukhov is analyzed as an example. It is found possible to extract irradiation of an individual beam of particles against the background of receiver noise within one revolution of the beam in the complex.
References 6: 2 Russian, 4 Western.
[188-6900/12947]

PASSIVE MODE LOCKING IN MASERS WITH NONEQUIDISTANT SPECTRA

Moscow ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian Vol 87, No 12, Dec 84 (manuscript received 13 Jul 84 after revision) pp 1894-1904

BESPALOV, P. A., Institute of Applied Physics, USSR Academy of Sciences

[Abstract] It is shown theoretically that passive mode locking is possible in a plasma maser system. The shape of the short pulse passing through a plasma maser system with a nonequidistant spectrum is shown to be described by Haus' equation with complex coefficients, for which soliton solutions are obtained. The characteristics of pulse trains with high relative pulse durations are established, including the frequency behavior of the electromagnetic radiation spectrum not corresponding to the linear dispersion equation. Other similarities between the operating modes of maser and laser systems are pointed out. Absorption saturation during cyclotron interaction of whistler waves and high energy electrons is analyzed in an appendix.
References 22: 13 Russian, 9 Western.
[204-6900/12947]

RESONANT FLUORESCENCE DIAGNOSTIC SYSTEM FOR REGISTERING CV ION

Moscow PISMA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 11, No 6, 23 Mar 85 (manuscript received 22 Nov 84) pp 351-354

MOSKALENKO, I. V., BERIK, Ye. B., MIKHKELSOO, V. T. AND SHEGLOV, D. A., Scientific Research Institute for Electrophysical Equipment imeni D. V. Yefremov

[Abstract] A diagnostic system is described for laser resonance flourescence detection of CV ions. The frequency doubler employs a potassium pentaborate crystal, and the dye laser is pumped by an XeCl excimer laser. The expected signals and signal/noise ratios are estimated in order to select the composition and parameters of the radiation recording system for the geometry and parameters of the T-10 tokamak. It is found that, given a sufficiently high CV ion concentration, a tunable radiation source will soon make it possible to make local Doppler measurements of ion temperatures by taking the absorption contour for the $2 \rightarrow 5$ transition. References 5: 3 Russian, 2 Western.
[370-6900/12947]

UDC 621.373.826

CHARACTERISTICS OF A GARNET MAGNETIC MIRROR WITH WAVELENGTH OF 1.15 μm

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY MV I SSO SSSR: RADIOFIZIKA in Russian Vol 28, No 3, Mar 85 (manuscript received 30 May 84) pp 388-392

ANDRONOVA, I. A., GUSEV, Yu. A., KONOPLEV, Yu. N., MAMAYEV, M. A., NOVIKOV, M. A., and TURKIN, A. A., Institute of Applied Physics, Academy of Sciences of the USSR

[Abstract] The properties of a mirror consisting of a thin magnetic film, whose axis of easy magnetization lay in the plane of the film, on a nonmagnetic garnet substrate on which an antireflection coating was deposited, and an optically nontransmitting multilayer dielectric mirror deposited on the magnetic garnet layer was studied theoretically and experimentally at a wavelength of 1.15 μm. Such mirrors are of interest in creating frequency splitting in laser gyroscopes. The losses, amplitude and phase nonreciprocities were calculated as a function of the phase thickness of the magnetic layer. The amplitude and phase nonreciprocities were found to be periodic functions of the phase thickness of the magnetic layer; the phase nonreciprocity is maximum when the amplitude nonreciprocity vanishes. The phase nonreciprocity of a mirror based on a bismuth-containing magnetic film ≃ 5.37 μm thick was measured as a function of the angle of incidence: when the angle of incidence varied from 27 to 43° the phase nonreciprocity varied from a minimum to a maximum value. A submicron garnet film will enable decreasing the losses at 1.15 μm with the same phase nonreciprocity to 0.1-0.2%. Figures 3; references 10: 5 Russian, 5 Western.
[400-9638/12947]

UDC 535.8:681.3

RECONSTRUCTION OF THE CHARACTERISTICS OF LIGHT TRANSMISSION IN A DISPERSIVE MEDIUM BY THE ARGUMENTS GROUPING METHOD (AGM)

Kiev AVTOMATIKA in Russian No 2, Mar-Apr 85
(manuscript received 5 Jan 81) pp 87-89

KONOVAL, V. A. and SHPOT, A. S., Ukrainian Scientific-Production Union of the Cellulose-Paper Industry

[Abstract] It was shown for a suspension of cellulose fibers that the Lambert-Bouguer-Beer law

$$I = I_0 \exp(-\mu X_1 X_2) \qquad (1)$$

where I_0 is the intensity of the incident light beam, μ is the absorption (scattering) coefficient which depends on the optical properties of the suspension and on the wavelength of the radiation, and X_1 and X_2 are the layer of suspension and the concentration of the suspension, respectively, can still be used to determine the physical parameters of the suspension even

when the fiber density in the suspension becomes so large that the direct application of Eq. (1) results in a large error. This was done by applying the arguments grouping method, i.e., rewriting Eq. (1) in the form

$$I = f(X_2)\exp(-F(X_2)X_1X_2) \qquad (2)$$

and choosing $f = I_0\exp(k_1)/(k_3\log X_2)$ and $F = k_2\log X_2$. The constants k_i were determined by minimizing the mean-square error and the absolute error in the predicted transmitted light intensity. The rms error in both cases was equal to 0.029 and 0.0299, respectively, as compared with an rms error of 0.044 obtained by the direct application of Eq. (1). References 6: all Russian.
[392-9638/12947]

UDC 681.513

CHOICE OF OPTIMALITY CRITERIA IN IDENTIFICATION PROBLEMS

Kiev AVTOMATIKA in Russian No 2, Mar-Apr 85
(manuscript received 17 Jul 84) pp 84-87

KIKU, A. G. and BURLAKOV, V. M., Kiev Polytechnical Institute

[Abstract] It was demonstrated that in identification problems single criteria for evaluating the closeness of an object to its model are not all equally adequate. It was found that better results are achieved by solving identification problems using a set of closeness criteria combined with a set of preliminary data reduction operators. The technique was illustrated for the problem of evaluating the parameters of an object described by the solution to the diffusion equation in an isotropic unbounded medium with an instantaneous point source. The model parameters were the temperature T and the intensity of the source Q, and two closeness criteria and two reduction operators were selected. It was shown that the rms deviations of Q and T obtained with the use of the same criterion and reduction operator for both Q and T differed widely, while the use of different criteria and reduction operators for Q and T not only gave similar results for both parameters, but it made it possible to minimize the deviations for both parameters. Figures 1; references 1: in Russian.
[392-9638/12947]

UDC 535.417

SYNTHESIS OF MULTILAYER OPTICAL COATING WITH RESPECT TO DISPERSION AND ABSORPTION

Moscow VESTNIK MOSKOVOSKOGO UNIVERSITETA SERIYA 3: FIZIKA ASTRONOMIYA in Russian Vol 26, No 1, Jan-Feb 85 (manuscript received 17 Jan 84) pp 11-16

N. V. GRISHINA and A. V. TIKHONRAVOV, Department of Mathematics

[Abstract] A method is proposed for synthesizing multilayer dielectric coatings with assigned spectral properties that takes dispersion and absorption into account. The influence of these effects on the synthesis process, and the parameters of the synthesized systems, are investigated. A variational statement is employed for the synthesis problem. Formulas are derived for the transmission coefficient of an N-layer system, and the gradient of the estimation functional is determined. The estimation functional is minimized by using the gradient descent method in conjunction with the method of conjugate directions. A FORTRAN program for carrying out the calculations is described. The influence of dispersion and absorption on the spectral properties of the synthesized systems is investigated. Optimal systems obtained with and without allowance for absorption are found to differ significantly in structure, indicating that absorption and dispersion must be taken into account from the very beginning of the synthesis process. References 7: 2 Russian, 5 Western.
[358-6900/12947]

UDC 621.378.3

INFLUENCE OF LASER RADIATION DIVERGENCE ON ANGLE CHARACTERISTICS OF VECTOR SYNCHRONISM DURING FREQUENCY DOUBLING

Minsk DOKLADY AKADEMII NAUK BSSR in Russian Vol 29, No 4, Apr 85 (manuscript received 9 Apr 84) pp 318-321

Belorussian SSR Academy of Sciences academician B. V. BOKUT, N. S. KAZAK, A. S. LUGINA, Ye. M. MIKLAVSKAYA, A. V. NADYENYENKO, V. K. PAVLYENKO, Yu. A. SANNIKOV, Institute of Physics, Belorussian SSR Academy of Sciences

[Abstract] The influence of laser radiation divergence on the frequency doubling process for vector synchronism is investigated for the case in which the orientation of the crystal changes with respect to the incident radiation while the angle between the beams at the fundamental frequency remains unchanged. Second-harmonic generation for oo-e type vector interaction is considered. It is found that the divergence of the beams at the fundamental frequency during vector synchronism reduces the criticality if the angular position of the crystal significantly. The calculated angular phase matching bandwidth is found to be unsuitable as a measure of the sensitivity of a nonlinear crystal to angular displacement. References 3: 1 Russian, 2 Western.
[3-6900/12947]

UDC 621.371.332.3:523.164.8

DISPERSION RELATIONSHIPS AND INVERSE PROBLEM OF SCATTERING BY SLIGHTLY ROUGH SURFACE

Gorky IZVESTIYA VYSSKIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28, No 2, Feb 85 (manuscript received 11 Jan 84) pp 177-183

I. M. FUKS, Institute of Radio Physics and Electronics, Ukranian SSR Academy of Sciences

[Abstract] The inverse problem of determining the electrodynamic properties of a reflecting surface and the roughness parameters of its relief is solved for a broad class of slightly rough surfaces producing near-mirror reflection. A two-scale model is used to investigate the relationship between the radar cross-section of scattering by a statistically uneven surface and the angle of incidence and radiation frequency. It is shown that the complex permittivity, the probability distribution density of the angles of inclination of the roughness, and their spatial energy spectrum, can be obtained from the analytical data. Universal formulas are derived that describe the relationship between the frequency behavior of the scattering cross-sections in the mirror and the diffusion component. Scattering by a surface described by a step spectrum, such as a rough ocean surface, is analyzed as an example. The frequency data agree well with the experimental findings. References 13: 10 Russian, 3 Western.
[359-6900/12947]

UDC 537.531:535.2

DIFFRACTION THEORY OF GLANCING MODES IN CONVEX MIRRORS AND X-RAY BAND CAVITIES. II

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 55, No 3, Mar 85 pp 567-574

A. A. VINOGRADOV, V. F. KOVALYEV, I. V. KOZHYEVNIKOV, V. V. PUSTOVALOV

[Abstract] A wave approach is employed to examine the rotation of a soft X-radiation beam. The structure of the electromagnetic field near the surface is found in quasi-classical approximation, making it possible to determine the characteristic diameter of a beam that can be rotated effectively by a cylindrical surface, as well as the cross-sectional intensity distribution. The penetration into the medium of an electromagnetic wave incident on a convex interface boundary at an angle exceeding the limiting angle of total internal reflection is examined by exact solution of the wave equation. Conditions are defined under which the radiation loss effect restricts the coefficient of reflection from a convex cylindrical mirror. The possibility of using cylindrical mirrors in X-ray band laser cavities and rotating devices is discussed. References 14: 9 Russian, 5 Western.
[365-6900/12947]

UDC 537.534.37

ELECTROSTATIC MIRRORS EMPLOYING DUAL-PLATE ELECTRODES IN DEVICES FOR ANALYZING ENERGY AND MASS OF CHARGED PARTICLES

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 55, No 3, Mar 85 (manuscript received 30 Jun 84) pp 580-585

S. P. KARETSKAYA, V. M. KELMAN, N. Yu. SAYCHENKO, Institute of Nuclear Physics, Kazakh SSR Academy of Sciences

[Abstract] The focusing properties, dispersion and aberration of three-electrode mirrors with assigned distance between electrodes and entry angle of the axial beam trajectory are investigated. The data can be used to find the potentials on the electrodes for which it is feasible to use the mirror to analyze the energy of charged particles in electrostatic spectrometers, or to achieve energy focusing in mass spectrometers. Dual-plate mirrors are shown to simplify the construction and reduce the size of analytical instruments. Examples of the use of such mirrors are presented. References 9: 8 Russian, 1 Western.
[365-6900/12947]

UDC 621.373.826.038.823

CHANGE IN SHAPE OF HIGH-POWER IR LASER PULSE PASSING THROUGH ABSORBING MOLECULAR GAS

Moscow KVANTOVAYA ELEKTRONIKA in Russian, Vol 12, No 2, Feb 85 (manuscript received 22 May 84) pp 426-427

BAGRATASHVILI, V. N., BURIMOV, V. N. and SVIRIDOV, A. P., Scientific Research Center for Technological Lasers, USSR Academy of Sciences

[Abstract] This study investigates the temporal evolution of the shape of a high-power CO_2 laser pulse passing through absorbing C_2F_6 and SF_6 molecular gases. A TEA CO_2 laser employing vibrational-rotational line selection with IR pulse energy of up to 3 J are employed. The collimated radiation beam was passed through a gas-filled cuvette; the pulse energy and shape was recorded before and after passing through the gas. The change observed in the shape of the IR pulse is explained by inharmonic shifting of the band of IR molecule absorption when the molecules are strongly heated by the laser pulse. Depending upon the position of the radiation frequency in relation to the IR absorption band, the medium may be 'bleached,' leading to a reduction in the intensity of the leading portion of the pulse, or it may be 'darkened,' which cuts off the 'tail' of the pulse abruptly and reduces its effective length. References 2: 1 Russian, 1 Western.
[340-6900/12947]

UDC 535.416.3

COMPENSATION OF NONLINEAR DISTORTIONS OF LIGHT BEAMS BY ADAPTIVE FLEXIBLE MIRROR EMPLOYING DIFFERENT CONTROL GEOMETRIES

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 2, Feb 85
(manuscript received 10 Jul 84) pp 355-360

SUKHORUKOV, A. P., TROFIMOV, V. A. and SHAMEYEVA, T. Yu., Moscow State University imeni M. V. Lomonosov

[Abstract] This study analyzes the compensation of nonlinear distortions of a light beam passing through a thin defocusing layer in order to estimate the number of drives needed to form the optical wavefront with highest intensity. Compensation for nonlinear divergence in a stationary medium is analyzed on the assumption that compensation performance depends upon the number of drives, as well as on the radius of the perturbing effect of an individual drive to the radius of the beam. The formation of focused beams by flexible mirrors is investigated, and the number of drives needed, and their arrangement, are determined. The findings make it possible to assess the quality of compensation of nonlinear distortions by real mirrors and to determine the number of drives needed. Conditions under which segmented mirrors must be used are determined. References 5: 4 Russian, 1 Western.
[340-6900/12947]

UDC 681.7.064.43

STABILITY OF TRANSMISSION AND REFLECTION OF LIGHT BY NONLINEAR MEDIA

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 2, Feb 85
(manuscript received 21 Feb 84) pp 280-288

RESHETIN, V. P., Institute of Heat- and Mass-Exchange imeni A. V. Lykov, Belorussian SSR Academy of Sciences

[Abstract] The stability of nonlinear reflection with respect to the development of small three-dimensional perturbations is investigated. The nonlinear stage of perturbations propagating into the medium is investigated numerically in unidimensional approximation. The steady-state transmission mode is unstable in the region corresponding to the bifurcation parameter values. Self-sustained oscillating reflection modes are used to modulate laser radiation in the picosecond region. The findings provide a partial answer to the question of implementing a bi-stable element based on optical hysteresis at a nonlinear boundary. References 17: 12 Russian, 5 Western.
[340-6900/12947]

UDC 621.398

RECOVERY OF IMAGES OF ROTATING BODIES OF ARBITRARY ANGULAR DIMENSIONS. II. DOPPLER INTERFEROMETRY

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 2, Feb 85
(manuscript received 1 Mar 84) pp 266-268

ANDROSOV, A. M., VYGON, V. G. and USTINOV, N. D.

[Abstract] This study investigates the connection between the correlation characteristics of the Doppler spectral components of coherent signals scattered by a rotating rough surface and the image and form of that surface. The cross-correlation characteristics of Doppler components of the spectra obtained under various wideband sounding conditions are investigated. Examples are presented that demonstrate the usefulness of Doppler interferometry to obtain images of rotating rough surfaces with small angular dimensions. References 4: 3 Russian, 1 Western.
[340-6900/12947]

UDC 621.398

RECOVERY OF IMAGES OF ROTATING BODIES OF ARBITRARY ANGULAR DIMENSIONS. III. DYNAMIC DOPPLER APPROACH

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 2, Feb 85
(manuscript received 1 Mar 84) pp 269-272

ANDROSOV, A.M., VYGON, V. G. and USTINOV, N. D.

[Abstract] The characteristics of the dynamic structure of Doppler spectra of a coherent signal scattered by a rotating surface are analyzed over long spectral analysis intervals, inasmuch as nonstationarity contains information about the geometric structure of the surface. The influence of destabilizing external factors on the Doppler spectra is examined. Fluctuations of the phase of the transmitter signal and of the scattered signal synthesized by rotation of a body in the turbulent medium cause random variations in the field along the aperture. Dynamic variations also influence the resolution of Doppler methods. The theoretical findings indicate the practical possibility of obtaining non-coordinate information about bodies of small angular dimensions.
[340-6900/12947]

UDC 621.398

RECOVERY OF IMAGES OF ROTATING BODIES OF ARBITRARY ANGULAR DIMENSIONS. I. DOPPLER SPECTRUM STRUCTURE AND IMAGE RECOVERY FROM PROJECTIONS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 2, Feb 85
(manuscript received 1 Mar 84) pp 259-265

ANDROSOV, A. M., VYGON, V. G. and USTINOV, N. D.

[Abstract] The connection between the temporal correlation characteristics of the scattered signal and the image of a rotating surface is investigated by analyzing the correlation function of the signal obtained in quasi-static approximation for a smooth-surface model. It is shown that the Doppler spectrum is the Radon transform of the function L(x,y), proportional to the distribution of the surface reflection coefficient. The spectra obtained from different directions of reception can be used to obtain a series of projections onto the different directions, and to recover the actual function L(x,y). The approach can be used only for a small range of observation angles, in which the function L(x,y) is independent of the direction of observation. References 9: 3 Russian, 6 Western.
[340-6900/12947]

UDC 621.373.826

PHASE MODULATION OF PICOSECOND OPTICAL PARAMETRIC OSCILLATOR

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84
(manuscript received 25 Jan 84) pp 2375-2378

PISKARSKAS, A., STABINIS, A. and YANKAUSKAS, A., Vilnyus State University imeni V. Kapsukas

[Abstract] The phase-time relationships in the radiation spectrum of a superluminescent optical parametrical oscillator pumped by the second harmonic of a picosecond YAG:Nd^{3+} laser are investigated to provide an explanation for the causes of spectrum broadening. It is determined through dynamic interferometry that an $LiNbO_3$ crystal pumped as described exhibits fast chaotic as well as slow quadratic phase modulation. When the parametric oscillator output is passed through a system employing a diffraction grating to produce anomalous dispersion, the pulse length was reduced by a factor of five. It is concluded that linear frequency sweeping, in conjunction with stimulated Raman scattering and 2-photon absorption, is one of the fundamental causes for the poor energy efficiency of $LiNbO_3$ optical parametric oscillators. References 18: 6 Russian, 12 Western.
[178-6900/12947]

UDC 621.373.8

WAVEGUIDE CAVITY WITH WAVEFRONT CONJUGATING MIRRORS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84
(manuscript received 24 Jan 84) pp 2325-2330

BELDYUGIN, I. M., VYSOTSKIY, Yu. P., GALUSHKIN, M. G., GRIGORYANTS, V. V. and SINITSYN, A. M.

[Abstract] Cavity modes and losses in a waveguide cavity with wavefront conjugating mirrors are determined for the important case in which the conjugating mirror has a relatively large aperture and can be considered unbounded. An axisymmetrical waveguide cavity with windows set at the Brewster angle is examined. It is found that transverse hybrid cavity modes in a hollow axisymmetrical waveguide cavity with ideal wavefront conjugating mirrors are the same as the coinciding waveguide modes, and that the properties of such cavities are determined by the characteristics of the waveguide. The spatial characteristics of the radiation output by the subject cavity are examined and compared with the corresponding characteristics of waveguide cavities with external spherical mirrors. The properties of cavities with wavefront conjugating mirrors are found to be significantly different from those of ordinary waveguide cavities with external spherical mirrors. The losses and selectivity of cavities with wavefront conjugating mirrors, as well as the angular characteristics of the output radiation, are independent of the distance between the end of the waveguide and a wavefront conjugating mirror with a sufficiently large aperture. The spatial structure of the cavity modes of the cavity with wavefront conjugating mirrors is the same as the structure of the waveguide modes, and their selectivity is determined by losses in the waveguide. References 18: 3 Russian, 15 Western.
[178-6900/12947]

UDC 621.375.826+537.531.7+621.373.8:535.31+621.3.038.8+681.4.072

REFRACTION IN PLASMA AND LASER CAVITIES FOR VACUUM ULTRAVIOLET

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84
(manuscript received 2 Jan 84) pp 2253-2266

CHIRKOV, V. A., Physics Institute imeni N. P. Lebedev, USSR Academy of Sciences

[Abstract] The propagation characteristics of beams of rays with trajectories distorted by smooth electron density gradients during cylindrical expansion of the plasma are examined. Refraction of rays by $N_e = N_{eo} x_o/x$ and N_{eo} $[1-(y/y_o)^2]$ profiles is analyzed. Waveguide propagation by 'holes' in the density profile is examined. Cavity configuration for radiation refracted in plasma are considered. It is found that refraction in the plane parallel to the surface of the target usually has a stronger influence on ray

trajectory curvature than refraction in the direction normal to the target. Cavity arrangements are proposed that provide effective feedback for multiple passes of the radiation. Flat and spherical mirrors are shown to be sufficient for building such cavities. References 53: 37 Russian, 16 Western. [178-6900/12947]

UDC 621.373.826

ATOM-ABSORPTION MEASUREMENTS IN LASER FLAME AT REDUCED PRESSURE

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84 (manuscript received 2 Jan 84) pp 2246-2252

SUKHOV, L. T., Institute of Physics imeni L. V. Kirenskiy, Siberian Department USSR Academy of Sciences

[Abstract] The analytical capabilities of a monopulse laser employed as an atomization and excitation source for spectral analysis are investigated. The influence of the pressure surrounding the laser flame on the sensitivity and reproducability of atom-absorption measurements is determined. It is found that a substance utilization efficiency of 6% is achieved when the specimen is evaporated by radiation from a Q-modulated solid state laser, with absolute measurement sensitivity of 10 pg. The influence of external pressure on the optical properties of the laser flame is examined, revealing an abrupt change in the flame decay process below 3 mm Hg. The sensitivity of the method drops off at pressures below 0.1 mm Hg because of the large difference in the line widths of the absorbing atoms and the radiation lines of the spectral flashlamps. References 10: 9 Russian, 1 Western. [178-6900/12947]

UDC 621.378.325

STABLE CONCENTRATED NEODYMIUM PHOSPHATE GLASS LASER FOR PICOSECOND-RESOLUTION SPECTROSCOPY

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84 (manuscript received 26 Dec 83) pp 2232-2240

VISHCHAKAS, Yu., GULBINAS, V., KABELKA, V. and SYRUS, V., Institute of Physics, Lithuainian SSR Academy of Sciences

[Abstract] This study reports the development of a neodymium glass laser that produces picosecond light pulses with fairly stable characteristics, and the application of this device in a picosecond tunable spectrometer. The capabilities of the spectrometer are illustrated by using new measurement methods to investigate fast processes in dye solutions. The laser developed employs concentrated neodymium phosphate glass elements to overcome the

inherent operating instability of mode-locked lasers. The use of parametric lasers to adjust the frequency of the picosecond pulses is described. A CAMAC based data acquisition, control and preliminary processing system is described. The laser is shown capable of producing three ps pulses for periods of fifty hours at a 1 Hz repetition frequency. The automated multi-purpose frequency-tunable spectrometer based on the laser demonstrated good reproducability in terms of time and energy characteristics, making it possible to develop a backgroundless method for measuring the relaxation time of dyes that is almost twice as accurate as the widely used absorption method. References 30: 18 Russian, 12 Western.
[178-6900/12947]

UDC 535.36;538.3

INVESTIGATION OF FORWARD AND BACK SCATTERING MODES OF SPATIALLY NONCOHERENT PUMPING

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84
(manuscript received 16 Dec 83) pp 2227-2231

ANIKEYEV, I. Yu., GORDEYEV, A. A., ZUBAREV, I. G. and MIKHAYLOV, S. I.,
Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] An original method is used to investigate the characteristics of forward and back scattering for arbitrary relationships between the integral pumping spectrum width and the inverse lifetime of the active medium phonons. The interaction efficiency of a Stokes field that is not correlated with the pumping is shown to be independent of the direction in which it propagates with respect to the pumping; conversely, the effectiveness of the interaction of a Stokes signal that is correlated with the pumping is a strong function of the relative directions in which the fields move. Exact expressions are derived for the structure of the fields and amplification increments for back scattering; no simple exact analytical expressions can be obtained for the modes of the Stokes signal and increment for forward scattering; however, sufficiently precise approximate expressions are derived for Stokes signal configurations having the greatest increment. Comparison of the relationships between the amplification increments and pumping spectrum width shows that a configuration that reproduces the pumping spectrum mainly occurs when the integral pumping spectrum width exceeds the inverse phonon lifetime for waves propagating in the same direction. The selective properties of the process are not enhanced similarly for counter propagation; degeneration occurs as the integral pumping spectrum width approaches infinity. References 13 Russian.
[178-6900/12947]

UDC 621.375.826

CONDITIONS FOR OCCURRENCE OF NEGATIVE IMAGE IN OPTICAL SIGNAL AMPLIFIER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84
(manuscript received 27 Jan 84) pp 2185-2190

KUZNETSOVA, T. I. and KUZNETSOV, D. Yu., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] The occurrence of negative images, which has much in common with wavefront conjugation, during the amplification of space modulated light beams in active optical systems is investigated. The occurrence of negative images in short amplifying media is a manifestation of spatially inhomogeneous depletion of inversion in a strong field. For longer media, wave propagation of the signal must be taken into account. It is found that saturation of the active medium promotes the formation of negative images in short as well as long devices. The nonlinear field interaction that results in negative growth occurs only where the strong-field intensity is in the proper range; therefore, increasing the amplifying length does not always facilitate more effective negative formation. References 8: 6 Russian, 2 Western.
[178-6900/12947]

UDC 534.212:548.535

INVESTIGATION OF HOLOGRAM RECORDING IN IMPURITY CRYSTALS OF LITHIUM NIOBATE AT 325 nm

Yerevan DOKLADY AKADEMII NAUK ARMYANSKOY SSR. in Russian Vol 79, No 5, Sep-Oct 84, pp 214-217

KOZLOVA, V. Yu. and OVSEPYAN, R. K., Institute of Physical Research, Armenian SSR Academy of Sciences

[Abstract] Photo refraction is investigated in $LiNbO_3$ crystals at 325 nm in order to determine the mechanism that underlies recording at that wavelength, and to determine recording sensitivity. The experiments employed pure and iron-doped Y-cut $LiNbO_3$ crystals 300 μm thick. The induced change in birefringence was measured holographically and polarization-optically. The diffraction efficiency of the holograms is analyzed as a function of exposure during reading and writing. Reading causes the hologram to be erased, with a time constant far shorter than in the visible band. No macroscopic phase distortions of the recorded segment that would degrade hologram quality were observed during reading and writing, which allows repeated read-write cycles without significant degradation in hologram sensitivity or quality. The maximum diffraction efficiency and photo refractive sensitivity are tabulated. Photo refraction at 325 nm is found to occur primarily due to a diffuse mechanism of separation of nonequilibrium carriers. Lithium niobate crystals can be used to record dynamic holograms, and for real time interferometry. References 4: 2 Russian, 2 Western.
[375-6900/12947]

INVESTIGATION OF STATISTICAL DISTRIBUTION OF PICOSECOND LASER PULSE DURATION

Leningrad PISMA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 11, No 5, 12 Mar 85 (manuscript received 25 Oct 84) pp 264-267

ANDRYUNAS, K., VISHCHKAS, Yu., KABELKA, V. and SYRUS, V., Institute of Physics, Lithuanian SSR Academy of Sciences

[Abstract] A second-harmonic beam method is described for statistical measurements of picosecond laser pulses. A measurement setup is described for studying pulses produced by a concentrated neodymium phosphate glass laser. The second-harmonic beam width at the half-power level of the signal contains direct pulse duration information. The beam width is registered by an MF-14 V-3 (M) photoarray. Statistical processing of the measurement results indicates a mean of 5.25 $\pm$ 0.1 psec at the 0.05 significance level. The system is helpful in kinetic spectroscopy experiments. References 7: 3 Russian, 4 Western.
[374-6900/12947]

UDC 771.537

COMPENSATION FOR SPACE-DEPENDENT IMAGE DISTORTIONS IN MOVING OPTICAL SYSTEMS

Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 84 (manuscript received 26 Apr 83) pp 51-61

AGRANOVSKIY, M. L.

[Abstract] This study presents an analytical approach to the problem of correcting images that are distorted due to inhomogeneous movement, while assuming spatial dependence. The model employed represents one of the components of movement by a Heaviside-type function, reflecting the situation in which one of the dynamic parameters (such as the orientation or altitude of the camera above the object of the plane) changes abruptly during the exposure process. Correction for spatially dependent distortions, distortions occurring during rotary-reciprocal movement during rectilinear movement with variable orientation, and distortions occurring during movement with variable altitude is analyzed. The proposed method makes it possible to obtain from the intensity of the distorted image both a spectral and a spatial expression for the object's intensity; and these expressions are computationally fairly simple to implement. References 3 Russian.
[208-6900/12947]

PLASMA PHYSICS

NUMERICAL MODELING OF TWO-DIMENSIONAL LANGMUIR TURBULENCE

Moscow PISMA V ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian Vol 40, No 11, 10 Dec 84 (manuscript received 27 Sep 84) pp 455-459

DEGTYAREV, L. M., IBRAGIMOV, I. M., SAGDEYEV, R. Z., SOLOVEV, G. I., SHAPIRO, V. D. and SHEVCHENKO, V. I., Institute of Space Research, USSR Academy of Sciences

[Abstract] This study presents the results of numerical modeling of two-dimensional (x,y) turbulence created by a pumping wave with electrical field oriented along the X axis and unidimensional amplitude. The pumping models either the electromagnetic wave in the vicinity of plasma resonance, or long-wave plasma oscillations excited by the beam in the plasma. The turbulence is modeled on the basis of Zakharov's equations, modified to allow for the presence of the pumping wave and for absorption of oscillations by resonant particles in the short wave part of the spectrum for both modes forming the turbulence - the high frequency plasma and slow modes of quasineutral density perturbations. It is found that the Langmuir oscillation energy is localized in continuously generated collapsing caverns that 'burn up' due to Landau attenuation. The integral characteristics of the quasisteady state obtained numerically agree satisfactorily with the analytical model. References 7: 6 Russian, 1 Western.
[185-6900/12947]

UDC 551.510.535

MOVEMENT OF IONOSPHERIC PLASMA ALONG FORCE LINES OF MAGNETIC FIELD

Gorky IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 27, No 11, Nov 84 (manuscript received 11 Jun 84 after revision) pp 1474-1477

PAVLOV, A. V., Institute of Terrestrial Magnetism, Ionosphere and Radiowave Propagation, USSR Academy of Sciences

[Abstract] Equations are derived for determining the average ion velocities in an ionospheric plasma on the basis of the Chapman-Enskog method. In the latter method the average velocities are found by solving a system of algebraic equations for the diffusion velocities and a single differential

equation for the hydrodynamic velocity, instead of a number of differential equations. An atmosphere consisting of two sorts of electrons, ions and several sorts of neutral components is examined in linear approximation. References 11: 7 Russian, 4 Western.
[205-6900/12947]

UDC 533.951

HIGH FREQUENCY PLASMA HEATING AT FINITE PRESSURE IN REGION OF ION CYCLOTRON FREQUENCIES

Moscow FIZIKA PLAZMY in Russian Vol 10, No 6, Nov-Dec 84
(manuscript received 31 Jan 84 after revision) pp 1211-1218

GREKOV, D. L. and STEPANOV, K. N., Kharkov Physical-Technical Institute, Ukrainian SSR Academy of Sciences

[Abstract] The heating of an inhomogeneous plasma cylinder by electromagnetic waves at approximately the ion cyclotron frequency is investigated. Analytical expressions are derived for the amount of power absorbed by the plasma. It is found that ion cyclotron resonance of the primary gas is an effective heating mechanism in Drakon-type installations with reactor parameters, in contrast to systems with small beta. The cyclotron attenuation at harmonics of the ion cyclotron frequency of the primary gas is found to be very strong. The width of the cyclotron resonance zone for waves with small enough values of $k_{\parallel}$ is smaller than the plasma dimensions because of the plasma diamagnetism. Cherenkov absorption by electrons is also strong. It is found possible to excite intrinsic oscillations only for small values of $k_{\parallel}$ or in small installations; cyclotron resonance by the Alfven branch of the oscillations can be employed in small installations. References 13: 2 Russian, 10 Western.
[202-6900/12947]

UDC 533.95

RESONANT RESISTIVE INSTABILITY OF CHARGED PARTICLE BEAM IN PLASMA WITH LONGITUDINAL MAGNETIC FIELD

Moscow FIZIKA PLAZMY in Russian Vol 10, No 6, Nov-Dec 84
(manuscript received 20 Apr 84) pp 1253-1261

GOREV, V. V., GRIGOREV, S. F. and ZAKHAROV, S. V., Institute of Atomic Energy imeni I. V. Kurchatov

[Abstract] The characteristics of the development of resonant resistive instability in a plasma with an external longitudinal magnetic field are investigated. The beam instability is investigated within the framework of a

system of equations consisting of the kinetic Vlasov equation with self-consistent and external fields for the distribution function of the beam particles, and Maxwell's equation for the vector potential. This approach makes it possible to allow for spread in the betatron oscillations, and to isolate two qualitatively different instability development conditions. The mechanism underlying resonant resistive beam instability is resonant interaction between the beam particles, oscillating in betatron fashion in the asmuthal magnetic field of the beam current and reverse induction current in the plasma, with periodic perturbations of the magnetic field. References 4 Russian.
[202-6900/12947]

UDC 533.933

TEMPORAL CHARACTERISTICS OF RECOMBINING LASER PLASMA RADIATION INTERACTING WITH VARIOUS CONFIGURATIONS OF SOLID STATE OBSTACLES

Moscow FIZIKA PLAZMY in Russian Vol 10, No 6, Nov-Dec 84
(manuscript received 5 Dec 83 after revision) pp 1187-1194

BOYKO, V. A., BRYUNETKIN, B. A., BUNKIN, F. V., DERZHIYEV, V. I., DYAKIN, V. M., MAYOROV, S. A., SKOBELEV, I. Yu., FAYENOV, A. Ya., FEDOSIMOV, A. I., SHILOV, K. A. and YAKOVLENKO, S. I. All-Union Scientific Research Institute for Physical-Technical and Radio Technical Measurements

[Abstract] This study investigates the interaction of an expanding laser plasma with obstacles of different configurations: a flat screen, a convex cylindrical surface (a tube) and two flat plates set an angle to one another (forming a 'roof'). The radiation source employed was a neodymium glass laser producing approximately 20 - 50 J with pulse durations of approximately 10 nsec focused on a flat beryllium plate 0.5 mm thick in a 0.2 x 40 mm line. The placement of a screen in the path of the laser plasma changes its glow significantly. The time-integrated spatial structure of the plasma glow in different spectral bands is investigated in conjunction with the temporal behavior of the glow intensity in different spectral lines. The plasma emittance can be increased significantly by placing a cylindrical tube or 'roof' in the path of the plasma. The main effects are caused by peculiarities in the structure of the plasma shockwave, especially the density discontinuity against a background of continuous variation in the electron temperature. References 4 Russian.
[202-6900/12947]

UDC 533.9.932:533.9.952

ELECTRON ESCAPE AND PLASMA PINCHING IN HIGH-CURRENT DIODE

Moscow FIZIKA PLAZMY in Russian Vol 10, No 6, Nov-Dec 84
(manuscript received 22 Dec 83 after revision) pp 1180-1186

IVANENKOV, G. V., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] Electron escape in a confined plasma is investigated, with emphasis on critical field and current values. The intrinsic magnetic field produced by the current is found to result in an electron escape mechanism other than the Dreicer mechanism during radial oscillations of electrons accelerated near the axis. Escaped electrons are transferred to the axial region due to radial drift or collisions in the hybrid fields. Transverse oscillations of the electrons accelerating into the axis occur for fast particles in every case, while Dreicer escape occurs only for certain ranges of variation in the field and velocity. Plasma pinch conditions are defined under which the skin layer acts as an initial current shell that is capable of further compression. References 12: 5 Russian, 7 Western.
[202-6900/12947]

GENERATION OF HIGHER HARMONICS OF LASER RADIATION IN PLASMA DURING INVERSION OF ELECTRON FLOWS

Moscow ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian Vol 87, No 12, Dec 84 (manuscript received 12 Jun 84) pp 1914-1924

ISICHENKO, M. B. and YANKOV, V. V., Institute of Atomic Energy imeni I. V. Kurchatov

[Abstract] A detailed description is provided for discontinuities represented by electron flow inversion, which has been shown experimentally to result in the formation of hundreds of harmonics in a plasma target irradiated by a powerful CO_2 laser. Electron flow inversion, and radiation during inversion are analyzed. Cherenkov excitation of Langmuir waves by an inverted wave is investigated. It is found that the nature of the singularities occurring during inversion can be investigated analytically. The generation of higher harmonics observed experimentally is probably associated with the intersection of the electron trajectories (inversion). Spectra similar to those obtained by observing the interaction between a reverse electron flow and small-scale perturbations of the ion density. References 17: 1 Russian, 6 Western.
[204-6900/12947]

UDC 533.951

EMISSION OF ELECTROMAGNETIC WAVES BY A MODULATED ELECTRON BEAM IN A RECTANGULAR WAVE GUIDE FILLED WITH A LONGITUDINALLY INHOMOGENEOUS PLASMA

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY MV I SSO SSSR: RADIOFIZIKA in Russian Vol 28, No 3, Mar 85 (manuscript received 28 Feb 84) pp 298-302

LEVITSKIY, S. M. and ANISIMOV, I. A., Kiev State University

[Abstract] The electromagnetic field produced by the interaction of a modulated electron beam with an isotropic longitudinally-inhomogeneous plasma in a rectangular metallic wave guide, in the radiation zone (at distances which are much larger than the characteristic size L of the spatial inhomogeneity of the plasma) was found by an application of Lorentz's lemma. The types of modes emitted were determined by the cut-off condition for wave guides. The radiation was found to be transition radiation whose intensity is proportional to the relative change in the dielectric constant along the path of the emitting charged particle, which is especially large near the plasma resonance. For L = 5 cm, a 10 x 10 cm^2 wave-guide cross section, single-mode emission at $\omega = 2 \cdot 10^{10}$ cm^{-1}, beam current I_0 = 10 mA, an accelerating voltage U_0 - 1 kV, and $v/\omega = 5 \cdot 10^{-3}$, where v is the velocity of the beam, the radiation power is $\simeq$ 10 mW. References 6: 5 Russian, 1 Western.
[400-9638/12947]

UDC 533.951

TRANSIENT CHARACTERISTICS OF RADIATION FROM A MOVING ISOTROPIC PLASMA

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY MV I SSO SSSR: RADIOFIZIKA in Russian Vol 28, No 3, Mar 85 (manuscript received 19 Mar 84) pp 293-297

GAVRILENKO, V. G. and ZAYTSEV, S. I., Gorkiy State University

[Abstract] The saddle-point method was used to derive formulas for the transient and steady-state radiation (electric) fields of a dipole source embedded in a moving, homogeneous, isotropic, cold, collisionless, electron plasma in the absence of an external magnetic field. The source was assumed to be of the form $\vec{j}^{ext} = \vec{P}\delta(\vec{r})U(t)\exp(-i\omega_0 t)$, where U(t) = 0 if $t \leqslant 0$ and 1 if $t > 0$, $\delta(\vec{r})$ is the Dirac delta function and $\vec{P}$ is the dipole moment. Maxwell's equations were solved using the dielectric constant of a moving plasma. The process of formation of a wake by fast and slow space-charge waves excited by the source in the plasma was studied. It was shown that the transient field vanishes as the velocity of the plasma $v \to 0$. Figures 1; references 5: all Russian.
[400-9638/12947]

UDC 533.951.7

SPACE ECHO ON SLOW MAGNETOSONIC MODE

Moscow FIZIKA PLAZMY in Russian Vol 11, No 3, Mar 85
(manuscript received 26 Mar 84 after revision) pp 376-380

S. M. RYEVYENCHUK, Institute of Nuclear Research, Ukrainian SSR Academy of Sciences

[Abstract] The amplitude of a space echo signal in a homogeneous magnetoactive plasma is investigated. It is found that two extrinsic perturbations with frequencies ω_1 and ω_2, localized at respective points z=0 and z=1, excite echo signals in the plasma at the difference frequency as well as the sum frequency in a sequence of points. The maximum amplitude of the echo signals occurring at different points are determined assuming that the frequencies of the extrinsic perturbations and of the echo oscillations lie in the region of frequencies of the slow magnetosonic mode. Comparison of these amplitudes can be helpful for plasma diagnosis. References 10: 3 Russian, 7 Western.
[351-6900/12947]

UDC 533.9.07

PLASMA TRANSFER IN TOKAMAK WITH HIGH LONGITUDINAL PARTICLE VELOCITIES

Moscow FIZIKA PLAZMY in Russian Vol 11, No 3, Mar 85
(manuscript received 26 Feb 84) pp 344-351

V. S. TSYPIN, Sukhumy Physical-Technical Institute imeni I. N. Vekua

[Abstract] The influence of high longitudinal particle velocities and strong radial electrical fields on transfer processes occurring in an axisymmetrical tokamak is studied. The Pfirsh-Schluter mode is investigated. It is demonstrated for the plateau mode that steady-state poloidal plasma rotation velocities comparable with the speed of sound cannot exist. Transfer processes in the banana mode are investigated. The ion heat flux in the Pfirsh-Schluter mode is found to increase with a approximately as a^2, linearly as a in the plateau mode and as the square root of in the banana mode. References 23: 13 Russian, 10 Western.
[351-6900/12947]

UDC 533.951

ENERGY SPECTRA OF ION BEAMS FORMED IN PLASMA FOCUS

Moscow FIZIKA PLAZMY in Russian Vol 11, No 3, Mar 85
(manuscript received 26 Apr 85) pp 281-287

V. I. KRAUZ, R. G. SALUKVADZYE, and E. Yu. KHAUTIYEV, Sukhumy Physical-Technical Institute imeni I. N. Vekua

[Abstract] The KPF-3 plasma focus system (40 kV, 250 kJ) is employed in conjunction with an ion analyzer to record fast ions with good time resolution. The detector employed consists of nuclear photoemulsions, which make it possible to determine the integral picture of the distribution of the ions passing only through the transverse magnetic field, or through the magnetic and electrical fields, with the same energy resolution. The spectra of the ion beams recorded in each discharge exhibit a pronounced discrete spectrum. The energy of different ion beams, and the number of ions, are found analytically to change from discharge to discharge, and there is some replication of beam generation in the corresponding energy ranges. The duration of beam generation is found to be approximately the same in the energy ranges studied, comprising 20-30 nsec at half height. The relationship between ion beams and neutron yield is studied, indicating that the total neutron yield in each discharge is comprised of a "base" portion due to the thermonuclear mechanism, as well as a second part that is associated with the interaction between high-energy ions and the plasma target. References 8: 3 Russian, 5 Western.
[351-6900/12947]

UDC 533.951

ION-SOUND RESPONSE DURING IMPULSE SOUNDING OF PLASMA

Moscow VESTNIK MOSKOVOSKOGO UNIVERSITETA Seriya 3: FIZIKA ASTRONOMIYA in Russian Vol 26, No 1, Jan-Feb 82 (manuscript received 3 Apr 84) pp 79-81

Yu. V. KORPUSOVA, A. A. KUZOVNIKOV, K. G. PUKALOV, V. S. SVIRIDKINA, A. K. SUKHOV, and V. V. TARASOVA, Department of Electronics

[Abstract] The behavior of ion-sound waves excited by a voltage pulse in an argon plasma, and the influence of spatial inhomogeneity of the plasma density on their propagation, were investigated. The plasma created by a positive glow discharge column in a glass tube 60 mm in diameter and 60 cm long was investigated. The ion-sound perturbations were recorded by cylindrical probes that output signals to a dual-trace oscilloscope and a spectrum analyzer. The development and propagation of ion-sound perturbations were observed by changing the distance between the probe and the ring electrode. The measured phase velocities were compared with the figures calculated from the probe measurement data, showing satisfactory agreement. The

amplitude of the oscillations investigated and the wavelength were found to be independent of the amplitude and duration of the applied pulse. The amplitude function of ion-sound perturbations is found to reduce over time at a fixed point in space. References 2: 1 Russian, 1 Western.
[351-6900/12947]

UDC 533.932

RECOMBINING HELIUM-NEON PLASMA

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 55, No 3, Mar 85 (manuscript received 26 Jun 84 after revision) pp 524-532

A. K. BYELYAYEV, Leningrad State Pedagogical Institute imeni A. I. Gertsen

[Abstract] The level populations of helium and neon in a recombining helium-neon plasma are calculated for free electron concentrations of 10^{13}-10^{17} cm^{-3} and electron temperatures of 0.05-0.50 eV with heavy particle concentrations smaller than 10^{18} cm^{-3}. A pure neon plasma is found to be unsuitable as the working substance in a laser. A system of equations is presented for finding the concentrations of the excited levels of the discrete spectrum. The findings are valid for the recombination of a helium-neon plasma, and for the case in which neon atoms in the fundamental state are mixed with a recombining helium plasma. Simple formulas are derived for estimating the level populations. Stable lasing is found to occur on 4s-3p transitions in neon atoms in a recombining helium-neon plasma; the optimum helium and neon ratios are determined. References 18: 13 Russian, 5 Western.
[375-6900/12947]

UDC 533.9:621.378.9

SHIFT IN RECOMBINATION JUMP IN X-RAY SPECTRUM OF LASER TARGETS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 2, Feb 85 (manuscript received 19 Jun 84) pp 444-445

GOROKHOV, A. A., ZAPYSOV, A. L., ZUYEV, A. I., IZRAILEV, I. M., KOMAROV, V. M., KRYUCHENKOV, V. B., LYKOV, V. A., PODGORNOV, V. A. and CHARUKHCHEV, A. V.

[Abstract] The x-ray spectrum of a hot dense plasma obtained by using a high-powered neodymium laser to irradiate glass shell targets is investigated. A significant shift (of approximately 0.1 keV) is detected in the recombination jump that corresponds to electron capture by the hydrogen-like silicon ion. The experimental findings for the most part agree with results of unidimensional numerical analyses of target compression and heating performed under the Zarya program. The development of instabilities during shell compression appears to cause greater inhomogeneity in the density of the shell material than is predicted by unidimensional calculation. References 7: 6 Russian, 1 Western.
[340-6900/12947]

UDC 621.373.826:533.9

LIGHT AMPLIFICATION BY H-ION TRANSITIONS IN LOW-TEMPERATURE PLASMA

Moscow KVANTOVAYA ELEKTRONIKA in Russian, Vol 12, No 2, Feb 85
(manuscript received 11 Mar 84) pp 289-293

BOROVSKIY, A. V., KOROBKIN, V. V. and MUKHTAROV, Ch. K., Institute of General Physics, USSR Academy of Sciences

[Abstract] Amplification by 5 - 4, 4 - 3 and 3 - 2 H-ions in a low-temperature optically thin plasma is investigated. A formula for the gain is derived in the form of a shock-radiation approximation. The plasma parameters are identified for the region in which amplification is sufficiently high, and the degree of plasma imperfection in that region is determined. The analytical approach employed makes it possible to understand the peculiarities of creating inversion in H-ion plasma. The method can be employed to analyze amplification by other ion transitions. References 9: 7 Russian, 2 Western.
[340-6900/12947]

UDC 621.373.826.038.825.3

X-RAY EMISSION FROM NEODYMIUM GLASS LASER PLASMA MIRROR

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84
(manuscript received 11 May 84) pp 2361-2364

KALAL, M., PINA, L. and VRBOVA, M., Polytechnical Institute, Prague, Czechoslovakian SSR

[Abstract] The temporal structures of optical beams incident on a laser target and reflected by the plasma mirror formed near the surface, as well as the X-radiation emitted by the plasma filament, were investigated in order to define the mechanism that determines the reflecting capability of the plasma. The analysis indicates that the mechanism responsible for the reflecting capacity of the plasma mirror is stimulated Brillouin scattering. The nonlinear relationship observed between the light scattered back from the mirror and the intensity of the incident light, the estimated coefficient of reflection of the plasma mirror, and the gain found by measuring the plasma temperature agree completely with the findings of a previous study in which SBS is the primary mechanism underlying light backscattering. References 8: 3 Russian, 5 Western.
[178-6900/12947]

UDC 621.378.325

INFLUENCE OF LASER PULSE SHAPE ON FORMATION OF PLASMA NEAR ABSORBING TARGETS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84
(manuscript received 29 Dec 83) pp 2241-2245

MINKO, L. Ya., CHUMAKOV, A. N. and CHIVEL, Yu. A., Institute of Physics, Belorussian SSR Academy of Sciences

[Abstract] A phenomenological approach is developed to analyzing measurements of plasma formation time for absorbing materials exposed to laser radiation. The action of laser radiation on a number of materials with strongly differing thermophysical parameters is investigated for a wide range of laser radiation power densities. The plasma formation time was measured in the vicinity of aluminum, zinc, bismuth and ebonite targets irradiated at atmospheric pressure by powerful microsecond laser pulses. A formula is derived for estimating the initial plasma formation time as a function of the shape of the leading edge of the laser pulse and the maximum density of the high power laser radiation. The plasma formation time is found to decrease significantly as the wavelength of the laser radiation increases from 1.06 to 10.6 μm, indicating that the laser power density, as well as the plasma formation threshold, depend upon the wavelength of the laser radiation. References 8 Russian.
[178-6900/12947]

SHOCKWAVES IN WEAKLY IONIZED NONISOTHERMIC PLASMA

Leningrad PISMA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 11, No 5, 12 Mar 85 (manuscript received 8 Jan 85) pp 274-278

MISHIN, G. I., Physical-Technical Institute imeni A. F. Ioffe, USSR Academy of Sciences

[Abstract] It is established experimentally that shockwave velocities and pressure gradients at a plasma shockwave front correspond to the effective speed of sound in plasma of 1300 - 1400 m/sec for maximum speed increases, adn 1100 - 1200 m/sec for moderate values. The high effective speed of sound in plasma is interpreted as resulting from a strong mechanism which transforms part of the shockwave energy to the kinetic energy of the neutral particles in front of the shockwave. This energy transfer is suggested to come about as the result of ion-sound waves generated by the shockwave front. The parameters of an argon plasma surrounding a soundwave front are estimated. It is found analytically that the occurrence of a high-temperature precursor accelerates the shockwave in a manner similar to that occurring when a shockwave enters a pre-heated gas. References 6 Russian.
[374-6900/12947]

FINE STRUCTURE OF TOROIDAL PLASMA CONFIGURATIONS

Moscow PISMA V ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian
Vol 40, No 9, 10 Nov 84 (manuscript received 30 Aug 84) pp 372-374

BOGOMOLOV, L. M. and ZAKHAROV, L. Ye., Institute of Atomic Energy imeni I. V. Kurchatov

[Abstract] A sufficient condition is formulated under which a toroidal plasma configuration should spontaneously enter a new near-equilibrium state by virtue of equilibrium conditions alone, with the near-equilibrium state representing a set of magnetic islands. This renders the traditional representation of configuration structure invalid. The sufficient condition is shown to be satisfied for a tokamak in the region $q(p) < 1$. References 2 Russian.
[210-6900/12947]

CREATION AND HEATING OF CURRENTLESS PLASMA BY EXTRAORDINARY WAVE ON L-2 STELLARATOR IN ELECTRON CYCLOTRON RESONANCE MODE

Moscow PISMA V ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian
Vol 40, No 9, 10 Nov 84 (manuscript received 12 Sep 84) pp 377-379

ANDRYUKHINA, E. D., AGAPOV, L. N., BATANOV, G. M., BEREZHETSKIY, M. S., BLOKH, M. A., BOGDANOV, S. D., VORONOV, G. S., GIPPIUS, Ye. F., DONSKAYA, N. P., DYABIRIN, K. S., LARIONOVA, N. F., LITVAK, A. G., KLADOV, S. V., ILYUKHIN, B. I., KURBATOV, V. I., KOVRIZHNYKH, L. M., KOLESNIKOV, V. N., KOLIK, L. V., NOVIKOVA, A. V., PARAMONOV, A. V., POPOV, S. N., SAPOZHNIKOV, A. V., SARKSYAN, K. A., SBITNIKOVA, I. S., SMOLYAKOVA, O. B., SMIRNOVA, A. D., SUBOROV, Ye. V., SUKHODOLSKIY, V. N., MESHCHERYAKOV, A. Ye., PETROV, A. Ye., FEDYANIN, O. I., FRAYMAN, A. A., KHOLNOV, Yu. V. and SHPIGEL, I. S., Institute of General Physics, USSR Academy of Sciences

[Abstract] L-2 stellarator experiments are reported in which a currentless plasma was created in the electron cyclotron resonance mode at the first harmonic of the electron gyrofrequency employing waveguide modes in the presence of a wave with extraordinary polarization. These initial experiments on extraordinary-wave heating of currentless plasma demonstrated good microwave power absorption efficiency (approximately 35 - 45%), making it possible to obtain a plasma with $T_e(0) \simeq 500$ eV, $T_i(0) \simeq 60$ eV for $\bar{n}_e \simeq 4 - 6 \cdot 10^{12}$ cm^{-3}. References 5: 2 Russian, 3 Western.
[210-6900/12947]

UDC 533.9.15:537.52.7

NUMERICAL STUDY OF OPTICAL PLASMOTRON PERFORMANCE

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84
(manuscript received 10 Jan 84) pp 2301-2310

RAYZER, Yu. P. and SURZHIKOV, S. T., Institute of Problems of Mechanics, USSR Academy of Sciences

[Abstract] The equations describing a continuous optical discharge maintained by radiation froma CW laser are integrated numerically with no simplifications regarding the physical properties of the plasma or radiant losses to produce a unidimensional model of the phenomenon. Calculations were performed for argon and for atmospheric air. The composition, electron density and thermodynamic parameters of air are analyzed. The temperature profiles for air and argon are found to be similar, and agree well with experimental findings. The physical principles underlying plasmotron operation are discussed. The influence of radiant heat exchange on the propagation of the optical combustion wave is analyzed. References 16: 15 Russian, 1 Western. [178-6900/12947]

MICROSECOND RELATIVISTIC ELECTRON BEAM OBTAINED IN DUAL-MODULE LC OSCILLATOR

Leningrad PISMA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 11, No 5,
12 Mar 85 (manuscript received 4 Oct 84) pp 267-270

VOROPAYEV, S. G., LEBEDEV, S. V., CHIKUNOV, V. V. and SHEGLOV, M. A., Institute of Nuclear Physics, Siberian Department, USSR Academy of Sciences

[Abstract] Experiments are described in which a second module similar to the primary module of an LC-type pulse voltage generator is connected in parallel to increase the energy content of the generated beam. The modules are connected sectionally by cables so that the switches of the first module serve both and invert the voltage across the capacitors in both modules. The geometry of the magnetic field is arranged so that the line of force touching the electrode passes near the surface of the cathode and enters the aperture of a calorimeter. The total energy released in the diode during a pulse is 135 ± 7 kJ, of which 105 ± 5 kJ reaches the aperture of the calorimeter.

A relativistic electron beam is obtained with current density of up to 200 A/cm^2, electron energy of up to 900 keV, and potential energy exceeding 100 kJ with energy released in the diode of 135 kJ. References 3 Russian. [374-6900/12947]

UDC 621.384.65:621.039.64

CRITERIAL ANALYSIS OF DIRECT-ACTING HIGH-VOLTAGE CHARGED-PARTICLE ACCELERATORS

Kiev TEKHNICHESKAYA ELEKTRODINAMIKA in Russian No 6, Nov-Dec 84 (manuscript received 8 Jun 84) pp 3-8

BELYAYEV, V. K., YEMETS, Yu. P., KHOMINICH, V. I. and SHOSTAK, V. A.

[Abstract] This study employs similarity theory to analyze a system of basic equations describing the propagation of a charged particle beam in an accelerating system under the influence of electrical and magnetic fields. Expressions are derived and analyzed for a number of important similarity criteria that make it possible to model the acceleration processes correctly and to indicate adequate simplified equations for the dynamics of the charged particles and the electromagnetic field. It is found that the intrinsic magnetic field can influence the movement of an uncompensated beam only for relativistic particle velocities. A series of examples is presented. References 4 Russian.
[186-6900/12947]

UDC 621.317.31

MEASUREMENT OF CHARGED-PARTICLE BEAM CURRENT USING GALVANOMAGNETORECOMBINATION ELEMENTS

Moscow RADIOELEKRONIKA USKORITELEY I FIZICHESKOGO EKSPERIMENTA in Russian 1982 (signed to press 6 Jul 82) (manuscript received 1 Apr 82) pp 28-33

BOLOTIN, I. M., LEVITAS, I. S., MAMAYEV, G. L. and MANYUSHITE, V. Yu.

[Abstract] The use of galvanomagnetorecombination (GMR) elements to replace Hall-effect and other sensors to measure the current of charged-particle beams formed by bunches or sequences of relatively short beams of particles is described. In the GMR effect, if a semiconducting specimen with both polarities of charge carriers and an electrical current flowing along as it is placed in a magnetic field, the carrier pairs (electrons and holes) are deflected by the Lorenz effect and accumulate near one of the surfaces perpendicular to the Lorenz force, while the electron-hole pair concentration on the opposite surface becomes smaller. The redistribution of the carriers can change the average concentration over the cross section of the specimen,

with a corresponding change in the conductivity of the latter. GMR elements are semiconducting resistors whose resistance changes in a magnetic field due to the GMR effect. A GMR beam current meter is described that combines galvanomagnetic and induction current meters. This combination expands the frequency bandwidth significantly.
[188-6900/12947]

UDC 621.374.22

MEGAVOLT RECTANGULAR PULSE GENERATOR PRODUCING MICROSECOND STRONG-CURRENT ELECTRON BEAMS

Moscow RADIOELEKRONIKA USKORITELEY I FIZICHESKOGO EKSPERIMENTA in Russian 1982 (signed to press 6 Jul 82) (manuscript received 15 Mar 82) pp 45-52

KAZANSKIY, L. N., KUDRYAVTSEV, A. F., MESHEROV, R. A., RYBALKO, V. S., KAMBULOV, I. N., YAMPOLSKIY, I. R., BOLSHAKOV, Ye. P., ISTOMIN, Yu. A. and LATMANIZOVA, G. M.

[Abstract] This study describes the computer modeling of circuits for producing rectangular pulses with durations of approximately 10 μsec for use in voltage generators. Of the versions investigated, the optimum generator is found to be that employing artificial shaping lines to obtain quasi-rectangular pulses. The stages of the generator consist of identical shaping lines, and the stages are connected in an Arkadyev-Marks arrangement. The analysis indicates that the inductance in the first section of the artificial shaping line should be replaced with a parallel LR compensating circuit, and that the generator should be matched with the load by using shaping line impedance smaller than the reduced load impedance by a factor of 2 or 3. A voltage pulse generator with design parameters of 1.8 MV 10 kA and 10 μsec is described for a strong current accelerator for investigating collective methods for accelerating ions in direct strong current electron beams. The experimental findings agree well with the analytical results. References 8: 6 Russian, 2 Western.
[188-6900/12947]

UDC 621.384.628.18

OSCILLATIONS OF RELATIVISTIC ELECTRON IN CYLINDRICAL HIGH FREQUENCY POTENTIAL WELL

Moscow RADIOELEKRONIKA USKORITELEY I FIZICHESKOGO EKSPERIMENTA in Russian 1982 (signed to press 6 Jul 82) (manuscript received 7 Sep 81) pp 92-100

DZERGACH, A. I. and KUZMIN, V. V.

[Abstract] The properties of potential wells of charged particles in microwave electromagnetic fields for the collective acceleration of ions by

electron beams is investigated. Nonlinear effects are found to be associated with the influence of y- and z-oscillations coupling through a high frequency magnetic field. The relativistic motion equations for charged particles are solved by computer, revealing the existence of stable oscillations lasting for 20 - 200 HF periods in the region of the parameters of stable decoupled oscillations. This finding makes it possible to reduce the amount of computation required to determine the structure of the U region. References 13 Russian.
[188-6900/12947]

UDC 621.384.6
681.511.2

TRANSIENTS IN NETWORK FOR DIRECT COMPENSATION OF CHARGED PARTICLE ORBIT IN RING ACCELERATOR

Moscow RADIOELEKRONIKA USKORITELEY I FIZICHESKOGO EKSPERIMENTA in Russian 1982 (signed to press 6 Jul 82) (manuscript received 2 Dec 81) pp 119-131

DZERGACH, A. I., DOBROKHOTOV, S. Yu. and ZLOTNIK, A. A.

[Abstract] This study investigates the stability and transient conditions in a circuit containing a chain of measurement device-compensator sections for compensating orbital deviations of charged particles in accelerators and accumulators. The arrangement employs no computer; the measuring devices and correctors are connected in pairs and placed uniformly along the ring. The circuit is shown capable of correcting a distorted orbit rapidly (approximately within the time constant of the compensating magnet), and maintaining the compensated orbit for periods or the order of several seconds. This analytical method is also suitable for circuits in which each compensator is controlled by signals from several measuring devices. References 13: 10 Russian, 3 Western.
[188-6900/12947]

UDC 538.561

NONLINEAR THEORY OF INDUCED CYCLOTRON AND SYNCHROTRON RADIATION OF RELATIVISTIC ELECTRON BEAMS AT HARMONICS OF GYRO FREQUENCY

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 55, No 3, Mar 85 (manuscript received 6 Jun 84) pp 479-487

V. L. BRATMAN, N. S. GINZBURG, and A. S. SYERGYEYEV, Institute of Applied Physics, USSR Academy of Sciences

[Abstract] This study addresses the possibilities of operating cyclotron autoresonance masers at gyro frequency harmonics and the prospects of synchrotron maser-generators. Narrowband versions of devices are considered,

in which the electrons perform numerous cyclotron rotations in the interaction space, and the cyclotron resonance condition is satisfied only at one harmonic of the gyro frequency. A model and equations for particle movement are derived. The efficiency of energy exchange between the electron beam and wave is assessed. Induced dipole radiation in near-autoresonant modes is investigated. Constraints on the spread of the parameters of the helical electron beam are identified that must be satisfied to achieve induced synchrotron radiation at high harmonics. References 18: 17 Russian, 1 Western.
[365-6900/12947]

UDC 621.3.017.71:621.373.826

CHARACTERISTICS OF THERMAL FIELD OCCURRING DURING LASER HEATING OF METALS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 11, Nov 84
(manuscript received 25 Jan 74) pp 2331-2335

KIRICHENKO, N. A. and MOROZOV, Yu. Yu., Institute of General Physics, USSR Academy of Sciences

[Abstract] This study analyzes the stability of the thermal field occurring during laser heating of a massive metal specimen in an oxidizing medium (air), and investigates behavior of the stability boundary for different external conditions. A system of three equations is derived that defines the surface which divides the entire parameter space into regions with different numbers of steady-state solutions of the slot boundary problem. The stability boundary is calculated for several values of the heat loss parameter, and the behavior of the temperature along the stability boundary is examined. The boundary problem is characterized by the intensity of radius of the radiation beam, in addition to the heat loss factor. References 5 Russian.
[178-6900/12947]

UDC 533.72

KINETIC COOLING IN BINARY MIXTURES OF MOLECULAR GASES DURING TWO-QUANTUM EXCHANGE OF OSCILLATING ENERGY

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA: SERIYA 3 FIZIKA, ASTRONOMIYA in Russian Vol 25, No 6, Nov-Dec 84 (manuscript received 13 Jan 84) pp 44-47

DZHURABEKOV, U. S. and OSIPOV, A. I., Department of Molecular Physics

[Abstract] The effect of kinetic cooling in a binary mixture of molecular gases is analyzed assuming two-quantum exchange of oscillation energy between the components, where two quanta of one molecule become one quanta of another (2V-V'-exchange). Formulas are derived for finding the two-quantum exchange time from kinetic cooling data. Kinetic cooling in a CH_4 -O_2 mixture is analyzed. It is found that the kinetic cooling effect caused by two-quantum oscillation exchange is experimentally observable. References 4: 2 Russian, 2 Western.
[183-6900/12947]

UDC 621.373.826.038.825.4

THEORY OF GENERATION OF PICOSECOND PULSES BY EXTERNAL-CAVITY MODE-LOCKED INJECTION LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian, Vol 12, No 2, Feb 85
(manuscript received 23 Apr 84) pp 331-338

VASILYEV, P. P. and MOROZOV, V. N., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] The generation of a continuous sequence of picosecond pulses by an hf resonant pumped external-cavity injection laser is investigated theoretically. A traveling-wave laser with a ring cavity is examined in which a pulse with a specified shape is assumed to propagate in the cavity. The variation in the pulse parameters as it passes through the elements of the cavity is determined, assuming a two-component active medium with a weak non-linear absorption. An iterative scheme for calculating the steady-state pulse parameters is presented, in which each iteration corresponds to one complete trip of the pulse through the cavity. A theory that describes pulse duration shorter than 3 psec (with 0.56 psec obtained experimentally) must take into account multiple passes of the pulse within the active medium itself, as well as interaction of the pulse with the reflected wave.
References 17: 5 Russian, 12 Western.
[340-6900/12947]

UDC 518.9

SIMULTANEOUS SEARCH GAME AND RANDOM DISTRIBUTION OF POINTS ON PLANE

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA: MATEMATIKA, MEKHANIKA, ASTRONOMIYA in Russian No 1, Jan-Mar 85 (manuscript received 21 Jun 84) pp 31-35

L. A. PETROSYAN

[Abstract] A convex closed bounded set S is assigned on a plane. The hider selects a system of k different points $x_1 \ldots x_k$ belonging to S, and the seeker selects a system of s points $y_1 \ldots y_s$ belonging to S. The choices are simultaneous and independent of one another. A point x_{i0}, $i0 \in 1,\ldots,k$ is considered to have been found by the seeker if a $j_0 \in \{1,\ldots,s\}$ is found such that $\{(x_i, y_j)\} < L/2$ $(L>0)$, i.e. if the open circle with center at x_i and radius $L/2$ contains at least one of the points y_j. The goal of the hider is to minimize the total number of detected points, while that of the seeker is the opposite. The seeker's score is the number of detected points. A new solution to the problem is proposed on the basis of mixed strategies for the hider and the seeker; estimates of the outcome using the strategies are given. References 3: 3 Russian.
[305-6900/12947]

UDC 519.676

GENERAL NONASYMPTOTIC ESTIMATES OF THE RATE OF CONVERGENCE OF ITERATIVE STOCHASTIC ALGORITHMS

Moscow ZHURNAL VYCHISLITELNOY MATEMATIKI I MATEMATICHESKOY FIZIKI in Russian
Vol 25, No 3, Mar 85 (manuscript received 6 May 83; revised 2 Sep 83)
pp 344-355

ALBER, Ya. I. and SHILMAN, S. V., Gorkiy

[Abstract] The convergence of iterative stochastic algorithms of the following form as studied:

$$x_{n+1} = \Pi_G[x_n - a_n s_n(x_n)], \quad n = 1, 2, 3, \ldots,$$

where x_n is a vector in R^m, $s_n(x_n)$ is a vector of random observations at the n-th iteration at the point x_n, $a_n \geqslant 0$ is the step parameter, and Π_G is a projection operator onto a closed convex set $G \in R^m$. Such algorithms are widely used to solve diverse probabilistic problems, in particular, the minimization of functions in the presence of random errors. Previous work on obtaining analytic estimates of the indicators indicating the accuracy of the iterative process for a_n of the form an^{-1} and $n > 0$ was extended to arbitrary forms of a_n. The rate of convergence of the quantity $\lambda_n = M[V(x_n)]$ to zero, where M is the mathematical expectation operator and V is the Lyapunov function of the form $\rho^2(x, X^*)$, i.e. the square of the distance of the point x from the set X^* of all solutions, was studied and theorems on the upper limit of λ_n were proved. References 10: all Russian.
[391-9638]

UDC 519.85

OPTIMAL METHODS OF SMOOTH CONVEX MINIMIZATION

Moscow ZHURNAL VYCHISLITELNOY MATEMATIKI I MATEMATICHESKOY FIZIKI in Russian Vol 25, No 3, Mar 85 (manuscript received 10 Jun 83; revised 29 Dec 83) pp 356-369

NEMIROVSKIY, A. S. and NESTEROV, Yu. Ye., Moscow

[Abstract] Iterative methods for solving problems of the form $\min\{f(x) \mid x \in Q\}$, where Q is a closed convex set in a Banach space, and problems of the form $\min\{f(x) = F(f(x)) \mid x \in Q\}$, where Q is a convex closed subset of a Hilbert space $(E, \|\cdot\|)$, $F(u): R^m \to R^1$ is a convex function and $f(x) = (f_1(x), \ldots, f_m(x))$ is a set of convex functions belonging to the class $C^{1,1}(E)$, are constructed. Error estimates are obtained and it is shown that the rates of convergence cannot be improved significantly. References 4: all Russian.
[391-9638/12947]

UDC 539.14+539.142

RESTRICTED-DYNAMICS HAMILTONIANS AND THEIR MATRIX REPRESENTATION IN THREE-PARTICLE SYSTEMS

Vilnius LITOVSKIY FIZICHESKIY SBORNIK in Russian Vol 25, No 1, Jan-Feb 85 (manuscript received 19 Apr 84) pp 3-13

VANAGAS, V. V. and KATKYAVICHUS, O. D., Institute of Physics, Lithuanian SSR Academy of Sciences

[Abstract] Using the isospin formalism and a supermultiplet representation of operators, formulas are derived for the matrix representation of the following three-body Hamiltonians for systems with two different types of particles in terms of the three-body basis functions: 1) the exact Hamiltonian H; 2) the restricted-dynamics Hamiltonian H_0; and, 3) the collective part of H_0. The genealogical expansion of the three-body orbital functions is derived and formulas for the Clebsch-Gordon coefficients are given. The formulas derived are useful for comparing calculations performed with exact and restricted-dynamics Hamiltonians. References 18: 9 Russian, 9 Western.
[390-9638/12947]

UDC 681.513.3

CONVERGENCE OF A MATRIX STOCHASTIC ALGORITHM FOR CONTROL OF A STATIC OBJECT WITH CONTROL CONSTRAINTS

Kiev AVTOMATIKA in Russian No 2, Mar-Apr 85 (manuscript received 20 Dec 84) pp 43-51

BORISENKO, A. I., ZELYK, Ya. I., Kuntsevich, V. M., and LYCHAK, M. M., Scientific-Technical Branch of the Institute of Cybernetics imeni V. M. Glushkov, Ukrainian SSR Academy of Sciences

[Abstract] Control problems of the following form were studied:

$$Y = A_1 X A_2 + \eta$$

where X and Y are n x n complex-valued matrices of the input and output signals, A_1 and A_2 are given n x n complex-valued matrices of coefficients, and η is an n x n complex-valued matrix of the noise at the output with zero mean and bounded variance. The problem was recast as a minimization problem as follows: find a matrix X in a bounded closed convex subset Ω of the set of all complex-valued square matrices that for given output values Y minimizes the functional $J(X) = \|A_1 X A_2 - Y\|^2$. An iterative stochastic matrix gradient method was formulated to solve this variational problem and a convergence theorem was proved. The same gradient procedure was also studied with constraints and a convergence theorem was proved for this case also. References 9: all Russian.
[392-9638/12947]

UDC 681.513.5

STRUCTURAL PARAMETRIC OPTIMIZATION OF DISCONTINUOUS DYNAMIC SYSTEMS

Kiev AVTOMATIKA in Russian No 2, Mar-Apr 85 (manuscript received 22 Nov 82) pp 37-42

GARASHCHENKO, F. G., Kiev State University

[Abstract] Algorithms were constructed for calculating the derivatives of a functional with respect to the control parameters of a structurally variable system. These algorithms are useful for design optimization in accelerator technology. Systems described by the following system of differential equations were considered:

$$\frac{d\vec{x}}{dt} = \vec{f}^{(i)}(\vec{x}, t, \vec{\alpha}), \quad t_{i-1} < t < t_i, \quad i = 1, 2, \ldots, N + 1$$

with fixed initial conditions $\vec{x}(t_0) = \vec{x}(t_0 + 0) = \vec{x}_0$, where $\vec{f}^{(i)}$ are n-dimensional vector functions which together with their partial derivatives with respect to $\vec{x}$, t, $\vec{\alpha}$, and t_i are continuous. Here t_i are the points at which the structure of the system changes ($t_{N+1} = T$) and the trajectories $x(t)$ have jumps

$$\vec{x}(t_i + 0) = \Phi_i(\vec{x}(t_i - 0), t_i, \alpha), \quad i = 1, 2, \ldots, N$$

$\vec{\alpha}$ is an r-dimensional vector of the control parameters. For such systems, methods were constructed for calculating the partial derivatives $\partial\Phi/\partial\alpha_i$ and $\partial\Phi/\partial t_i$ of a functional $\Phi(\vec{x}(T))$ which is to be minimized with respect to the parameters $\vec{\alpha}$. The methods developed were applied to the solution of optimization problems for a charged-particle beam in a linear, resonance, ion accelerator with drift tubes using iterative gradient descent. References 11: all Russian.
[392-9638/12947]

UDC 517.9

RESONANT STATES FOR SCHRODINGER EQUATION WITH ZERO-RADIUS POTENTIALS

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA: MATEMATIKA, MEKHANIKA, ASTRONOMIYA in Russian No 1, Jan-Mar 85 (manuscript received 28 Dec 82) pp 35-39

I. Yu. POPOV

[Abstract] The operator expansion method is used to construct an S-matrix for the problem of scattering by n zero-radius potentials. Exponential growth of the matrix is studied, providing useful results for studying S-matrix factorization. The resonances, i.e., zeros, of the S-matrix are studied within the framework of the Lax-Phillips approach. The resonances are found to be arranged serially; the asymptote of the direction vectors is examined for each of the series for the case of two and three potentials. References 4: 3 Russian, 1 Western.
[305-6900/12947]

UDC 519.676

CONVERSION OF RANDOM BITS TO RANDOM QUANTITIES WITH ARBITRARY DISCRETE DISTRIBUTIONS

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA MATEMATIKA, MEKHANIKA, ASTRONOMIYA in Russian No 1, 1985 (manuscript received 4 Feb 82) pp 39-43

B. B. POKHODYEY

[Abstract] This study examines the concept of the optimality of arbitrary discrete distribution algorithms "in the strongest sense" and its correlaries, infinitely-complex optimal arbitrary discrete distribution algorithms, the fundamentality of entropy as the lower bound for the complexity of arbitrary discrete representation algorithms, and the procedure for "refining" arbitrary discrete distribution trees. An algorithm is constructed for modeling an arbitrary discrete distribution that is optimal "in the strongest sense." It is shown constructively that an arbitrary discrete distribution algorithm exists that is optimal in the strongest sense for any arbitrary (infinite in the general case) discrete distribution. References: 4 Russian.
[305-6900/12947]

UDC 621.391:519.217

OPTIMAL ESTIMATION OF STATE OF DYNAMIC SYSTEMS: ALGORITHMS FOR DETECTING ABRUPT PARAMETER CHANGES

Gorky IZVESTIYA VYSSKIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28, No 2, Feb 85 (manuscript received 14 Mar 84 after revision) pp 184-194

A. A. MALTSYEV and A. M. SILAYEV, Gorkiy State University

[Abstract] An optimal system is synthesized for estimating the state of dynamic systems and detecting possible abrupt changes in their parameters. The synthesis assumes that the moments of occurrence of the changes are distributed arbitrarily. Optimal estimation and detection of abrupt changes in discrete and continuous time is analyzed. Equations for optimal estimation algorithms are obtained that are suitable for dynamic systems in which several abrupt changes in parameters are interrelated, or changes with aftereffects occur. References 9: 7 Russian, 2 Western.
[359-6900/12947]

UDC 530.145

INVERSE SCATTERING PROBLEM FOR MAGNETIC FIELD IN GLAUBER'S APPROXIMATION

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 55, No 3, Mar 85 (manuscript received 23 May 84 after revision) pp 468-474

I. V. BOGDANOV, Leningrad Institute of Precision Mechanics and Optics

[Abstract] A method is developed for recovering an axisymmetrical magnetic field from the angular behavior of the scattering amplitude with fixed energy in Glauber's approximation. The scattering of a quantum nonrelativistic spinless charged particle in an axisymmetrical magnetic field directed along the z axis is analyzed. A quadrature solution is found in the form of an explicit conjugation algorithm that recovers the vector potential from the angular behavior of the scattering amplitude. Integral and differential equations are derived for the eiconal amplitude. The relationship between the eiconal method and the classical and Born methods is explained. Three-dimensional (non-central) eiconal inverse problems for electrical and magnetic fields are discussed. References 24: 18 Russian, 6 Western.
[365-6900/12947]

UDC 681.3.06

ROTATION-INVARIANT INDENTIFICATION ALGORITHMS FOR FRAGMENTS OF TWO IMAGES

Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 84 (manuscript received 9 Feb 84) pp 61-64

YEFIMOV, V. M. and REZNIK, A. L.

[Abstract] A method and algorithm are described for bridging two images of the same object that differ from one another due to noise, offset and relative rotation. Each of the images is viewed as a function in two variables and is replaced with a rotation-invariant expansion based on a specially selected function. The main purpose of the algorithms is to 'thin out' the search field and obtain an estimate of the angle of rotation for subsequent detailed analysis by correlation of isolated axes of the image; even so, the identification in the experiment was accurate enough in some cases to require no subsequent detailed analysis. While retaining all of the advantages of the correlation method, the proposed method reduces the amount of calculation required by eliminating the need to examine image rotation.
[208-6900/12947]

UDC 621.391.681.3.01

ALGORITHMS FOR CORRECTING AMPLITUDE DISTORTIONS IN SERIES OF IMAGES

Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 84 (manuscript received 12 Jan 84) pp 64-68

KIRICHUK, V. S. and PUSTOVSKIKH, A. I.

[Abstract] A number of heuristic algorithms for correcting amplitude distortions in images are examined. It is shown that a two-dimensional histogram G_{ij} is a sufficient statistic for the amplitude transformation function (where an element g_{ij} is the number of points at which the signal amplitude has a value of i in one image and j in the other). Formulation of the problem in terms of a two-dimensional histogram generally makes it possible to translate a numerical solution to an array of smaller dimensions (from a coordinate plan to an amplitude plane), which reduces the amount of machine time required. A modified procedure is described in which the maximum correlation of the levels of clipped images is sought, instead of the overall maximum correlation; the use of this algorithm is illustrated by an example. References 2 Russian.
[208-6900/12947]

UDC 621.391

ITERATIVE IMAGE RECOVERY ALGORITHM WITH VARIABLE ESTIMATE CORRIDOR WIDTH

Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 84
(manuscript received 26 Mar 84) pp 87-92

MARTIROSYAN, V. R.

[Abstract] This study describes a modification to the Jansson-Van Sittert iterative image recovery algorithm and proposes new versions of the modification: one employing a fixed 'corridor' of possible estimate values centered on the curve of the observed data, and the other with a variable estimate corridor. The Jansson-Van Sittert, fixed-corridor and variable-corridor methods are compared for the same object, point scattering function and noise (with a relaxation coefficient of unity). Little spread is found among the algorithms. Janssons algorithm requires more iterations, but provides better recovery quality. Van Sittert's algorithm has poor noise tolerance. The fixed and variable estimate corridor methods provide average recovery quality with an optimum number of iterations; however, they provide the best values of δ_5 (increase in error five iterations after optimum), with the variable-corridor algorithm having the highest value. The variable-corridor method is found to be competitive with other similar methods, and can be used to recover unidimensional signals as well as images. References 6: 3 Russian, 3 Western.
[208-6900/12947]

UDC 538.56

BAYESIAN ESTIMATION OF PROBABILITY DISTRIBUTION FUNCTION

Gorky IZVESTIYA VYSSKIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28, No 2, Feb 85 (manuscript received 20 Dec 83) pp 249-251

V. I. TIKHONOV and A. I. FYEDOROV

[Abstract] This study describes the Bayesian approach to estimating the unknown probability distribution function of a random quantity using an independent sample of finite size. In contrast to the traditional method, the Bayesian approach makes allowance for a priori information about the nature of the random quantity in question, and makes it possible to determine the sample size needed to obtain an estimate with the required variance. The Bayesian approach is found to be inadvisable for small samples because of the large variance. References 7: 6 Russian, 1 Western. [359-6900/12947]

UDC 519.248

INVESTIGATION OF STRUCTURAL RELIABILITY OF COMPLEX RECOVERABLE SYSTEMS

Yerevan DOKLADY AKADEMII NAUK ARMYANSKOY SSR in Russian Vol 79, No 4, Jul-Aug 84, pp 173-176

GASPARYAN, Yu. M. and TSATURYAN, G. Zh., Erevan Polytechnical Institute imeni K. Marx

[Abstract] The possibility of using a logical probablistic approach is studied for investigating the reliability of complex recoverable systems. The systems are modeled by semi-Markov processes. Formulas are derived in closed form for the steady-state characteristics of system reliability expressed through the given initial characteristics of the elements. The serviceability function of the system and the activity ('weight') of the system elements are obtained. The formulas can be used to solve the problem of optimum redundancy and distribution of the required reliability level among the elements for complex recoverable systems. The relationship between the basic steady-state reliability indicators and the activities of

the elements make possible a structural analysis of the reliability of complex recoverable systems, making it possible to identify 'role' or 'weight' of individual elements in the overall operating reliability of the system. References 8 Russian.
[376-6900/12947]

UDC 681.513

ANALYSIS OF THE TRAJECTORY SENSITIVITY OF ADAPTIVE STOCHASTIC CONTROL SYSTEMS

Kiev AVTOMATIKA in Russian No 2, Mar-Apr 85
(manuscript received 7 Nov 84) pp 51-59

PETROV, A. I., ZUBOV, A. G., and MININ, V. V., Moscow Aviation Institute

[Abstract] Methods for studying the sensitivity of the trajectories of adaptive stochastic control systems, described by symmetric linear stochastic differential matrix equations with additive Guassian noise and coefficients which are analytic functions of the time and of the Gaussian noise vector, to parametric and coordinate perturbations were constructed and applied to the study of adaptive systems with a stochastic standard model and with identifiers and to model-following systems and traditional linear systems with feedback. It was shown that in both insensitivity-optimal adaptive systems and model-following systems the use of a stochastic standard model makes it possible to decrease the effect of uncontrollable perturbations, which result is linked to the inherently closed nature of the adaptation processes in these systems.
References 15: 13 Russian, 2 Western.
[392-9638/12947]

CSO: 1862/000

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