JPRS-UPM-86-007

23 MAY 1986

USSR Report

PHYSICS AND MATHEMATICS

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service (NTIS), Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semimonthly by the NTIS, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

JPRS-UPM-86-007

23 MAY 1986

USSR REPORT

PHYSICS AND MATHEMATICS

CONTENTS

HIGH-TEMPERATURE PHYSICS

LASERS

NUCLEAR PHYSICS

OPTICS AND SPECTROSCOPY

THEORETICAL PHYSICS

ACOUSTICS

UDC 534.26

RESONANT REFLECTION OF SOUND FROM LAYER WITH IRREGULAR BOUNDARIES

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 31, No 3, May-Jun 85
(manuscript received 18 Sep 83) pp 399-401

LAPIN, A.D., Acoustics Institute imeni N.N. Andreyev, USSR Academy of Sciences

[Abstract] Scattering of a plane harmonic wave from small periodic irregularities on the boundaries of homogeneous liquid half-spaces with waveguide acoustic propagation occurring in the layer is examined. It is found that the effective coefficients of reflection and transparency for a layer with irregular boundaries during resonance differ from the corresponding coefficients of reflection and transparency for a layer with flat boundaries. The amplitudes are investigated as a function of the period of irregularities. It is found that, during resonance, the incident wave is completely reflected from a layer with periodic irregularities on its boundaries. References 2 (Russian).
[476-6900]

USEFUL FLICKERING OF COLD FIRE

Kiev TASS in Russian 9 Aug 85

[Text] Soviet scientists have discovered a unique physical phenomenon - acoustoluminescence of crystals. In science this is a radically new method of studying substances; in practice it is a way to streamline technological processes of creating high-quality semiconductor instruments.

It is known that many crystals shine if electric current is applied to them, if they are irradiated by X-rays, heated or, finally, simply strongly compressed. These types of luminescence, a TASS correspondent was told in the Kiev State University, obey a common rule - the energy exciting the crystal must be greater than the energy of the light emanating from it. But it turns out that the crystal's radiance can also be caused by high-frequency ultrasound. Here the phonon energy - the "portions" of acoustic vibrations - is immeasurably less than the light quantum. However, this does not contradict the law of preservation of energy. Calculations and experiments have shown: ultrasound does not impart its energy to the whole of the crystal, but only to small parts, in which there are defects, for example atoms which have been dislodged from the crystal lattice.

In this way ultrasound luminescence is fundamentally different from its other forms both in the way in which the energy is applied to the material, as well as in the physics of the process itself.

Now physicists are thinking about making practical use of acoustoluminescence. It will make it possible to use crystals that are "no good" for semiconductor elements. Since it is precisely these that shine better than the good ones, why not turn them into light sources? Finally, if it is possible to create on the basis of ultrasound luminescence original kinescopes which expend little energy, a pencil of ultrasound will "run" in such kinescopes, drawing the necessary picture, instead of an electron beam passing along the screen.

/13046/476

UDC 621.373.826.038.825.4

SINGLE CRYSTALS OF $ZnSe_{1-x}Te_x$, $Zn_{1-x}Cd_xSe$, $Zn_xCd_{1-x}S$ SOLID SOLUTIONS FOR LASERS WITH ELECTRON-BEAM PUMPING

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 5, May 85 (manuscript received 18 Jul 84, after completion 21 Nov 84) pp 1113-1115

AKHEKYAN, A.M., KOZLOVSKIY, V.I., KOROSTELIN, Yu.V., NASIBOV, A.S., POPOV, Yu.M. and SHAPKIN, P.V., Institute of Physics imeni P.N. Lebedev, USSR Academy of Sciences, Moscow

[Abstract] Blue lasers are now produced with ZnSe single crystals (450 nm wavelength) grown from the vapor phase, or epitaxially from organo-element compounds, or from the melt after additional high-temperature annealing in liquid zinc. Increasing the laser power above 3 W, with liquid-nitrogen cooling, to match the eye sensitivity at this wavelength requires larger single crystals and better electron-beam scanning. As a practical alternative, shifting the radiation wavelength into the 470-480 nm band, where the eye sensitivity is much better, has been considered. Raising the temperature of a ZnSe single crystal to room level will, however, either lower its emission power or shorten its life. Another solution to the problem is sought in replacement of ZnSe with ternary compounds $ZnSe_{1-x}Te_x$, $Zn_{1-x}Cd_xSe$, $Zn_xCd_{1-x}S$ or certain quaternary ones. Single crystals of those ternary compounds ($ZnSe_{1-x}Te_x$ with $x \leq 0.03$, $Zn_{1-x}Cd_xSe$ with $x \leq 0.15$, $Zn_xCd_{1-x}S$ with $x \leq 0.35$) were successfully grown from the gaseous phase on seeding substrates in a sealed crucible inside an electric resistance furnace, ingots 30-50 mm in diameter and up to 50 mm high after 80 hours of pulling. Their cathodoluminescence spectra were measured and compared with those of ZnSe single crystals, all specimens being cooled with liquid nitrogen while being pumped with 50 keV electrons at current densities from 10^{-5} to 200 A/cm^2. Specimens of each kind were used as active laser medium, with a resonator formed by a 40 μm thick semiconductor wafer with an opaque coating (92% reflection) facing the electron beam for longitudinal pumping on one side and an semitransparent 6-layer interference coating (93% reflection) on the opposite side. A comparative evaluation of their performance characteristics indicates that the $ZnSe_{1-x}Te_x$ group is unsuitable, because the emission line shifts fast toward shorter wavelengths while the longer-wave radiation saturates fast, hypothetically owing to formation of a deep level above the valence band. It also indicates that the performance of the $Zn_{1-x}Cd_xSe$ group will not be significantly improved by increasing x, but hopefully by high-temperature annealing. Figures 1; tables 1; references 11: 9 Russian, 2 Western.
[504-2415]

UDC 666.11.01:537.635

INFLUENCE OF FOUNDING CONDITIONS ON PROPERTIES OF RADIATION COLOR CENTERS IN LANTHANUM PHOSPHATE GLASSES

Leningrad FIZIKA I KHIMIYA STEKLA in Russian Vol 11, No 2, Mar-Apr 85 (manuscript received 23 June 83) pp 181-187

KARAPETYAN, G.O., RUSAN, V.V. and YASHCHURZHINSKAYA, O.A., Leningrad Polytechnical Institute imeni M.I. Kalinin, State Optics Institute imeni S.I. Vavilov

[Abstract] The influence of ionizing radiation on the radiation processes occurring in phosphate glasses is investigated. The radiation yield is estimated comparatively for radiation color centers of different types, and their behavior during thermal decoloration is investigated. Electron paramagnetic resonance analysis, and analysis of the optical spectra of gamma-irradiated lanthanum phosphates glasses synthesized under various conditions, indicates that the conditions under which the glass is synthesized have a strong influence on the radiation yield of the color centers, as well as the behavior of their absorption intensity during the coloration. The findings are explained for trigonal centers by the existence of two types of defects in nonirradiated glass that differ in the valent state of the phosphorus, as well as the assumption that the phosphorus is capable under these conditions of being recovered to the atomary state. Figures 5; references 17: 14 Russian, 3 Western.
[461-6900]

UDC 666.266:535.361

INTERRELATION BETWEEN LIGHT SCATTERING IN HETEROGENEOUS PHOTOCHROMIC GLASSES AND OPTICAL CHARACTERISTICS AND DIMENSIONS OF LIGHT-SENSITIVE MICROCRYSTALS IN VARIOUS MATRICES

Leningrad FIZIKA I KHIMIYA STEKLA in Russian Vol 11, No 2, Mar-Apr 85 (manuscript received 13 July 84) pp 247-248

DOTSENKO, A.V. and TSEKHOMSKIY, V.A.

[Abstract] The subject interaction is investigated on the basis of a monodisperse system of particles that create optical density in the glass matrix which is made up of two terms: the first determined by light absorption by the particles, and the second by light scattering. The size of particles that can be realized in photochromic glass so that the optical density at a specified wavelength does not exceed that assigned by the operating requirements of the glass in question is investigated. The analysis indicates that the photochromic properties depend strongly upon the size of the light-sensitive inclusions, indicating that highly refractive glasses are promising matrices for obtaining photochromic materials with a wide range of photochromic properties. Figures 1; references 2 (Russian).
[461-6900]

UDC 621.373.826

EFFICIENT NONLINEAR OPTICAL CONVERTERS USING $KTiOPO_4$ CRYSTALS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 7, Jul 85 (manuscript received 26 Feb 85) pp 1333-1334

ALEKSANDROVSKIY, A.L., AKHMANOV, S.A., DYAKOV, V.A., ZHELUDEV, N.I. and PRYALKIN, V.I., Moscow State University imeni M.V. Lomonosov

[Abstract] High-quality KTP single crystals have been produced by crystallization from solution in a melt, with KPO_3 and excess K_2O as solvent. The crystals have flat <100>, <110>, <011>, <201> facets corresponding to rhombic syngonality, with a $Pn\alpha 2_1$ space group. Their size is 9x12x15 mm^3 and their lattice parameters are α = 1.282 nm, b = 0.64 nm, c = 1.059 nm. They are transparent to radiation over the entire 0.35-4.5 μm region of the spectrum and, unlike crystals grown by the hydrothermal method, have no absorption band around the 2.8 μm wavelength. These crystals were used for doubling the frequency of picosecond pulses from a YAG:Nd^{3+} laser with forced mode locking. With the laser emitting radiation pulses of 70 ps duration and 400 kW power at the 1.064 μm wavelength, its average output power being 0.8 W, a 52% efficiency of conversion to the second harmonic was attained by interaction of the second kind. Figures 2; references 8: 1 Russian, 7 Western.
[582-2415]

UDC 548.0:535

SPECTRAL CHARACTERISTICS, CONVERSION, AND NONLINEAR ABSORPTION OF COLOR CENTERS IN RbI-BASED CRYSTALS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 59, No 1, Jul 85 (manuscript received 6 Aug 84) pp 76-80

POPOVA, M.G., MAKUSHEV, K.A., BRYUKVIN, V.V., PENZINA, E.E. and SOBOLEV, L.M.

[Abstract] Absorption and luminescence spectra of color centers in crystals of RbI and other halides of alkali metals were studied for confirmation of the Maulvot-Ivey rule relating a shift of the peak in the absorption band toward longer waves with an increase of the lattice constant and for application of such crystals as passive laser shutters. Specimens of RbI+ 0.1 wt.% Ba crystals were grown by the Czochralski method. Color centers were produced by heating them in vapor of the alkali metal to temperatures near the melting point of RbI. Optical absorption over the 0.35-2 μm spectrum was measured at 77 K with an MPS-50L spectrometer. Luminescence over the 1-3 μm spectrum was recorded at temperatures ranging from 77 to 300 K with an FSV-19AA photoresistor. The readings indicate the presence of Z_2 and Z_4 centers. Additive coloration of these crystals, as well as of

crystals of other alkali halides, was found to facilitate diffusion of molecules or ions adsorbed at the crystal surface during storage and their interaction with color centers. The mechanism of this process is not yet understood, neither are the nature of diffusing molecules and the end products of their interaction with color centers. Crystals of RbI-Ba with Z_2 centers were experimentally used for Q-switching the resonator of a YAG:Nd^{3+} laser operating at the 1.06 μm wavelength, that resonator having been formed by two plane mirrors with 40% reflection and 100% reflection, respectively. With an initial 50% transmission, 0.1 cm thick crystal plates with 1x1 cm^2 cross-section extracted up to 10^4 giant laser radiation pulses of up to 20 ns duration at a repetition rate of 25 Hz, but with an attendant degrading of the shutter characteristics in the process. Figures 3; references 9 (Russian).
[573-2415]

UDC 535.37

AGGREGATE CENTERS IN CORUNDUM

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 43, No 1, Jul 85 (manuscript received 9 Feb 84) pp 132-138

GULCHUK, P.F., LITVINOV, L.A., PETRENKO, P.V. and CHERNINA, E.A.

[Abstract] The authors have discovered luminescence of nonirradiated corundum (not ruby) within the 510-595 nm region of the spectrum. A subsequent study of nominally pure corundum (leucosapphire) single crystals and of those with up to 10^{-3} wt.% Fe, Si, Mg, Ca impurities but not more than 10^{-4} wt.% other impurities has yielded their luminescence spectra with characteristic peaks corresponding to aggregate color centers of variously charged adjacent anion and cation vacancies. Only crystals grown by the Kiropulos method (under vacuum) or by the Stepanov method (in inert atmosphere) were luminescent without irradiation, most intensely when grown in graphite crucibles from a supercooled melt; crystals grown by the Verneuil method became luminescent only after bombardment by 30 MeV neutrons with a fluence of 5.10^{17} pR/m^2. Crystals grown in an inert atmosphere poisoned with carbon monoxide, in graphite crucibles, were also not luminescent. Subsequent irradiation with γ-quanta produced some luminescence of these crystals, but reduced the luminescence of crystals grown under vacuum. Cooling from room temperature to 77 K did not significantly affect the luminescence, but cooling to 4.2 K reduced its intensity sharply. The luminescence of crystals grown under vacuum at high rate of growth and additionally colored by introduction of defects, as well as the luminescence of crystals grown in the presence of carbon monoxide and then irradiated, was found to be most intense at the 550 nm wavelength. Figures 3; tables 1; references 20: 6 Russian, 14 Western
[570-2415]

UDC 539.4.015:537.533:661.1.053.5

STRUCTURE, EMISSION ACTIVITY, AND ANNEALING DYNAMICS OF POLISHED CdS SURFACE

Moscow POVERKHNOST: FIZIKA KHIMIYA MEKHANIKA in Russian No 8, Aug 85 (manuscript received 19 Jan 84, final version received 11 Apr 84) pp 142-144

ZHUK, V.A. and SOTNIKOV, V.T., Kharkov Institute of Aviation

[Abstract] A study of polished CdS single crystals was made, of concern being their surface structure and the energy structure of their emission activity centers. The surface structure in the (0001) plane was examined by electron diffractography, and the energy structure was determined on the basis of thermally stimulated exoelectron emission. Specimens of these crystals were grown from the melt under pressure in an inert atmosphere. They were polished successively with diamond powder, lapping paste, etchant (33% CrO_3 solution in 2.9 N HNO_3), and finally by chemomechanical treatment. Exoelectron emission spectra were recorded at temperatures increasing in 50 K steps from room temperature through the annealing process up to 550 K, covering the change from an amorphous phase coexisting throughout a rather thick surface layer above a deeper layer of irregular grains with non-parallel crystallographic axes to crystallization with an attendant weakening of stray effects and appearance of a mosaic texture. The transition was manifested by peaking of the thermally stimulated exoelectron emission within the 520-530 K temperature range. The peaking of the current and of the photoconductance of CdS devices within the same temperature range indicates that thermally stimulated emission of exoelectrons by a polished CdS surface with an amorphous layer during annealing involves principally exoelectrons leaving the conduction band of the semiconductor material. Figures 2; references 9: 8 Russian, 1 Western.
[577-2415]

UDC 621.315

TRANSFER OF EXCITATION ENERGY FROM RADIATIVE COLOR CENTERS IN RUBY BY Cr^{3+} IONS

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR: FIZIKA in Russian Vol 20, No 2, Mar-Apr 85 (manuscript received 5 May 84) pp 110-112

ATABEKYAN, R.R., GEVORKYAN, V.A., YEZOYAN, R.K., YERITSYAN, G.N. and SARKISOV, V.Kh., Yerevan Institute of Physics

[Abstract] An efficient transfer of excitation energy in ruby from color centers to Cr^{3+} ions has been discovered by the authors in an experiment with excitation of ruby crystals by high-energy electrons and resulting formation of color centers. The crystals had been grown by the Verneuil method, polished 1x1x1 cm^3 cubes and 0.05-0.1 cm thick plane-parallel plates, with a 0.03 wt.% Cr^{3+}-concentration. They were bombarded with 50 MeV

electrons at room temperature in a linear accelerator. Spectrometric analysis has revealed an intensification of R-line luminescence in the 300 nm band and an attenuation of luminescence in the 350-600 nm pumping region. Subsequent annealing at 300°C and 350°C restored the luminescence intensity throughout this entire spectral region, with an appearance of four discrete bands (300, 350, 460, 640 nm). A thermally stable additional absorption spectrum attributable to radiative structural defects was found to coincide with the absorption spectrum attributable to energy transfer from color centers to Cr^{3+} ions, suggesting attendant luminescence in bands almost overlapping the 550 nm absorption band of Cr^{3+} ions at the $^4A_2 \rightarrow {}^4T_2$ transition as the mechanism of this energy transfer through excitation of the ^2E-state and subsequent emission of R_1 and R_2 lines. Figures 2; references 7: 3 Russian, 4 Western.
[566-2415]

UDC 533.6.011

INTERACTION OF SIMPLE WAVES WITH CONTACT DISCONTINUITY IN ONE-DIMENSIONAL PROBLEM OF SCATTERING OF PRODUCTS OF EXPLOSION OF CONDENSED EXPLOSIVES

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 2 Mar-Apr 85 (manuscript received 15 May 84) pp 114-117

KONONOV, A.V.

[Abstract] The interaction of a simple rarefaction wave with a contact discontinuity reflected from the center of symmetry is examined in the one-dimensional problem of the scattering of a plane layer of compressed gas for K = 3 and arbitrary γ, where K is the adiabatic exponent within the layer, and γ is the adiabatic exponent outside the layer. Exact solutions are constructed for all of the waves. The solution obtained can be used to analyze the gas dynamics of the initial stage of the explosion of plane charges of explosives as investigated within the framework of the instantaneous detonation model. Figures 2, references 7 (Russian). [462-6900]

UDC 533.6.011.72:534.222.2

DETONATION COMBUSTION OF COMBUSTIBLE MIXTURE FROM DOUBLE EXPLOSION

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian, No 2 Mar-Apr 85 (manuscript received 12 Dec 83) pp 126-131

AFANASYEV, A.A. and LEVIN, V.A.

[Abstract] The propagation of multiple-front detonation combustion is investigated in a combustible mixture consisting of gaseous fuel and an oxidant with additives of solid or liquid particle fuel arising as the result of a double point explosion. Two cases are considered, depending upon the moment of occurrence of the second explosion: that of a "fast" double explosion, in which the second explosion occurs close to the first, and a "slow" double explosion, in which enough time elapses between the explosions for the second to occur after a near self-similar flow has been formed after the first detonation wave. Fast and slow double discharges are analyzed numerically for gas moving with axial and spherical symmetry. The detonation

wave induced by the second explosion in the case of a fast double explosion propagates behind the first wave through highly heated gas; there is not enough time between the explosions for a self-similar two-front detonation combustion mode to occur. The time at which the waves merge, and the degree of amplification of the lead wave, depend upon the interval between the explosions and the parameter θ of the second explosion, which is determined by the initiation energy. Figures 5; references 15: 13 Russian, 2 Western.
[462-6900]

UDC 533.6.011.72:532.529

TOWARD A THEORY OF REGULAR AND MACH REFLECTION OF SHOCK WAVES IN TWO-PHASE GAS-LIQUID MEDIUM

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 2 Mar-Apr 85 (manuscript received 2 Apr 84) pp 188-190

VOLOSHINOV, A.V., KOVALEV, A.D. and SHINDYAPIN, G.P.

[Abstract] Regular and Mach reflection of a shock wave of moderate intensity from a solid wall is investigated using an equilibrium model of a two-phase gas-liquid medium that allows for the content, density, and compressibility of the components. The pressure on the wall behind the shock wave, the angle of refraction, and the angle of departure of the triple point are found to be complex nonmonotonic functions of the gas content, the angle of incidence, and the intensity of the incident wave. Oblique reflection for moderate and small gas content results in a stronger reflected shock wave than does normal reflection. The reflection parameters are calculated for an air-water mixture showing good agreement for normal reflection with existing experimental data for small and moderate gas content. Figures 2; references 6: 5 Russian, 1 Western.
[462-6900]

MODES OF COMBUSTION OF EXPLOSIVE GAS MIXTURES IN CHANNELS WITH CHANGING CROSS-SECTION

Novosibirsk DINAMIKA MNOGOFAZNYKH SRED in Russian No 68, 1984 (signed to press 28 Dec 84) pp 124-131

SUBBOTIN, V.A. and KUZNETSOVA, A.Ya.

[Abstract] An experimental study with explosive gas mixtures was made, for determining the dependence of the ignition mechanism and of the combustion rate on the initial gas pressure in channels with periodically changing cross-section. Two such channels were built with 1.5 mm thick duralumin sheet and with 1.0 mm thick acrylic glass sheet, forming corrugations along the channel axis of symmetrically connected equidistant parallel circular

cylindrical shells, with the channel height becoming maximum in the center section of each successive cylinder (cylinder diameter d = 4.8 mm in one channel and d = 16 mm in the other) and minimum along the straight connectors (h = 0.25d) between cylinders. The corrugation period was 1.2d. The first experiment was performed with $C_2H_2:O_2$ = 1:2.5 and $C_2H_2:O_2$ = 1.5 mixtures, a $C_3H_8:O_2$ = 1.5 mixture, and a $C_3H_6O:O_2$ = 1:4 mixture. The results with strong ignition such as an electric discharge and high initial gas pressure revealed a fast slowing down of the process along the channel, already after one or two cylindrical compartments. A fast process could be maintained over a longer initial channel segment by strong ignition but with a lower initial gas pressure; however, the process was then found to be unstable and to be degenerating soon into a slow one. With weak ignition and high initial gas pressure, the initially slow process was found to build up to a fast one, both process modes coexisting within some intermediate pressure range with a jump from slow to fast process at some pressure. Such a transition is caused by adiabatic self-ignition, while the mechanism of a slower process at low pressures is convective. In a subsequent experiment, the relations during the slow stage of the process were studied on $H_2:O_2$ = 2:1 and $H_2:O_2$ = 1:1.66 mixtures, as well as on $H_2:O_2$:He = 2:1:3 and $H_2:O_2$:Ar = 2:1:3 mixtures. The results reveal a higher limiting pressure for mixtures diluted with a noble gas, 1.3 times higher with argon and 2.1 times higher with helium, while dilution with excess oxygen lowers the temperature in the induction zone and thus raises the pressure beyond which the process speed already does not increase much further. That point on the speed-pressure curve corresponds to sustained emission of a detonation wave. Interestingly, the minimum process speed in $H_2:O_2$ = 2:1 and $H_2:O_2$:He = 2:1:3 mixtures was found to be 15% higher than the speed of sound in the respective cold gas. Figures 5; tables 1; references 7 (Russian).
[569-2415]

UDC 532.593:532.529

INTERACTION OF AIR SHOCK WAVES AND POROUS COMPRESSIBLE MATERIALS

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian No 3 May-Jun 85 (manuscript received 9 Apr 84) pp 111-115

GVOZDEVA, L.G., FARESOV, Yu.M. and FOKEYEV, V.P., Moscow

[Abstract] Interaction of air shock waves and porous compressible materials was studied in an experiment with two foam-plastic materials: PPU-3M-1 polyurethane (density 33 kg/m^3) and much more rigid PKhV-1 polyvinyl chloride (density 50 kg/m^3). Tests were performed in a shock tube with 0.1x0.1 m^2 square cross-section, a single diaphragm separating its 8 m long low-pressure segment with inspection zone and 1.5 m long high-pressure segment. The instrumentation included an array of piezoelectric pressure transducers and a digital frequency meter for velocity measurements, a

Tectronix 451A oscillograph, and IAB-451 shadowgraph, and a ZhFR camera with slit scanning. Air was used as compressing gas, its initial pressure being varied from 10^3 Pa to 10^5 Pa, helium and nitrogen were used as propelling gas. The impact velocity of shock waves was varied over the N_M = 2-5 range of the Mach number. The maximum amplitude of the pressure pulse increased as the thickness of the foam layer was increased up to 80 mm and then remained constant with further increase of that thickness, at a level depending on the material and on the initial conditions. A maximum pressure rise by a factor of approximately 10 was attained, with $1.3 \cdot 10^3$ Pa initial pressure and an impact velocity N_M = 5. Reducing the initial pressure to below $(0.1\text{-}0.3) \cdot 10^3$ Pa, with the impact velocity maintained at N_M = 5, reduced the pressure rise to a factor below 3. The results are interpreted taking into account elasticity forces in the solid skeleton phase and gas filtration through the pores. Figures 6; references 6 (Russian).
[576-2415]

UDC 519.6:533.7

LOCAL CONSERVATISM OF DIFFERENCE SCHEMES FOR EQUATIONS OF GAS DYNAMICS

Moscow ZHURNAL VYCHISLITELNOY MATEMATIKI I MATEMATICHESKOY FIZIKI in Russian Vol 25, No 8, Aug 85 (manuscript received 20 Jul 83, after revision 6 Aug 84) pp 1176-1188

KUROPATENKO, V.F., Chelyabinsk

[Abstract] Difference schemes approximating the differential equations of gas dynamics for numerical integration are analyzed for local conservatism and dissipative properties. The system of 10 differential equations, including the laws of energy, momentum, and mass conservation, is formulated for an ideal nonviscous and nonconducting medium without energy sources. This system of equations contains three dependent thermodynamic variables, functions of time, and four independent ones. The approximating system of difference equations, in differential form, is indeterminate. Existence of solutions is established on the basis of three theorems, after the concepts of conservatism with respect to mass and conservatism with respect to entropy have been introduced. The first theorem establishes the convertibility of difference equations from divergent form to nondivergent form and vice versa. The other two theorems with a corollary establish the necessary and sufficient condition for mass conservation and entropy conservation, respectively. The principle is demonstrated on type-4 difference schemes and their analysis for closeness to entropy conservation. The results reveal that difference schemes for the energy equation in divergent form include thermodynamically anomalous ones, while most of those for the energy equation in nondivergent form are thermodynamically normal and include some weakly dissipative ones. Completely conservative difference schemes, on the other hand, include strongly dissipative ones. References 16: 14 Russian, 2 Western.
[575-2415]

UDC 532.517.4

EXPERIMENTAL STUDY OF HYDRODYNAMIC INSTABILITY OF DIVISION BOUNDARY BETWEEN MEDIA OF DIFFERENT DENSITIES IN AN ACCELERATION FIELD

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 23, No 3, May-Jun 85 (manuscript received 5 Jun 84) pp 535-541

ZAYTSEV, S.G., LAZAREVA, Ye.V., CHERNUKHA, V.V. and BELYAEV, V.M., Power Engineering Institute imeni G.M. Krzhizhanovskiy

[Abstract] Quantitative information is derived on the intensification of mixing upon transmission of a shock wave through a laser over a broad range of ratios of the densities of contacting flows for high intensity shock waves. The influence of the acceleration pulse created by the shock wave moving from a light gas to a heavier gas and in the area of contact of two streams of different density resulting from breakdown of the film separating the two gases is studied. The work was performed in a shock tube with the initial separation of the gases in the low pressure chamber by a Lavsan film. The parameters of the contacting flows were determined by calculation, ignoring the film. Conditions were determined under which the film does not influence the wave picture of the process. The acceleration pulse created by the shock wave was found to intensify the mixing process, regardless of the direction of movement of the shock wave. Figures 9; references 8 (Russian).
[530-6508]

UDC 517.958:533.7

MOTION OF RAREFIED GAS CAUSED BY EJECTION OF FINITE GAS MASS ORIGINATING FROM SINGLE POINT

Moscow ZHURNAL VYCHISLITELNOY MATEMATIKI I MATEMATICHESKOY FIZIKI in Russian Vol 25, No 7, Jul 85 (manuscript received 28 Dec 83, after revision 10 Sep 84) pp 1066-1077

ARISTOV, V.V. and SHAKHOV, Ye.M., Moscow

[Abstract] Spherically symmetric explosion flow of a rarefied gas following a momentary ejection of a finite gas mass and thus also of a finite energy is analyzed in the one-dimensional approximation, according to the model in which the entire explosive mass is originally concentrated within an infinitesimally small sphere so that all particles have the same velocity in the same direction. All forms of energy other than explosion energy in this process are ignored. The corresponding Boltzmann equation is formulated in a spherical system of coordinates for solution in Dirac delta-functions with respect to the radial coordinate and the modulus of molecular velocity. The three terms of the solution represent, respectively, particles dispersing from the center of the sphere, ambient particles, and

particles (F-molecules) forming after collisions. The asymptotic solution for time $t \rightarrow 0$ is obtained by using the solution to the simpler problem of a strong explosion as reference. The analogous difference equations into which the Boltzmann system has been converted is then solved numerically by difference schemes appropriate for the spherically symmetric problem. Both problems were solved by this procedure, and the results were found to correlate with experimental data, also with the results of calculations based on the "snow coma" model. Beyond a certain time, however, the error of nonconservatism will increase. Figures 6; references 12: 9 Russian, 3 Western (1 in Russian translation).
[544-2415]

UDC 519.6:533.7

NUMERICAL INVESTIGATION OF POINT EXPLOSION IN RADIATING GAS

Moscow ZHURNAL VYCHISLITELNOY MATEMATIKI I MATEMATICHESKOY FIZIKI in Russian Vol 25, No 6, Jun 85 (manuscript received 10 Oct 83) pp 925-932

KOROBEYNIKOV, V.P., PUTYATIN, B.V. and SHARIPOV, A.K.

[Abstract] The problem of the propagation of a localized perturbation in a gas is investigated numerically with allowance for radiation. A solution is obtained numerically for the initial stage of the explosion, as well as for times when the gas motion is substantial. The gas dynamic part of the computational algorithm is based on a different scheme employing artificial viscosity. The transfer equation is examined in the diffusion approximation of the spherical harmonic method. The analysis shows that the explosion process can be separated into two stages: radiation-heat and gas dynamic. The heat wave first propagates through the cold gas at a high velocity, with the density remaining practically constant, and the gas velocity remaining near zero, except for a small vicinity at the center where a significant gas flow begins. As the heat wave propagates, its velocity drops; the process then begins to restructure as the gas continues to cool. The shock wave, in which the gas is compressed strongly, retreats from the front of the heat wave. The results indicate that the nature of the solution becomes increasingly similar to the solution of the self-similar problem of a strong explosion in a nonradiating gas as time passes the radiation has less effect. Figures 4; references 14: 12 Russian, 2 Western.
[463-6900]

EXPERIMENTAL INVESTIGATION AND ANALYSIS OF SIMILARITY OF FLOW DURING DETONATION OF LINEAR EXPLOSIVE CHARGE IN ATMOSPHERE

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 21, No 2, Mar-Apr 85 (manuscript received 18 Jan 84) pp 134-139

MALI, V.I., NOVOPASHIN, S.A. and CHEKMAREV, S.F.

[Abstract] The motion of the detonation products and surrounding gas during the detonation of a linear explosive charge in the atmosphere is investigated, with the primary emphasis on the flow at large distances from the detonation wave (greatly exceeding the charge radius). A version of the defocused diaphragm method is used to visualize the shock waves in the atmosphere. A theory of flow similarity is developed that employs an analogy between flow during the detonation of a linear explosive charge and the emission of a supersonic gas jet (the jet analogy). The experimental findings confirm the conclusions regarding the similarity of the flow with respect to the influence of different conditions in the atmosphere for like explosive charges. The jet analogy is found to agree with the principle of energy similarity of explosive wave propagation as regards the explosive shock wave. It is suggested that the similarity relationships flowing from the jet analogy will hold for a wide group of explosives. Figures 3; references 8: 7 Russian, 1 Western.
[491-6900]

UDC 517.934:534.222

EVOLUTION OF WAVE BEAM IN INHOMOGENEOUS AND HIGHLY NONLINEAR MEDIUM

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA FIZIKA, KHIMIYA in Russian Vol 11, No 2, May 85 (manuscript received 22 Jun 84) pp 10-15

MOLOTKOV, I.A. and VAKULENKO, S.A.

[Abstract] An asymptotic (as $\omega \to \infty$) solution is sought for the plane problem for the nonlinear Helmholtz equation describing wave propagation in a medium with a special boundary condition that assigns a narrow wave beam that is concentrated for $x = 0$ in the vicinity of $y = 0$. The problem is that of the evolution of a concentrated wave beam in a highly nonlinear, inhomogeneous medium in the region $x \geqslant 0$. Formulas are derived for the axial line of the beam, its phase velocity, and amplitude distribution. Figures 1; references 3 (Russian).
[470-6900]

DEVELOPMENT OF BUBBLE IN LIQUID IN PRESENCE OF GAS EMISSION SOURCE

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 21, No 2, Mar-Apr 85 (manuscript received 19 Jan 84) pp 76-81

MARGOLIN, A.D. and KRUPKIN, V.G.

[Abstract] An analysis is presented of bubble development in a liquid in the presence of a gas emission source (occurring, e.g., due to combustion) with a limited active time. A system of equations and boundary conditions are derived that describes the change over time of the radius of the bubble, and the pressure and temperature therein. The role of the site of diffusion combustion in the emission of gas in a liquid is discussed. Figures 4; references 3 (Russian).
[491-6900]

UDC 621.378.9:533.9.02

EXPERIMENTAL INVESTIGATION OF X-RADIATION OF TARGETS HEATED BY HIGH-POWER LASER

Moscow EKSPERIMENTALNOYE ISSLEDOVANIY RENTGENOVSKOVO IZLUCHENIYA MISHENEY, NAGREVAYEMYKH MOSHCHNYM LAZEROM in Russian 1984 pp 3-19

KOLOGRIVOV, Andrey Aleksandrovich

[Abstract] A diagnostic system is developed for recording continuous X-radiation of laser plasma that employs a set of detectors that can be used over a wide range of quantum energies. The properties of the detectors are analyzed, and practical recommendations are given for their diagnostic use. An algorithm is developed for reconstructing the spectrum of X-radiation from the attenuation curves in matter. The algorithm is based on solving an integral Fredholm equation of the first kind by minimizing directional divergences. Experiments with spherical targets at laser energies of 100-200 J are described. The amount of absorbed energy that is transformed into electromagnetic radiation in the soft X-ray and vacuum ultraviolet bands is found to be approximately 1% for shell targets and approximately 2-5% for flat targets, which agrees with theoretical calculations. The influence of the aspect ratio on the target compression is investigated on the basis of data from X-ray obscurograms. The nature of the density and temperature profiles is found to vary as a function of the aspect ratio. References 9 (Russian).
[441-6900]

UDC 535.35

DYNAMICS OF PLASMA OCCURRING DURING LASER ACTION ON SOLID STATE BARRIERS

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA in Russian Vol 49, No 6, Jun 85 pp 1132-1139

YELYASHEVICH, M.A., MINKO, L.Ya., ROMANOV, G.S., STANKEVICH, Yu.A., CHIVEL, Yu.A. and CHUMAKOV, A.N., Scientific Research Institute for Applied Physical Problems imeni A.M. Sevchenko

[Abstract] Two-dimensional modeling of the dynamics of the plasma formed when laser radiation strikes solid-state obstacles is reviewed, and the results are compared with experimental findings. The primary emphasis is on

microsecond single pulses at $\lambda = 1.06$ μm. The plasma formation processes that occur when laser radiation of moderate intensity strikes metal plasma-forming bodies, which are closely associated with evaporation and heating of the vapors that form, are analyzed. The dynamics of supersonic unbroadened laser erosion plasma flames are investigated. Two-dimensional numerical modeling of the processes occurring make it possible to obtain a number of singularities in the dynamics of laser erosion plasma flames that correspond to actual experimental findings. Calculations show that the position of the shock wave depends little upon the interaction conditions, so that the prediction regarding the position of the direct shock wave on the surface of the target when the flux density of the interacting laser radiation is highly modulated is incorrect, and can lead to significant errors. The spike mode is characterized by higher temperatures following the shock wave than for the stationary mode. Two-dimensional numerical modeling is found to provide overall good agreement with the physical picture observed in our experiments; however, it is not yet capable of disclosing certain effects that can have a strong influence on the transmission of the laser radiation to the surface. Figures 4; references 36: 35 Russian, 1 Western.
[473-6900]

UDC 621.378.325

CHANGE IN OPTICAL PROPERTIES OF POROUS BODIES UNDER THE INFLUENCE OF LASER RADIATION

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA in Russian
Vol 49, No 6, Jun 85 pp 1170-1172

LEVDANSKIY, V.V., Institute of Heat- and Mass-Exchange imeni A.V. Lykov, Belorussian USSR Academy of Sciences

[Abstract] The influence of laser radiation on the adsorption capacity of a porous body, with which the optical properties of the porous body (adsorbate system) are associated, is examined. Change in the adsorption capacity of this system under the influence of laser radiation is due to the kinetics of the adsorption-desorption processes, as well as the capillary adsorbate transfer process which, in turn, are strongly influenced by heating the system due to adsorption of the incident radiation by the porous body and by the adsorbed particles. The adsorption distribution in a plate is analyzed using the example of a single cylindrical capillary for Langmuir adsorption kinetics and a weakly molecular gas flow mode. It is found for resonant radiation that the adsorbate-adsorbent system is also influenced by photo-stimulated nonthermal effects, which can also change the adsorption capacity of porous bodies and its related optical characteristics (adsorbing capacity and coefficient of refraction). References 9 (Russian).
[473-6900]

UDC 535.211:536.522

THRESHOLD TEMPERATURES OF PHYSICAL-CHEMICAL PROCESSES DURING LASER HEATING OF GLASSES

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA in Russian
Vol 49, No 6, Jun 85 pp 1188-1193

ZELIKIN, N.V., KASK, I.Ye., LEKSINA, Ye.G., PROKOFYEVA, Zh.S., FEDOROV, G.M., FEDOROVICH, O.V., CHOPOPNYAK, D.B. and YABOROV, M.T., Scientific Research Institute for Nuclear Physics, Moscow State University imeni M.V. Lomonosov

[Abstract] Direct measurements of threshold surface softening and destruction temperatures of various optical glasses exposed to a quasi-continuous laser pulse approximately 10 msec long are described. The bulk destruction temperature of the glass is found by analyzing the kinetics of the change in the index of refraction of the heated glass. A thermodynamic model is proposed that explains the difference between the bulk and surface destruction threshold temperatures. The surface threshold temperatures were measured by sputtering thin metal films with known melting points and also by employing Pt-Pt, Rh high-temperature thermocouples; both approaches produced similar results. References 13 (Russian).
[473-6900]

UDC 535.375+621.373

INFLUENCE OF TEMPORAL PULSE SHAPE ON OPTICAL BREAKDOWN AND RAMAN SCATTERING IN OPTICAL GLASSES

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA in Russian
Vol 49, No 6, Jun 85 pp 1194-1199

BALKYAVICHYUS, P.Y., BUZYALIS, R.R., DEMENTYEV, A.S., KOSENKO, Ye.K. and MALDUTIS, E.K., Institute of Physics, Lithuanian SSR Academy of Sciences

[Abstract] The influence of the spectral and temperature parameters of laser radiation on stimulated Raman scattering and self-focusing in optical glasses is investigated. An experimental set-up is described that employs linearly polarized radiation with pulses 12 nsec long collimated by a Kepler telescope, which are circularly polarized and amplified by two 6.3x75 mm YAG:Nd elements. The temporal characteristics of the pulses incident upon and reflected from the specimen are measured by a high-speed FK-26 photoelectric converter and S7-19 oscilloscope. Plots of the probabilities of volumetric breakdown as a function of the pulse energy exhibit a broad transitional region within which the breakdown probability increases from zero to unity. It is found that breakdown occurs when the maximum pulse power exceeds a certain threshold power. Microscopic examination reveals sites with long thin filaments originating at the geometric focus

and terminating in a small star at the end toward the lens. The morphology of the residual destruction caused by short pulses is found to be analogous to the destruction caused by broad-spectrum pulses. Figures 3; references 24: 22 Russian, 2 Western.
[473-4900]

UDC 621.375

DESTRUCTION OF GALLIUM ARSENIDE BY CONTINUOUS RADIATION FROM BRIGHTENED YAG:Nd LASER

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA in Russian
Vol 49, No 6, Jun 85 pp 1200-1202

BUMYALIS, A.-V.Y., VAYCHIKAUSKAS, V.V., MURAUSKAS, E.Ya. and PETSKUS, A.M., Institute of Physics, Lithuanian SSR Academy of Sciences, Institute of Semiconductor Physics, Lithuanian SSR Academy of Sciences

[Abstract] The behavior of the surface destruction threshold of GaAs by continuous radiation at 1.06 μm during brightening by pulsed radiation from a ruby laser (λ = 0.69 μm) is investigated. Specimens of undoped n-type gallium arsenide with free electron concentration of $5 \cdot 10^{15}$ cm^{-3} in the form of polished parallel plane plates 2 mm thick are investigated. The surface destruction threshold is determined by the occurrence of a residual change in the reflection of the sounding He-Ne laser. It is found that, as long as $\bar{h}\omega_1 < E_g < \bar{h}\omega_2$, thermal modulation of the width of the forbidden zone of the semiconductor can be used to change the destruction threshold of the semiconductor by continuous laser radiation at two frequencies. Figures 3; references 2 (Russian).
[473-6900]

UDC 535.21

LOW-THRESHOLD OPTICAL BREAKDOWN AND SURFACE DAMAGE OF TARGET BY POLARIZED PULSES FROM CO_2 LASER

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA in Russian
Vol 49, No 6, Jun 85 pp 1203-1207

BONCH-BRUYEVICH, A.M. and SMIRNOV, V.N.

[Abstract] Localization of absorbing inhomogeneities with low optical breakdown threshold is investigated by comparing experimental findings with analytical relationships. The nature of change caused by CO_2 laser radiation polarized parallel and perpendicular to the plane of incidence in absorbing inhomogeneities located above and below a surface is examined.

The morphology of the damage to the entry and exit surfaces of a germanium plate is discussed. Damage found on the front surface beyond the limits of the irradiated region is analyzed. The latter is found to result from radiation reflected from the back surface of the specimen. Figures 1; references 10: 5 Russian, 5 Western.
[473-6900]

UDC 621.373.826

AIR BREAKDOWN NEAR TARGET CAUSED BY TWO SUCCESSIVE CO_2 LASER PULSES. MAGNETIC FLUID

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA in Russian Vol 49, No 6, Jun 85 pp 1208-1213

KONOV, V.I., NIKITIN, P.I. and PROKHOROV, A.M., Institute of General Physics, USSR Academy of Sciences

[Abstract] The generation of spontaneous magnetic fields during two-pulse breakdown of air with the secondary absorption wave propagating in the relaxing plasma formed by the first optical discharge is investigated. The space-time structure of the spontaneous magnetic field of the laser spark ignited by pairs of pulses in atmospheric air in the absence of a target is investigated. The measurement results are compared with experiments in which the plasma is ignited on metal and dielectric specimens. By changing the delay between pairs of laser pulses, it is possible to change the propagation modes (and sometimes the direction) of the discharges, the basic parameters of the plasma, and their spatial distribution to create shock waves in ionized gases, etc. The use of paired laser pulses may be of interest for increasing the efficiency of the plasma chemical effect on the surface of targets, for generating sound in liquids, and for creating plasma active media for short-wave lasers. Figures 3; references 23: 15 Russian, 8 Western.
[473-6900]

UDC 621.378.9

INVESTIGATION OF LASER PLASMA FLAME EXITING CYLINDRICAL ORIFICE INTO A VACUUM

Minsk VESTSI AKADEMII NAVUK BSSR: SERYYA FIZIKA-MATEMATYCHNYKH NAVUK in Russian No 3, May-Jun 85 (manuscript received 25 Jun 84) pp 101-106

SHKURKO, V.V., Institute of Physics, Belorussian SSR Academy of Sciences

[Abstract] The ion composition and energy characteristics of multiply-charged ions in a lateral plasma flame exiting a cylindrical opening into a vacuum are investigated. The parameters of the flame are investigated as a

function of the diameter of the input cavity and the length of the lateral channel. It is shown possible in principle to control these parameters. The plasma studied was produced by an Nd laser with pulse energy of 2-3 J and half-width duration of 20 nsec. A transit-time analyzer in conjunction with a cylindrical electrostatic energy analyzer was used to analyze the ion composition and study the energy characteristics of the multiply-charged ions. The plasma flame was found to contain ions with different charges whose physical characteristics depend upon the energy profile of the laser pulse, as well as the geometric dimensions of the input cavity and output channel. It was found that, by varying the latter, plasma flames can be formed with preassigned parameters, providing a gain in energy ions over that achieved by focusing the radiation on a flat target. Figures 4; references 9: 8 Russian, 1 Western.
[471-6900]

NUMERICAL ANALYSIS OF TURBULENT DIFFUSION COMBUSTION ON VERTICAL SURFACE

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 2, No 3, May-Jun 85 (manuscript received 14 Aug 84 after revision) pp 8-14

ARTYUK, L.Yu., KASHKAROV, V.P., and LOKTIONOVA, I.V.

[Abstract] The development of a turbulent diffused flame formed when fuel is forced at a constant velocity through the surface of a porous vertical plate into a stationary surrounding oxidant medium is investigated. The calculated average and pulsation velocity profiles, as well as temperatures, are found to agree well with probabilistic experimental data. The three-parameter k-ε-$\overline{T'^2}$ model of turbulence developed for inert flows is found to describe the development of a reacting turbulent boundary layer with chemically-active gases injected with no additional change in the empirical constants of the model. The flow is found analytically to achieve the self-similar condition, with the best profile similarity observed using different similarity variables in the region ahead of and behind the maximum. Data are obtained on the change of the surface of friction and the local coefficient of heat release along the flow. Figures 6; references 9: 7 Russian, 2 Western.
[492-6900]

EFFICIENCY OF COMBUSTION OF HYDROGEN-KEROSENE FUEL IN DUCT CHANNEL

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 21, No 3, May-Jun 85 (manuscript received 28 Aug 84 after revision) pp 30-32

ANNUSHKIN, Yu.M. and MASLOV, G.F.

[Abstract] The influence on the proportion of hydrogen in a combined hydrogen-kerosene fuel on the completeness of combustion at stagnation

temperatures of the air of 630-650 K and of the hydrogen of 300-720 K. The investigations were performed in a cylindrical model combustion chamber of 190 mm in diameter and 558 mm long. The fuel consisted of kerosene and gaseous hydrogen burned together and separately in the chamber. It is found that combustion becomes more efficient as the relative hydrogen content in the combined fuel increases, and that combustion of the combined fuel is most complete for a certain optimal relative hydrogen content. The location of the maximum is determined by the excess air in the chamber and the overall total fuel combustion efficiency. Figures 3; references 5 (Russian).
[492-6900]

UDC 535.343:621.378.325

CHANGE IN TRANSMISSION SPECTRUM OF OPTICAL GLASS DURING LASER HEATING

Leningrad FIZIKA I KHIMIYA STEKLA in Russian Vol 11, No 2, Mar-Apr 85 (manuscript received 4 May 84 after revision) pp 175-180

ZELIKIN, N.V. and KASK, N.Ye., Scientific Research Institute for Nuclear Physics, Moscow State University imeni M.V. Lomonosov

[Abstract] The temperature changes in the absorption spectra of optical glass heated to temperatures over 2000 K in the pulse mode are investigated. Significant reversible changes in the absorption in the 400-470 nm wavelength region are observed in ZhS 11 glass heated to approximately 2000 K. The shift of the absorption edge before the anomalous interval begins is approximately $8 \cdot 10^{-2}$ nm·K^{-1}, which drops to approximately $2.5 \cdot 10^{-2}$ nm·K^{-1} at higher temperatures. The experimental findings are described approximately on the basis of Urbach's rule, using different constants for the two temperature regions. Pressures of up to 10^4 atm make no significant contribution to the shift of the absorption edge. Figures 4; references 18: 14 Russian, 4 Western.
[461-6900]

UDC 621.373.826.038.823

SPECTRAL AND TEMPORAL CHARACTERISTICS OF HIGH-POWER NEODYMIUM GLASS LASER EMPLOYING CASCADE FREQUENCY CONVERSION IN VACUUM ULTRAVIOLET REGION

Moscow SPEKTRALNYYE I VREMENNYYE KHARAKTERISTIKI MOSHCHNOGO LAZERA NA NEODIMOVOM STEKLE S KASKADNYM PREOBRAZOVANIYEM CHASTOTY V OBLAST VAKUUMNOGO ULTRAFIOLETA in Russian 1984 pp 3-20

KOROBKIN, Yuriy Vasilyevich

[Abstract] This study describes the development and investigation of a subnanosecond and picosecond source of pulse coherent radiation with output characteristics variable in the infrared, visible, and ultraviolet regions of the spectrum. Systems for recording the temporal parameters of super-short laser pulses are investigated. The generation of coherent radiation in the vacuum ultraviolet region is studied. The way in which the spatial coherence of the radiation field of a light wave changes when the radiation from a subnanosecond mode-locked laser is converted to higher-order harmonics in nonlinear crystals is established. The influence of confining processes on conversion efficiency as the pumping wavelength changes is studied experimentally, indicating that the increase in the nonlinear susceptance of Xe as the wave discrepancy becomes smaller has practically no effect on conversion efficiency due to the increased absorption of Xe in the region of the 9th harmonic, as well as the change in the index of refraction of Xe. References 9 (Russian).
[441-6900]

UDC 621.373.826.038.823

EFFICIENT FLASHLAMP PHOTOLYSIS-INITIATED PULSE HYDROGEN FLUORIDE LASERS

Moscow EFFEKTIVNYYE IMPULSNYYE FTOROVODORODNYYE LAZERY S INITSIIROVANIYEM LAMPOVYM FOTOLIZOM in Russian 1984 pp 3-18

PORODINKOV, Oleg Yevgenyevich

[Abstract] This study investigates enhancement of the efficiency of pulse chemcial lasers employing a hydrogen fluorination chain reaction in which vibrationally excited HF (DF) molecules are formed. Because of the chain

mechanism of the reaction, each active center that is formed during initiation can, under certain circumstances, form a large number of vibrationally excited hydrogen fluoride molecules. This means that a long lasing length can be achieved in hydrogen fluoride lasers, indicating the number of HF molecules contributing to coherent radiation per active center created during initiation. The concentration of fluorine atoms created by flashlamp radiation is determined on the basis of the absorption of UV radiation by FO_2 radicals formed in the reaction between atomary fluorine and oxygen. A method is developed for preparing the working mixture that provides good reproducibility of results. Photo-initiated H_2-F_2- and B_2-F_2-CO_2 lasers are created with efficiencies of 49 and 70%, providing pulse energy of about 200 J. The physical efficiencies obtained are shown to be close to the maximum possible, indicating that further total efficiency improvement can be achieved only be increasing the efficiency of the pulse lamps and the way in which their radiation is utilized. References 4 (Russian).
[441-6900]

LINE SELECTION AND LASING FREQUENCY ESTIMATE OF CONTINUOUS GAS-DISCHARGE OF CO_2 AND CO-LASERS

Moscow SELEKTSIYA LINIY I PERESTROYKA CHASTOTY GENERATSII GAZORAZRYADNYKH NEPRERYVNYKH CO_2 I CO-LAZEROV in Russian 1984 pp 3-15

UDALOV, Yuriy Borisovich

[Abstract] This study addresses the interrelated problems of strict selection of laser transitions and stabilized lasing frequency adjustment in CW gas-discharge CO and CO_2 lasers with open cavities. The frequency-selective properties of this version of laser cavities are investigated. The possibility of realizing strict selection for a wide range of molecular transitions in lasers with different dispersion elements and different cavity configurations is studied. The method is implemented for stabilizing the frequency of a tunable laser by employing a two-section interferometer. The method expands the stabilized tuning band of the laser. References 9: 4 Russian, 5 Western.
[441-6900]

UDC 621.373.826.038.823

MECHANISM LIMITING OPTIMUM EMISSION PULSE REPETITION RATE OF LASERS ON SELF-LIMITED TRANSITIONS IN METAL VAPORS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 5, May 85 (manuscript received 7 Mar 84) pp 945-952

BOKHAN, P.A., Institute of Thermophysics, Siberian Department, USSR Academy of Sciences, Novosibirsk

[Abstract] Lasers on self-limited transitions in metal vapors are among the most powerful and efficient ones at visible and near-infrared wavelengths, a laser on copper vapor being able to deliver an average power of up to 100 W/m at a physical efficiency of 5.3% and a real efficiency of 3%. An increase of the laser power must be based on a higher pulse repetition rate, inasmuch as the energy density is limited. Although the pulse repetition rate has already been raised from the order of 1 kHz to above 10 kHz and even up to 20 kHz, there is still a mechanism that limits the feasibility of raising it further. In an earlier study this author had proposed a new mechanism, namely, slow recombination of the plasma during the afterpulse period at a rate determined by ambipolar diffusion, in addition to breakdown of active levels by nonexciting collisions with residual plasma electrons. Several ways to increase the recombination rate and thus raise the optimum pulse repetition rate along with the average emission power have been devised: 1) increasing tube diameter to accommodate for additives such as neon and hydrogen (60 W output power); 2) increasing tube diameter to facilitate volume recombination (100 W output power); and 3) increasing the pressure of the buffer gas (180 W output power with transverse excitation and neon under atmospheric pressure). In a subsequent study a laser on the active transition $^3P_1^0 - {}^1D_2$ (0.723 nm wavelength) in lead vapor was considered for experimentation. It was pumped by two methods, with a gas discharge and with an electron beam. A high pressure of 1.7 kPa could be maintained in a ceramic (BeO) tube with a tungsten-barium thermionic cathode, as opposed to only 0.9 kPa in a quartz tube with a molybdenum cathode. The results of tests indicate that in a Pb-laser with gas-discharge pumping the emission pulse characteristics do not depend on the relaxation rate of metastable levels, and the optimum pulse repetition rate is limited either by overheating or by the recombination rate between pulses. In a Pb-laser with electron-beam pumping the average emission power is limited by overheating of the active medium. A maximum energy extraction of 5 $\mu J/cm^3$ with physical efficiency of 2% (real efficiency 0.1%) was attained with electron-beam pumping, so that an output power of 400 W/m_3 appears to be feasible, while a maximum energy extraction of only 2 $\mu J/cm^3$ with physical efficiency of 0.05% or 0.8 $\mu J/cm^3$ with physical efficiency of 0.2% (real efficiency 0.15%) was attained with gas-discharge pumping. The author thanks A.R. Sorokin for assistance in the experiments. Figures 7; references 23: 20 Russian, 1 Polish, 2 Western.
[504-2415]

UDC 621.373.826.038.825.4

CONTROLLING SPIKE EMISSION MODE OF TWO-COMPONENT HETEROSTRUCTURE LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 3, May 85 (manuscript received 26 Apr 84) pp 953-958

GOLDOBIN, I.S., LUKYANOV, V.N., SOLODKOV, A.F. and YAKUBOVICH, S.D., All-Union Scientific Research Institute of Optical Physical Measurements, Moscow

[Abstract] Two-component injection lasers on semiconductor heterostructures, such as GaAl/As with space-nonuniform excitation, are eminently suitable for measurements, as well as data transmission and processing, since spike emission is one of their characteristic operating modes. The conditions for stabilization of this mode within the ambiguity range of their S-curve power-current characteristic are examined analytically on the basis of a model which consists of three equations describing the emission dynamics in terms of injection current density and excess charge carrier concentration kinetics. Thermal processes and boost pumping of weak-injection regions with superluminescence radiation are disregarded, as are also the modal content of emitted radiation and the stochastic nature of spontaneous emission. Calculations reveal unexpectedly that within a narrow suthreshold range of ambiguous solutions the phase trajectories, depending on the initial conditions, converge either to a stable point which corresponds to spontaneous emission or to a limit cycle containing an instability point which corresponds to spike emission. Calculations yield also the dependence of the self-modulation frequency and of the fundamental-harmonic amplitude in the radio-frequency spectrum on the pumping current, the frequencies of self-modulation locking with a harmonic external signal, the photochronograms of a spike, and the spectrum of spike sequences. On the basis of these results the amplitude-frequency characteristics of an LFD-2 photodiode and an ELU-FTK fast photomultiplier are calculated. These characteristics have been checked and calibrated against measurements made and oscillograms taken on two-component semiconductor homostructure lasers. The authors thank Yu.A. Tambiyev and I.A. Rachkov for assistance in the experiments, also L.A. Rivlin, Yu.F. Fedorov, and S.V. Tikhomirov for helpful discussions.
Figures 6; references 14: 12 Russian, 2 Western.
[504-2415]

UDC 621.373.826.038.823

EFFECT OF PARAELECTRODE PROCESSES ON CONTRACTION OF SPACE CHARGE IN PERIODIC-PULSE LASERS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 5, May 85 (manuscript received 1 Jun 84) pp 971-976

ARYTYUNYAN, R.V., BARANOV, V.Yu., BORISOV, V.M., VINOKHODOV, A.Yu. and KIRYUKHIN, Yu.B., Institute of Atomic Energy imeni I.V. Kurchatov, Moscow

[Abstract] A characteristic feature of periodic-pulse electric-discharge CO_2-lasers and excimer lasers is contraction of the space charge as the pulse repetition rate increases. The emission energy per pulse decreases as a consequence, with the average laser power first ceasing to increase linearly beyond a certain corner repetition rate and then decreasing beyond a certain critical repetition rate. A study of this phenomenon was made, for the purpose of separating the effect of paracathode processes from the effect of gas dynamics and then evaluating the effect of the former alone. In the experimental part of this study, paraelectrode perturbations were simulated by focusing the radiation from an XeCl-laser on the cathode surface in an atmosphere of nonabsorbing gases. Laser pulses of up to approximately 0.5 J energy and of approximately 50 ns duration were focused by a lens with 30 cm focal length within a spot of 1 mm^2 area on a cathode inside a discharge chamber, with the power density of incident radiation regulated by means of an attenuator. A space charge within a volume of 2.5x4.5x9 cm^3 was generated between this specially shaped cathode and a mesh anode with an approximately 50% optical transmission coefficient, both electrodes having been made of stainless steel. The space charge in helium and in neon was photographed, and the time lag of a discharge pulse behind a contracting laser pulse was measured as function of the laser pulse energy for these two gases, as well as for a $He+Cl_2$ gas mixture. The general trend was found to be the same in each case, the time lag increasing with increasing energy first at a slower rate up to a critical energy level and then faster. It has been established that plasma does not build up on the cathode before the laser pulse energy reaches 30 mJ (for a 3 mm^2 surface area), while plasma glow begins as the laser pulse energy reaches 150 mJ. A contracted channel begins to form within the laser-cathode interaction space, with an attendant fast increase of the time lag owing to evaporation of the cathode metal. That evaporation is the mechanism of space charge contraction and is confirmed by theoretical estimates, as well as by the observed absence of contraction in the absence of intense-evaporation channels. The authors thank N.Ya. Smirnov for assistance in building and setting up the experimental apparatus. Figures 4; references 8: 6 Russian, 2 Western (1 in Russian translation).
[504-2415]

UDC 621.378.826.038.825.4

HIGH-FREQUENCY AMPLITUDE NOISE IN STRIP-LINE INJECTION LASERS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 5, May 85 (manuscript received 1 Aug 84) pp 1116-1118

VASILYEV, M.G., RIVLIN, L.A., SOLODKOV, A.F., KHARCHEV, A.V., TSAGERADSKIY, V.B. and YAKUBOVICH, S.D., All-Union Scientific Research Institute of Optical Physical Measurements, Moscow

[Abstract] Amplitude fluctuation spectra of four injection lasers were measured over the 0.1-2.2 GHz frequency range, all four lasers being produced in the USSR with an approximately 10 μm wide strip-line or mesastrip-line active region suitable for continuous-wave operation at threshold currents of the order of 100 mA. These lasers are: 1) 32DL-103 multimode laser on a GaAl/As diheterostructure (0.85 μm wavelength); 2) ILPN-2 single-frequency laser on a GaAl/As diheterostructure operating near the threshold (0.87 μm wavelength); 3) LPN-1M single-frequency laser on a GaAs homostructure operating over a wide range of injection current with liquid-nitrogen cooling (0.85 μm wavelength); 4) InGa/PAs milliwatt heterostructure laser (1.3 μm wavelength). All four lasers were tested in steady-state operation and were monitored for absence of self-modulation noise. The measurements covered the frequency dependence of the noise intensity at various injection levels and the injection current dependence of the noise intensity at the 100 MHz frequency, also the power-current characteristic of each laser. The differences between the four lasers in terms of their noise characteristics were found to correlate with the differences in the modal content of their emission. Figures 2; references 11: 3 Russian, 8 Western.
[504-2415]

UDC 621.373.9

SWEEP LASER ON NEODYMIUM GLASS WITH ELECTRONIC CONTROL OF EMISSION KINETICS AND EMISSION SPECTRUM

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 5, May 85 (manuscript received 29 Aug 84) pp 1091-1094

KRAVCHENKO, V.I. and TARANOV, V.V., Institute of physics, UkSSR Academy of Sciences, Kiev

[Abstract] A solid-state laser on neodymium glass is described which features wavelength sweeping by electronic rather than mechanical control of the emission kinetics and the emission spectrum. A stable basic operating mode and a luminance of each radiation spike, even at high sweep rates, were attained by active Q-switching of the dispersive resonator during its tuning.

Using an acoustooptical deflector-modulator for this purpose was tried as a novel approach to facilitating electronic control. In the experiment an LGS24-5 laser 5 mm in diameter and 70 mm long was pumped with an IFP-800 flashlamp. The dispersive resonator was formed by a plane mirror with a high reflection coefficient and a holographic diffraction grating on bichromated gelatin with a lead-in glass wedge serving as holographic selector of total internal reflection. The acoustooptical device also serving as telescope with 2.4x magnification, placed between the active laser cell and the holographic selector, consisted of a TeO_2 crystal and an $LiNbO_3$ plate with a cut corresponding to a resonance frequency of 40 MHz. A sound guide vacuum-soldered to that plate terminated into an indium wedge as sound absorber at the other end. The device was controlled by a frequency synthesizer through an electronic commutator for discrete frequency regulation and smooth signal length regulation at each frequency, with constant signal power maintained by means of an LC matching circuit. The intensity of individual radiation spikes in each laser packet was varied through control of the sinusoidal envelope of the high-frequency input signal to the acoustooptical deflector-modulator. The laser emission wavelength was varied through programmatic electronic control during laser pumping, namely, through frequency control of the deflector-modulator input signal, a definite spectral line corresponding to each laser pulse or spike packet. The position of the emission spectrum, within the luminescence band of neodymium glass, was found to be determined by the mutual orientation of the holographic selector and the acoustooptically deflected laser beam. This arrangement allows a wide range of regulation, while the initial wavelength and the positions of the other wavelengths in the spectrum are determined by the synthesizer frequency alone and do not depend on the spread of pumping energy. Figures 4; references 7 (Russian).
[504-2415]

UDC 621.373.826.038.823

STIMULATED RAMAN SCATTERING OF RADIATION FROM PERIODIC-PULSE ELECTRIC-DISCHARGE XeCl-LASER IN COMPRESSED HYDROGEN

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 5, May 85 (manuscript received 20 Sep 84) pp 1110-1102

BARANOV, V.Yu., BORISOV, V.M., VINOKHODOV, A.Yu., KIRYUKHIN, Yu.B. and STEPANOV, Yu.Yu., Institute of Atomic Energy imeni I.V. Kurchatov, Moscow

[Abstract] Stimulated Raman scattering in a compressed gas widens the spectral range of excimer lasers and in the case of an XeCl-laser (308 nm wavelength) shifts its radiation into the visible region, a major problem here being to increase the conversion efficiency. An experimental study of this problem was made with a wideband periodic-pulse XeCl-laser and with compressed hydrogen as the most suitable medium, because it provides the largest possible Stokes shift with a sufficiently high gain. A single-pass

oscillator scheme was used so as to more easily avoid four-wave mixing and thus limiting the efficiency of conversion into higher-order Stokes lines. Pumping was done by electric discharge, making high pulse repetition rates up to 10^3 Hz and high average emission power up to 130 W technologically feasible. The main purpose of the experiment was to establish the feasibility of stimulated Raman scattering without gas pumping at high pulse repetition rates. The active medium was an HCl:Xe:Ne = 1:10:1000 gas mixture under a total pressure of 4 atm, emitting pulses of up to 0.6 J energy and of 40 ns duration at repetition rates up to 50 Hz. A plane-parallel unstable resonator 1 m long with 2.4x magnification was formed by an aluminum mirror and a CaF_2 plate without coating, the plane-parallel configuration minimizing the laser beam divergence to within 10^{-3}-10^{-2} rad without special devices. The laser radiation was focused on a test cell through either of two quartz lenses, a sharp one (focal length 0.6 m) or a soft one (focal length 2.0 m), a part of the energy being diverted to a calorimeter. Radiation of the first three Stokes lines (353 nm, 414 nm, 499 nm), as well as the pumping radiation, were dispersed by a quartz prism and focused alternately by each quartz lens, the sharp lens also revealing a weak fourth Stokes line and a weak first anti-Stokes line. Measurements have revealed that the energy of each Stokes line increases as the gas pressure is increased, and the conversion efficiency increases as the pumping power density is increased. Considering that the gain of collisional Raman transitions does not depend on the gas pressure within a certain pressure range, which for hydrogen is 8-150 atm, pressures up to 20 atm are adequate as well as technologically preferable to higher pressures. Conversion efficiencies of 33%, 15%, and 2.5%, respectively, were attained for the first three Stokes lines at 20 atm, with the total energy of laser emission 28-350 mJ. Figures 3; references 11: 5 Russian, 6 Western.
[504-2415]

UDC 621.373.826.038.823

GAIN AND SATURATION POWER OF CO_2 WAVEGUIDE LASER WITH LONGITUDINAL CAPACITIVE AC DISCHARGE

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 5, May 85 (manuscript received 3 Oct 84) pp 1102-1105

ANTYUKHOV, V.V., GLOVA, A.F., KACHURIN, O.R., LEBEDEV, F.V. and YARTSEV, V.P., Institute of Atomic Energy imeni I.V. Kurchatov, Moscow

[Abstract] An experimental study of a continuous-wave CO_2 waveguide laser with capacitive ac discharge was made, mainly for measuring its small-signal gain and saturation power but also for verification of applicable similarity laws. Such a laser was excited with longitudinal capacitive ac discharge at frequencies of 5-100 kHz, its operation stabilized in a single mode with a 0.5-25 W regulation of the output power and with diffusion cooling. Two active mixtures were tested, CO_2:N_2:He = 1:1:3 and CO_2:N_2:He = 1:1:6, pumped

through glass tubes 1.3, 2.5, 5.5, and 10 mm in diameter at a velocity of 1 m/s under pressures of 20-60 mm Hg. Electrodeless discharge was effected through metal rings around the tubes. The steady-state temperature drop from tube axis to tube wall was measured, as function of the electric input power per unit length of positive column. Small-signal gain and saturation output power were measured as functions of the gas pressure. Similarity laws were established with respect to the variables pR, W_{el}, Jp, J/R, E/N (p - gas pressure, R - tube radius, W_{el} - electric input power, J - radiation intensity, E - electric field intensity, N - electron concentration) and in the case of a uniformly widened emission line also W_s (saturation power) and K_0 (small signal gain). The results are compared with available analogous data on pumping of such a laser with self-sustained dc discharge, pulse discharge, and high-frequency discharge. Capacitive ac discharge is technologically preferable, because of its relative simplicity, and because it avoids contamination of the gas-discharge plasma by products of electrode corrosion. Figures 3; tables 1; references 13: 4 Russian, 9 Western.
[504-2415]

UDC 621.373.826.038.824

CERENKOV LASER OPERATING IN MODE OF TOTAL INTERNAL REFLECTION

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 5, May 85 (manuscript received 27 Mar 84, after completion 23 Nov 84) pp 1058-1063

OGANESYAN, S.G., Scientific Research Institute of Physics of Condensate Media, Yerevan State University

[Abstract] A Cerenkov laser with total internal reflection of the electromagnetic wave in a dielectric waveguide and with the electron beam propagating above the waveguide surface is considered, its advantages being enlargement of the interaction space and elimination of multiple electron scattering. Calculations based on the Klein-Gordon quantum-mechanical equation reveal an absence of field amplification and beam modulation, inasmuch as the same electron, according to the corresponding dispersion equation, is involved in absorption and emission of a photon. A subsequent analysis based on waveguide theory and energy relations indicates a net amplification or attenuation when the ambient medium is a dielectric such as a gas rather than vacuum. The classical gain is calculated first for an electron beam with a Gaussian energy distribution moving parallel to the waveguide and then for an interaction space of finite length, specifically with the waveguide inside a ring resonator. In the former case the gain is determined by the width of the energy spread in the electron beam. In the latter case the gain is determined by the envelope of the spectrum of spontaneous radiation from the beam electrons. As the wavelength becomes smaller, the gain in the first mode decreases fast till it becomes equal to and then smaller than the gain in the second mode, while the latter gain

remains constant. The author thanks V.M. Arutyunyan for discussing the results. References 10: 7 Russian, 3 Western (1 in Russian translation). [504-2415]

UDC 621.378.325

CHAIN-REACTION HF-LASER WITH TRIGGERING REACTANT ON STANDING DETONATION WAVE

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 5, May 85 (manuscript received 25 Jun 84) pp 1034-1038

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

[Abstract] An autonomous supersonic HF-laser on chain reaction had been proposed by N.G. Basov and A.N. Orayevskiy in 1967, subsequently combined with "firing" of the chain reaction at the front of a stationary compression shock by V.A. Shcheglov in 1970, and then experimentally realized by J.P. Moran in 1977. Schematically, an F_2-He primary mixture at room temperature is discharged from a gas generator into a supersonic channel where it expands and cools down. At a certain distance downstream, an H_2-NO secondary mixture is injected, and both mixtures then flow together till they are completely blended without having chemically reacted (because at low temperatures the "priming" reaction $F_2 + NO \xrightarrow{k_0} F + NOF$ is extremely slow, with $k_0 \approx 10^{-17}$ cm^3/s at $T \approx 100$ K). The energy characteristics and performance indicators of such a laser are evaluated theoretically, assuming a primary mixture highly diluted in helium, with emphasis on the subsequent chain reaction as pumping mechanism. Two characteristic situations are considered, namely, a stoichiometric mixture with $[H_2]_0 = [F_2]_0$ and a nonstoichiometric one with $[H_2]_0 \ll [F_2]_0$, with the concentration of the triggering reactant NO assumed to remain constant or almost constant. The equations of vibrational kinetics in the radiation field of a continuous chemical laser are applied here, including VT-relaxation and VV-exchange, a peculiarity of an HF-laser being that the probability of quenching vibrational states is proportional not to the level number but to the level number cubed, so that the model of a harmonic oscillator is not valid here. Numerical estimates for an H_2:F_2:NO:He = 1:5:2:30 molar mixture at a temperature of 450 K indicate the feasibility of extracting an energy of 180 J/g within an 80% wide lasing band, at a chemical efficiency of 12.5% and a quantum efficiency of 30%. Figures 1; tables 1; references 11: 4 Russian, 7 Western.
[504-2415]

UDC 621.373.826.038.823

EFFICIENCY OF RADIATION EXTRACTION FROM RESONATOR IN LASERS WITH SHORT EMISSION PULSE

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 7, Jul 85 (manuscript received 10 Jul 84) pp 1377-1386

BOROVICH, B.L. and YURCHENKO, N.I.

[Abstract] The efficiency of radiation extraction from the unstable resonator of a copper-vapor laser, a laser on self-limiting transitions with a correspondingly short emission pulse, is calculated by the Monte Carlo method and thus on the basis of "radiation portion" or "photon" amplification statistics along random trajectories. The resonator efficiency is defined as the ratio of radiation energy leaving the exit mirror to total energy leaving the active cell, per pulse. This efficiency is calculated first for an active cell of a fixed length with almost nonreflecting lateral walls, depending on the reflection coefficient of the semitransparent resonator mirror and depending on the resonator length. Calculation of the energy is based on the excitation kinetics and the probabilities of lasing transition. An active cell of the same length but with either specularly or diffusely reflecting lateral walls is considered next, and the efficiency of radiation extraction is calculated as a function of their reflection coefficient in each case. Numerical results reveal that the energy loss associated with nonaxial radiation and its reflection by the lateral laser walls do not significantly depend on the laser operating mode, but are determined principally by the ratio of characteristic photon lifetime in the resonator to characteristic emission buildup time, in the first approximation, and amount to 20-50% on the average in a typical copper-vapor laser. Avoidance of nonaxial radiation thus imposes an upper limit on the ratio of laser length to pulse duration for design and performance evaluation. The authors thank V.V. Buchanov for discussing the results and for valuable comments. Figures 5; tables 2; references 10: 6 Russian, 4 Western.
[582-2415]

UDC 621.373.826.038.823

SMOOTHLY TUNABLE RAMAN NH_3-LASER WITH PUMPING AT 9R(16) LINE OF CO_2-LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 7, Jul 85 (manuscript received 17 Jul 84) pp 1414-1419

AKHRAROV, M., VASILYEV, B.I., GRASYUK, A.Z., YEFIMOVSKIY, S.V. and KURBASOV, S.V., Institute of Physics imeni P.N. Lebedev, USSR Academy of Sciences

[Abstract] An experimental study of an NH_3-laser was made, such a laser emitting radiation at wavelengths beyond the range of a CO_2-laser and also

being smoothly tunable. Its active medium was pumped with a CO_2-laser at the wavelength of the latter's 9R(16) line, the frequency of this pumping laser with a CO_2:N_2:He = 1:1:4 active mixture being smoothly variable from pulse to pulse. The pumping radiation intensity was varied over the 1-10 MW/cm^2 range, a high intensity being attained by amplification in a triple-pass configuration. The ammonia pressure was varied over the 1-15 mm Hg range, for determining the pressure dependence of the laser performance. The efficiency of emission was found to peak to approximately 10% at a pressure of approximately 4 mm Hg. The deviation of emission frequency from pumping frequency and thus the tuning range were found to increase with increasing pressure up to approximately 700 cm^{-1} at pressures of approximately 8 mm Hg and higher. The results indicate that the mechanism of emission in such a laser, at the 12.8 μm wavelength, is Raman scattering of the pumping radiation, without a noticeable dynamic Stark effect. Figures 5; references 18: 2 Russian, 16 Western.
[582-2415]

UDC 621.373.826.038.823

LUMINESCENCE SPECTRA OF XeF_2 EXCITED BY RADIATION FROM Xe_2* AND Kr_2* EXCIMERS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 7, Jul 85 (manuscript received 19 Jul 84) pp 1425-1430

BASOV, N.G., DANILYCHEV, V.A., DOLGIKH, V.A., KERIMOV, O.M., SAMARIN, A.Yu. and TAMANYAN, G.Yu., Institute of Physics imeni P.N. Lebedev, USSR Academy of Sciences, Moscow

[Abstract] An experimental study of spontaneous emission from XeF* molecules at their B-X transition was made, with electron-beam excitation of XeF_2 mixtures with better than 99.98% pure Ar, Xe, Kr, or N_2 as buffer gas. A beam of 250 keV electrons, with a current of 30 A in pulses of 1.5 μs duration, was used for excitation of xenon under atmospheric pressure. The resulting radiation from Xe_2 molecules was extracted through a CaF_2 window into a vessel containing the mixture of XeF_2 and the buffer gas after having been prepassivated with fluorine and then evacuated. The radiation spectrum of XeF* molecules at their B-X transition were photographed on RF-3 film with a 0.1 nm resolution, the luminescence spectra of XeF_2* and Xe_2F* molecules were photographed on aerial-grade 29 film with a 2.5 nm resolution. The power of spontaneous emission from XeF* molecules at their B-X transition was measured as a function of buffer gas pressure, the data revealing vibrational relaxation of levels and intensification of emission lines at some pressure. The data also reveal that photodissociation of XeF_2 molecules results in formation of XeF* molecules essentially at the first five vibrational levels of the B-state, emission of red light resulting from the three-particle process XeF* + Xe + (Ar,Xe,Kr,N_2) $\longrightarrow$ Xe_2F* + (Ar,Xe,Kr,N_2) with almost the same rate of XeF*(B) quenching by XeF_2

molecules at each of the five vibrational levels. Figures 3; tables 1; references 13: 2 Russian, 11 Western.
[582-2415]

UDC 621.373.826.038.823

ENERGY EFFICIENCY OF VARIOUS METHODS OF IONIZING ACTIVE MEDIA FOR GAS LASERS WITH NONSELF-SUSTAINED DISCHARGE

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 7, Jul 85 (manuscript received 25 Jul 84) pp 1459-1464

POLSKIY, Yu.Ye., AYBATOV, L.R. and KHOKHLOV, Yu.M., Kazan Institute of Aviation imeni A.N. Tupolev

[Abstract] The energy efficiency of ionizing the active medium for a gas laser with nonself-sustained discharge is defined and evaluated for general preionization and three methods of principal ionization, the factors being established which determine the most effective use, as well as the limitations of each method. For ionization with an electron beam, the optimum product of gas pressure and discharge gap length is limited from below by the threshold electron energy for transparence of shield, typically an aluminum or titanium foil. Efficiency and nonuniformity of ultraviolet ionizing radiation are determined not only by the product of gas pressure and discharge gap length but also by the composition of the active mixture. Efficiency of ionization with high-voltage pulses depends on maintenance of the optimum ratio of electric field intensity to gas pressure, the product of gas pressure and discharge gap length not being relevant here. Figures 4; references 23: 19 Russian, 4 Western (1 in Russian translation).
[582-2415]

UDC 621.373.826.038.823

STEADY-STATE MODE LOCKING IN Ar^+-LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 7, Jul 85 (manuscript received 12 Oct 84) pp 1503-1510

GAFUROV, Kh.G., KRINDACH, D.P. and YAKOVLEV, A.G., Moscow State University imeni M.V. Lomonosov

[Abstract] Steady-state emission from and Ar^+-laser with passive mode locking is evaluated, considering that it depends on the small-signal gain and absorption coefficient, as well as on the resonator losses, the cross-section and the relaxation time for amplification and for absorption, the

cross-section of the light beam, and the interval between pulses in both amplifier and absorber. An experiment was performed with an Ar^+-laser emitting continuous trains of pulses at the 488 nm wavelength with an average power of 0.3-0.5 W, the pulse duration being of the order of 100 ps and the interval between pulses being of the order of 10 ps. Two GL-301 gas-discharge tubes were used in the experiment, an 80 cm long one with normal argon pressure as amplifier and a 15 cm long one with higher argon pressure as absorber. Measurements under the condition for steady-state emission with passive mode locking have yielded the pattern of pulse propagation through the resonator, the gain-time characteristic and its dependence on the pulse train structure, the gain dependence of the emission characteristics, and the dependence of the maximum density of luminous energy in both resonator and absorber on the small-signal absorption coefficient, on the time interval between equidistant pulses, and on the S-parameter. Analysis of the results indicates optimal performance with a pulse duration not shorter than 90 ps but necessarily much shorter than the relaxation time in both amplifier and absorber, and with the time interval between pulses over the 5-15 ps wide range. With an S-parameter approximately equal to or larger than optimum ($S_{opt} = 2.8$), high stability of the pulse repetition rate ($\Delta F/F \approx 2 \cdot 10^{-5}$) was attained with a small-signal absorption coefficient $K_0 > 0.15$, $S = S_{opt}$ being necessary for time intervals between pulses longer than the relaxation time in the amplifier, and $S > S_{opt}$ being permissible for time intervals between pulses equal to or shorter than that relaxation time. The authors thank V.T. Platonenko for valuable discussions. Figures 6; references 10: 6 Russian, 4 Western. [582-2415]

UDC 621.373.826.038.825.4

CdS AND GaAs PULSED LASERS WITHOUT COOLING WITH LONGITUDINAL ELECTRON-BEAM PUMPING

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 7, Jul 85 (manuscript received 21 Jan 85) pp 1517-1519

BOGDANKEVICH, O.V., ZVEREV, M.M., KOSTIN, N.N., KOPYT, S.P., KRASAVINA, Ye.M., KRYUKOVA, I.V., MATVEYENKO, Ye.V., PEVTSOV, V.F., USHAKHIN, V.A. and YAKUSHIN, V.K., All-Union Scientific Research Center for Study of Surface and Vacuum Properties, Moscow

[Abstract] High-power high-efficiency pulsed lasers without cooling on CdS and GaAs crystals with high quantum yield were attained by optimization of both structure and technology. Semiconductor wafers were bonded to or deposited on transparent leucosapphire single crystals as substrate, whereupon they were cut into separate cells and the slots between the latter filled with a light absorbing material. An opaque mirror with a 100% reflection coefficient was laid on one side of a polished plane-parallel plate facing an electron beam through an iris, a semitransparent exit mirror

with a reflection coefficient variable over the 20-90% range being laid on the other polished side of that plate. With the reflection coefficient of that exit mirror equal to 40-50% and with the area of exposed active semiconductor surface approximately $5 \cdot 10^{-4}$ cm^2, longitudinal pumping by an electron beam of 200 keV energy and up to 1000 A/cm^2 current density in single pulses of 10 ns duration yielded an average efficiency of 2-8% and a maximum efficiency of 10-15% with the best-quality crystals. The laser output power was measured as function of the pumping current density. A maximum laser pulse power of 9 MW and 1.7 MW was attained, respectively, with a CdS target emitting over an area of approximately 7 cm^2 and a GaAs target emitting over an area of approximately 1 cm^2, the energy in a light pulse being correspondingly 55 mJ and 17 mJ. The target structure before and after breakdown by intrinsic laser radiation, with only partial optical decoupling of laser target cells, was monitored on photographs. Figures 3; references 2 (Russian).
[582-2415]

UDC 621.373.826.039.825.4

MULTICELL SEMICONDUCTOR PULSED LASER WITH UNSTABLE RESONATOR

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 7, Jul 85 (manuscript received 21 Jan 85) pp 1519-1521

BOGDANKEVICH, O.V., VOROBYEV, N.D., ZVEREV, M.M., KOPYT, S.P., KRASAVINA, Ye.M., KRYUKOVA, I.V., PEVTSOV, V.F., USHAKHIN, V.A. and YAKUSHIN, V.K., All-Union Scientific Research Center for Study of Surface and Vacuum Properties, Moscow

[Abstract] An unstable resonator was used experimentally for a multicell semiconductor laser with electron-beam pumping so as to most efficiently suppress spontaneous radiation of nonaxial reflected modes. The active region was a 150 μm thick plane-parallel CdS single crystal on a 10 mm thick sapphire disk as substrate, cut by 70 μm wide slots into a grating with a 300 μm period. The slots were filled with a light absorbing material, for optical decoupling of the cells. The top side of the disk facing the electron beam had an optically reflective coating, while its back side was cleared for light at the emission wavelength. The plane-convex resonator included a convex exit mirror with a radius of curvature which could be varied over the 20-60 mm range and a lens with a focal length of 150 mm for wavefront correction. The laser was pumped by an electron beam 10 mm in diameter, of 200 keV energy, and with a 300-500 A/cm^2 current density, in pulses of 10 ns duration. Measurements of the intensity distribution over the surface of the active region and of the intensity distribution in the far field have revealed a much narrower radiation pattern with this unstable resonator than with a plane one, and a half-width of 30' as compared with a half-width of 10°. With a 60% reflection coefficient of the exit mirror and a 14 mm long resonator, the attained emission power was 200 kW and thus not much lower than 250 kW with a plane resonator. Breakdown of the active

region by the field of the reverse light wave was monitored on photographs. Figures 2; references 5 (Russian).
[582-2415]

UDC 621.373.826.038.823

HIGH-PRESSURE POWER LASER ON 3p-3s Ne-I TRANSITIONS AT 703 nm AND 725 nm WAVELENGTHS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 7, Jul 85 (manuscript received 25 Jan 85) pp 1521-1524

BASOV, N.G., BARANOV, V.V., DANILYCHEV, V.A., DUDIN, A.Yu., ZAYARNYY, D.A., USTINOVSKIY, N.N., KHOLIN, I.V. and CHUGUNOV, A.Yu., Institute of Physics imeni P.N. Lebedev, USSR Academy of Sciences, Moscow

[Abstract] Quasi-continuous emission at 3p $[1/2]_1$ - 3s $[3/2]^0_2$ and 3p $[1/2]_1$ - 3s $[3/2]^0_1$ transitions in neon-I was attained by depletion of the long-life lower 3s laser levels. For this purpose, mixtures of Ne or He-Ne and Ar, Kr, or Ar-Kr as quencher in various ratios were pumped with a beam of fast electrons. Maximum power of red light emission at 703 nm and 725 nm wavelengths was attained with a He/Ne:Ar/Kr ≈ 20:1 ratio, along with intense emission of infrared light at 1.79 μm and 2.40 μm wavelengths on 3d-4p transition in argon, as well as at 2.52 μm and 3.06 μm wavelengths on 4d-5p and 6p-6s transitions in krypton. Measurement of the dependence of energy output and efficiency on the pressure of active mixture over the 1-3.5 atm range reveal that both peak at a pressure of approximately 2.5 atm, the energy output reaching 240 mJ at an efficiency of 0.1%. Complete conversion of energy from the 703 nm wavelength to the 725 nm wavelength was achieved through variations of the Kr:(Kr+Ar) ratio from 1 to 0. The mechanism of pumping and thus populating the upper laser levels is not yet understood, most likely being chain reactions which involve neon atoms and ions in mixtures without helium or formation and dissociation of complex $HeNe^+$ ions in mixtures containing helium. Figures 4; references 12: 8 Russian, 4 Western.
[582-2415]

UDC 621.378.325

WAVEGUIDE LASER WITH PASSIVE LiF:F_2^- SHUTTER

Minsk DOKLADY AKADEMII NAUK BSSR in Russian Vol 29, No 10, Oct 85 (manuscript received 28 Mar 85) pp 886-888

BOYKO, B.B., academician (BSSR Academy of Sciences), VASILYEV, N.N., VASHKEVICH, I.M., UVAROVA, N.N. and SHKADAREVICH, A.P., Institute of Solid-State and Semiconductor Physics, BSSR Academy of Sciences

[Abstract] The performance of a passive LiF:F_2^- shutter for Q-switching was evaluated in an experiment with a GLS-1 neodymium-glass laser. As active element, a 120 mm long pentahedral prism with one right base and one oblique base was used. Plane-parallel LiF plates with color centers produced by exposure to γ-radiation from a ^{60}Co source were mounted at an angle corresponding to the Brewster angle between the oblique base of the laser prism and the exit mirror of a waveguide resonator. The transmission coefficient of this shutter at the 1.064 μm wavelength increased from initial 0.4-0.6 to 0.96 after warm-up. The active element was placed in a luminaire with a single IFP-2000 lamp and a cylindrical specular reflector. The thresholds for emission of one and then two monopulses of 0.45 J energy (32.2% of free-emission energy) and 30 ns duration, with a beam divergence not exceeding $1.2 \cdot 10^{-3}$ rad in the selection plane, were pumping pulses of 800 J energy and 900 J energy, respectively - with a 42%-reflection resonator exit mirror. This performance, as well as stability of the monopulses in terms of shape and duration, indicate the advantage of a waveguide resonator over a flat one. Figures 2; tables 1; references 4 (Russian).
[34-2415]

EFFICIENT SMOOTH FREQUENCY TUNING OF INJECTION LASER WITH EXTERNAL DISPERSIVE RESONATOR

Leningrad PISMA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 11, No 13, 12 Jul 85 (manuscript received 19 Mar 85) pp 777-780

AKULSHIN, A.M., VELICHANSKIY, V.L., ZVERKOV, M.V., ZIBROV, A.S., NIKITIN, V.V., OKHOTNIKOV, O.G., SAUTENKOV, V.V., SENKOV, N.V., TARANENKO, V.B. and YURKIN, Ye.K., Institute of Physics imeni P.N. Lebedev, USSR Academy of Sciences, Moscow

[Abstract] The unique feature of injection lasers with external coupling, which other tunable lasers do not have, namely, additional discrimination of undesirable modes and thus a frequency range of continuous tuning much wider than the intermode interval was experimentally utilized for tuning such lasers with "self-stabilization of single-frequency emission." The dispersive resonator necessary for this purpose included a holographic

total-internal-reflection selector (dispersion coefficient 3200 mm^{-1}) or a diffraction grating (dispersion coefficient 600 mm^{-1}) with a Fabry-Perot etalon (dispersion range Δ = 15 GHz, sharpness F = 5). Both tuning range and continuity were monitored with the aid of a Fabry-Perot interferometer (Δ = 75 GHz, F = 5) acting as amplitude-frequency discriminator. The results of this experiment performed with various laser medium structures (strip, mesa, planar, separate limiting) reveal that self-stabilization does not depend on the structure but does critically depend on the technology. The conditions necessary for stabilization are adequate matching of the active region to the outer part of the resonator and a flux density of coherent radiation not lower than 0.1-1 MW/cm^2 with a selection band not wider than 20-40 times the intermode interval. The range of continuous tuning between longitudinal modes can be widened by increasing the emission power, on which the tuning band directly depends. This will be achieved by closer coupling, more powerful pumping, and shift of the selector band along the amplification line contour. Even an anomalously wide range of continuous tuning requires not more than a 10% increase of emission power. The authors thank A.P. Bogatov and P.G. Yeliseyev for making the manuscript of the relevant article (KVANTOVAYA ELEKTRONIKA Vol 10, 1983, pp 1851-1856) available. Figures 1; tables 1; references 3 (Russian).
[591-2415]

PECULIARITIES OF HIGH-CURRENT SPACE-CHARGE FORMATION IN CO_2-LASER WITH PLASMATIC ELECTRODES

Leningrad PISMA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 11, No 13, 12 Jul 85 (manuscript received 12 Mar 85) pp 786-790

ATANASOV, P.A., GOLUBCHENKO, V.P., KARLOV, N.V., KOVALEV, I.O., KUZMIN, G.P. and PROKHOROV, A.M., Institute of General Physics, USSR Academy of Sciences, Moscow

[Abstract] A CO_2-laser with plasma-sheet electrodes is considered, experiments having been performed with such a laser containing an active region 70x70 mm^2 in cross-section between the two electrodes. Measurements were made for determining the dependence of the interelectrode voltage on the composition and the pressure of the gas mixture, a representative mixture ratio being CO_2:N_2:He = 1:1:3 and the pressure being varied over the 0.25-1.0 atm range. The electrode circuit consisted of a controllable discharger and a discharge resistor in series, the latter shunted by a current peaking capacitor across the electrodes and both shunted by a storage capacitor for the sliding discharge. Measurements have yielded a linear dependence of pressure on voltage and a linear dependence of voltage on input energy to the active mixture during nonself-sustained main discharge with or without photoelectron multiplication, the input energy being consistently lower with photelectron multiplication. The results indicate the feasibility of attaining high-current space charge for a CO_2-laser by using plasma-sheet electrodes. The characteristics of sliding discharge were

found to improve with helium depletion and ionizing photoelectron multiplication was found to be most effective at the E/p ratio of electric field intensity to gas pressure corresponding to maximum laser efficiency. Figures 2; references 10 (Russian).
[591-2415]

STABILIZED He-Ne/$^{127}I_2$ LASER WITH COMPOUND RESONATOR EMITTING AT 612 nm WAVELENGTH

Leningrad PISMA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 11, No 13, 12 Jul 85 (manuscript received 19 Mar 85) pp 827-830

DANILEYKO, M.V., KRAVCHUK, A.L., TSELINKO, A.M. and YATSENKO, L.P., Institute of Physics, UkSSR Academy of Sciences, Kiev

[Abstract] The performance of an He-Ne/$^{127}I_2$ laser emitting at the 612 nm wavelength is evaluated, the resonator of such a laser being formed by three mirrors and a light-beam splitting plate. Absorption can here be saturated at the optimum level by matching the reflection coefficient R of that plate, as was done within the $2\% < R < 13\%$ range for single-mode emission over a 1200 MHz frequency range in an experiment with a ^{3}He:^{20}Ne = 8:1 mixture. Nonlinear resonances were detected within that frequency range, 21 of them corresponding to the hyperfine structure of the iodine line R(47) and 17 others corresponding to the hyperfine structures of the iodine lines R(48) and P(48). The intensity of the third-harmonic signal was found to depend largely on that reflection coefficient R, on the iodine pressure, on the modulation amplitude, and on the losses in the passive resonator arm due to imprecise matching of Gaussian light beams in all resonator arms. Stability of emission was monitored by means of two identical lasers, one stabilized with respect to the m-component and one with respect to the n-component of the hyperfine R(47)-line structure. Stability was established by conventional measurement and analysis of beats, in terms of the Allan parameter and its dependence on the averaging time. The stability of this laser was found to be much higher than that of a He-Ne/I_2 laser with a Fabry-Perot resonator emitting at either the 612 nm wavelength or the 633 nm wavelength (now used as secondary standard for unit of length). Figures 2; references 4: 2 Russian, 2 Western.
[591-2415]

UDC 621.373:535

DYNAMIC CHARACTERISTICS OF Ar^+-LASER

Leningrad OPTIKA I SPEKTROSKOPIA in Russian Vol 59. No 1, Jul 85 (manuscript received 20 Apr 84) pp 155-160

AKCHURIN, G.G., SINICHKIN, Yu.P. and TUCHIN, V.V.

[Abstract] The results of earlier experimental studies pertaining to the dynamics of a multiwave Ar^+-laser are analyzed and evaluated for determination of the dynamic transfer of perturbations from discharge current to coherent induced radiation and to spontaneous radiation. The experimental laser was made to operate at four wavelengths (4765, 4880, 4965, 5145 Å) and 0.01-10% modulation of the discharge current at frequencies from 20 Hz to 5 MHz was effected by means of a modulator built on two KT802 transistors in parallel with the discharge tube, as well as with a 1 ohm segment of a ballast resistor. Measurements of the modulation transfer ratio m_P/m_{Id} as a function of the modulation frequency (m_P - modulation factor of laser output power, m_{Id} - modulation factor of discharge current) yielded a constant high ratio over the 10^3-10^5 Hz frequency range and a steep drop to a very low ratio at 10^6 Hz already, the high value of this ratio depending on the current level and on the repetition rate of excitation pulses. Measurements revealed no difference in the fluctuation dynamics upon transition from TEM_{mnq}-mode to TEM_{00q}-mode operation. This drop of the modulation transfer ratio or dynamic perturbation transfer coefficient at high modulation frequencies is attributed to sluggishness of the inverse populations at the laser levels and to sluggishness of the field in the resonator. This hypothesis is supported by calculations for a laser with a nonuniformly widening gain line and a discharge tube with recombination of ions at the wall. The fact that as the discharge current increases, so do the electron temperature and the potential difference across the radius of the discharge tube is also taken into consideration. The authors thank M.I. Lobachev for constructing the modulator. Figures 3; references 14: 10 Russian, 4 Western.
[573-2415]

UDC 621.378.325

SWEEP LASER ON NEODYMIUM GLASS WITH ELECTRONIC CONTROL OF RADIATION WAVELENGTH

Novosibirsk PERESTRAIVAYEMYYE PO CHASTOTE LAZERY in Russian 1984 (signed to press 12 Jul 84) pp 56-59

GALIN, G.A., KRAVCHENKO, V.I., ZAIKA, V.V., TARANOV, V.V. and SAMUSENKO, I.I.

[Abstract] The stability of a sweep laser during technological processes requiring strong interaction with the treated material can be increased by

means of stimulated Q-switching during its dynamic tuning. This was done experimentally with an acoustooptical deflector-modulator inserted into the resonator of a neodymium-glass laser. Using a resonator with angular dispersion facilitated electronic control of the radiation wavelength without the need for mechanical frequency tuning. The resonator was 100 cm long, formed by a 95%-reflection plane mirror and a 60%-efficient holographic total-internal-reflection selector with an angular dispersion of 5'/nm. The active element was a 70 mm long DGS-24-5 glass rod 5 mm in diameter, pumped by light pulses from an IFP-800 flashtube. The acoustooptical device with a 6x18 mm^2 aperture between the active element and the holographic selector consisted of a para-TeO_2 crystal (acoustic velocity 617 m/s) and a $LiNbO_3$ piezotransducer, the latter joined by cold vacuum diffusion welding to a sound guide and trimmed to size matching the given resonance frequency. The optical radiation was controlled by modulating with an electronic switch the high-frequency carrier of the frequency synthesizer, which served as source of acoustic excitation. The duration of control pulses could be varied over the 3-20 μs range, and their repetition rate could be varied over the 5-30 kHz range. The laser was successfully used in precision fabrication of thick-film resistors for hybrid integrated circuits. Figures 3; references 4 (Russian).
[563-2415]

UDC 621.373.826

SPECTRAL AND ENERGY CHARACTERISTICS OF LASERS ON LiF:($F_2 \rightarrow F_2^+$) AND LiF:F_2^- UNDER HIGH-INTENSITY PUMPING

Novosibirsk PERESTRAIVAYEMYYE PO CHASTOTE LAZERY in Russian 1984 (signed to press 12 Jul 84) pp 83-90

BASIYEV, T.T., KARPUSHKO, F.V., MIROV, S.B., MOROZOV, V.P., SASKEVICH, N.A., SINITSYN, G.V., TARANENKO, V.B. and SHKADAREVICH, A.P.

[Abstract] An experimental study of two LiF lasers with color centers was made for determining the feasibility of more efficient conversion of pumping radiation into tunable radiation. A YAG:Nd^{3+} laser was used as pumping source, emitting pulses of 1 J energy and 10 ns duration at fundamental repetition rates up to 10 Hz, in a beam with a diameter of 7 mm. LiF laser emission was obtained on F_2^+ with color centers, after preionization $F_2 \rightarrow F_2^+$ in the pumping channel. Three specimens of such a crystal were tested, each 3 cm long, two with their end facets parallel to the holder walls and one with its end facets perpendicular to the diagonal of the holder. With the LiF:F_2^- laser, all 8 cm long crystal specimens radiatively colored, emission was obtained after initial absorption of the pumping radiation at the 1.06 μm wavelength with a 0.5 cm^{-1} absorption coefficient. The first laser was tested for saturation time and efficiency buildup as functions of the pumping power density, also for the tuning range in terms of efficiency as function of the wavelength using a holographic selector, a

grating replica, or a prism as tuning device. The efficiency was found to peak within the 0.81-1.09 μm range of wavelengths and to be highest with a holographic selector. The second laser was tested for emission power and efficiency as functions of the pumping power density, both found to peak within the 80-110 MW/cm^2 range of the latter. The emission power was, moreover, found to peak at the 1.18 μm wavelength and the 0.59 μm wavelength, depending on the holographic selector used during quasi-longitudinal pumping. Optimization of the pumping system maximized the emission efficiency to at least 70%. Optimization of the tuning system and use of a holographic selector with a space frequency of 2100 mm^{-1} as dispersing device narrowed the emission line to 0.06 nm. Figures 4.
[563-2415]

UDC 621.373

STIMULATED EMISSION OF RADIATION FROM LiF:F_2^- CRYSTALS WITH COLOR CENTERS OPTICALLY PUMPED AT ROOM TEMPERATURE

Novosibirsk PERESTRAIVAYEMYYE PO CHASTOTE LAZERY in Russian 1984
(signed to press 12 Jul 84) pp 91-94

KARPUSHKO, F.V., MOROZOV, V.P. and SINITSYN, G.V., Institute of Physics, BSSR Academy of Sciences

[Abstract] An experimental study of radiatively colored LiF crystals as laser sources was made, its results establishing the feasibility of a tunable infrared laser on such crystals with optical pumping at room temperature. An excitation power density of 0.1-0.5 MW/cm^2 within the absorption band of these crystals was attained using available appropriate flashtubes, such high power levels being necessary for reaching the emission threshold and considering that no appreciable losses are induced over a period up to 150 μs or longer by pumping with quasi-continuous laser radiation. Crystal specimens were produced by IOF (Institute of General Physics, USSR Academy of Sciences) technology and irradiated by a luminaire consisting of four flashtubes with spectral selection. Electric discharge pulses of 730 J energy produced pumping pulses of 50 μs duration with a rise time not exceeding 10 μs. Amplification in a crystal was attained by optimization of the pumping spectrum selection. Stimulated emission in a crystal at room temperature was attained with the use of a 50 cm long resonator formed by a spherical mirror (1000 mm radius of curvature) and a plane exit mirror, the former opaque and the latter with a 0.7 reflection coefficient for radiation in the 1.1-1.3 μm wavelength band. An emission energy of 40 mJ, with its maximum near the 1.1.85 μm wavelength, was obtained at room temperature. The emission energy was found to decrease as the interval between emission pulses was decreased while the pumping level maintained constant, this process being slowed down by forced air cooling and possibly also by other factors. The original energy level was usually restored within 1-1.5 hours. The crystal specimens were produced by T.T. Basiyev and S.B. Mirov (Institute of General Physics, USSR Academy of Sciences). Figures 2; references 4 (Russian).
[563-2415]

UDC 621.373.826.038.825

ACTIVATED LiF CRYSTALS AS NOVEL ACTIVE MEDIA FOR TUNABLE LASERS

Novosibirsk PERESTRAIVAYEMYYE PO CHASTOTE LAZERY in Russian 1984
(signed to press 12 Jul 84) pp 98-104

PARFIANOVICH, I.A., KHULUGUROV, V.M., IVANOV, N.A., MIKHALENKO, A.A., CHEPURNOY, V.A. and SHKADAREVICH, A.P., Irkatsk State University imeni A.A. Zhdanov

[Abstract] An experimental study of LiF:OH and LiF:Me^{2+} (Me = Mg, Ni, Co) crystals was made, for establishing their suitability as active laser media. Specimens of these crystals were grown by the Kiropulos method in air, injection of OH ions being facilitated by moistening the raw material and then comminuting it so as to increase its active surface area. The LiF:OH crystals were activated with up to 10^8 R doses of γ-radiation from a ^{60}Co source at temperatures below 250 K, then pumped with second-harmonic radiation from a YAG laser. The LiF:Me^{2+} crystals were activated with up to 10^8 R doses of x-radiation, then pumped with second-harmonic radiation from a neodymium laser. The resonator was formed by two plane mirrors with respective reflection coefficients of 0.98 and 0.35 within the 750-1100 nm emission range, and each with a reflection coefficient of 0.1 at the 532 nm wavelength. Their absorption spectra and the luminescence spectra of their unstable and stable F_2^+ color centers were measured, also their energy characteristics in terms of efficiency as a function of wavelength and pumping power density. The results indicate the feasibility of operating such lasers for only 10-15 h at room temperature owing to thermal breakdown of F_2^+* centers but almost indefinitely at 270 K owing to thermal stabilization of F_2^+* centers. Figures 6; tables 1; references 9 (Russian). [563-2415]

UDC 621.375.826

POWER LASER ON COLOR CENTERS IN LiF WITH PULSE REPETITION RATE AND OPERATING IN 0.8-1.0 μm WAVELENGTH BAND

Novosibirsk PERESTRAIVAYEMYYE PO CHASTOTE LAZERY in Russian 1984
(signed to press 12 Jul 84) pp 109-111

LOKTYUSHIN, A.A., TROITSKIY, V.O., SUKHANOV, V.B., CHERNYSHOV, A.I., POTORELOV, Yu.L., BAYEV, S.Yu., SOLDATOV, A.N. and STROITELEV, A.D., Tomsk State University, Institute of Atmospheric Physics, Siberian Department, USSR Academy of Sciences

[Abstract] Following a preliminary feasibility study of a laser on color centers in LiF crystals pumped with coherent radiation from a metal vapor and emitting radiation pulses at the 0.9 μm wavelength with a repetition rate of

8-10 kHz, with high pulse energy (40 kW) and high average energy (2-3 W), another study was made for obtaining an efficient laser tunable over the 0.8-1.0 μm wavelength band. The first aim of this study was to refine the technology of crystal growth and thus ensure viability of the color centers as active laser sources. This aim has been reached by doping the crystals simultaneously with magnesium and hydroxyl, which shortens the half-life of color centers and increases their luminescence yield. The second aim was to refine the radiative treatment and to optimize the pumping. Treatment with a 107 R dose of x-radiation at -10°C temperature and subsequent pumping with radiation from a copper-vapor laser (511 nm and 578 nm) or gold-vapor laser (630 nm) directly, or from a copper-vapor laser through an oxazine-17 dye laser (630 nm) was intermediate pumping stage, resulted in efficient emission at 0.8-1.0 um wavelengths. The experimental LiF crystals were 2.5x2x0.5 cm^3 in size and doped to an Mg-concentration not exceeding 0.03 wt.%. The nonselective resonator was formed by two spherical mirrors, the entrance mirror with a 240 mm radius of curvature and the exit mirror with a 190 mm radius of curvature. Their reflection coefficients at the 910 nm wavelength were 1.0 and 0.5, respectively. The length of the resonator cavity was varied from 19 cm to 24 cm. Obtaining a laser depended critically on precise placement of the crystal in the resonator confinement, emission ceasing upon a slight displacement from the correct position. This restriction vanished completely and the laser efficiency increased appreciably, however, upon cooling to -25°C. References 1 (Russian). [563-2415]

UDC 621.373.826.038.824

NARROWING AND SHIFTING EMISSION LINE OF DYE LASER BY MEANS OF IODINE VAPOR ATTACHMENT

Novosibirsk PERESTRAIVAYEMYYE PO CHASTOTE LAZERY in Russian 1984 (signed to press 12 Jul 84) pp 349-351

ALEKSEYEV, V.A., KONSTANTINOV, B.A., MIKHALINA, T.I., TRINCHUK, B.F., USTINOV, N.G. and SHULENIN, A.V.

[Abstract] The characteristic feature of I_2-molecules, namely, the dense spectrum of vibrational-rotational levels in their combining electron states making the mean distance between their emission lines comparable with the width of their Doppler contour, has been experimentally utilized for narrowing the emission lines of continuously-pumped tunable dye lasers. In one such experiment iodine vapor was used during pumping of an LZhI-406 dye laser with a coaxial flashtube. Use of iodine vapor during pumping of etalon dye lasers on coumarin-30, coumarin-7, and rhodamine-6Zh emitting pulses of 1 μs duration and 0.1-50 mJ energy made possible narrowing their emission lines from 1.5 nm to 0.0035 nm and smooth tuning over the 500-610 nm range, through Fabry-Perot interferometers with 5100 nm and 1000 nm bases. The iodine-vapor cell was 265 mm long and 16 mm in diameter, with Brewster window. The saturated-vapor pressure was regulated by varying the

temperature of the extension pipe. The resonator for this iodine-vapor pumping laser was formed by two plane mirrors with a 1.9 mm thick quartz-plate selector. Its emission spectrum was found to consist of approximately $5 \cdot 10^5$ lines within the 0.66-1.25 μm range of wavelengths. Figures 1; references 5: 2 Russian, 3 Western.
[563-2415]

UDC 621.375.826

INVESTIGATION OF PARAMETERS OF ACTIVE MEDIUM OF ATMOSPHERIC-GAS CO_2 LASER

Tashkent IZVESTIYA AKADEMII NAUK UZSSR: SERIYA FIZIKO-MATEMATICHESKIKH NAUK in Russian No 2, Mar-Apr 85 (manuscript received 21 Jul 82) pp 65-68

SHUKUROV, N. and CHERKASOV, Ye.M., Tashkent Order of Friendship of Peoples Polytechnical Institute imeni ABU Raykhana Beruni

[Abstract] Amplification on the 00°1-01°0 transition of the CO_2 molecule in a gas-discharge CO_2 laser is investigated as a function of the parameters of the discharge and temperature variations, which have a strong influence on the rate of oxidation of the graphite electrode and on the relaxation processes of the excited molecules under different discharge conditions. The gain is investigated as a function of the time elapsed from the initiation of the discharge with the graphite electrode serving as the cathode and as the anode. The temperature variations occurring in the discharge, in which homogeneous and inhomogeneous chemical reactions occur, are analyzed. The increase in temperature with the increase in current and the increase in pressure is explained. The experimental gain measurements correlate well with the findings obtained in previous work by the authors. Figures 4; references 7 (Russian).
[493-6900]

UDC 535.36

UNSTEADY ENERGY EXCHANGE BETWEEN POWERFUL OPPOSING PULSES IN RESONANT ABSORBING MEDIUM

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 6, Jun 85 (manuscript received 23 Mar 83; after revision 27 Jan 84) pp 1006-1009

ABRASHIN, V.N., APANASEVICH, P.A., AFANASYEV, A.A., DRITS, V.V. and URBANOVICH, A.I.

[Abstract] A study is made of unsteady energy exchange between opposing pulses with arbitrary intensity relationship. This allows determination of the dynamic range of gain of radiation in resonant media due to this energy exchange. A threshold effect is observed. The threshold pumping power is

lowest at resonance, increasing rapidly with amplified radiation power. Energy is transferred from the high power to the low power pulse. One characteristic feature of resonant energy exchange is the possibility of amplifying the weak radiation upon excitation in the medium only by the amplitude component of the diffraction grating. Figures 2; references 4: 3 Russian, 1 Western.
[472-6508]

UDC 621.378.82

PULSED-PERIODIC YAG:Nd^{3+} LASER WITH UNSTABLE RESONATOR AND PASSIVE SHUTTER BASED ON LiF CRYSTAL WITH F_2^- DYE CENTERS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 6, Jun 85 (manuscript received 26 Jul 83; after revision 2 Apr 84) pp 906-910

RAKUSH, V.V. and STAVROV, A.A.

[Abstract] A study is presented of the specifics of generation of a YAG:Nd^{3+} laser using an unstable resonator and an LiF:F_2^- passive shutter. A diffuse reflector of MS-20 glass was used. The active element of 6.3 mm in diameter and 80 mm long had ends tilted at 2 degrees. Lower values of divergence of generated radiation are achieved, accompanied by a bell-like shape of the single pulse produced. The device can operate at high pulse repetition frequencies without significant power loss, indicating the promise of the use of passive shutters of the type studied in pulsed periodic YAG:Nd^{3+} lasers with unstable resonator. Figures 2; references 10: 6 Russian, 4 Western.
[472-6508]

UDC 535.37

SECONDARY EMISSION DURING EXCITATION OF HIGH ELECTRON STATES: SURVEY

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 43, No 1, Jul 85 (manuscript received 9 Jul 84) pp 5-24

KLOCHKOV, V.P. and BOGDANOV, V.L.

[Abstract] Secondary emission is an important source of information about ultrafast intramolecular photophysical and photochemical processes associated with high energy states, a particular area of usefulness being development and design of lasers on organic molecules. Extensive studies in this area have covered methods of exciting high-energy states and emission from short-life higher states, as well as emission from long-life lower states. The two basic methods of exciting higher states are direct $S_0 \rightarrow S_n$ transition upon abosrption of a photon with an energy

$h\nu_h \geq h\nu^{00}_{0n}$ (ν^{00}_{0n} - 0,0-frequency of $S_0 \rightarrow S_n$ transition) and stepwise population of the S_n state. Emission from high electron states depends on the energy gap ΔE_{21} between adjacent states involved in the transition, double luminescence occurring fast but being not so intense when the adjacent states are close and closeness or gap width being a relative concept associated with temperature. The emission characteristics and the luminescence spectra are determined essentially by the lifetime of the S_n states, that lifetime of higher states ($n > 2$) in all known organic molecules being short within the 0.01-1 ps range and in this case two-step excitation of such states being attended by anti-Stokes electron-vibrational scattering of light. The principal parameters of secondary emission are its quantum yield and duration, both functions of the state energy E_n. They also depend on the properties of the medium such as its viscosity, which contributes to polarization of luminescence and anisotropy of glow from long-life lower states or causing a shift of spectrum and vibrational relaxation in short-life higher states. Important from the practical standpoint are the mode and the efficiency of energy transfer through conversion of absorbed energy into secondary emission. Several dye lasers have been developed which perform well, rhodamine R6Zh alone or with POPOP, TOPOT, or BBOT being typical examples. Figures 8; tables 1; references 92: 48 Russian, 44 Western.
[555-2415]

UDC 621.378.5

SUBMILLIMETRIC-WAVELENGTH LASER ON DEUTERIUM-SUBSTITUTED ETHYL HALIDES

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 43, No 1, Jul 85 (manuscript received 26 Mar 84) pp 33-40

BUGAYEV, V.A. and SHLITERIS, E.P.

[Abstract] A total of 70 new submillimetric-wavelength laser transitions have been obtained in 12 vaporous or liquid isotopic ethyl halides, with up to three hydrogens replaced by deuteriums, suitable for spectroscopy with pumping by a low-pressure CO_2-laser. The active media include CH_3CHDX, CH_3CD_2X, CD_3CD_2X compounds with X = Cl, Br, I. Most of the transitions occur under a pressure within the 0.5-8 Pa range, with a pumping power of 2-10 W. The optoacoustic spectra have been measured, including infrared as well as submillimetric-wavelength series. A preliminary identification of transitions is proposed on the basis of the molecular structure with consideration of symmetry. The most intense transition of all is that at the 676.5 μm wavelength (9R26 pump line) in CH_3CD_2Cl, most intense absorption (1068-1095 cm^{-1}) occurs on the 9R branch of a CO_2-laser in CH_3CD_2I. Figures 3; tables 1; references 17: 3 Russian, 14 Western.
[555-2415]

UDC 621.378.5

CLEARANCE OF PASSIVE REGIONS IN GaAs HETEROSTRUCTURE LASERS WITH STRIP CONTACT

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 43, No 1, Jul 85 (manuscript received 6 Mar 84) pp 40-43

VORONIN, V.F., GRIBKOVSKIY, V.P., ZHUKOV, N.D., RYABTSEV, G.I. and SOSNOVSKIY, S.A.

[Abstract] An experimental study was made concerning saturation of radiation absorption by lateral passive regions in GaSb/AlGaAsSb heterostructures of injection lasers with strip contact. First of all, a clearance of GaSb single crystals beginning at an excitation level of approximately 50 W/cm^2 was discovered. Measurements were made on 67 μm thick p-type layers polished on both sides and doped with acceptors to a hole concentration of approximately $5 \cdot 10^{18}$ cm^{-3}. As probing radiation source, a GaSb/AlGaAsSb laser diode emitting at room temperature current pulses of 0.6 μs duration at the 1.697-1.7 μm wavelength at a repetition rate of 6 kHz was used. The results of measurements with an FD-7G photodiode on a D-4 laser heterostructure have yielded the dependence of the translucence and of the absorption coefficient in the passive region, as well as of the gain in the active region on both the emission intensity and the pumping current at three ambient temperatures (248, 251, 291 K). The absorption and amplification spectra of a D-7 laser diode were measured at 248 K with the pumping current varied over the 0.28-1.0 A range, also the emission characteristics of both its front face and back face. The results indicate that GaSb clears well, saturation of absorption by the passive regions being caused by laterally propagating radiation. Reduction of gain at high excitation levels contributes to appearance of laterally propagating high-intensity radiation within the corresponding spectral range. Figures 4; references 4 (Russian). [555-2415]

UDC 535.376

LUMINESCENCE OF MOLECULAR XENON IN Xe-Ar-NF_3 AND Xe-He-NF_3 MIXTURES EXCITED BY ELECTRON BEAM

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 43, No 1, Jul 85 (manuscript received 8 Feb 83, after completion 19 Feb 85) pp 49-54

DYMSHITS, Yu.I. and KOROBITSYN, V.A., deceased

[Abstract] Luminescence of molecular xenon in the vacuum-ultraviolet region was studied in an experiment with electron-beam excitation of Xe-Ar-NF_3 and Xe-He-NF_3 mixtures. The intensity of radiation of Xe_2^*, also from XeF*, was measured as a function of time and as a function of the NF_3 pressure over the

p_{NR_3} = (1-60)·10^3 Pa range with the partial pressures of xenon p_{Xe} = 10^5 Pa and of the other inert gas p_{Ar} = p_{He} = 10^6 Pa maintained constant throughout. All mixtures were excited with an electron beam of E_{max} = 300 keV energy and j = 140 A/cm^2 current density, in pulses of 5 ns duration. The results reveal a strong quenching of vacuum-ultraviolet Xe_2^* luminescence by even small amounts of NF_3, at the beginning of the pulse during conversion of xenon particles into xenon molecules, while ultraviolet XeF* luminescence begins and builds up with increasing concentration of those Xe_2^* molecules. Accordingly, an XeF* excimer is produced principally by deactivation of excited xenon particles (Xe^+, Xe**, Xe*, Xe_2**), predecessors of Xe_2^*, by NF_3 molecules. At low NF_3 pressure, however, the dissociation rate of Xe_2^* molecules upon collisions with NF_3 molecules does not exceed the quenching rate of Xe_2^* molecules in "pure" Xe-Ar mixture so that vacuum-ultraviolet luminescence still occurs, though attenuated. As the NF_3 pressure is increased, the time at which the ultraviolet pulse begins to fall approaches the time at which the mixture begins to become excited. The fraction of excited argon and Xe_2^* predecessor particles then increases so that they play an increasing role in the kinetics of XeF* generation and annihilation. Relaxation in helium mixture proceeds at a slower rate because xenon does not become resonantly excited there. Figures 3; references 4 Western (1 in Russian translation).
[555-2415]

NONLINEAR CONVERSION OF CW RADIATION TO SEQUENCE OF HIGH-POWER SHORT PULSES IN LIGHT GUIDE LASERS

Moscow PISMA V ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian
Vol 4, No 8, Apr 85 (manuscript received 31 Jan 85) pp 323-325

DIANOV, Ye.M., PILIPETSKIY, A.N., PROKHOROV, A.M. and SERKIN, V.N.,
Institute of General Physics, USSR Academy of Sciences

[Abstract] The possibility is investigated of employing fiber optic light guides to convert CW laser radiation to a periodic train of high-power short pulses with the help of a stimulated Brillouin scattering laser, in which Brillouin scattering is stimulated in a fiber optic light guide contained in the optical cavity. As lasing builds up, high-power short reverse-scattering pulses are formed that gather up all of the pumping energy stored during the cavity period in each successive pass through the light guide. The lasing dynamics of the stimulated Brillouin scattering laser are analyzed numerically within the framework of the plane wave model, with allowance for saturation and the finite relaxation time of the hypersonic wave. The pulse length obtained is an order of magnitude shorter than the relaxation time. It is suggested that the proposed method may be used for intracavity conversion of CW radiation from A CO_2 laser. Figures 2; references 9: 5 Russian, 4 Western.
[511-6900]

POSSIBILITY OF CONTROLLING LASER RADIATION BY MEANS OF STIMULATED MANDELSHTAM-BRILLOUIN SCATTERING IN OPTICAL FIBER

Leningrad PISMA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 11, No 7, 12 Apr 85 (manuscript received 2 Jan 85) pp 389-393

KUZIN, Ye.A. and PETROV, M.P., Institute of Engineering Physics imeni A.F. Ioffe, USSR Academy of Sciences, Leningrad

[Abstract] The possibility of switching high-intensity radiation by means of stimulated Mandelshtam-Brillouin scattering in an optical fiber is considered, this being one particular manner of controlling high-intensity light beams by low-power light pulses in a nonlinear medium. In the simplest scheme powerful pumping radiation at some frequency passes through a semi-transparent plate and a lens before it enters an optical fiber. In the absence of control this radiation passes through the fiber without obstacles and reaches an output channel at the fiber exit. When a control radiation from a source at the fiber exit is simultaneously sent through the fiber in the opposite direction, at a frequency equal to the pump frequency minus the frequency shift caused by Mandelshtam-Brillouin scattering, then nonlinear interaction of the two waves produces a hypersonic wave in the fiber. Subsequent interaction of the three waves can result in a complete transfer of energy from the pumping wave to the control wave, with the latter now carrying all radiation into another channel at the fiber entrance. An estimate of the control radiation power necessary for such a switching is made on the basis of the two equations $\delta I_S/\delta z = -gI_SI_P$ and $\delta I_P/\delta z = -gI_SI_P$ in the theory of steady-state Mandelshtam-Brillouin scattering with a Stokes wave carrying the control radiation (I_P - intensity of pumping radiation, I_S - intensity of Stokes radiation, g - coefficient of stimulated Mandelshtam-Brillouin scattering, coordinate z = 0 at fiber entrance and z = L at fiber exit). For a quartz fiber (hypersonic wave velocity $v_{hs} = 6 \cdot 10^5$ cm/s, width of Stokes line 74 MHz for pumping radiation at 6328 Å wavelength, $g = 5 \cdot 10^{-9}$ cm/W) such an estimate yields a control pulse of $2.5 \cdot 10^{-9}$ J energy or approximately 25 MW for a switching speed of the order of 100 ns, considering that the relaxation time for a hypersonic wave in fused quartz is of the order of 10 ns. This estimate was verified experimentally with a multimode fiber 7 m long and 30 μm in core diameter. Pumping pulses of 30 W power and 200-300 ns duration from a ruby laser were applied at one end. Upon application of a control pulse of 3 W power at Stokes frequency from the other end, 70% of all pumping energy was switched from one channel to the other. This discrepancy with the theoretical estimate is attributable to multimodality of the fiber, which causes fast depolarization of both pumping and control waves. Figures 2; references 3 (Western). [510-2415]

HIGH-POWER HIGH-PRESSURE VISIBLE GAS LASER ON 3p-3s TRANSITIONS IN NEON ATOMS

Leningrad PISMA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 11, No 7, 12 Apr 85 (manuscript received 21 Jan 85) pp 435-438

BASOV, N.G., ALEKSANDROV, A.Yu., DANILYCHEV, V.A., DOLGIKH, V.A., KERIMOV, O.M., MYZNIKOV, N.F., RUDOY, I.G. and SOROKA, A.M.

[Abstract] Producing a powerful quasi-continuous visible laser on 3p-3s transitions in neon atoms by electron-beam pumping is considered, such a vacuum-ultraviolet laser on transitions in excimer molecules and an infrared laser on transitions in xenon atoms having already been successfully produced. Despite the availability of a large cross-section for stimulated emission and of an efficient mechanism for populating the lower $np^5(n+1)s$ levels, the problem in producing a visible laser in this class is the slow populating of the lower (n+1)s level. The energy of the resonance level in neon is 16.72 eV, higher than the ionization potential of most available "quenchers" of that lower laser level. In order to effect inversion through dissociative electron-ion recombination, a selective "quenching" atom or molecule must be one to which a Ne_2^+ ion transfers charge at a slow rate. Use of a binary mixture under high pressure is problematic, because of the fast intrinsic quenching of the 3p-3s laser transitions. A buffer gas is needed, therefore, helium being the only suitable one for neon because of the slower charge transfer to the "quencher" than to helium. An analysis of the process kinetics indicates that the optimum neon concentration is determined by a tradeoff between intrinsic quenching of the upper laser level and the charge transfer from helium to neon with attendant recombination of the molecular He_2^+ ions. Then krypton can be used for scattering the lower laser level. The efficiency of steady emission will correspondingly be maximum under steady pumping such that $j_e \cdot p_{He} \sim 10$ (mA/cm^2)·atm (j_e - current density in the electron beam, p_{He} - pressure of the buffer gas), with a power of 100 W/cm^3, for which the neon pressure should be 10-30 torr. These estimates were verified experimentally with a 250 keV pumping electron beam of 20x200 cm^2 cross-section. The resonator cavity was formed by a 99.5%-reflection mirror and a 75%-reflection mirror, each 5 cm in diameter, spaced 220 cm apart. Excitation of the active medium was achieved with an electron beam from a "cold"-cathode accelerator in pumping pulses of 0.5 μs duration, its current density being 0.5 A/cm^2 and thus much higher than the theoretically optimum 20-30 mA/cm^2. Emission was achieved by pumping a He:Ne:Kr = 70:1:1.5 mixture under pressures of 0.5-3 atm with an electron beam from a "hot"-cathode accelerator in pulses of 15-100 μs duration, its current density being 1-30 mA/cm^2. It appears that the fast populating of a neon atom by 3s resonance states makes feasible a quasi-continuous laser on the transitions $3p^1[1/2] - 3s[3/2]^0_1$ (5400.6 Å wavelength), $3p^1[1/2]_1 - 3s^1[1/2]^0_1$ (65999.0 Å wavelength, $3p[1/2]_1 - 3s[3/2]^0_1$ (7245.2 Å wavelength), depending on the selective resonator. Figures 1; references 7: 4 Russian, 3 Western.
[510-2415]

VILNYUS UNIVERSITY'S HIGH-SPEED LASER R&D CENTER

Vilnius SOVETSKAYA LITVA in Russian 29 May 85 p 4

[Excerpt] The laboratories of the laser research center of Vilnyus University are equipped with dozens of unique units which were developed here.* Some of them have no counterparts either in our own country or anywhere in the world.

"This is a far from complete 'collection' of the quantum generators we have developed," observed Doctor of Physical-Mathematical Sciences Algis Piskarsas, head of the center and a USSR State Prize laureate. "A considerable number of them are already operating in major scientific research centers of the country and in scientific-technical associations. The Institute of General Physics and Institute of Radio Engineering and Electronics of the USSR Academy of Sciences have acquired laser spectrometers that we built."

One of the research center's latest developments is the world's first picosecond parametric light generator. The process of research with the picosecond laser is completely automated. The unit is controlled by a computer.

A femtosecond laser complex which has been developed at the center is the latest word in laser physics.

Works of the Vilnyus scientists have earned wide recognition. Last year the USSR State Prize was awarded jointly to Algis Piskarskas, head of the laser research center, and a group of associates of the Institute of General Physics and Institute of Applied Physics of the USSR Academy of Sciences, the Uzbek Academy of Sciences' Institute of Electronics, Gomel University and a number of research-and-production associations.

"We shall go on advancing basic research of lasers in the fields of physics, chemistry, biology and medicine," said Algis Piskarskas. "We shall do a portion of this work in line with the USSR targeted inter-higher-school program 'Laser', which is under the direction of academician A. Prokhorov, a laureate of the Lenin and Nobel prizes, as well as other all-Union targeted programs."

*See also the Daily SNAP, January 14, 1985, p 3, col 2

Algis Piskarskas is a scientist of the younger generation; he is only 42 years old. This son of school teachers from Kedaynyay studied at Vilnyus University and subsequently at Moscow University, where he was a graduate student.

A. Piskarskas presented papers at the International Conference on Quantum Electronics in Boston (USA), and he has lectured at the universities of Leiden (the Netherlands), Jena (German Democratic Republic), Prague (Czechoslovakia) and Munich (Federal Republic of Germany).

FTD/SNAP
/13046
CSO: 1862/487

UDC 621.378.325

LASING KINETICS IN DISTRIBUTED FEEDBACK LASERS WITH TIME-DELAYED INTEGRATING PULSES

Baku IZVESTIYA AKADEMII NAUK AZERBAYDZHANSKOY SSR: SERIYA FIZIKO-TEKHNICHESKIKH I MATEMATICHESKIKH NAUK in Russian Vol 6, No 1, Jan-Feb 84 (manuscript received 10 Jun 84) pp 92-95

KARAMALIYEV, R.A. and KHOY, Dao Suan

[Abstract] Lasing in a distributed feedback dye laser with the pumping pulses delayed with respect to one another is investigated. When coherent pumping pulses strike the active medium with a delay, population inversion and a light-induced structure were created. The interference of the time-separated light pulses causes the pumping to be redistributed along the z axis of the active medium. It is found that delaying the pumping pulses with respect to one another can be used to control a distributed feedback laser and makes it possible to shorten the lasing duration. Figures 2; references 2: 1 Russian, 1 Western.
[460-6900]

UDC 621.378.33

ENERGY AND FREQUENCY CHARACTERISTICS OF He-Ne LASER (λ = 0.63 μm) IN MUTUALLY ORTHOGONAL TRANSVERSE MAGNETIC FIELDS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 3, Mar 85 (manuscript received 27 Sep 84 after revision) pp 364-368

GUDELEV, V.G., DZYUBENKO, G.M., KLOCHKO, A.I., KUZNETSOV, I.M. and YASINSKIY, V.M.

[Abstract] The energy and frequency characteristics of a helium-neon laser operating on the 3 S_2-$2P_4$ transition (λ = 0.63 μm) in uniform and hybrid transverse magnetic fields is investigated experimentally. The characteristics of the dual-frequency operating mode and minimization of fluctuations in the beat frequency are stressed. The influence of cavity detuning, discharge current, and transverse magnetic field induction on beat frequency and intensity of waves with orthogonally linear polarization is studied. The

difference frequency provided is found to be especially stable, which expands the possibilities of using such a design in dual-frequency laser interferometers, ellipsometers, anemometers, and other heterodyne measuring devices. Figures 2; references 11: 8 Russian, 3 Western.
[384-6900]

UDC 621.373.826

USE OF TWO-WAVE CARBON DIOXIDE LASER FOR DETERMINING SMALL CONCENTRATIONS OF SUBSTANCES

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 3, Mar 85 (manuscript received 30 Dec 83) pp 369-372

VOYTOVICH, A.P., DUNAYEV, V.B. and PROKOPOV, A.P.

[Abstract] The use of a two-wave carbon dioxide gas laser for measuring small optical densities of gases and gas concentrations is investigated. The experiments were conducted on a set-up incorporating a CO_2 laser, a system for controlling the spectral composition of the radiation, a recording system, and a system for inputting absorbing gas into the cuvette. The absorbing medium employed was trichlorethylene. The intensities generated on transitions at two different frequencies were investigated as a function of the pressure of the absorbing gas for different operating modes. Lasing was achieved simultaneously at 975.88 cm^{-1} and 944.194 cm^{-1}, which corresponds to vibrational transitions with a common lower level of $J' = 20$. The sensitivity of the intensity to changes in the gas concentration with the laser generating two frequencies simultaneously was found to be significantly greater than for single-frequency operation. However, the noise level was found to be somewhat higher for the two-frequency mode. Figures 3; references 8: 5 Russian, 3 Western.
[384-6900]

UDC 539.184:546.32

INVESTIGATION OF PROMISING TRANSITIONS FOR USE IN POTASSIUM-VAPOR VUV LASERS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian, Vol 58, No 6, Jun 85 (manuscript received 10 Apr 84) pp 1341-1344

KUPLYAUSKENE, A.V. and KUPLYAUSKIS, Z.Y.

[Abstract] This study investigates transitions between the quartet levels of $3p^5 3d4s$ and $3p^5 4s4p$ configurations and doublet levels that are stable with respect to coulomb autoionization. The transitions between the upper and lower working levels in such potassium-vapor lasers are studied. The

characteristics of the electron transitions to excited $3p^6 4p$ and $3p^6 3d$ configurations, as well as the basic configuration of the potassium ion, are determined. The autoionization probabilities are computed for all states. The wavelengths, oscillator forces, and probabilities of transitions between 34 acceptor and upper working levels and 12 working transitions of VUV potassium-vapor lasers are tabulated. Those transitions that are promising for pumping are identified. Tables 2; references 9: 5 Russian, 4 Western.
[513-6900]

UDC 621.378.325

EXCITATION OF GAS LASERS BY HEAVY ACCELERATED CHARGED PARTICLES

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 55, No 5, May 85 (manuscript received 25 May 84) pp 864-868

KUZNETSOV, A.A. and SULAKSHIN, S.S., Scientific Research Institute of Nuclear Physics at Tomsk Polytechnic Institute imeni S.M. Kirov

[Abstract] The performance of visible and ultraviolet gas lasers depends largely on the pumping power density for excitation of the active medium and, therefore, since maximum power densities of only $10^6 - 10^7$ W/(cm^3·atm) have so far been attained by conventional means, excitation by ions heavier than the proton is considered as means of still further optimizing the performance of these lasers. The problem is analyzed on the basis of the Bethe-Bloch relation, according to which the pumping power density an accelerated charged particle can deliver to a gas is proportional to the stopping power of the electric field. The feasibility of producing higher power densities is examined accordingly, proton pumping having already been found to produce power densities approximately 100 times higher than those produced by electron pumping. First of all, the particle entrance velocity is assumed to be much higher than the velocity of a knocked out electron ($v_i \gg \sqrt{2E_b/m}$, E_b - energy of electron bond in an atom, m - mass of electron). Next, the two other parameters are considered, namely, density of the gas and charge number of the nucleus, considering that every kind of ion has its optimum accelerating voltage. The optimum accelerating voltage is found to increase with increasing mass of the particle, but does not exceed 2-3 MV for particles with a mass number below 70. Experimental data on argon, with excitation of levels by collisions with an entering ion and also by collisions with knocked out secondary electrons, indicate a possibility of exceeding $10^8 - 10^9$ W/cm^3·atm) attainable with proton pumping. Experimental data on excitation of an Ar + 5%N_2 laser under pressures of 1-3 atm with 1.5z MeV H, D, He, N ions, respectively, in clusters of up to 80 mJ energy and 10-15 ns duration, indicate that also the laser efficiency can be improved. While the relative efficiency referred to the input energy increases monotonically and steeply with increasing atomic mass, the absolute percent efficiency peaks above 0.2% corresonding to 4 a.m.u.

Charge exchange between the heavier nitrogen ions tends to reduce the effective (mean) charge and thus also the pumping efficiency. The authors thank A.N. Didenko for interest in this study, V.M. Bistritskiy and V.N. Podkatov for assistance in the experiments. Figures 4; references 18: 13 Russian, 5 Western (2 in Russian translation).
[459-2415]

UDC 621.373.826.038.823

LONGITUDINAL-DISCHARGE CO_2 PULSE WAVEGUIDE LASER

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR: FIZIKA in Russian Vol 19, No 6, Jun 85 (manuscript received 5 May 83) pp 346-349

ARAKEAYAN, V.S., AKOPOVA, K.A. and BARKHUDARYAN, G.R., Institute of Radiophysics and Electronics, Armenian SSR Academy of Sciences

[Abstract] The energy characteristics of a waveguide CO_2 laser employing longitudinal pulse discharge and a high pulse repetition frequency are investigated experimentally. A pumping source based on a TGI-100/8 thyratron transmitter coupled to the laser discharge channel is employed. The average lasing power is determined as a function of the pressure of the active medium for different compositions of CO_2-N_2-He mixtures. The optimum ratio of these components in terms of average output power is found to be 1:1:4, with a maximum average power, measured at 38 mm Hg, comprising 0.3 W. As the helium content increases, the pressure corresponding to the optimum average output power increases. The findings confirm the feasibility of developing and investigating waveguide CO_2 lasers employing short pumping pulses. Increasing the repetition frequency of the pumping pulses and optimizing the coefficient of reflection of the exit mirror increases the average output power. Figures 2; references 7: 3 Russian, 4 Western.
[465-6900]

ATOMARY OXYGEN SOURCE FOR CHEMICAL CO LASER

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 21, No 2, Mar-Apr 85 (manuscript received 28 Jul 84) pp 88-90

BYSTROVA, T.V. and CHIKHOV, Yu.L.

[Abstract] The possibility is investigated of implementing an atomary oxygen generator that can produce streams of gas with high static pressure. A source is described in which the reagents S_2 and O_2 are burned in a combustion chamber, with the combustion products exiting through a supersonic nozzle, after which they are mixed with a supersonic stream of carbon disulfide containing a ballast gas. It is found that a wide range of pressures and ratios of the reagents S_2 and O_2 supports an operating mode in

the atomary oxygen generator that makes it possible to obtain supersonic streams containing large numbers of oxygen atoms with static pressure of the order of several atmospheres. Such a source makes it possible to build a chemical CO laser that does not require an evacuation system. Figures 3; references 7: 5 Russian, 2 Western.
[491-6900]

KINETICS OF CHEMICAL TRANSFORMATION IN CO-N_2O MIXTURE IN GAS DYNAMIC LASER

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian, Vol 21, No 3, May-Jun 85 (manuscript received 16 Apr 84) pp 60-68

KRYUCHKOV, S.I., KUDRYAVTSEV, N.N. and NOVIKOV, S.S.

[Abstract] The chemical transformations occurring in a CO+N_2O mixture are analyzed on the basis of the chain reaction mechanism caused by hydrogen and water vapor admixtures. Superequilibrium pumping is observed in CO_2 gas dynamic lasers employing CO+N_2O in the region of high values of T = 1.5-2.3 kK in the reaction stages following ignition characterized by a high degree of completion of the chemical transformations. The contribution of individual elementary stages to superequilibrium pumping of the asymmetrical mode of CO_2 is analyzed. A kinetic reaction scheme is developed that makes it possible to model the chemical transformation kinetics over a wide range of variation of the initial composition of the mixture. Figures 4; references 28: 15 Russian, 13 Western.
[492-6900]

UDC 548.0+535.35

LASING PROPERTIES OF α-$Al_2O_3 \cdot Ti^{3+}$ CRYSTALS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 282, No 4, Jun 85 (manuscript received 25 Jul 84) pp 848-850

BAGDASAROV, Kh.S., KRASILOV, Yu.I., KUZNETSOV, N.T., KURATEV, I.I., POTEMKIN, A.V., SHESTAKOV, A.V., ZVEREV, G.M., CIYUCHENKO, O.G. and ZHITNYUK, V.A., Institute of General and Inorganic Chemistry imeni N.S. Kurnakov, USSR Academy of Sciences, Institute of Crystallography imeni A.V. Shubinkov, USSR Academy of Sciences

[Abstract] The spectral-luminescent and lasing characteristics of Ti^{3+} in corundum are investigated. A twin-mirror cavity with dispersion prism made of TF-4 glas driven by a YAG Nd laser with Q-switched amplifier producing up to 40 mJ (λ = 532 mm) is employed. The comparative characteristics of a number of materials for tunable lasers are tabulated. A comparison of the lasing characteristics of α-$Al_2O_3 \cdot Ti^{3+}$ and other materials indicates that

titanium-activated corundum crystals are superior to their analogs, and show significant promise for practical use. Figures 4; references 6: 4 Russian, 1 Western.
[479-6900]

UDC 535:621.375.8

OPTIMUM LOADING OF CONTINUOUS-WAVE LASER ON SUCCESSIVE TRANSITIONS

Novosibirsk AVTOMETRIYA in Russian No 2, Mar-Apr 85 (manuscript received 16 Feb 84) pp 75-77

GUTIN, M.A., KOLCHENKO, A.P. and TROITSKIY, Yu.V., Novosibirsk

[Abstract] Power optimization of a multifrequency continuous-wave molecular laser with successive transitions is considered. Only a selective mirror with an appropriately frequency-dependent transmission coefficient is capable of maximizing the laser output power at the wavelength of each spectral line. Neither theoretical nor experimental data are available on the power advantage of selective over nonselective optimization. This advantage can be estimated on the basis of the dependence of the total output power at all transitions P on the small-signal gain α_k and the nonselective resonator losses L_k, assuming that all transitions are uniformly widened and that only one mode-line with the corresponding frequency ν_s is excited at each transition. This relation is analyzed and the power advantage is calculated for the specific case of a resonator whose one mirror is full reflecting $R(\nu_s) = R$ while the other mirror is selectively transmitting $T_s = f(\nu_s)$ and has nonselective losses Δ. For this case, in the relation $P = \sum_{s,k} \gamma_s p_{sk}(\alpha_k - L_k)$ there appears $\gamma_s = T_s/(T_s + \Delta)$ ($p_{sk} = \bar{P}_s \beta'_{sk}$, β_{sk} - elements of the transitions coupling matrix, $\bar{P}_s$ - saturation factor, s - transition index, and s,k = 1,2,...,n). A relation for the power advantage δP is obtained which simplifies to the approximate form $\delta P = A\Delta(\Delta + 2T_0)/T_0^2$ (T_0 - transmission coefficient of optimum mirror), where the coefficient $0 \leq A \leq 1$ accounts for the characteristics of transitions and thus for the differences between transmission coefficients at different wavelengths (frequencies). An advantageous δP 1 is attainable only near the emission threshold ($\alpha_s \simeq \Delta$), which is of no practical interest. The condition for efficient laser operation is $\Delta \ll \bar{\alpha}$ and, evidently the power advantage of selective over nonselective energy extraction is then essentially small. References 2 (Russian).
[457-2415]

MAGNETOHYDRODYNAMIC STABLE CONFINEMENT OF ROTATING PLASMA

Moscow PISMA V ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian Vol 4, No 12, 25 Jun 85 (manuscript received 20 Mar 85) pp 494-497

BOCHAROV, V.N., ZAVADSKIY, N.A., KISELEV, A.V., KONSTANTINOV, S.G., KUDRYAVTSEV, A.M., MYSKIN, O.K., PANASYUK, V.M. and TSELNIK, F.A., Institute of Nuclear Physics, Siberian Department, USSR Academy of Sciences

[Abstract] The production of a rotating plasma in an axisymmetrical trap is described. MHD stable profiles are realized in an experiment on a rotation stabilization and density profile system designated SVIPP. The required density profile is obtained by generating a dense plasma shell on the outer boundary that maintains a profile with $dn/dr > 0$ at the edge of the region where $V \neq 0$ and forms a transitional layer between the rotating plasma and the liner. MHD stable plasma with density of 10^{13} cm^{-3} and rotation energy of 250 eV/ion is obtained. The phenomena observed are interpreted as the manifestation of centrifugal stabilization. Figures 3; references 9: 7 Russian, 2 Western.
[514-6900]

UDC 621.039.61

CONTROL OF PLASMA DENSITY PROFILE NEAR WALL OF TV-1 TOKAMAK BY SUPERIMPOSING RADIOELECTRICAL FIELD

Moscow FIZIKA PLAZMY in Russian, Vol 11, No 6, Jun 85 (manuscript received 4 Jul 84), pp 648-654

FIDELMAN, G.N., Institute of High Temperatures, USSR Academy of Sciences

[Abstract] The effect of forming an electrical field in the region near the wall of a TV-1 Tokamak by applying potential to the Tokamak limiter is investigated. The electrical field is induced by applying a potential difference between the aperture diaphragm, which is electrically connected to the walls of the chamber, and a rail-type limiter placed 28 mm from the center of the chamber. It is found that a radial electrical field can be created on the boundary of the plasma filament with the help of a system of

two diaphragms placed at different radial distances from the center of the chamber and carrying different potentials. Investigation of the voltage-current characteristics of the limiter show that the amount of electron current flowing from the limiter when the potential is the same as the chamber potential creates a significant portion (30-40%) of the limiter saturation "electron" current. Figures 6; references 9: 4 Russian, 5 Western.
[506-6900]

UDC 537.525

EXCITATION OF ROTATIONAL LEVELS OF ELECTRON STATES OF MOLECULES BY ELECTRON IMPACT IN A GAS DISCHARGE

Moscow TRUDY ORDENA LENINA FIZICHESKOGO INSTITUTA IM. P.N. LEBEDEVA AKADEMII NAUK SSSR: ELEKTRONNOVOZBUZHDENNYYE MOLEKULY V NERAVNOVESNOY PLAZME in Russian Vol 157, 1984 pp 86-123

OTORBAYEV, D.K., OCHKIN, V.N., RUBIN, V.L., SAVINOV, S.Yu., SOBOLEV, N.N. and TSKHAY, S.N.

[Abstract] A study is made of the possibility of changing the rotational state of a molecule in the process of excitation of electron states by electron impact. The simplest case of a nonisothermal mixture of particles of two types with two different densities and masses is studied. The adiabatic approximation is applied to the theory of electron-molecule collisions. The experimental studies performed indicate that it is possible for an electron to transmit rotational momentum to a molecule upon excitation to a higher electron state. The problem has now become one of determining the concrete matrix of cross sections of electron oscillating transitions excited by direct electron impact. This article takes a first step in this direction, presenting an experimental and theoretical analysis of the processes of excitation of electron-oscillation-rotation levels of H_2 by electron impact. Future studies should move both in the direction of expanding the range of molecular states studied and in the direction of deeper study of the nature of the process. Figures 19; references 78: 47 Russian, 31 Western.
[542-6508]

NUCLEAR PHYSICS

UDC 621.373.826

INVESTIGATION OF THERMONUCLEAR LASER PLASMA IN TARGETS WITH INVERTED CORONA

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 282, No 4, Jun 85
(manuscript received 30 Jul 84) pp 857-861

BESSARAB, A.V., DOLGALEVA, G.V., ZARETSKIJ, A.I., KIRILLOV, G.A., KOCHEMASOV, G.G., MURUGOV, V.M., NASYROV, G.F., ROGACHEV, V.G., ROMANOV, Yu.A., SENIK, A.V., and SUKHAREV, S.A.

[Abstract] A target with "inverted corona" is examined that is distinguished by near-70% efficient transfer of energy to the ions of the thermonuclear material, making it possible to obtain high plasma temperatures and substantial neutron yield. The inverted-corona target is a hollow spherical shell whose inner surface is coated with a layer of material containing heavy hydrogen isotopes such as $(CD_2)_n$. The inner surface is irradiated by means of a laser through a hole in the shell, using a pulse short enough to prevent the hole from being covered by the expanding plasma. The radiation evaporates a thin layer of the thermonuclear material and forms a laser corona that moves toward the center of the target. As the material slows, a high temperature region forms in the center of the target in which the ion temperature significantly exceeds the electron temperature. The temperatures of ions with different mass then equalize, and thermonuclear reactions begin. Experiments with deuterium-containing targets are described. The target is found to be a convenient device for experimental investigation of physical processes occurring in high temperature plasma. Figures 4; references 4: 3 Russian, 1 Western.
[479-6900]

UDC 621.373.826.53

INFLUENCE OF SPONTANEOUS MAGNETIC FIELDS ON ENERGY LEFT BY CHARGED THERMONUCLEAR PARTICLES IN LASER TARGETS

Moscow FIZIKA PLAZMY in Russian Vol 11, No 6, Jun 85 (manuscript received 16 Jul 84 after revision) pp 674-783

GUSKOV, S.Yu., LEBO, I.G., ROZANOV, V.B. and TREBULEVA, L.Ye., Physics Institute imeni P.N. Lebedev, USSR Academy of Sciences

[Abstract] The influence of spontaneous magnetic fields on the energy and angular distribution of charged thermonuclear particles in laser targets is investigated for arbitrary harmonic numbers and magnetic field strengths. Spontaneous magnetic fields generated through the development of Rayleigh-Taylor instability during the compression of spherical laser targets are found to exert a strong influence on the transfer of charged thermonuclear particles. The relationship between the amount of energy left by thermonuclear particles in the target and the angular distribution of the particles emitted by the laser plasma is investigated as a function of the field strength, the characteristic width of its localization region, and the harmonic number. The influence of a magnetic field on the energy of thermonuclear alpha-particles left in a compressed DT-fuel target is analyzed as an example. The anisotropy of the angular distribution of the particles exiting the plasma can be used to diagnose magnetic fields, and thus to investigate hydrodynamic instability. Figures 5; references 10: 8 Russian, 2 Western.
[506-6900]

TENTH IAEA CONFERENCE ON PLASMA PHYSICS AND CONTROLLED THERMONUCLEAR FUSION -- STATUS AND PROSPECTS OF RESEARCH ON LASER THERMONUCLEAR FUSION

Moscow FIZIKA PLAZMY in Russian Vol 11, No 6, Jun 85 (manuscript received 20 Jan 85 after revision) pp 745-757

GUSKOV, S.Yu., Physics Institute imeni P.N. Lebedev, USSR Academy of Sciences

[Abstract] The program of the tenth International Atomic Energy Agency (IAEA) conference, held 12-19 September 1984 in London, is described. The status and prospects for development of research on laser thermonuclear fusion are summarized on the basis of a review of 16 of the 20 reports presented at the section on inertial plasma confinement. Rapid progress continues on high-power lasers for various types of laser thermonuclear fusion, and large solid state laser systems are reaching energy levels close to that needed to demonstrate the physical threshold of the thermonuclear reaction. A thorough understanding of the basic physical processes occurring in laser plasma is being achieved, as evidenced by the findings of leading laboratories in experiments at the E_1 = 1-20 kJ level, as well as in theoretical investigations of reactor-scale targets. References 19: 10 Russian, 9 Western.
[506-6900]

WORK ON SELF-PROPAGATING HIGH-TEMPERATURE FUSION TECHNOLOGY

Moscow KOMMUNIST in Russian 31 Dec 85 p 2

[Abstract] The authors discuss the technology of self-propagating high-temperature fusion and its applications, and they comment on progress in introducing the technology.

The authors recall that discoveries made in 1967 at the USSR Academy of Sciences' Institute of Chemical Physics provided the basis for development of principles of self-propagating high-temperature fusion, as well as methods for the control of processes employing it. Basic and applied research in this field is being organized and coordinated by the USSR State Committee for Science and Technology's scientific council on the problem "Theory and Practice of Self-Propagating High-Temperature Fusion Processes".

The authors relate that facilities for producing a number of valuable ceramic powders by the new method have been put into operation since 1981, in line with a nationwide scientific-technical program. These facilities are located in Kirovakan, Baku, Zaporozhye, Makeyevka and other cities. The introduction of self-propagating high-temperature fusion processes has already yielded an economic benefit of more than 150 million rubles, it is claimed. Nitrided ferrovanadium and titanium carbide are now being produced by such processes. This carbide is the main component of two new brands of abrasive paste, "KT" and "KTIOL", which have been put into industrial production.

Particular attention is devoted to the organization and results of work in this field which has been done in the Armenian republic since 1972. The authors relate that an efficient process for obtaining metal hydrides capable of storing hydrogen has been developed on the basis of self-propagating high-temperature fusion at the Armenian Academy of Sciences' Institute of Chemical Physics. A special design-and-technological bureau of refractory materials at this institute has done much to promote products of the new technology. Its first industrial utilization reportedly took place at the Kirovakan High-Temperature Heater Plant, where a process for obtaining molybdenum disilicide was mastered for the first time. Original processes for producing silicon nitride and carbide and a number of composite materials, using local rocks as raw materials, have been proposed at the "Rock and Silicates" Research and Production Association.

In conclusion, the authors call upon interested ministries and industrial enterprises for assistance in expediting the introduction of the latest fusion processes developed at the Armenian academy's chemical-physics institute and elsewhere.

FTD/SNAP
/13046
CSO: 1862/114

UDC 621.375.534.222

SHAPING OF ULTRASHORT PULSE IN CO_2-LASER AMPLIFIER WITH BOUNDED AMPLIFICATION SPACE

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 5, May 85 (manuscript received 11 Oct 84) pp 1105-1107

KANDIDOV, V.P., OGNEV, L.I. and PLATONENKO, V.T., Moscow State University imeni M.V. Lomonosov

[Abstract] Shaping of nanosecond pulses in a CO_2-laser amplifer is analyzed, assuming a bounded population inversion space. Amplification is treated on the basis of the two-level model, rotational kinetics being described by the model of strong collisions. The system of equations of coherent amplification includes not only the difference between populations of rotational and vibrational sublevels in the resonant transition $(00^\circ1) \rightarrow (10^\circ0)$ but also diffraction and rotational relaxation, also resonant absorption. This system of four equations, with all variables normalized, is solved for the appropriate initial and boundary conditions. The solution based on a sharp resonance at a single frequency reveals that a narrow population inversion space limits the width of the pulse beam, while the attendant increase of diffraction losses lowers the radiation intensity peak. Figures 3; references 6 (Russian).
[504-2415]

UDC 621.373.826

WAVEFRONT REVERSAL IN SOLUTIONS OF ORGANIC DYES IN FIELD OF PICOSECOND LIGHT PULSES

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 5, May 85 (manuscript received 17 Oct 84) pp 1107-1109

BONDARENKO, S.V., IVAKIN, Ye.V., KABELKA, V.I., MIKHAYLOV, A.V. and RUBANOV, A.S., Institute of Physics, BSSR Academy of Sciences, Minsk

[Abstract] An experimental study of degenerate four-wave interaction in nonlinear media has for the first time revealed excitation of hypersonic waves by interference of almost opposing waves. Ethanol solutions of three organic

dyes (rhodamine 6Zh, oxazine 9, 2635u) were used as nonlinear medium in the conventional triangular configuration of light paths. A single picosecond pulse, typically of 10 mJ energy and 30 ps duration, extracted by means of a Pockels shutter from a pulse train emitted by a YAG:Nd^{3+} laser was amplified in three stages with space filtering after the first and third stages. The second-harmonic radiation was divided by two splitters into two pumping beams of approximately the same energy and a signal beam with an energy amounting to approximately 2% of the total, the energy of that signal beam being regulated by means of a wedge. Two adjustable delay lines in the arms of the triangular interferometer equalized the optical paths of the two pumping beams with that of the signal beam, whereupon three plane mirrors reflected them all into a 1 mm thick glass vessel with dye solution. Wavefront reversal in the signal beam was measured with a telescope in its path consisting of two lenses and a diaphragm between them. Three photodiodes were used for measuring the energy of the signal beam, the energy of the reversed wave, and the pumping energy, respectively. The results, processed according to the CAMAC standard with the aid of a JLS1-21 microcomputer, have revealed formation of two acoustic diffraction gratings in the dye solution and a wavefront reversal by diffraction as efficiently as by degenerate four-wave interaction, with the reversal coefficient R as function of the pump lag time osciallating first from 0 to R_{max} and after about 30 ps from $R_{min} > 0$ to a successively lower level, and with the period of acoustic grating oscillations determined by the period of the interference pattern. These results are applicable to recording of dynamic holograms. Figures 2; references 6: 3 Russian, 2 Western.
[504-2415]

UDC 621.378.32:535.89

MAXIMUM GAIN OF MULTISTAGE LASER AMPLIFIER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 5, May 85 (manuscript received 29 Aug 84) pp 1054-1058

MAKAROV, A.I. and POTEMKIN, A.K., Institute of Applied Physics, USSR Academy of Sciences, Gorkiy

[Abstract] The problem of self-focusing of powerful laser pulses on thermonuclear targets with wavefront reversing mirrors is considered, this operation requiring a laser amplifier with a gain higher than 10^4. Difficulties in producing such an amplifier are caused essentially by superluminescence and self-excitation, the former resulting in depletion of the active transition and the latter resulting from parasitic reflections, as well as from backscattering along rough surfaces of the active cell or optical components. It therefore is important to establish the maximum gain attainable with a laser amplifier. This is done here for a laser on neodymium glass with a cylindrical active cell. The energy density of spontaneous noise at the amplifier output is calculated first of all, assuming an optimum luminaire geometry and a sufficiently long cell so that the gain is neither a function

of transverse coordinates nor a function of the viewing angle. Calculations are made first for a single-stage amplifier and then for an amplifier with additional stages. Estimates based on an active cell made of GLS1 glass yield a gain of the order of 10^7 when the viewing angle does not exceed 3 mrad. These estimates have been verified and confirmed experimentally on a two-pass four-stage amplifier with glass rods 10 mm in diameter at the Brewster angle. For cooling a concentrate of Na_3N in water was used, a substance with minimal absorption of radiation at the 1.06 μm wavelength. A set of four IPF-1200 lamps with elliptical mirrors produced a gain uniformly distributed over the cell cross-section. The solid angle of the superluminescence beam was measured in the focal plane of a lens with a 375 mm focal length behind the amplifier. Cell-excitation, even at a gain level of 10^6, had to be suppressed by means of light filters behind the amplifier. The results overall indicate the feasibility of a high-gain laser amplifier, but also that superluminescence even when propagating at low angle to the axis will limit the gain to the 10^7 level. The authors thank G.A. Pasmanik for helpful discussions. Figures 2; references 12: 9 Russian, 3 Western. [504-2415]

UDC 621.373.826

ACCOUNTING FOR QUANTUM NOISE IN ADAPTIVE FOCUSING OF OPTICAL RADIATION

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 5, May 85 (manuscript received 11 Jun 84) pp 1009-1016

LOGINOV, V.A. and ANTSIPEROV, V.Ye., Moscow Institute of Engineering Physics

[Abstract] Adaptive focusing of optical radiation is considered, particularly minimization of the effect of quantum noise during recording of a signal by a detector and measurement of its phase distribution over the aperture for the purpose of wavefront correction. A self-luminous object is assumed to lie in some plane cutting through the atmosphere at a distance S away from the receiver-transmitter aperture, and the detector is placed behind the aperture at a distance Z. The problem of maximizing the power transmitted to the object, which will brighten the latter up, is formulated as the problem of finding the field distribution in the plane of the aperture which will yield the maximum payoff in terms of average power on the object at fixed a priori and a posteriori data, in the Bayes sense. The optimum control algorithm is constructed on this basis and on the basis of three physically permissible simplifying assumptions. The first assumption is that the radiation propagation time from object to receiver and back to object plus the signal processing time in the receiver and the signal shaping time in the transmitter are together shorter than the atmosphere's "freeze in" time. The second assumption is that the object is a point source with a radius r_0 smaller than the width of the first Fresnel zone $r_F = \sqrt{\lambda S}$ (λ - wavelength of radiation) and lies within the phase isoplanarity region, the latter characterized by a correlation radius of the atmosphere phase $R_{atm} > r_0$.

The third assumption is that both the object and the optical system emit highly coherent monochromatic radiation. With the approximation of Gaussian exponential functions, the integral equation representing the condition for power maximality and obtained by the method of indeterminate Lagrange multipliers reveals that the control algorithm, as well as both a posteriori and mean payoffs, depend on two receiver parameters which must be determined. These are intensity F(0) of a normally incident plane wave focused on the detector at the point of zero argument and its characteristic dimension $2F(0)/F''(0)$. The algorithm will then prescribe the optimum phasefront slope and the radiation intensity taper from center to edge of the aperture corresponding to maintenance of full power. The optimum average power on the object is then expressed as the sum of an asymptotically converging infinite series and evaluated as such, taking into account the diffraction spot produced by the aperture in the plane of the object. Figures 1; references 10: 7 Russian, 3 Western (2 in Russian translation).
[504-2415]

UDC 621.373.826

MEASUREMENT OF NONLINEAR REFRACTIVE INDEX IN Nd^{3+}-DOPED ACTIVE LASER MEDIA

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 5, May 85 (manuscript received 5 Jun 84) pp 997-1001

VASILYEVA, M.A. and MASALOV, A.V., Institute of Physics imeni P.N. Lebedev, USSR Academy of Sciences, Moscow
VISCHAKAS, J., GULBINAS, V., KABELKA, V. and SYRUS, V., Institute of Physics, LiSSR Academy of Sciences, Vilnyus

[Abstract] The refractive index in active media of YAG:Nd^{3+} lasers, dependent on the electric field intensity of the light wave according to the relation $n = n_0 + n_2\bar{E}^2 = n_0 + \frac{1}{2}n_2E_0^2$ (n_0 - quiescent refractive index) and thus on the light intensity $I = E_0^2 n_0 c/8\pi$ (c - speed of light) according to the relation $n = n_0 + n_2 I$ was measured by the method of diffraction grating, rather than by conventional interferometry requiring high-precision instruments or the not very precise method of self-focusing. Birefringence with the optical Kerr effect and spontaneous rotation of the polarization ellipse are also inadequate for this purpose, since the mechanism of nonlinearity is not known. Measurements were made on 4 mm thick plane-parallel specimens of GLS1, GLS22, LGS55 glasses, as well as of KNFS glass developed at the Institute of Physics (USSR Academy of Sciences). Two light beams intersecting within a specimen at a small angle were used for inducing in the latter a phase grating corresponding to the interference pattern of the resultant light field, with the depth of the resulting modulation of the refractive index increasing proportionally to n_2. Self-diffraction of the beams produced new beams at the grating exit, namely, diffraction beams, their intensity at a fixed intensity of incident radiation serving as the

measure of n_2. Measurements were made with a nanosecond spectrometer at the Institute of Physics (LiSSR Academy of Sciences), with the energy of single picosecond laser pulse boosted by a two-pass amplifier to 2 mJ and then space-filtered for smoothing of its space distribution. The laser pulse beam was split into two almost equal parts converging on the specimen at an angle of 1/125 rad. They were focused on a spot approximately 0.5 mm in diameter, producing radiation intensities of up to 10^{11} W/cm^2. The accuracy of measurements with inevitably fluctuating pulse energy and duration was improved by averaging the diffraction signals with respect to both energy and duration. Two photodiodes for this purpose measured the energy of an incident pulse and the energy of its specially extracted second-harmonic component, respectively, the output signal of the second photodiode being inversely proportional to the pulse duration at a fixed output signal of the first photodiode. The results indicate that, at incident radiation intensities up to $5 \cdot 10^{10}$ W/cm^2, the diffraction pulse energy is proportional to the laser pulse energy cubed, which corresponds to the approximation of low diffraction efficiency. The upper bound for validity of this approximation is $n_2 = 10^{-15}$ cm^2/W for the given glasses. Measurements included also the diffraction energy as function of the time lag between incident pulses, an indicator of the relaxation time for the added component of the refractive index in these media. Such a determination is possible because of the phase modulation of picosecond Nd^{3+}-laser pulses. In these measurements the pulse coherence time was approximately one third of the pulse duration. When relaxation time is shorter than pulse coherence time, moreover, the dependence of diffraction energy on lag time has a characteristic peak width which is determined by the duration of successive pulses. Figures 2; tables 1; references 10: 4 Russian, 6 Western.
[504-2415]

UDC 535.2+535.317.1

A METHOD FOR COMPENSATING DISTORTIONS CAUSED BY ATMOSPHERIC TURBULENCE

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 3, Mar 85
(manuscript received 22 May 83) pp 634-639

FILINOV, V.N. and CHERNYY, G.P.

[Abstract] A holographic method is described for compensating distortions caused by atmospheric turbulence by averaging the phase of the field in the aperture plane of the optical system. The method is based on making the average value of the phase fluctuations caused by the atmosphere equal to zero. The phase distribution of the field at the input aperture of the system is determined from interference experiments. The influence of the finite dimensions of the investigated object at the attainable angular resolution in the recovered image is investigated, and the size of the zone of isoplanatism is determined. The analysis shows that it is possible in principle to compensate phase distortions caused by atmospheric turbulence by

computer-averaging the phase of the field in the aperture plane of the optical system after determining the phase distribution from interference measurements. An expression is derived for estimating the zone if isoplanatism assuming that the diffraction angular resolution is the same as the angular resolution governed by the finite dimensions of the object. Figures 2; references 9: 7 Russian, 2 Western.
[460-6900]

UDC 621.373.535

INVESTIGATION OF INFLUENCE OF PERTURBATIONS IN ACTIVE MEDIUM ON BROADENING OF RADIATION LINE OF STABILIZED He-Ne LASER WITH INTERNAL MIRRORS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 3, Mar 85
(manuscript received 28 Feb 84) pp 717-719

VLASOV, A.N., KRYLOV, P.S. and PRIVALOV, V.Ye.

[Abstract] An investigation is made of the influence on line broadening of modulating the discharge current of a laser with internal mirrors that is stabilized with no frequency deviation. The experimental instrument was based on a commercially produced LGN-208 unstabilized laser. The frequency of the laser was stabilized by regulating the average temperature of the wall of the active element, on which a spiral is wound: the error signal that controls the automatic frequency control system is zero when the intensities of the two orthogonally polarized frequencies are the same. By providing a discharge current pulsation level of 0.01%, the laser can be used to build a small radiation source with a line width of several kilohertz and a highly stable line center with none of the frequency deviation that is characteristic for most stabilized lasers. Inasmuch as the latter exhibit line widths that are several orders of magnitude greater, the proposed instrument opens up new possibilities in spectroscopy. Figures 2; references 8: 5 Russian, 3 Western.
[460-6900]

UDC 621.373.826

SPACE STATISTICS OF LIGHT BEAM REFRACTED BY WIND IN TURBULENT ATMOSPHERE

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 7, Jul 85
(manuscript received 9 Aug 84) pp 1490-1496

KANDIDOV, V.P. and SHLEYNOV, S.A., Moscow State University imeni M.V. Lomonosov

[Abstract] Refraction of a light beam by wind is analyzed statistically, the coherent light source with given aperture being a quasi-continuous one and thus emitting light pulses of duration much longer than the pressure transient

in an atmosphere with Karman turbulence. The turbulence scale is assumed to be not larger than the radius of the Gaussian light beam. The thermal diffusion time characterizing perturbations of the temperature field due to atmospheric turbulence and nonlinearity is assumed to be much longer than the characteristic convection time, which corresponds to high wind velocity and negligible temperature fluctuations within the optical channel. The corresponding wave equation for the light field in a temperature field and equation of heat transfer from light beam to surrounding atmosphere in a wind blowing normally to the light path at constant velocity are formulated with deterministic boundary conditions for the light field and random boundary conditions for the temperature field. Analysis in an approximation of the "smooth perturbations" method and a phase approximation of the Kirchhoff-Huygens method, with phase dispersion along twice the diffusion distance and with small-scale fluctuations of the refractive index taken into account, has yielded isophots of the light beam and the dependence of the effective beam width on the nonlinearity parameter, as well as space correlation coefficients for light intensity fluctuations in the wind direction and normally to it. Figures 5; references 13: 12 Russian, 1 Western.
[582-2415]

UDC 621.373.826

UNIVERSAL RELATION BETWEEN REFLECTION COEFFICIENT OF STIMULATED-MANDELSHTAM-BRILLOUIN-SCATTERING MIRROR AND EXCESS ABOVE THRESHOLD

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 7, Jul 85
(manuscript received 16 Jul 84) pp 1402-1406

ANDREYEV, N.F., DVORETSKIY, M.A., LESHCHEV, A.A., MANISHIN, V.G., PASMANIK, G.A. and SAMARINA, T.P., Institute of Applied Physics, USSR Academy of Sciences, Gorkiy

[Abstract] A relation is established describing the nonlinear dependence of the reflection coefficient on the energy excess above the threshold for a stimulated-Mandelshtam-Brillouin-scattering mirror. The relation is derived from the system of corresponding Maxwell and Navier-Stokes equations for such a mirror in the path of a focused single-mode laser beam. The excess is defined as the larger-than-unity ratio of laser pulse energy to threshold energy. The laser beam is assumed to pass through a lens and to continue propagating along the axis of the latter. The system of equations is solved in the geometrical optics approximation, with slowly varying complex amplitudes. The resulting relation characterizing an asymptotic approach to a unity reflection coefficient is found to cover both steady-state and transient operation of a mirror, in close agreement with experimental data.
The authors thank V.G. Sidorovich for interest and helpful discussions.
Figures 3; references 4: 3 Russian, 1 Western.
[582-2415]

UDC 621.373.826

HYPER-RAMAN SCATTERING AND FOUR-WAVE PARAMETRIC INTERACTION DURING TWO-PHOTON PUMPING OF METAL VAPOR

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 7, Jul 85 (manuscript received 6 Jul 84) pp 1365-1376

MALAKYAN, Yu.P., Institute of Physical Research ArSSR Academy of Sciences, Ashtarak

[Abstract] Resonant frequency conversion of infrared and ultraviolet laser radiation by the mechanism of hyper-Raman scattering and four-photon parametric interaction is considered, such a conversion having been attained experimentally during two-photon excitation of a metal vapor. The attendant nonlinear phenomena are interpreted now, taking into account saturation and collisions as well as four-wave parametric interaction. For determining the nonlinear polarization of the medium accordingly, the equation of the propagation for emitted radiation is solved with the aid of the density matrix. Only two-photon excitation of the medium by pumping pulses longer than the relaxation times is considered, interaction of the medium with ultrashort radiation pulses being disregarded. Basic relations are established first for weak pumping fields with negligible Stark shifts, then for strong pumping fields with both an optical Stark effect and a dynamic polarizability. Calculations based on this model yield the nonlinear polarization and the resonant hyper-Raman scattering, also the parametric superluminescence. The two extreme cases of purely radiative relaxation and predominant collisional relaxation are evaluated, including the critical density of metal vapor which corresponds to transition from one relaxation mode to the other. The author thanks M.L. Ter-Mikayelyan for valuable discussions and D.G. Sarkisyan for helpful comments. Figures 4; references 17: 6 Russian, 11 Western.
[582-2415]

UDC 621.373.826.038

CHARACTERISTICS OF MAGNETIC MIRROR BASED ON POLAR KERR EFFECT AT 0.63 um WAVELENGTH

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28, No 4, Apr 85 (manuscript received 5 Mar 84) pp 518-523

KUVATOVA, Ye.A. and MAMAYEV, Yu.A., Institute of Applied Physics, USSR Academy of Sciences

[Abstract] The amplitude-phase characteristics of a magnetic mirror operating on the basis of the polar Kerr effect are analyzed, the purpose being to establish the conditions for attaining maximum phase nonreciprocity between circularly polarized opposing incident waves with minimum losses

and attendant elimination of their amplitude nonreciprocity. A multilayer dielectric structure of alternate strongly refracting and weakly refracting layers deposited on an opaque polarly magnetized ferromagnetic substrate is considered as a model of such a mirror. The thickness of the bottom dielectric layer adjacent to the substrate is variable, for controlling mirror performance characteristics. All other dielectric layers are of quarter-wavelength thickness with a given transmission coefficient, their role being to maximize the reflection coefficient. Calculations are based on the scattering matrix. First, the reflection coefficients for both s- and p-components of the electric field of an incident wave are determined. Then, the reflection coefficients for circularly polarized opposing incident waves are found. The resulting analytical relation indicates that the change of polarization from circular to elliptic, upon reflection, does not significantly depend on the magnetization and that, therefore, the magneto-optic effect is negligible here. Numerical results have been obtained for a mirror consisting of an MnBi-film substrate with an SiO_2 (refractive index $n_1 = 1.46$) "control" layer and a stack of up to 15 alternately ZnS ($n = 2.3$) layers and MgF_2 ($n = 1.38$) layers on top, with 0.63 um waves incident at 45° angles. The ratio of phase nonreciprocity to losses, as figure of merit, is found to be attained with a "control" layer of 156° or 178° phase thickness, while the amplitude nonreciprocity vanishes when the phase thickness of the "control" layer is 154° or 180°. With a magnetic mirror based on the polar Kerr effect, unlike the one based on the equatorial Kerr effect, reducing the losses by decreasing the number of layers decreases that figure of merit.
The authors thank A.I. Andronov and M.A. Novikov for helpful discussion of the results, also I.L. Bershteyn for valuable comments. Figures 4; references 9: 4 Russian, 5 Western.
[450-2415]

WORK ON CRYOGENIC METHODS FOR LASER SPECTROSCOPY

Riga SOVETSKAYA ESTONIYA in Russian 21 Jun 85 p 2

MOPPEL, Kh., Correspondent (Tartu)

[Abstract] The article reports on cryogenic methods which have been developed for optical measurements. Original experiments with these methods, which expand capabilities of solid-state physics research, have been in progress in the low-temperature sector of the Estonian Academy of Sciences' Institute of Physics in Tartu.

Optical measurements of the molecular structure of matter reportedly have been made at a temperature of 0.05 Kelvin, using a cryostat that was recently developed. It was built by the Helium Machinery Research and Production Association in Moscow and perfected by Viktor Korrovits, senior science associate of the sector, and Mart Trummal, associate of the sector. They were assisted by Sergey Boldarev, senior science associate of the All-Union Scientific Research Institute of Helium Technology.

The new cryostat reportedly has proved suitable for spectral studies of matter using a new method in which a laser and low temperatures are used simultaneously. Work on this method has been nominated for the 1985 USSR State Prize. This work was done by a group of scientists of the physics institute's laser spectroscopy sector who were under the direction of K. Rebane, corresponding member of the USSR Academy of Sciences. Anshel Gorokhovskiy, senior science associate of the sector, reported that the cryostat performed well in a recent series of experiments. Optical measurements were made with the aid of the cryostat and a powerful laser, which were located in different laboratories at a distance of about 60 meters from each other.

(A photograph is given showing V. Korrovits and M. Trummal working with laboratory equipment.)

FTD/SNAP
/13046
CSO: 1862/489

UDC 535.241.13:535.555

REFLECTION OF LIGHT BY ELECTROOPTICAL LAYER NEAR TOTAL REFLECTION ANGLE

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 3, Mar 85
(manuscript received 23 Dec 83) pp 461-466

OLEFIR, G.I., PETROV, N.S. and CHERNYAVSKIY, V.A.

[Abstract] The incidence of light of a plane-parallel electrooptical layer placed between two semi-infinite media with the same indices of refraction is investigated with the intensity vector of the electrical field of the electromagnetic wave lying in or perpendicular to the plane of incidence. The theoretical results are checked by an experimental modulator based on a thin plane-parallel layer of electrooptical material. The theoretical findings, as well as the experimental results, indicate that efficient light modulators can be built that exploit reflection from thin layers of electrooptical materials. The control voltages of such modulators are small, and amplitude modulation of the radiation can be obtained without additional optical elements. The behavior of the shifts in the minima of the coefficients of reflection near the angle α_0 indicates that the device can be used as an active element for separating radiation spatially by polarization. Figures 2; references 7 (Russian).
[384-6900]

UDC 535.33:621.378.3

POSSIBILITY OF VARIABLE REFERENCING OF LASING SPECTRUM OF BROADBAND LASER TO ABSORPTION LINE OF PARTICLE BEAM

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 3, Mar 85
(manuscript received 1 Dec 83) pp 476-479

APANASEVICH, P.A., AFANASYEV, A.A. and CHURKIN, A.V.

[Abstract] This study presents a theoretical investigation of the possibility of controlling a narrowed lasing spectrum of the broadband laser by changing the angle θ between the beam of resonant-absorbing particles and the axis of the cavity. Steady-state lasing is examined in a linear laser with a particle beam passing through its cavity at an angle θ to the z axis having

an absorption line in the region of the emission band of the laser. It is shown theoretically that the spectrum can be controlled continuously by changing the angle θ. It is found that the spatial divergence of the beam can be disregarded. Figures 3; references 8: 7 Russian, 1 Western. [384-6900]

UDC 535.36

CORRECTION OF CHARACTERISTICS OF LASER MICROPARTICLE ANALYZERS CONSIDERING IRREGULAR DISTRIBUTION OF RADIATION FLUX DENSITY

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 5, May 85 (manuscript received 4 Oct 84) pp 8-10

OVOD, V.I. and SHLYUKO, V.Ya.

[Abstract] This study presents the results of an analysis of the influence on the working characteristics of laser microparticle analyzers of irregular distribution of the radiation flux density of the fundamental TEM_{00q} mode in elliptical and circular beams. A method is presented for calculating the relative errors in determining these characteristics of analyzers that result from failing to allow for irregularity of the flux density distribution. The latter is found to decrease the slope of the working characteristic of the analyzers as the particle size becomes larger and to reduce the resolution of the instruments. If irregularity is not taken into account, the error in determining the working characteristic of the analyzers exceed 5% for particles with radius exceeding $0.22\Omega_x$ (for amplitude processing of the scattered pulses) and $0.33\Omega_y$ (in the integration mode). Figures 3; references 11: 10 Russian, 1 Western. [474-6900]

UDC 535.87

PROPERTIES OF MIRRORS DURING OBLIQUE INCIDENCE OF LIGHT

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 4, Apr 85 (manuscript received 3 Aug 83) pp 900-904

GRISHINA, N.V. and TIKHONRAVOV, A.V.

[Abstract] The properties of two-component dielectric interference mirrors with angles of incidence of the order of 90° are investigated analytically. The width of the region of reflection during oblique incidence of light is determined. The maximum region of reflection is provided by systems in which the effective optical thickness of all of the layers for a given angle of incidence are the same. Expressions are derived for the center wavelength of the region of reflection at which the coefficient of reflection reaches

its maximum. Quarter-wave mirrors are examined for the case of glancing incidence, with the angle of incidence close to $\pi/2$. The spectral coefficients of reflection are calculated for a nine-layer mirror and a ten-layer mirror with angles of incidence of 85 and 89°. Comparison of the data shows that the formulas derived can be used to estimate the coefficient of reflection of mirrors with oblique incidence of light with sufficient accuracy. The formulas describe well the form of the spectral curve away from the center wavelength as well. References 5 (Russian). [475-6900]

UDC 535.317.1

POSSIBILITY OF UNAMBIGUOUS RECOVERY OF IMAGE OF OBJECT FROM MODULUS OF ITS SPATIAL SPECTRUM

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 4, Apr 85 (manuscript received 6 Apr 83) pp 905-907

BAKUT, P.A., RYAKHIN, A.D., SVIRIDOV, K.N. and USTINOV, N.D.

[Abstract] This study investigates the problem of using the recorded (or obtained from processing) modulus of the spatial spectrum of the object to recover its phase and then to recover the image by taking the inverse Fourier transform of the latter. The phase of the object can be determined only to within the linear term corresponding to simple displacement of the image; the complex-conjugate spectrum corresponding to the object is the solution. An iterative image recovery algorithm is described. Examples of the iterative recovery of an undistorted image of an object from the modulus of its spatial spectrum are shown. Comparison of the recovered image with the true image shows that the phase problem of coherence theory can be solved iteratively. Figures 1; references 5: 1 Russian, 4 Western. [475-6900]

UDC 621.373:535

COMPENSATION OF DISTORTIONS OF POLARIZATION STATE OF LASER BEAM IN WAVEFRONT CONJUGATION SYSTEMS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 4, Apr 85 (manuscript received 14 Jan 84) pp 920-924

BELOUSOV, V.N. and NIZIENKO, Yu.K.

[Abstract] A simple, effective method is proposed and implemented for compensating distortions of the wavefront, as well as the polarization state in wavefront conjugation systems. The method combines the familiar method of recovering the initial polarization state and the wavefront conjugation

phenomenon (in that the phase relationships between the linear orthogonal polarizations are maintained when a beam is reflected from a wavefront conjugation mirror). Experiments are described that demonstrate the compensation of polarization state distortions. The method is found to be effective for real laser systems, in which depolarization is expressed mainly in smooth changes of the polarization state, and the birefringence value is less than 10^{-4}. Figures 1; references 6 (Russian).
[475-6900]

UDC 621.378.4

GENERATION OF ULTRASHORT LIGHT PULSES IN 220-266 nm REGION IN POTASSIUM PENTABORATE CRYSTAL

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR. FIZIKA in Russian Vol 20, No 1, Jan-Feb 85 (manuscript received 20 May 83) pp 39-42

PETROSYAN, K.B. and POKHSRARYAN, K.M., Scientific Research Institute for Physics of Condensed Media, Yerevan State University

[Abstract] Frequency tuning of single picosecond pulses is achieved in a 220-266 nm band by doubling the frequency of a KDP laser in $LiIO_3$ and KB5 crystals. A mode-locked YAG:Nd^{3+} laser was employed, with a Pockels shutter to extract a picosecond pulse from the pulse train emitted, which was then amplified by two YAG:Nd^{3+} amplifier stages. By adding the frequency in KB5, the short wave boundary of the continuous tuning range of parametric ultrashort pulse generators is reduced to 200 nm. Figures 3; references 10: 3 Russian, 7 Western.
[481-6900]

UDC 535.3

INFLUENCE OF NONCOHERENCE OF LASER PULSES ON CHARACTERISTICS OF NONSTATIONARY ACTIVE SPECTROSCOPY SIGNAL

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA SERIYA 3: FIZIKA, ASTRONOMIYA in Russian Vol 26, No 3, May-Jun 85 (manuscript received 2 Jul 84) pp 48-55

NIKITIN, S.Yu.

[Abstract] The influence of random modulation of laser pulses on the energy, form, and duration of the impulse response observed in nonstationary active Raman scattering spectroscopy is investigated. All possible modes determined by different ratios of relaxation time, laser pulse length, and correlation time of the noise substructure are examined. A model is developed that takes into account the full range of characteristics of the pulsed nonstationary spectroscopy signal: energy, duration, spectrum, correlation function, and convolution. References 8: 6 Russian, 2 Western.
[480-6900]

UDC 535.416.3

NONLINEAR DISTORTIONS OF TUBULAR BEAMS IN MOVING MEDIUM

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA SERIYA 3: FIZIKA, ASTRONOMIYA in Russian Vol 26, No 3, May-Jun 85 (manuscript received 14 Dec 84) pp 55-58

SUKHORUKOV, A.P., TIMOFEYEV, V.V. and TROFIMOV, V.A.

[Abstract] Nonlinear aberrations of a split beam with a disc on its axis, passing through a thin layer of a moving medium exhibiting a thermal nonlinearity mechanism, are analyzed. The possibilities of compensating distortions of Gaussian and tubular beams with the same power are compared. It is found that tubular beams suffer less nonlinear distortion and are suitable for transporting light energy if the adaptive system is capable of processing only the lower aberration modes. Figures 2; references 6 (Russian).
[480-6900]

UDC 535.317.1

VISIBILITY OF OBJECTS OF ARBITRARY DIMENSIONS THROUGH TURBID LAYERS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 6, Jun 85 (manuscript received 27 Sep 83) pp 1351-1354

BELOV, V.V., ZUYEV, V.Ye., and KREKOV, G.M.

[Abstract] Previous findings by the authors on the visibility of objects through turbulent media are extended to the case of objects of arbitrary dimensions with positions of the scattering layer on the observation path that significantly overlap the region of existence of the t-effect described previously for objects with limited dimensions. A linear systems approach is employed for problems of the theory of vision, using Monte Carlo computer simulation of optical experiments. It is found numerically that the image quality of objects of any dimensions (close to the center of the image plane) as a function of the position of the scattering medium on the observation path depends on the spatial spectrum of the object itself, regardless of object size. Estimates of the frequency-contrast characteristic are derived for the visual system that takes lateral illumination to account and makes it possible to propose somewhat better visibility of objects as $t \rightarrow 0$ if the layer of the turbid medium is characterized by a more elongated indicatrix and for $t \rightarrow 1$ for a less elongated indicatrix (at least for media such as clouds, fog, or smoke). Figures 2; references 6 (Russian).
[513-6900]

UDC 621.373:535

USE OF COMBINED MIRRORS TO SUPPRESS COMPETING LASING AT 3.39 μm IN VISIBLE-BAND He-Ne LASERS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 6, Jun 85 (manuscript received 30 Mar 84) pp 1362-1364

BONDARCHIK, Ya.M., LEONTYEV, V.G. and LIPSKIY, V.V.

[Abstract] The use of combined mirrors to suppress competing lasing at 3.39 μm in the He-Ne lasers operating at 0.63 μm is investigated. A dielectric mirror coating structure is developed for a 0.63 μm laser that effectively establishes a low coefficient of reflection at 3.39 μm. The effectiveness of suppression of completing lasing with the help of combined mirrors in lasers using different types of active elements is investigated. The spectral characteristics of 9- and 19-layer dielectric ZnS and Na_3AlF_6 mirrors deposited on a fused-quartz substrate are investigated. A mirror with optimal reflection at 0.6328 μm and minimum reflection at 3.39 μm is created by making the thickness of the center layer of the dielectric coating equal to half the wavelength of the suppressed radiation. The performance of the mirror in different He-Ne lasers is compared and shown to be highly effective. Figures 2; tables 1; references 4 (Russian). [513-6900]

UDC 621.373:535.01

VECTOR SYNCHRONISM IN NONLINEAR LASER RADIATION FREQUENCY DOUBLERS OVER BROAD SPECTRAL REGION

Minsk DOKLADY AKADEMII NAUK BSSR in Russian Vol 29, No 6, Jun 85 (manuscript received 21 May 84) pp 519-522

BOKUT, B.V., academician (BSSR Academy of Sciences) and LUGINA, A.S.

[Abstract] Doubling the frequency of laser radiation by means of a nonlinear crystal is considered where a single cut will suffice for tuning the second-harmonic emission over the entire transparence spectrum of the crystal, with attendant vector synchronism utilized for this purpose. The optics of such a frequency doubler include a pair of lenses, a plano-convex one followed by a convexo-plane one, and an interchangeable biprism preceding the nonlinear crystal (potassium dihydrogen phosphate). A design and performance analysis of this frequency doubler, capable of tuning the synchronism over the given spectral range during ω - e interaction of waves, reveals that a set of four glass biprisms with obtuse angles 150.4°, 139.2°, 132.5°, 127.5°, respectively, suffices for frequency doubling with a single KDP crystal over the 514-1600 nm range of wavelengths. The crystal must be cut so as to incline the normal to its active faces at 80° to the optical axis and thus allow the angle of phase synchronism to be varied over the 70-90° range at

any fixed angle between the two fundamental-frequency laser beams. A corollary to this analysis is that it can be preferable to optimize the frequency conversion process on the basis of vectorial rather than collinear interaction, owing to the larger number of adjustable parameters. This has been demonstrated with a 20 mm long optimally cut plane-parallel KDP crystal. A conversion efficiency of 1-2% was attained with a 127.5° biprism for a Nd-glass laser emitting pulses of 30 ns duration and 0.6 J energy (beam divergence not exceeding 10') in the Q-switching mode. A conversion efficiency of 0.2% was attained with a 150.4° biprism for a rhodamine 6Zh dye laser tunable over the 560-600 nm range of wavelengths and emitting pulses of 0.1 J energy, upon quasi-longitudinal excitation by second-harmonic radiation from that Nd-glass laser, this efficiency level being comparable with that attainable on the basis of collinear interaction and the spectrum of second-harmonic radiation being here approximately 4.5 nm wide. Figures 2; tables 1; references 2 (Russian).
[449-2415]

UDC 535:621.391

ON THE PROBLEM OF ADAPTATION IN OPTICAL INFORMATION SYSTEMS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 3, Mar 85 (manuscript received 3 Aug 83) pp 494-498

USTINOV, N.D., MATVEEV, I.N., ANUFRIEV, A.V., ZIMIN, Yu.A. and BOLPOV, A.L.

[Abstract] A method is synthesized for optimal processing of random light fields in order to extract useful information by employing probability density functionals. The conditions are identified under which optimal adaptive processing can be implemented without using recursive algorithms to refine the a priori information and with no constraints on the geometric characteristics of the objects. The adaptation method is shown to be optimal from the viewpoint of analysis of the probability density functionals and can be used for an unknown object of a general type for which only the ratio of the undistorted images is known. Figures 3; references 5: 3 Russian, 2 Western.
[464-6900]

ENERGY LOSS SYSTEM AT EXIT FROM LINEAR ACCELERATOR OF UP TO 2 GeV ELECTRONS

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 55, No 5, May 85
(manuscript received 17 May 84) pp 907-909

AFANASYEV, N.G., DEMENTIY, S.V., DOVBNYA, A.N., POPENKO, V.A., RANYUK, Yu.N., NEMASHKALO, A.A. and SHENDRIK, V.A., Kharkov Institute of Engineering Physics, UkSSR Academy of Sciences

[Abstract] An energy loss system for high-resolution spectrometry of high-energy electrons by the scattering method has been developed which involves neither regulating the width of the collimator-monochromator slit with unavoidable attendant aberration nor compression of the spectrum after longitudinal debunching of electrons by the magnetic method. This energy loss system prevents the energy dispersion in the electron beam from influencing the resultant energy resolution of the recording apparatus. It consists of two principal components, a spectrometer and a conveyor which transports the electron beam from the accelerator to the spectrometric target. Such a system has been designed for the LUE-2 GeV electron accelerator, to be placed at the exit from the latter. The conveyor consists of an array of five quadruple electron lenses, one behind another, and a collimator-monochromator, all between two identical zonal-sectoral magnets producing uniform magnetic fields and rotatable through 45°. After passing through this system, the electron beam enters a scattering chamber with a target inside in front of the SP-103 magnetic spectrometer. A distinguishing feature of this system is that both conveyor and spectrometer disperse the electron beam in the horizontal plane, with the shift of electrons in the focal plane of the spectrometer depending only on the nuclear interaction process in the target and thus only on the energy loss on nuclear excitation. Experimental spectrometry of electrons scattered by ^{12}C nuclei with the electron beam conveyor operating in the standard achromatic mode and in the energy-loss mode has confirmed the advantages of this system and the feasibility of attaining an energy resolution of 0.1% or better. Figures 2; references 6: 3 Russian, 3 Western.
[459-2415]

UDC 535.317.1

COMPARISON OF RECOVERY METHODS FOR PHASE OF SPATIAL SPECTRUM OF ASTRONOMICAL OBJECTS FROM SERIES OF ATMOSPHERICALLY DISTORTED BRIEF-EXPOSURE IMAGES

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 6, Jun 85
(manuscript received 31 Jan 84) pp 1314-1317

BAKUT, P.A., KUKLIN, Ye.N., RAKHIN, A.D., SVIRIDOV, K.N. and USTINOV, N.D.

[Abstract] The phase-averaging method for recovering the phase of the spatial spectrum of astronomical objects is compared for the one-dimensional case with the Knox-Thompson method. The potential phase recovery accuracy

is found to be the same for both methods; however, the phase-averaging method is based on the assumption that the phase of the spectrum can be represented as a continuous function, which is invalid in the general case and calls that method into doubt for certain classes of objects. The Knox-Thompson method is shown by numerical example to be superior to the phase averaging method. Figures 2; references 8: 2 Russian, 6 Western.
[513-6900]

UDC 535.317.1

RECOVERY OF IMAGES OF EXTENDED OBJECTS UNDER PARTIALLY COHERENT ILLUMINATION

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 6, Jun 85
(manuscript received 1 Aug 83) pp 1330-1334

FILINOV, V.N. and CHERNYY, G.P.

[Abstract] The possibility is investigated of compensating distortions of the images of extended objects associated with imperfection of the propagation medium (atmospheric turbulence). The possibility of using recovery methods developed for coherent and noncoherent radiation for the case of partially coherent radiation is examined. Image recovery under conditions of partial coherent radiation can be achieved using radiation with a low degree of coherence by solving Fredholm's equation, or holographically by using radiation with a high degree of coherence. The attainable resolution is limited in the former case, and the dynamic range of the recovered image is reduced in the latter. Figures 1; references 12: 10 Russian, 2 Western.
[513-6900]

UDC 535.317.1

NUMBER OF HALF-TONES IN IMAGE OBSERVED UNDER COHERENT ILLUMINATION

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 6, Jun 85
(manuscript received 7 May 84) pp 1335-1340

GALPERN, A.D.

[Abstract] The number of observable brightness gradations of coherently illuminated objects is investigated as a function of the threshold contrast of the observer's eye considering averaging to account for eye movements, as well as coherent noise caused by scattering by the photographic material and nonlinearity of the holographic recording. The number of observable gradations is calculated for the case of $J_{max}/J_{min} = 50$, where J is the mathematical expectation of the intensity, for contrast of 0.01 and M = 10, where M is the number of picture dots passing over a given section of the retina within the visual inertia interval. A figure of 11 image gradations is obtained, which is sufficient for comfortable viewing of the image. Tables 2; references 10: 6 Russian, 4 Western.
[513-6900]

UDC 535.3:621.391.83

RECOVERY OF IMAGES OF PARTIALLY COHERENT QUASI-HOMOGENEOUS SOURCES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 6, Jun 85 (manuscript received 18 Feb 83) pp 1119-1125

BAKUT, P.A., DERYUGINA, A.I. and KURASHOV, V.N.

[Abstract] The possibility is investigated of using the eigenfunctions of the forming system for linear image recovery for one class of partially coherent sources. The forming system for quasi-homogeneous sources is shown to be equivalent to a noncoherent system with effective impulse response depending upon the spatial correlation coefficient of the field of the object. The use of the proposed method to recover the defocused image of a quasi-homogeneous source is described as an example. It is found that the eigenfunction method can be used to recover images of a quasi-homogeneous object with the correlation properties of its radiation unknown. The resolution of the method is determined by the additive noise of the system and by the satisfaction of the approximation of local homogeneity of the field characterizing the band of spatial frequencies of the object. Figures 3; references 12: 8 Russian, 4 Western.
[477-6900]

UDC 621.371.255

SPATIAL CORRELATION OF RANDOM DISPLACEMENTS OF LIGHT BEAMS IN TURBULENT ATMOSPHERE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28, No 5, May 85 (manuscript received 9 Apr 84) pp 654-656

MILYUTIN, E.R., FREZINSKIJ, B.Ya. and SAMELSON, G.M., Leningrad Electrotechnical Communications Institute

[Abstract] The spatial correlation functions of random displacements of the centers of gravity of two beams that differ from one another, in general, by the diffraction dimension of the emitting aperture (frequency and initial radius of the beam) and the focusing parameter are investigated. The behavior of the correlation coefficient of the spatial fluctuations of beams is investigated for different initial beam radii and different radii of curvature of the phase front in the center of the emitting aperture. The behavior is found to be independent of the frequency separation of the beams. The findings indicate that there is a very strong correlation between the spatial fluctuations of the centers of gravity of collimated and focused beams, especially during strong turbulence. It is concluded that it is sufficient to examine the collimated beam in investigating a range of problems associated with determining random displacements of the center of gravity of a light beam. Figures 1; references 5 (Russian).
[478-6900]

UDC 535.416.3

NONLINEAR DISTORTIONS OF HYPERTUBULAR LIGHT BEAMS

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian
Vol 28, No 5, May 85 (manuscript received 10 Jan 84) pp 624-633

TROFIMOV, V.A., Moscow State University

[Abstract] Nonlinear distortions of hypertubular light beams encountered in nonlinear adaptive optics are examined numerically and analytically. The behavior of tubular light beams in thick and thin nonlinear layers is examined. The cases of a Kerr medium and thermal self-interaction in a moving medium are investigated. It is found that hypertubular beams experience significantly smaller nonlinear distortions than Gaussian beams, and that significantly less mirror deformation is required to focus such beams. Hypertubular beams are found to experience practically no shifting due to movement of the medium after passing through an atmospheric layer. Figures 4; references 14 (Russian).
[478-6900]

DECAY OF OPTICAL SOLITONS

Moscow PISMA V ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian
Vol 42, No 2, 25 Jul 85 (manuscript received 31 Jan 85, after revision
18 Jun 85) pp 74-77

GOLOVCHENKO, Ye.A., DIANOV, Ye.M., PROKHOROV, A.M. and SERKIN, V.N.,
Institute of General Physics, USSR Academy of Sciences

[Abstract] A numerical computer experiment with femtosecond power pulses propagating through optical fibers was made, for a study of their nonlinear dynamics on the basis of the appropriately modified nonlinear Schrödinger equation in normalized variables describing the evolution of an initial wave packet. Calculations of the propagation characteristics and the spectrum dynamics have revealed a compression of the initial wave packet into a narrower pulse with a noteworthy absence of a "pedestal," also a dependence of the peak intensity and of the pulse duration on the fiber length, and a structural instability of coupled soliton states in a multisoliton pulse of laser radiation with eventual decay of the initial wave packet and of the multisoliton pulse. Figures 3; references 10: 4 Russian, 6 Western.
[578-2415]

PLASMA PHYSICS

UDC 533.915+537.523+621.378.324

STRUCTURE AND PROPERTIES OF OPTICAL-DISCHARGE PLASMA IN CO_2-LASER BEAM NEAR TARGET SURFACE

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 5, May 85 (manuscript received 11 Jun 84) pp 1002-1008

DANSHCHIKOV, Ye.V., DYMSHAKOV, V.A., LEBEDEV, F.V. and RYAZANOV, A.V., Institute of Atomic Energy imeni I.V. Krchatov, Moscow

[Abstract] An experimental study of optical-discharge plasma in a CO_2-laser beam at a target surface was made for the purpose of exploring the not yet understood role of this plasma in the laser-target interaction process. Such a plasma was produced by means of a quasi-continuous CO_2-laser with an unstable resonator, its power being maintained constant for 1 ms periods. Its radiation was focused on the surfaces of thick and "seeding" thin Al, Ti, Ta targets inclined at an approximately 70° angle to the beam, inside a hermetic chamber containing air, argon, or helium under atmospheric pressure. The radiation intensity distribution over the focal plane and the nearest caustic surface in the laser beam was measured along with the plasma parameters, the latter by the methods of spectral analysis and photoelectric recording. The instrumentation for this purpose included an MDR-3 monochromator with an entrance slit, a double electron-optical converter, a memory oscillograph, and an SI-10-30 ribbon lamp as radiation reference standard for calibration of absolute as well as relative measurements. For an evaluation of the results, the readings were supplemented with tables containing data on the spectral lines of metal and gas atoms and ions. Temperature measurements were made with pyrometers and the same double electron-optical converter, local emissivity of the plasma being determined with the aid of the Abel transformation. The results have yielded integral diametral intensity distributions of the emission lines Ti-II (457.2 nm), Ti-I (464 nm), Ar-II (461 nm), radial and axial temperature profiles of optical discharge in metal vapor in surrounding gas, and the radial temperature profile of irradiated metal surface at successive instants of time. The results reveal marked differences between the structures and the properties of optical-discharge plasma in metal vapor and in surrounding gas, optical discharge in the former being characterized by localization within the laser beam and optical discharge in the latter being characterized by a drift away from the target. All this information about steady plasma layers at a target surface, as well as about heat localization and the

transient temperature field is important for optimizing surface treatment of materials with continuous laser (CO_2-laser) radiation. Figures 4; references 15: 11 Russian, 4 Western (1 in Russian translation).
[504-2415]

UDC 533.8

DYNAMIC THEORY OF INTERACTION OF POWERFUL RADIATION WITH PLASMA

Moscow DINAMICHESKAYA TEORIYA VZAIMODEYSTVIYA MOSHCHNOGO IZLUCHENIYA O PLAZMOY in Russian 1984 pp 3-46

ANDREYEV, Nikolay Yevgenyevich

[Abstract] Research is described on predicting the quantitative regularities of nonlinear absorption and reflection of an electromagnetic field by an unsteady plasma. In studying the particle energy spectrum formed during absorption of the field energy, it is shown that a plasma with resonant parametric instability in a strong electromagnetic field changes to a highly turbulent state with anisotropic particle distribution, in which the high level of plasma oscillations causes effective transmission of the field energy to the plasma electrons, as well as the formation of accelerated ions. The dynamics of nonlinear bleaching of a plasma layer are investigated. Nonlinear absorption of polarized radiation from the expanding plasma corona of a target is studied. The energy spectra of accelerated electrons are investigated for different interaction modes between powerful radiation and moving plasma. A dynamic generation of the second and third harmonics of the frequency of the heating radiation in laser plasma is analyzed. A theory for a nonlinear wavefield in a stationary supersonic flow in a uniform plasma is constructed. The experimental findings agree well with the steady-state theory derived. Figures 11; references 27: 24 Russian, 3 Western.
[441-6900]

UDC 621.378.9;533.95

QUICK DIAGNOSIS OF HOT PLASMA IN INFRARED REGION OF SPECTRUM

Moscow SKOROSTNAYA DIAGNOSTIKA GORYACHEY PLAZMY V INFRAKRASNOY OBLASTI SPEKTRA in Russian 1984 pp 3-15

ISAKOV, Sergey Alekseyevich

[Abstract] Quick methods are described for investigating plasma dynamics at the plasma focus in the mid-infrared region of the spectrum (for a CO_2 laser operating at 10.6 μm). A multipurpose diagnostic system is developed that

incorporates two-channel recording of the intrinsic electromagnetic radiation of the plasma and employs interferometry with time resolution of approximately 1 msec and spatial resolution of approximately 100 μm. A pulse frame interferometry method is described that is based on up-conversion to the visible region of the spectrum employing a pulsed CO_2 laser and a neodymium glass laser, making it possible to obtain two-dimensional interferograms of plasma objects with dimensions of approximately 1-2 cm at 10.6 μm with 2 nsec time resolution and spatial resolution of 10 lines per millimeter. Experiments are described that demonstrate the effectiveness of the methods in thermonuclear experimentation. The processes occurring at the plasma focus in the dual-compression mode are studied. The correlation between the neutron yield of the plasma focus and the relative intensity of the first and second harmonics of the IR radiation is established.
References 3 (Russian).
[441-6900]

UDC 533.9.07

DYNAMICS OF FREE DISPERSAL OF LASER-PLASMA CLUSTER IN VACUUM

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR: FIZIKA in Russian
Vol 20, No 2, Mar-Apr 85 (manuscript received 26 Dec 83) pp 103-106

ARUTYUNYAN, S.G., GALECHYAN, G.A., DARBINYAN, K.R. and SARKISYAN, M.G.,
Scientific Research Institute of Physics of Condensated Media, Yerevan State University

[Abstract] Buildup of a plasma under laser radiation and the dynamics of its subsequent dispersal in vacuum were studied in an experiment, with radiation at the 1.06 μm wavelength from a passive Q-switched laser being focused on an aluminum target. Laser pulses of 0.2 J energy and 30 ns duration produced a spot 0.5 mm in diameter with a power density of 10^9 W/cm^2, while vacuum in the test chamber was maintained at 10^{-4} torr maximum. The polar diagram of plasma dispersal was measured with six 3 mm long probes 0.8 mm in diameter in a plane perpendicular to the target surface at 15°, 30°, 45°, 60°, 90° elevation angles and at distances varied from 5 cm to 25 cm in 2 cm steps. The dispersal velocity as a function of the elevation angle and the concentration profiles reveal that a plasma cluster produced by such a laser treatment of a metal target disperses in the direction normal to the target surface, then forms a wide cluster in the shape of a funnel with a 100° opening angle and becomes collisionless with a constant electron temperature of 0.9 eV at distances beyond 9 cm from the target. Figures 2; references 6: 3 Russian, 3 Western.
[566-2415]

ANALYSIS OF LASER-PLASMA DYNAMICS BASED ON X-RAY SPECTRA OF MULTICHARGE IONS

Moscow PISMA V ZHURNAL EKSPERIMENTALNOY I TEORETICHESKOY FIZIKI in Russian
Vol 42, No 2, 25 Jul 85 (manuscript received 18 Jun 85) pp 71-74

BASOV, N.G., KALASHNIKOV, M.P., MIKHAYLOV, Yu.A., RODE, A.V., SKLIZKOV, G.V. and FEDOTOV, S.I., Institute of Physics imeni P.N. Lebedev, USSR Academy of Sciences
HETZ, K. and FÖRSTER, E., Friedrich-Schiller University, Jena (GDR)

[Abstract] The dynamic behavior of a laser plasma is analyzed by the method of x-ray spectroscopy, on the basis of experiments performed in the "Delfin-1" facility. The hydrodynamic efficiency of target compression and the rate of target material evaporation are determined from the shift of the intensity peak on images of the plasma in the light of optically heavy x-ray spectral lines. Glass shells 400-500 μm in diameter with 0.5-4.0 μm thick walls containing deuterium-deuterium thermonuclear fusion fuel were compressed and heated in a spherically symmetric configuration at the 1-1.5 J level of laser energy, with 35-40% absorption. Images of the plasma in the light of emitted x-ray lines were formed by means of a spectrograph with a flat [10$\bar{1}$0] quartz crystal and a slit in the direction of plasma dispersal. The K-spectra of silicon plasmas within the 5-7 Å band were found to form a characteristic two-dimensional image in the light of He-ion line, with the peak at the center shifting in the direction of dispersal. This appears to be basically a consequence of the Doppler effect in a radio-symmetrically dispersing plasma. In thin shells the main contributor to bright x-ray lines are plasma regions with an electron concentration of the order of 10^{22} cm^{-3}, the outer corona with an electron concentration below 10^{21} cm^{-3} being almost transparent to resonant radiation so that a "blue" Doppler effect corresponds to the mean velocity of the denser plasma. In thicker shells the corona region is larger and resonant radiation emitted by denser plasma layers becomes largely absorbed by the nonuniformly expanding plasma itself, with an attendant "red" Doppler shift. In much thicker shells the plasma with still lower electron concentration of the order of 10^{20} cm^{-3} becomes the main contributor to emission, without appreciable absorption of radiation by the plasma itself and, consequently, with a "blue" Doppler shift. Glass shells with a 1.2-2.2 μm wall thickness were found to be optimally suited for high compression and heating of the D-D fuel, a compression ratio of $3.5 \cdot 10^3$ with a neutron yield of 10^7 n/pulse having been attained in the "Delfin-1" facility. The authors thank B.N. Chichkov for helpful discussions. Figures 2; references 8: 6 Russian, 2 Western. [578-2415]

UDC 538.4

DIFFUSION OF STRONG MAGNETIC FIELD INTO DENSE PLASMA

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian No 3, May-Jun 85 (manuscript received 21 Mar 84) pp 8-14

GARANIN, S.F., Moscow

[Abstract] Diffusion of a strong longitudinal magnetic field from vacuum into a dense collisional plasma is analyzed in the two-dimensional approximation, assuming an infinitely dense fully ionized homogeneous plasma in mutually orthogonal electric and magnetic fields. The corresponding system of equations of total pressure, both electric and magnetic fields, and heat balance are reduced to self-adjoint form on the basis of applicable similarity laws with normalized quantities - all quantities being functions of the longitudinal coordinate and of time. First, the initial stage of the process is considered, beginning with zero field intensities, when radiation from the discharge is still negligible and heat transfer by electrons through conduction and the Nernst effect is dominant so that the magnetic diffusion coefficients and the thermal diffusion coefficients are of the same order of magnitude. This stage of the process is significant only in a hydrogen plasma, with ionicity $z = 1$. Next, the second stage is considered, when radiation compensates Joule-effect heating and the discharge becomes steady. Last, the third stage is considered, when radiation from the discharge heats the inner plasma layers and radiative heat transfer becomes dominant so that the magnetic diffusion coefficients and the radiative diffusion coefficients are of the same order of magnitude. Numerical calculations are made for discharge in hydrogen and in acrylic glass C_5H_8O, in megagauss magnetic fields. Figures 6; references 5: 4 Russian, 1 Western.
[576-2415]

UDC 533.9

BEAM-PLASMA INSTABILITY OF CONFINED RELATIVISTIC ELECTRON BEAM

Moscow FIZIKA PLAZMY in Russian Vol 11, No 6, Jun 85 (manuscript received 27 Jul 84 after revision) pp 688-693

BAYTIN, A.V. and POPKOV, N.G., Institute of Atomic Energy imeni I.V. Kurchatov

[Abstract] The kinetic beam-plasma instability of a confined relativistic electron beam in a broad plasma channel is investigated. The parameter conditions of the beam and plasma are identified for which the instability does not become nonlinear. It is found that excursion of the oscillations from the region of the beam causes instability to cut off if $I<I_{thresh}$, where the latter is determined by the pulse spread of the beam, its

relativism, and the concentration and temperature of the plasma. If there is no magnetic field, the threshold current is small due to the smallness of the group velocity. The threshold current increases as the magnetic field grows and can be of the order of the Alfven current at the limit of a strong magnetic field. References 15: 8 Russian, 7 Western.
[506-6900]

UDC 621.372.8.029.7

DEPENDENCE OF PHASE OF COHERENT RADIATION IN FIBER OPTICS ON PRESSURE AND TENSION

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 5, May 85 (manuscript received 28 Aug 84) pp 1086-1086

SHATALOV, F.A., Moscow Institute of Engineering Physics

[Abstract] The performance of fiber optics transmitting coherent radiation is examined from the standpoint of their use in interference devices, where the phase of such a radiation is a most important parameter. The sensitivity of that phase to changes in tension and pressure is evaluated for any multi-layer fiber generally, with the core counting as the first layer. Approximate analytical expressions are derived for the dependence of the radiation phase on axial tension, radial pressure, and hydrostatic pressure. These expressions, based on the appropriate boundary conditions, indicate when the sensitivity of the radiation phase becomes ideally zero and really only minimum. Numerical calculations have been made for 3-layer and 5-layer fibers having SiO_2, $SiO_2 + GeO_2$, $SiO_2 + GeO_2 + P_2O_5$ cores and $SiO_2 + B_2O_3$ sheaths with aluminum or various polymer coatings. The author thanks V.N. Protopov for discussing the results. Tables 1; references 16: 5 Russian, 11 Western (1 in Russian translation).
[504-2415]

WORK ON CRYOGENIC TECHNOLOGY FOR 3-TRILLION-EV ACCELERATOR

Leningrad, LENINGRADSKAYA PRAVDA in Russian 8 Jun 85 p 2

[Abstract] The article reports on features of and plans for the accelerator-accumulator complex (UNK) which is under construction at the Institute of High-Energy Physics (IFVE) in Protvino.*

Plans call for the UNK to have a capacity of 3 trillion electron-volts. It will be equipped with a system consisting of 2,400 superconductive magnets operating in liquid helium at a temperature near absolute zero. The building of an additional superconductive magnet system is envisaged at a later date, for the purpose of creating counter beams. This will raise the energy from collisions of particles to 6 trillion electron-volts.

Professor Viktor Yarba, first deputy director of the institute, commented on the advantages of using cryogenic technology in the UNK and on technical problems which its developers had to solve. In particular, new electronics and instruments had to be developed with specifications substantially in advance of state-of-the-art technology of the day. As compared with the synchrotron now in operation at IFVE, the UNK's energy will be 40 times as high, but it will be only 14 times as long and its entire superconductive magnet system will weigh only 28,000 tons, thanks to these innovations.

Professor Lev Solovyev, director of the institute, mentioned plans for a program of physics research on the quark level, using the UNK. These experiments may shed light on specific features of quark forces which involve the opening up of a new range of energy.

The UNK's developers and personnel of a laboratory of the Joint Institute for Nuclear Research (OIYAI) in Dubna are said to be working on the problem of reducing heat release by superconductors. One result of this work has been the development, in Dubna, of an original unit for measuring heat release in superconductive wires and cables. IFVE and OIYAI specialists are also studying methods for research using the UNK, as well as physical problems and principles of multipurpose detectors for experiments with counter beams. The joint development of a large spectrometer has been proposed, in particular. It will be used to record events occurring in beams during collisions of hadrons.

*See also the Daily SNAP, March 20, 1985, p 3, col 1.

FTD/SNAP
/13046
CSO: 1862/489

UDC 533.915.03:621.373.826.038.823

SURFACE PLASMA IN BEAM OF CONTINUOUS CO_2-LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 7, Jul 85 (manuscript received 17 Apr 84, after completion 14 Dec 84) pp 1527-1528

VASILTSEOV, V.V., ZEBELIN, A.M., ZAKHARKINA, O.L., LEBEDEV, F.V., MINNEBAYEV, K.P., MOROZENKOV, A.A., RYAZANOV, A.V. and SHAKIROV, R.G., Scientific Research Center for Technological Lasers, USSR Academy of Sciences, Troitsk (Moscow oblast)

[Abstract] Quasi-steady optical-discharge plasma forming at the surface of materials welded together or otherwise heat treated by a CO_2-laser beam was studied in an experiment, the purpose being to establish the conditions for its existence in various states without kindling of a detrimental laser absorption wave. Measurements were made with an SPE-1 spectrograph and an IFO-451 microphotometer-densitometer, using a lens with a focal length of 20 cm for obtaining a bright spot not larger than 0.5 mm in diameter. The results indicate no kindling of a laser absorption wave in air at power densities up to $2 \cdot 10^6$ W/cm^2. An erosive flare with A10 emission lines was found to be maintainable at surfaces of aluminum alloys. Optical breakdown and surface discharge with emission lines of the target atoms and ions was found to occur in the metal vapor at steel and brass surfaces, without ionization of the surrounding air and formation of a laser absorption wave. The power necessary for ionization of air and maintenance of a laser absorption wave above a focusing spot smaller than 1 mm in diameter was found not to significantly depend on that diameter, a power of approximately 2 kW being the threshold in accordance with the Rayzer theory (Yu.P. Rayzer, 1974) as well as on the basis of known experimental data. The authors thank A.N. Savchuk for assisting with the experiment. Figures 2; references 7: 5 Russian, 2 Western.
[582-2415]

UDC 621.384.6

USE OF COAXIAL CAPACITOR IN SHAPING LINE OF HIGH-CURRENT ELECTRON ACCELERATOR

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 55, No 5, May 85
(manuscript received 22 Jun 83, in final version 22 May 84) pp 824-828

MOVSHEVICH, B.Z., Institute of Applied Physics, USSR Academy of Sciences, Gorkiy

[Abstract] A coaxial capacitor is considered as energy storing element in a high-current electron accelerator for free-electron lasers or for various other applications in high-frequency relativistic electronics. Such a capacitor should feed high-voltage nanosecond discharge pulses to a diode load after correction but without impedance matching, inasmuch as the energy rating of a shaping line is a multiply peaking function of the characteristic impedance and only under unmatched conditions is it possible to maintain the nominal pulse amplitude and duration. A comparative evaluation of the energy-size relations for a coaxial capacitor and a matched shaping line indicates that, while the latter with optimum high-permittivity dielectric material will perform well when the load resistance is low, a coaxial capacitor becomes more efficacious when the load resistance is 100 ohms or higher. Discharge from a coaxial capacitor generally produces a pulse with an exponentially drooping top, but it is quite possible to flatten the top by means of a corrective reactance output filter. A conventional filter, however, will either drop the voltage as much as one half when it consists of many elements, or will ripple the pulse top when it consists of a few elements. Filter analysis and synthesis by means of models have shown that this application requires only three reactance elements, an inductance followed by an inductance and a capacitance in parallel, but also requires one resistance element most expediently connected in series with the capacitance. Figures 6; references 8 (Russian).
[459-2415]

UDC 536.248.2:534:532

SONIC PHENOMENA OF BOILING

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 23, No 3, May-Jun 85 (manuscript received 24 Nov 83) pp 586-598

DOROFEYEV, B.M., Stavropol State Pedagogic Institute

[Abstract] This review, primarily covering the Soviet literature, discusses the state of studies of boiling sounds, useful for diagnosis of the operation of heat exchange apparatus, including nuclear reactors. Acoustical monitoring is the only method suitable for detection of boiling of heat transfer media and can quite accurately identify various stages of bubble boiling. Beginning with an analysis of the pulses of pressure generated by individual steam bubbles, the article discusses collective effects and thermoacoustical oscillations. Areas studied include their mechanism of generation, the process of formation of standing waves, changes in the compressibility of a two-phase medium in a channel, the relationship of variable pressure with the boiling process, and also with the instantaneous local surface temperature of the heat exchanger and of the fluid next to a heat exchange wall. Figures 6; references 104: 90 Russian, 14 Western.
[530-6508]

UDC 517.958:536.2

COMPLEX STRUCTURE OF TWO-DIMENSIONAL HEAT WAVE ABSORBING LASER RADIATION

Moscow ZHURNAL VYCHISLITELNOY MATEMATIKI I MATEMATICHESKOY FIZIKI in Russian Vol 25, No 6, Jun 85 (manuscript received 22 Oct 84 after revision) pp 946-947

POPOV, S.P. and FEDOROV, G.M.

[Abstract] Fundamentally new solutions are identified and investigated numerically that occur during the joint solution of the two-dimensional nonlinear heat conductance equation and the transfer equation for the radiation absorbed by a heat wave. The sources of the heat conductance equation model the absorption of radiation, and the one-dimensional transfer equation yields the intensity of the radiation. With the appropriate

coefficient, the system of equations derived permits solutions consisting of two or more heat waves, whose formation is explained by the two-dimensional nonlinear nature of heat propagation, as well as geometric factors. Figures 2; references 3 (Russian).
[463-6900]

UDC 533.15+541.141

STATISTICS AND KINETICS OF PARTICLES EXCITED BY EXTERNAL RESONANT FIELDS

Moscow STATISTIKA I KINETIKA CHASTITS, VOZBUZHDAYEMYKH VNESHNIM REZONANSNYM POLEM in Russian 1984 pp 3-26

SAZONOV, Vladimir Nikolayevich

[Abstract] A theory of laser kinetic processes is developed. The statistics and kinetics of particles (atoms and molecules) that are excited by an external resonant field and are contained in a temperature-controlled chamber not affected by the field are investigated. A theory of pumping a nonlinear quantum oscillator by an external resonant field is presented. The general problem considered from the viewpoint of statistics is that of the steady-state distribution function of a physical system excited by an external resonant field; in terms of kinetics, new experimental possibilities are examined that are opened up by selective excitation, with respect to velocity, of atoms and molecules in a gas mixture. Numerous simulations are presented that make it possible to investigate selective diffusion (or light-induced drift) of the components of a gas mixture, as well as the occurrence of excess population in the resonance regions of the phase space of a classical ensemble, or at the resonant energy levels of a quantum ensemble, where the natural frequency is close to that of the external resonant field. An increased yield of multiphoton dissociation of polyatomic molecules is discovered due to mixing of states with similar energies. References 27: 20 Russian, 7 Western.
[441-6900]

NONLINEAR THEORY OF SCATTERING OF ELECTROMAGNETIC WAVES BY PLASMA

Moscow NELINEYNAYA TEORIYA RASSEYANIYA ELEKTROMAGNITNYKH VOLN PLAZMOY in Russian 1984 pp 3-18

ZOZULYA, Aleksey Alekseyevich

[Abstract] Nonlinear scattering of electromagnetic radiation by plasma is investigated theoretically. Mandelstam-Brillouin scattering is investigated in an inhomogeneous rarified plasma with density far below critical, so that the plasma is transparent for all interacting waves. The conditions are

established under which Mandelstam-Brillouin scattering is either convective or absolute; the physical mechanism underlying the formation of absolute instability is identified. Mandelstam-Brillouin scattering is investigated in a laser plasma corona formed when laser radiation interacts with solid targets. The presence of a surface of critical density, which reflects incident electromagnetic radiation, is shown to result in the occurrence of a new type of absolute instability--dual stimulated Mandelstam-Brillouin scattering. The nonlinear stage of double Mandelstam-Brillouin scattering is investigated during oblique incidence of the pumping wave on the plasma. The generation of combination harmonics of the pumping wave caused by the convective stage of two-plasma instability is investigated. The influence of the focusing and recording optical systems on the spectrum of the combination harmonics is studied. Satellite broadening is discovered in the harmonic spectrum when the radiation is recorded using a lens with finite aperture angle. References 10: 9 Russian, 1 Western.
[441-6900]

UDC 621.378.4.6

EXPERIMENTAL STUDY OF ACTION OF CO_2-LASER PULSES ON WATER-DROPLET AND ICE-CRYSTAL CLOUDS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 5, May 85
(manuscript received 22 Jun 84) pp 1027-1033

BELTS, V.A., VOLKOVITSKIY, O.A., DOBROVOLSKIY, A.F., IVANOV, Ye.V., NASEDKIN, Yu.V. and PAVLOVA, L.N., Institute of Experimental Meterology, Obninsk (Kaluzhskaya Oblast)

[Abstract] Action of 0.1-10 MW/cm^2 pulses from a CO_2-laser on aqueous aerosol was studied experimentally in the laboratory, for the purpose of determining the pattern of pulse propagation through such a medium and its effect on the optical properties of the latter. Tests were performed in a temperature-pressure chamber of 100 m^3 capacity. Laser radiation pulses at the 10.6 μm wavelength were focused through a lens with a focal length of 2.5 m on the center of that chamber. The cloud of particles along the path of these pulses was probed with beams of two continuous-wave lasers, an LG-38 (0.63 μm wavelength) and an LG-126 (1.15 μm wavelength). The two main objects of the experiments were transformation of the cloud microstructure and kinetics of the optical transparence upon passage of high-intensity CO_2-laser pulses. The energy of pulses was measured with wire bolometers, the pulseform in the time domain was traced by an oscillograph through photoresistors. Measurements were made in water-droplet clouds over the 240-293 K temperature range and in ice-crystal clouds over the 246-261 K temperature range. The phase composition of clouds at temperatures below 273 K was determined with the aid of linearly polarized radiation from a He-Ne laser and the backscattering signal. Most important was measurement of the pulse attenuation by the medium, as basis for determining the optical thickness of a cloud along with the mean

particle size and concentration, as well as the mass fraction of particles converted into vapor. The data indicate that the characteristic time of cloud transformation under the given conditions is on the order of 5 μs. Their interpretation in terms of processes occurring within a length of time comparable with the pulse duration reveals that changes in concentration and optical transparence within such a period of time do not significantly depend on the temperature and the phase composition of such clouds. The authors thank V.V. Lenisova, V.S. Mileshin, A.G. Monakhov, and V.I. Larinov for participation in the experiments; also V.V. Lukashina and A.P. Vnukova for assistance in processing and formularizing the results of measurements. Figures 6; references 16: 10 Russian, 6 Western (1 in Russian translation).
[504-2415]

UDC 534.222.2

STATIONARY ZONE STRUCTURE AND RELAXATION INSTABILITY OF DETONATION WAVE IN INHOMOGENEOUS MEDIA

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 282, No 4, Jun 85 (manuscript received 18 July 84) pp 865-869

KOPOTEV, V.A. and KUZNETSOV, N.M., Institute of Chemical Physics, USSR Academy of Sciences

[Abstract] The detonation of a mixture of gaseous fuel containing inert nonevaporating particles is examined, and the results are extended to other inhomogeneous mixtures. The behavior of the Jouget point as $\beta \to \infty$, $\alpha \to \infty$, and $\alpha \to 0$ is analyzed. It is found that if one of the relaxation parameters α or β is contained between its critical values, the flat detonation front, like for homogeneous detonation, should experience relaxation instability. The findings can be extended to other inhomogeneous mixtures in which, for example, the condensed particles are inert but may evaporate, in which case an additional relaxation parameter appears in the system. The inhomogeneous detonation of a superenriched mixture of a gaseous oxidant and particles or droplets of fuel is discussed. Figures 1; references 4 (Russian).
[479-6900]

ION COMPOSITION OF PROPANE-BUTANE-AIR FLAMES AT REDUCED PRESSURE

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 21, No 3, May-Jun 85 (manuscript received 4 Apr 84 after revision) pp 32-42

FIALKOV, A.B. and FIALKOV, V.S.

[Abstract] The ion composition of propane-butane-air flames, and its relationship with combustion conditions, is investigated employing a set-up

that makes it possible to register the masses of all of the positive ions in the flame, and to investigate rarefied flames. The relationship between the ion composition and the stream of charged particles from the reaction zone is investigated in order to identify the mechanism underlying ion formation. Nonthermal ionization in the flame is found to occur in the chemionization zone, which nearly coincides with the chemilumeniscent zone, as well as in the region in which the mixture is prepared. A mechanism of ion formation in a flame is proposed in general form. Figures 4; references 42: 25 Russian, 17 Western.
[492-6900]

INFLUENCE OF TEMPERATURE AND VELOCITY INHOMOGENEITY ON STABILIZATION LIMITS OF FLAME OF PRE-PREPARED AIR MIXTURES

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 21, No 3, May-Jun 85 (manuscript received 16 Apr 84) pp 42-45

GRUZDEV, V.N.

[Abstract] An investigation employing pre-prepared fuel-air mixtures, conducted to determine the influence of temperature and velocity irregularities, is described. It is found experimentally that horizontal temperature irregularity expands the limits of stabilization of the flame of pre-prepared mixtures, while velocity irregularity reduces those limits. Figures 3; references 7 (Russian).
[492-6900]

IGNITION OF ALUMINUM-CONTAINING CONDENSED SYSTEMS BY SINGLE LASER PULSE

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 21, No 3, May-Jun 85 (manuscript received 18 Jul 84) pp 51-55

IOFFE, V.B., DOLGOLAPTEV, A.V., ALEKSANDROV, V.Ye. and OBRAZTSOV, A.P.

[Abstract] Experiments are conducted to investigate the influence of the content of finely dispersed aluminum (with average particle dimension of 2.2 μm) on the laser ignitability of various explosives and ammonium nitrite. A simple criterion for the flammability of individual condensed systems is proposed on the basis of the physical-chemical properties of single crystals, as well as the physical and optical characteristics of the dispersed medium. It is found that the more poorly ignitable the system (without additives), the greater the relative effect of introducing additives. Figures 3; references 11: 8 Russian, 3 Western.
[492-6900]

INFLUENCE OF FISSURE FORMATION ON IGNITION OF EXPLOSIVE BY LASER RADIATION

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 21, No 3, May-Jun 85 (manuscript received 12 Jul 84 after revision) pp 57-60

LISICHENKO, V.I. and CHERNAY, A.V.

[Abstract] A model of explosive initiation is proposed that takes into account the fissure formation process. The role of submicron fissures formed near absorbing micron inhomogeneities on the formation of the ignition site is investigated. The relationship between the ignition parameters and the external pressure and initial temperature of the explosive specimens is determined. It is found that thermal stresses caused by laser radiation can play a strong role in the radiant ignition of explosives. References 11: 10 Russian, 1 Western.
[492-6900]

INFLUENCE OF DYNAMICS OF VOID CLOSURE ON RAPID COMPACTION OF POWER MATERIAL

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 21, No 3, May-Jun 85 (manuscript received 16 Jan 84) pp 77-80

BALANKIN, S.A., GORBACHEV, L.P., GRIGORYEV, Ye.G. and DOBROVOLSKIY, V.B.

[Abstract] This study examines the influence of the amount of air contained in the voids, the visco-plastic properties of the powder material, the size and shape of the particles of powder material, and the rate of application of the pressing load, on the rapid compaction of a powder medium. Equations for the mechanics of solid media are used to study the rapid collapse of spherical and cylindrical voids. The basic dimensionless parameters and criteria that determine different void collapse modes are identified. A similar approach can be used for different void geometries and arbitrary pressure pulse shape considering the counterpressure of the gases and surface tension. References 5 (Russian).
[492-6900]

INFLUENCE OF RHEOLOGICAL PROPERTIES ON SELECTIVE SENSITIVITY OF AN EXPLOSIVE TO SHAPE OF SHOCK-WAVE PULSE

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 21, No 3, May-Jun 85 (manuscript received 22 Mar 84) pp 80-87

ANDREYEV, S.G., BOYKO, M.M., LAZAREV, V.V., SOLOVYEV, V.S. and CHERNOV, A.I.

[Abstract] The influence of the rheological properties of explosives on the relationship between the sensitivity of a particular explosive and the shape of the wave loading pulse (the pressure build-up and drop characteristics)

is investigated. The possibility of changing the sensitivity series of an explosive for monotonic profiles when going from single-stage compression without a drop to a profile with a drop following the shock front is examined. It is shown possible to accelerate the decomposition of TNT heated to 70°C to rarefaction waves behind the shock front. The phenomena noted are interpreted as features of the intermolecular and intramolecular interactions in explosives, such as heated TNT, that are manifested integrally for higher intrinsic temperatures. Possible mechanisms for accelerating the decomposition of explosives are proposed. Figures 4; references 9: 8 Russian, 1 Western.
[492-6900]

DYNAMICS OF ACCELERATION AND HEATING OF FINE-DISPERSE PARTICLES BY SUPERCOMPRESSED DETONATION WAVES

Novosibirsk DINAMIKA MNOGOFAZNYKH SRED in Russian No 68 (signed to press 28 Dec 84) 1984 pp 108-115

PROKHOROV, Ye.S.

[Abstract] Acceleration and heating of fine-disperse particles by products of a supercompressed detonation wave is considered in a tube of nonuniform circular cross-section. The velocity and the temperature of such particles behind the wavefront are calculated as functions of the radial coordinate and time in the quasi-one-dimensional approximation. The corresponding system of four differential equations is formulated for a tube closed at the wide end and open at the narrow end, containing a mixture of gaseous reactants ignited at the wide end, and including a conical transition segment between its wide and narrow segments. This system of equations is solved for the appropriate boundary conditions at the closed end and at the propagating wavefront, with the Chapman-Jouget condition added for a steady detonation wave and with friction as well as heat dissipation included. It was solved numerically for a $C_2H_2:O_2$ = 1:2.5 mixture in a tube with wide and narrow segments 0.08 m and 0.02 m in diameter, respectively, with various taper angles of the conical segment raging from 5° to 30°, and with various lengths of the narrow segment ranging from 0.25 m to 1 m. The results for a wave expansion angle larger than critical include pressure transients and velocity profiles, which are compared with those in a uniform circular tube. They indicate that maximum outlet velocity of solid particles is attainable with a narrow segment not longer than 10-15 diameters, also that finer particles are more readily accelerated. Figures 4; references 11 (Russian).
[569-2415]

UDC 517.977.8

METHODS OF SEEKING EFFECTIVE EQUILIBRIUM SITUATIONS IN DIFFERENTIAL MULTIPLAYER GAMES

Moscow ZHURNAL VYCHISLITELNOY MATEMATIKI I MATEMATICHESKOY FIZIKI in Russian Vol 2, No 8, Aug 85 (manuscript received 15 Feb 84, after revision 28 Jun 84) pp 1260-1263

KONURBAYEV, Ye.M., Moscow

[Abstract] An existence theorem for a weakly effective ε-equilibrium situation in a differential n-player game

$$\dot{x} = \sum_{j=1}^{n} f_j(t,u_j)$$

$0 \leq t \leq T$, $x(0) = x_0$, $u_k \in P_j$, $I_k(u_{xt}) = g_k(x(T))$, $j = 1,2,\ldots,n$, $k = 1,2,\ldots,n$ is proved, assuming that vectors c_k are non-negative (x,u_j - vectors in Euclidean spaces representing sets of admissible choices of players, P_j - convex compacts completely contained within cones of corresponding Euclidean spaces and containing a zero vector). A second theorem establishes the condition necessary for an ε-equilibrium positional situation on some weakly effective trajectory for a game describable by nonsteady-state equations with linear criteria. Any weakly effective solution to the problem-game, particularly an optimum one in the Pareto sense, can be found as the maximum of the weighted sum with non-negative coefficients of players' criteria

$$g(x) = \sum_{k=1}^{n} \nu_k g_k(\dot{x}) = (\sum_{k=1}^{n} \nu_k c_k x) = (h(\nu),x)$$

along the trajectory of the controlled system $\dot{x}$. On this basis, methods of seeking an effective equilibrium situation are proposed, which requires finding a point of intersection in the array of sets of a standard simplex according to Spörner's lemma. This problem is equivalent to the problem of seeking a stationary point on a continuous map of a simplex onto itself. Known algorithms of the solution, programmed in FORTRAN and involving subdivision of a simplex into many sufficiently small subsimplexes, are obviously inefficient. The volume of computations can be reduced either by selection of $\nu^1 = p(\frac{1}{2})$ and subsequent replacement of ν^1 with ν^0 or by fixation of a sufficiently small $h > 0$ and evaluation of $\nu^k = p^{k-1}(h)$ on each step. References 11: 9 Russian, 2 Western (1 in Russian translation). [575-2415]

UDC 519.85

NUMERICAL METHOD FOR MULTISTEP DECISION-MAKING PROBLEM UNDER AMBIGUOUS CONDITIONS

Moscow ZHURNAL VYCHISLITELNOY MATEMATIKI I MATEMATICHESKOY FIZIKI in Russian Vol 25, No 6, Jun 85 (manuscript received 15 May 84 after revision) pp 803-814

MUKHAMEDIEV, B.M.

[Abstract] A general scheme for solving a nonlinear multistep decision-making problem under ambiguous conditions is proposed; a numerical method implementing the scheme is presented and validated and extended to the case of a problem with several criteria. The method is based on approximating sets of acceptable states and controls. The conditions of convexity and compactness of sets of acceptable states and controls are identified. A numerical method for searching for ε-optimal strategies is described. References 14: 13 Russian, 1 Western.
[463-6900]

UDC 519.7

RECOGNITION ALGORITHMS WITH ASSIGNED MEASURE OF INCORRECTNESS

Minsk VESTSI AKADEMII NAVUK BSSR: SERYYA FIZIKA-MATEMATYCHNYKH NAVUK in Russian No 3, May-Jun 85 (manuscript received 15 Jun 82) pp 26-31

KONOVALOV, O.L. and KRASNOPROSHIN, V.V., Belorussian State University imeni V.I. Lenin

[Abstract] This study addresses the investigation of correct (i.e., non-error-producing) algorithms for stability with respect to changes in the samples S^q. The concept of stability is used to derive conditions under which the set of recognition algorithms contains an algorithm with an assigned measure of correctness over the entire permissible domain. A theorem is stated and proved from which it follows that any correct algorithm is stable for a task $\tilde{Z}$ if its recognition operator is stable with respect of the sample S^q. References 5 (Russian).
[471-6900]

UDC 621.373.826.53

MATHEMATICAL MODELING OF DIAGNOSTIC CHARACTERISTICS OF THERMONUCLEAR PARTICLES IN LASER PLASMA BY MONTE CARLO METHOD

Moscow FIZIKA PLAZMY in Russian Vol 11, No 6, Jun 85 (manuscript received 16 Jul 84) pp 684-687

VYGOVSKIY, O.B., GUSKOV, S.Yu., ILIN, D.V., LEVKOVSKIY, A.A., ROZANOV, V.B. and SHERMAN, V.Ye., Physics Institute imeni P.N. Lebedev, USSR Academy of Sciences

[Abstract] The spectra and yields of the alpha-particles and neutrons exiting the laser plasma of spherical targets are analyzed numerically by a program based on the Monte Carlo method. Particles of the statistical ensemble are distributed randomly in the phase space in conformance with the probability of their generation in the primary thermonuclear reactions of the plasma components for a given temperature and density distribution. The shift of the high energy peak of the initial spectrum of the recoil nuclei or its boundary energy to the region of lower energies due to braking of the

particles in the shell target is found to represent an important diagnostic characteristic. Figures 3; references 8: 7 Russian, 1 Western.
[506-6900]

UDC 621.391.8

TWO-DIMENSIONAL EXPONENTIAL SMOOTHING IN DIGITAL IMAGE PROCESSING

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 6, Jun 85 (manuscript received 12 Jul 84 after revision) pp 69-72

KORSHUNOV, Yu.M.

[Abstract] A recursive algorithm for smoothing noise in a two-dimensional discrete signal is investigated that extends the one-dimensional exponential smoothing algorithm to the two-dimensional case. Expressions are derived for the smoothing coefficients and error coefficients. The use of the exponential smoothing algorithm to estimate the position and value of the maximum of a two-dimensional function distorted by additive interference is described. Comparison of the performance of the two-dimensional and one-dimensional algorithms shows the two-dimensional algorithm to be significantly more accurate. References 4 (Russian).
[468-6900]

UDC 519.85

NECESSARY AND SUFFICIENT CONDITIONS OF SINGLE EXTREMALITY IN NONCONVEX MATHEMATICAL PROGRAMMING PROBLEMS

Moscow ZHURNAL VYCHISLITELNOY MATEMATIKI I MATEMATICHESKOY FIZIKI in Russian Vol 25, No 6, Jun 85 (manuscript received 11 Nov 83) pp 815-826

GASANOV, I.I. and RIKUN, A.D.

[Abstract] Mathematical programming problems with smooth objective function and constraints and with a compact connected acceptable domain are examined. The properties of the set of points that satisfy the necessary conditions of the extremum are investigated, and methods are proposed on that basis that make it possible to identify the classes of mathematical programming problems for which "local" algorithms are algorithms for finding the global extremum. Examples of investigating specific mathematical programming problems for single extremality are presented. References 9: 8 Russian, 1 Western.
[463-6900]

MODELING OF PRESSURE WAVES FORMED DURING DETONATION AND COMBUSTION OF GAS MIXTURES

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 21, No 2, Mar-Apr 85 (manuscript received 30 Jul 84 after revision) pp 90-97

BORISOV, A.A., GELFAND, V.Ye. and TSYGANOV, S.A.

[Abstract] A comparative analysis is presented of the data in the literature on explosions of explosives and gas mixtures based on so-called energy similarity curves, where the pressure and impulse field for the explosive is represented as a function of the reduced radius referred to the cube root of the energy, or to the radius of the charge. It is found possible to formulate energy similarity laws for spherical detonation explosions of clouds of gaseous mixtures in terms of pressure and impulse, and that existing data are described by a unified relationship, within the limits of acceptable experimental error. Inasmuch as the experimental errors are fairly large, however, it is inadvisable to use the so-called trotyl equivalent as a rigorous quantitative characteristic. Figures 4; references 17: 3 Russian, 14 Western.
[491-6900]

UDC 621.391.2

BAYESIAN DISCRIMINATION AND ESTIMATION OF RANDOM SEQUENCES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 3, Mar 85 (manuscript received 4 Mar 83) pp 476-485

BASILEV, K.K.

[Abstract] A Bayesian approach to the problem of simultaneous discrimination and estimation with uniform or simple gain functions is examined. Simple expressions are derived for constructing the decision rule. The most rational computational procedures are found for Markov parameters by the immersion method. Recursive relationships are derived that can be used in conjunction with algorithms for nonlinear filtering of random sequences to solve a broad group of problems associated with multichannel detection of nonstationary and non-Gaussian signals for almost any type of interaction between the data sequences in interference. Figures 2; references 17: 13 Russian, 4 Western.
[464-6900]

UDC 519.622

MONITORING STABILITY OF ALGORITHMS FOR MORE EFFICIENT INTEGRATION OF ORDINARY DIFFERENTIAL EQUATION

Moscow ZHURNAL VYCHISLITELNOY MATEMATIKI I MATEMATICHESKOY FIZIKI in Russian Vol 25, No 7, Jul 85 (manuscript received 6 Jan 84, after revision 3 May 84) pp 1023-1030

NOVIKOV, V.A. and NOVIKOV, Ye.A., Novosibirsk

[Abstract] Monitoring the stability as well as the accuracy of algorithms is proposed as means of a more efficient numerical integration of ordinary differential equations, inasmuch as this would avoid flutter of the integration step and thus a drop of efficiency within the range of conflicting stability and accuracy requirements. An additional advantage in solution of Cauchy problems is that evaluation and inversion of the Jacobi matrix in the transition intervals can then be replaced with an explicit scheme. Two algorithms are considered for illustration, one involving an explicit scheme and one with switching from an explicit scheme to a semi-explicit one according to the stability requirement. Both algorithms are applied to solution of the Cauchy problem $y' = f(t,y)$, $y(t_0) = y_0$, $t_0 \leq t \leq t_k$, $t_k > t_0$ by the constant-step method $y_{n+1} = y_n + h\phi_f(t_n,y_n,h)$. The first algorithm is based on the explicit second-order Runge-Kutta scheme. The second algorithm is based on an explicit scheme of the Runge-Kutta kind and a semiexplicit (implicit) Rosenbrok scheme with second-order approximations. The appropriate inequalities for monitoring both stability and accuracy are established for both algorithms. When a certain inequality holds true in the second algorithm, then the errors of both schemes are negligibly different so that the explicit scheme alone can be used. References 11: 6 Russian, 5 Western (2 in Russian translation). [544-2415]

UDC 621.391:519.26

QUALITY CRITERIA FOR CLASSIFICATION OF SIGNALS IN LONG-DISTANCE PROBING

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28, No 4, Apr 85 (manuscript received 2 Jul 84) pp 524-526

NOVAK, B.L. and ETKIN, V.S., Institute of Space Research, USSR Academy of Sciences

[Abstract] Probing the environment by radiophysical methods involves classification of signals by any of various discrimination procedures, the proper procedure being selected heuristically on the basis of expediency. As a general quality criterion for comparing various discrimination procedures when the statistical characteristics of signals are unknown,

the risk of error $\varepsilon = w_1\alpha + w_2\beta$ (α - probability of false-alarm error, β - probability of missed-hit error, w_1 and w_2 - weight factors) can be selected. Assuming a fixed α and using β as the specific quality criterion, the empirical value of the latter based on estimation by the C-method will be determined from the random distribution $\hat{}$ of β. An 8-step estimation algorithm has been constructed for a random quantity S^{o*} (signal) with a finite number of values, applicable to discrimination procedures in physical experiments. In one such experiment, 19 sample dispersions were used in testing for presence or absence of a useful component in the signal. The authors thank M.G. Bulatov for supplying data obtained in a field experiment and N.V. Sergeyeva for assistance in programming the algorithm.
Figures 1; references 2 Western (1 in Russian translation).
[450-2415]

PROBABILITY AND STATISTICS

FOURTH VILNYUS INTERNATIONAL CONFERENCE ON PROBABILITY THEORY

Vilnius SOVETSKAYA LITVA in Russian 23 Jun 85 p 3

[Excerpt] Soviet mathematicians and cyberneticists are combining their scientific forces with those of the socialist countries along lines of the Council for Mutual Economic Aid, and they are maintaining broad contacts with their colleagues all over the world. Evidence of this is the upcoming Fourth International Conference on Probability Theory and Mathematical Statistics, which will begin its work tomorrow in Vilnyus.

V. Statulyavichyus, vice-president of the Lithuanian Academy of Sciences and director of the academy's Institute of Mathematics and Cybernetics, told about the purposes and tasks of this forum of scientists from various countries, at the request of "Sovetskaya Litva" correspondent Zh. Naumova.

"In the first place, I should like to say a few words about the character and history of the Vilnyus international conferences," said comrade V. Statulyavichyus. "They are held once every four years, and their regular organizers are the USSR Academy of Sciences' Institute of Mathematics imeni Steklov, the Lithuanian academy's Institute of Mathematics and Cybernetics, and Vilnyus State University imeni Kapsukas. The first conference in our city of Vilnyus took place in 1973; prior to 1970, celebrated symposiums on probability theory and its applications had been held six times at the University of California in Berkeley, at five-year intervals. However, this university was unable to continue successfully the work it had begun, because of financial difficulties and for a number of other reasons. E. Neuman, an eminent statistician and the director of the symposiums, requested Soviet mathematicians to take up the scientific torch and transfer the implementation of such measures to the USSR. That was how the conference of mathematicians and cyberneticists found a permanent 'home' in our republic, which, it must be noted, holds strong positions in the fields of probability theory and mathematical statistics.

"The scientists attending the present forum represent 14 Union republics and 26 countries of the world. The most eminent mathematicians and cyberneticists of both the USSR and foreign countries will take part in the work of the fourth Vilnyus international conference. Among them are Yu.V. Prokhorov, member of the USSR academy of Sciences; A.A. Borovkov, corresponding member of the USSR Academy of Sciences; V.S. Korolyuk and

A.V. Skorokhod, members of the Ukrainian Academy of Sciences; and S.Kh. Sirazhdinov, member of the Uzbek Academy of Sciences and president of Tashkent University, for example.

"Upon what topics will the participants focus their attention? Asymptotic methods of probability theory, control of random processes, statistics of random processes, statistical physics and theory of mass service, application of mathematical probability methods of biology to technology and economics, etc.

"Summaries of papers given by participants in the conference will be published in four volumes. They will contain 631 scientific reports, of which 128 are by foreign scientists and 78 by Lithuanian scientists."

FTD/SNAP
/13046
CSO: 1862/489

UDC 519.21

DISTRIBUTION OF TIME IN WHICH DISCRETE COMPONENT OF ONE CLASS OF MARKOV PROCESSES FIRST REACHES GIVEN LEVEL

Baku IZVESTIYA AKADEMII NAUK AZEBAYDZHANSKOY SSR: SERIYA FIZIKO-TEKHNICHESKIKH I MATEMATICHESKIKH NAUK in Russian Vol 5, No 6, Nov-Dec 84 (manuscript received 7 May 84) pp 105-109

ALIYEV, T.M., Institute of Cybernetics, AzSSR Academy of Sciences

[Abstract] A class of Markov processes $\{\xi_t, \eta_t\}$ uniform in time $t \geq 0$ is considered in the phase space H X [0,±1,±2,...] (H - arbitrary abstract measurable space), with transition probabilities which satisfy certain conditions at $\Delta \downarrow 0$. A stochastically equivalent process $\{\xi^*_v, \eta^*_v\}$ in the $v > 0$ domain is introduced where $\xi^*_v = \xi_{u_0+v}$ and $\eta^*_v = \eta_{u_0+v} - \eta_{u_0-0}$, with u_0 denoting the instant of time at which $\eta_{u_0+0} = K$ and $\eta_{u_0-0} = K + 1$ ($K \geq 1$). Letting $\tau_K = \inf \{t: \eta_t = -K\}$ with $\tau_K \equiv \tau^0_{-K} = \tau^0_{-1} + \tau^{-1}_{-2} + \ldots \tau^{-(K-1)}_{-K}$, the distribution of time instants $\tau_1 = \tau^0_{-1}$ is determined upon introduction of Markov time instant and on the basis of the total-probability theorem with the aid of a Laplace-Stieltjes transformation. The general result is applied to a specific queuing model where a non-ordinary request flux with Poisson distribution and controllable intensity appears at the input of an unreliable servicing device, assuming an arbitrary given distribution of servicing time. References 5 (Russian) [451-2415]

UDC 517.977.58

CONVERGENCE OF DIFFERENCE APPROXIMATIONS AND REGULARIZATION OF OPTIMUM-CONTROL PROBLEMS FOR ELLIPTIC EQUATIONS

Moscow ZHURNAL VYCHISLITELNOY MATEMATIKI I MATEMATICHESKOY FIZIKI
in Russian Vol 25, No 7, Jul 85 (manuscript received 12 Dec 83) pp 983-1000

LUBYSHEV, F.V., Ufa

[Abstract] A problem for elliptic equations with variable coefficients and mixed boundary conditions is considered, namely, optimum control with a quadratic solution-dependent functional and solution by minimization of this functional with the boundary condition and the right-hand side as control. The boundary-value problem describing the controlled process is solved by a variant of the Tikhonov regularization method which ensures fast convergence of the minimizable sequence on the basis of a difference approximation of the differential equation, with the regularization parameter matching the error of solutions to the resulting difference problem of control. The procedure is based on two theorems, the second one preceded by two lemmas. A third theorem preceded by four lemmas and followed by a corollary establishes that the solution to the difference problem converges to the general solution to the original boundary-value problem. A fourth theorem preceded by two lemmas and followed by three more theorems establishes fast convergence with respect to the functional and weak convergence with respect to the control. The difference approximation is subsequently regularized for fast convergence of the minimizable sequence in the control space. The method of analysis can be extended to differential-difference approximation in problems of optimum control. References 15 (Russian).
[544-2415]

UDC 517.954

DECOMPOSITION METHOD FOR SOLUTION OF EQUATIONS AND BOUNDARY VALUE PROBLEMS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 282, No 4, Jun 85
(manuscript received 21 May 84) pp 792-794

PSHENICHNOV, G.I., Computer Center, USSR Academy of Sciences

[Abstract] A method is proposed for solving equations and boundary problems based on examining simpler auxiliary problems whose statement contains additional unknown functions. The sought solution coincides with the solutions of the auxiliary problems if the condition that these solutions be equal is satisfied. The proposed method, which was used earlier in investigating certain problems of the theory of elasticity, are generalized so that the auxiliary problems can be formulated in infinitely many ways. The effectiveness of the proposed decomposition method has been proved by solving a number of problems described by linear and nonlinear differential equations in partial derivatives, employing two or three auxiliary problems and yielding approximate as well as exact results.
References 1 (Russian).
[479-6900]

/13046
CSO: 1862 - END -