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, Springfield, Virginia 22151. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.


Indexes to this report (by keyword, author, personal names, title and series) are available through Bell & Howell, Old Mansfield Road, Wooster, Ohio, 44691.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.
# USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS - PHYSICS AND MATHEMATICS, No.29

## Abstracts

The report contains abstracts on aerohydrodynamics, magnetohydrodynamics, thermodynamics, physics of crystals and semiconductors, molecular, atomic and plasma physics, optics, spectroscopy, physical measurements, and on theoretical and applied mathematics.

## Key Words and Document Analysis

<table>
<thead>
<tr>
<th>Descriptors</th>
</tr>
</thead>
<tbody>
<tr>
<td>USSR</td>
</tr>
<tr>
<td>Lasers</td>
</tr>
<tr>
<td>Eastern Europe</td>
</tr>
<tr>
<td>Nuclear Physics</td>
</tr>
<tr>
<td>Mathematics</td>
</tr>
<tr>
<td>Structural Mechanics</td>
</tr>
<tr>
<td>Acoustics</td>
</tr>
<tr>
<td>Thermodynamics</td>
</tr>
<tr>
<td>Optics</td>
</tr>
<tr>
<td>Plasma Physics</td>
</tr>
</tbody>
</table>

## COSATI Field/Group


## Availability Statement

Unlimited Availability

Sold by NTIS

Springfield, Virginia 22151
This serial publication contains abstracts of articles from USSR and Eastern Europe scientific and technical journals on the specific subjects reflected in the table of contents.

Photoreproductions of foreign-language sources may be obtained from the Photoduplication Service, Library of Congress, Washington, D.C. 20540. Requests should provide adequate identification both as to the source and the individual article(s) desired.

CONTENTS

<table>
<thead>
<tr>
<th>Subject</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustics</td>
<td>1</td>
</tr>
<tr>
<td>Crystals and Semiconductors</td>
<td>15</td>
</tr>
<tr>
<td>Electricity and Magnetism</td>
<td>21</td>
</tr>
<tr>
<td>Fluid Dynamics</td>
<td>22</td>
</tr>
<tr>
<td>Lasers and Masers</td>
<td>29</td>
</tr>
<tr>
<td>Magnetohydrodynamics</td>
<td>42</td>
</tr>
<tr>
<td>Molecular Physics</td>
<td>47</td>
</tr>
<tr>
<td>Nuclear Physics</td>
<td>50</td>
</tr>
<tr>
<td>Optics and Spectroscopy</td>
<td>59</td>
</tr>
<tr>
<td>Superconductivity</td>
<td>61</td>
</tr>
<tr>
<td>Theoretical Physics</td>
<td>62</td>
</tr>
</tbody>
</table>
CRITICAL RANGE OF ACTIVE HEARING IN DOLPHINS

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 4, Jul/Aug 76 pp 622-623


[Abstract] An investigation is made of the critical range in that part of the dolphin's hearing apparatus that is used in analysis of echolocation signals. The results show a critical time range of 200-300 µs within which the characteristics of active hearing differ sharply from those outside this range. For instance the dolphin is able to distinguish intervals between pulse pairs only if these intervals are within the critical range; short

pulses of artificial reverberation exceeding the echo level by 50 dB affect the detection of an echo from a target if the interval between the reverb pulse and the echo pulse does not exceed the critical range, and so forth. Assuming that the critical range is a fundamental characteristic of active hearing, experiments were done to determine this range more precisely. It was found that the critical interval for the bottlenosed dolphin is 260 ± 25 µs. Experiments with long intervals showed that the dolphin is incapable of distinguishing intervals longer than the critical range. The confidence coefficient for the 260 µs result is 90%. References 3 Russian.

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 4, Jul/Aug 76 pp 622-629

[Abstract] The scientific session of Joint Science Council of the Soviet Academy of Sciences on the Complex Problem of Physical and Technical Acoustics, the Science Council of the Soviet Academy of Sciences on the Problem of Acoustics, the Science Council of the Soviet Academy of Sciences on the Problem of Ultrasound and the Science Council of the Acooustics Institute of the Soviet Academy of Sciences Dedicated to the Ninety-Fifth Birthday of Hero of Socialist Labor Academician N. N. Andreyev was held 17 December 1975 in the conference hall of the Acoustics Institute. The opening talk was given by Professor L. M. Lyamshev, chairman of the Joint Science Council of the Soviet Academy of Sciences on the Complex Problem of Physical and Technical Acoustics. He spoke of N. N. Andreyev's leading role in establishment and development of acoustics in the Soviet Union. The following papers were delivered at the session: "Critical Range of Active Hearing in Dolphins" by V. A. Vel'min and N. A. Dubrovskiy; "Magnetostriction Materials Under the Action of Compression" by I. P. Golyamina and V. K. Chulkova; "On the Generation of Sound by Thermal Sources" by L. M. Lyamshev and K. A. Naugol'nykh; "Nonlinear Phenomena in Magnetoelastic Media" by A. L. Polyakov; "Acoustics and Hydrodynamics of Some Marine Animals" by Ye. V. Romanenko. Recollections on N. N. Andreyev were presented by Professor V. S. Grigor'yev, Professor A. V. Rimskiy-Korsakov, Professor L. A. Chernov, S. G. Gershman and B. D. Tartakovskiy. Abstracts of the papers are given.
MAGNETOSTRICTION MATERIALS UNDER THE ACTION OF COMPRESSION

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 4, Jul/Aug 76 pp 624-625


[Abstract] The paper gives the results of an experimental study of the influence that compressive stresses have on the characteristics of magnetostriction materials that are of importance for acoustic emitters -- the magnetostriction constant $\alpha$ (ratio of the amplitude of the first harmonic of mechanical stress to the amplitude of the stimulating induction), the mechanical Q-factor and Young's modulus. The study specimens were Soviet magnetostriiction materials NP-2T nickel, 50KF Permendur and ferrites 21-SPA, F-42 and F-38. The range of compressive stress was 0-800 kg/cm$^2$ in magnetic fields from zero to 1.5-3 times the field corresponding to the maximum coefficient of electromechanical coupling. The results showed that the Q-factor increases with compression for all materials with negative striction. In Permendur, which has positive striction, the Q-factor drops with compression in fields of practical interest, and increases only with very weak or very strong magnetization. The Young's modulus increases with compression for all materials, the effect being most pronounced in relatively weak fields in materials with a high coupling coefficient -- ferrite F-42 and Permendur. The influence of compressive stress on both the Young's modulus and the Q-factor decreases with increasing magnetic field intensity. At the same time, compression reduces the $\Delta E$-effect of the material. It is concluded that the resonant frequency of acoustic emitters under working conditions is not appreciably changed by the influence of compression on the Young's modulus. References 8: 7 Russian, 1 Western.
LYAMSHEV, L. M. and NAUGOL'NYKH, K. A., Acoustics Institute, Academy of Sciences USSR

ON THE GENERATION OF SOUND BY THERMAL SOURCES

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 4, Jul/Aug 76 pp 625-627


[Abstract] A simplified model is proposed for explaining the principal features of sound emission into the ambient medium when energy is rapidly released into a limited region of matter, as frequently occurs when intense optical emission interacts with matter. Curves are given showing the profile of the spherical sound wave generated by such a thermal source for the limiting cases \( R_0 \gg c\tau \) and \( R_0 \ll c\tau \) (\( R_0 \) is the bounded spherical region where the given energy release occurs in time \( \tau \), and \( c \) is the speed of sound). An expression is found for the pressure in the vapor bubble formed when the energy density is sufficient to transform liquid to vapor. An approximate analysis is made of the hydrodynamic characteristics of the process of sound emission by thermal sources. References 3: 2 Russian, 1 Western.
NONLINEAR PHENOMENA IN MAGNETOELASTIC MEDIA

An examination is made of nonlinear phenomena described by the higher terms of the expansion for magnetoelastic energy with respect to magnetization and mechanical stress. An investigation is made of magnetostriction stresses in a material with magnetization \( M = M_0 + M_1 \sin \omega t \). The magnitudes of the first three stress harmonics are found as a function of the quantities \( M_0 \) and \( M_1 \), which are taken as arbitrary. Conditions are found that maximize the first harmonic. A method is proposed for determining the magnetoelastic constants from experimental data. Values of the maximum amplitude of the first harmonic of magnetostriction stress are calculated for a number of materials used in sound emitters -- nickel, Permendur, ferrites and so forth. The method of successive approximations is applied to analysis of propagation of longitudinal and transverse waves in a medium having both the magnetoelastic nonlinearity considered above and ordinary nonlinearity of elastic properties. It is shown that a second harmonic arises in the longitudinal wave that increases with distance, the nonlinear parameter being a function of the constant of magnetization \( M_0 \) applied in the direction of sound propagation. This parameter is \( \Gamma \approx \Gamma_{ac} + A M_0^2 \), where \( \Gamma_{ac} \) is the nonlinear parameter with consideration of elastic nonlinearity alone, and \( A \) is the combination of elastic and magnetoelastic constants. Estimates show that for practically realizable values of \( M_0 \) the nonlinear parameter \( \Gamma \) may be made an order of magnitude greater than \( \Gamma_{ac} \). References 2 Russian.
A survey of research on acoustics and hydrodynamics of marine mammals, primarily dolphins. Emphasis is placed on the use of self-contained miniaturized pickups and receivers, tape recorders, noise generators, biological monitors and so forth that are attached directly to the animals, allowing them freedom of movement throughout an experiment. Among the new facts acquired in this way: dolphins emit high-frequency echolocation pulses by a nonresonant mechanism; previously undetected low-frequency pulses with a fundamental tone of 300-400 Hz are emitted by dolphins with a weakly resonant mechanism; the duration of echolocation pulses emitted by dolphins differs for different directions -- pulses emitted in the forward direction are twice as long as those emitted to the sides; dolphins have a built-in shield to attenuate their own perception of the signals they emit so that these high-intensity sounds do not interfere with their acute hearing; the boundary layer surrounding the dolphin is partly laminarized, enabling the animal to swim with less effort; the fur covering of seals modifies the boundary layer, reducing drag. References 8: 4 Russian, 4 Western.
KALININ, V. L., Murmansk Marine Higher Engineering Academy

ON A METHOD OF DETERMINING THE DEPTH OF SUBMERSION OF UNDERWATER OBJECTS UNDER CONDITIONS OF A REFRACTING MEDIUM

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 4, Jul/Aug 76 pp 609-611 manuscript received 2 Feb 76

[Abstract] It is shown that the error due to refraction in determining the coordinates of an underwater object can be reduced by appropriate processing of depth-finder readings without using detailed hydrophysical information. It is assumed that the geometric theory of sound propagation is applicable, that the underwater object does not change its depth during observation, that there is no horizontal gradient in the speed of sound in the region of observation, and that the function of the vertical gradient of the speed of sound is time-independent. On the basis of Snell's law the author derives expressions for the length of an acoustic beam reflected from the underwater object, and for the horizontal distance to the object. A numerical example is given. References 4 Russian.

1/1

POLYANSKAYA, V. A., Acoustics Institute, Academy of Sciences USSR

CALCULATION OF THE FIELD AMPLITUDE WHEN RAYS ARE REFLECTED FROM A CURVED BOUNDARY IN A MEDIUM

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 4, Jul/Aug 76 pp 616-617 manuscript received 17 Oct 75

[Abstract] It is shown that when calculating fields by ray tracing in a three-dimensional medium with arbitrary variation of parameters, the presence of totally or partially reflecting interfaces with nonzero first derivatives of nearby parameters makes it necessary to introduce additional boundary conditions to account for these interfaces. Formulas are derived for the general case of reflection of sonic beams from an arbitrary fairly smooth curvilinear boundary. It is noted that disregarding the correction to the boundary conditions results in considerable loss of accuracy, particularly in the case of multiple reflections, as when calculating repeated reflection of sound waves from the ocean surface and bottom. References 4: 2 Russian, 2 Western.

1/1
YESIPOV, I. B., ZVEREV, V. A., KALACHEV, A. I. and NAUGOL'NYKH, K. A., Acoustics Institute, Academy of Sciences USSR, Radio Physics Scientific Research Institute, Gor'kiy

ON LOW-FREQUENCY PARAMETRIC EMISSION OF SOUND

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 4, Jul/Aug 76 pp 606-608

manuscript received 23 Jan 75

[Abstract] During emission of an intense amplitude-modulated sound wave, nonlinear parametric interaction of the signal components in the medium causes generation and independent propagation of a wave with the modulation frequency. The effect of parametric emission has been studied previously on comparatively high frequencies; in this paper the authors give the results of an experimental study of low-frequency parametric emission. The carrier wave on 105 and 123 kHz was generated by a piezoelectric disk transducer. The modulation frequency varied over a range of 1-5 kHz. The transducer was 92.5 cm in diameter, and was placed at a depth of 6 m below the surface of the sea in a position such that the main lobe of the radiation pattern touched neither the bottom nor the surface. Sound reception was by a spherical pickup 5 cm in diameter located 80 m from the emitter. Curves are given showing the signal level in dB as a function of angle. It was found that the curve becomes sharper with increasing modulation frequency. It was also found that the amplitude of the received signal increases as the square of the voltage across the emitter, whereas the pumping level changes linearly. The amplitude of the received signal is also a linear function of the percentage modulation. The results of this study confirm the feasibility of directional parametric emission on 1-5 kHz using an emitter that has comparable or smaller dimensions than the wavelength of the low-frequency signal. References 4: 3 Russian, 1 Western.
KOROVKIN, A. N.

DIFFRACTION OF SOUND OVER A WIDE BARRIER

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 4, Jul/Aug 76 pp 540-545

manuscript received 4 Oct 74

[Russian abstract provided by the source]

[Text] An examination is made of the problem of diffraction of a plane sound wave by a wide trapezoidal barrier having different flat faces, both ideal and with acoustic impedance. The solution is found by considering the sequential diffraction of sound by the edges of the barrier. Formulas are derived for the acoustic pressure in the "deep" shadow zone. The theoretical results are compared with experimental data. References 8: 5 Russian, 3 Western.

L'VOVSKAYA, G. F., Acoustics Institute, Academy of Sciences USSR

ON A METHOD OF INCREASING THE AMPLIFICATION FACTOR OF A DISK-AND-ROD ULTRASONIC TOOL WITH CONVERSION OF THE DIRECTION OF VIBRATIONS

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 4, Jul/Aug 76 pp 613-615

manuscript received 24 Dec 75

[Abstract] The author calculates the normal modes and coefficients of amplification of a disk-and-rod ultrasonic tool in which the thickness decreases by a power law from the periphery toward the center of the disk. The results are comparable with the case of a disk of constant thickness. Curves are given showing the resonant frequencies and amplification factors plotted against the dimensional characteristic $H - h_0$, where $H$ is half the overall length of the working rod, and $h_0$ is half the thickness of the disk at the center. The results show that a disk of variable thickness gives higher amplification factors than one of constant thickness. References 4: 3 Russian, 1 Western.
ON ABSORPTION OF SOUND IN A MEDIUM WITH NOISE

[Abstract] An analysis is made in perturbation theory of the nonlinear interaction of a monochromatic sound wave with noise during propagation in a fluid. The case of interaction between a high-frequency signal and low-frequency noise is emphasized. It is shown that in certain cases the signal energy is transferred to the noise, resulting in anomalously high signal attenuation. The proposed mechanism is confirmed by comparison with experimental data. References 7: 5 Russian, 2 Western.

ANGULAR DISPLACEMENT OF AN ACOUSTIC BEAM EXCITED BY A WEDGE-SHAPED PIEZOELECTRIC TRANSDUCER

[Abstract] An analysis is made of the problem of excitation of sound waves by a wedge-shaped piezoelectric transducer. It is shown that the wave front rotates with a change in frequency, the angle of turn being directly proportional to the taper angle of the wedge. As the frequency $f$ of the sonic beam changes, the angular displacement of the beam conforms to the relation $df/df_{y}$, where $\gamma = 2\pi fh/v_{0}$, $h$ is the thickness of an equivalent plane-parallel plate, and $v_{0}$ is the speed of sound in the piezoelectric. This effect of angular displacement of a sonic beam can be used to adjust the angle of incidence of the light in acousto-optical deflectors. Experiments with lithium niobate transducers confirmed the effect. References 5: 2 Russian, 3 Western.
INVESTIGATION OF TWO-LAYERED SONIC LENSES

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 4, Jul/Aug 76 pp 526-530

manuscript received 25 Jul 75

[Abstract] A theoretical and experimental study is made of the field in the focal plane of lenses with the Lüneberg property of focusing a plane acoustic wave on a surface lying opposite, and having an index of refraction that varies from the center to the edge in accordance with the law \( n(r) = \sqrt{2 - r^2} \) (where \( r \) is the instantaneous normalized radius). In practice, such lenses are multilayered structures in which the constant indices of refraction of the layers give a stepwise approximation to the given law \( n(r) \). To distinguish them from Lüneberg lenses they are called spheroidal or cylindroidal lenses. The authors consider two-layered spheroidal and cylindroidal lenses with concentric or coaxial layers having different indices of refraction. Curves are given for the distribution of sonic pressure in the focal plane of the lenses. The results show that two-layered lenses of the type considered may have sharp radiation patterns with width of the order of a few degrees. References 6 Russian.

1/1

NONLINEAR PROPAGATION OF A SOUND BEAM IN A NONDISSIPATIVE MEDIUM

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 4, Jul/Aug 76 pp 487-491

manuscript received 15 Sep 75

[Text] A nonlinear acoustics equation is numerically integrated for finite beams with time-periodic boundary condition and signal amplitude diminishing from the center of the beam toward the edges. Figures are given that show the shape of the density perturbation for different values of the parameter that defines the relative contribution of nonlinear and diffraction effects at different distances from the boundary of the nonlinear medium and at different points of the beam cross section. It is shown that there is an appreciable difference between the nonlinear distortions in the sonic beam and distortions of a plane wave. The region of shock wave formation in the beam is constructed for a given amplitude distribution.

1/1
L'VOVSKAYA, G. F., Acoustics Institute, Academy of Sciences USSR

THEORETICAL STUDY OF THE CHARACTERISTICS OF A DISK-AND-ROD ULTRASONIC TOOL

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 4, Jul/Aug 76 pp 552-557 manuscript received 24 Dec 75

[Abstract] A theoretical study is done on the disk-and-rod ultrasonic tool shown in the diagram. The analysis is based on a tool with the following parameters: \( R = 52 \) mm, \( R_2 = 41.5 \) mm, \( R_3 = 33.5 \) mm, \( r_0 = 6 \) mm, \( h = 4.5 \) mm, and \( H \) varies over a wide range with step of 1 mm (minimum \( H = 30 \) mm) \( \sigma_1 = 5400 \) m/s, \( \sigma_2 = 5790 \) m/s, \( \rho_1 = 4.5 \) g/cc, \( \rho_2 = 5.2 \) g/cc, \( \nu_1 = \nu_2 = 0.29 \), \( l(R_m) = 303 \) N/m\( \cdot \)A, \( \mu^e(R_m) = 10 \), \( a_1 = 10^{-3} \) and \( 10^{-4} \), \( a_2 = 10^{-2} \), where \( \sigma_i \), \( \rho_i \), \( \nu_i \) are the velocity of longitudinal Young waves, density and Poisson's ratio respectively of the active (\( i = 2 \)) and passive (\( i = 1 \)) materials, \( l(R_m) \) is the magnetostriction constant of the annular ferrite transducer on the middle radius of the ring, \( \mu^e(R_m) \) is the permeability of the "constricted" ferrite reduced to the permeability of a vacuum on the middle radius of the ring, and \( a_1 \) and \( a_2 \) are the coefficients of mechanical losses in the passive and active materials respectively. Calculations are done both for an unloaded tool, and for a loaded tool where the ratio of the specific mechanical resistance of the load to the wave impedance of the passive material is \( \zeta = 10^{-3} \). The results can be used in optimizing the design of ultrasonic tools of this type. References 3 Russian.

1--annular magnetostriction transducer; 2--outer passive part of the disk; 3--inner passive part of the disk; 4--working rod.
OSTROVSKIY, D. V.

STATISTICAL PARAMETERS OF A FLAT DISCRETE ANTENNA WITH CONSIDERATION OF THE INTERACTION BETWEEN ELEMENTS

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 22, No 4, Jul/Aug 76 pp 576-579 manuscript received 8 Dec 74

[Abstract] An examination is made of the statistical properties of discrete acoustic radiators with consideration of the interaction between elements. Exact formulas are derived for generalized Rayleigh distribution parameters of the modulus of directional gain as a function of amplitude-phase errors and element failures. Approximate formulas are found, assuming that random errors and failures do not cause additional redistribution of the vibrational velocities of the elements. It is shown that the resultant simplification has no effect on the way that the distribution parameters depend on errors, and that these parameters coincide for identical levels of directional gain. A numerical example is considered, and a comparison of curves for the standard deviation of the modulus of directional gain calculated from the proposed formulas shows that consideration of phase errors increases the standard deviation by 20-25%. Thus the variance in parameters of the elements causes a certain redistribution of vibrational velocities with respect to the antenna aperture. The simplified formulas are applicable for engineering estimates with a correction factor. References 11: 9 Russian, 2 Western.
ON THE ACOUSTICAL-MECHANICAL CHARACTERISTICS OF SPHEROIDAL EMITTERS AND SCATTERERS

Expressions are derived for the acoustic characteristics of oscillating spheroidal emitters and scatterers of arbitrary configuration with small wave dimensions, i.e. in the long-wave approximation. The asymptotic behavior of radial spheroidal functions is examined for the case of small values of the wave parameter. The force acting on a rigid spheroid in a sonic field is found, and an expression is given for this force in the limiting low-frequency case. It is shown that the axial force acting on a rigid sphere for low-frequency incident waves is $3\pi/4$ times greater than for a disk of the same diameter assuming identical incident wave pressure. The axial force is proportional to the ratio of diameter to wavelength practically up to 0.5 within wide limits of change in configuration for an oblate spheroid. References 8: 6 Russian, 2 Western.
Crystals and Semiconductors

ZASTAVNYY, A. V., KOROL', V. M. and LYSENKO, P. L., Scientific Research Institute of Physics, Rostov-na-Donu State University

INFLUENCE THAT BOMBARDMENT WITH 5.5 MeV PARTICLES HAS ON THE CHARACTERISTICS OF p-Si ION-DOPED SEMICONDUCTOR DETECTORS

Moscow PRIORY I TEKHNIKA EKSPERIMENTA in Russian No 4, Jul/Aug 76 pp 82-83 manuscript received 28 Mar 75

[Russian abstract provided by the source]

[Text] The paper compares the characteristics of ion-doped p-Si detectors and n-Si surface-barrier detectors after exposure to α-particles with energy of 5.5 MeV. It is shown that the spectrometric characteristics of the ion-doped detectors are more stable. Doses several times higher than for the surface-barrier detectors were required to reduce the energy resolution of the ion-doped detectors by a factor of two. References 7: 6 Russian, 1 Western.

1/1

USSR

TAKIBAYEV, ZH. S., GRISHCHENKO, V. F., GERACIMENKO, N. N., and GORELKINSKIY, YU. V.

CURRENT-VOLTAGE CHARACTERISTICS OF SILICON p-n JUNCTIONS BOMBARDED WITH SMALL DOSES OF $^{235}$U FISSION FRAGMENTS

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSKOY SSR SERIYA FIZIKO-MATEMATICHESKAYA in Russian No 4, 1976 pp 73-75 manuscript received 1 Mar 76

[Abstract] Current-voltage characteristics of silicon junctions bombarded with $^{235}$U fission fragments were studied. The fragments were generated by a thin layer of $^{235}$U bombarded with neutrons. An analysis is made of the recombination parameter $m$ that characterizes the processes taking place on the junction surface. The results show that individual fission fragments (heavy nuclei) can result in significant changes in the current-voltage characteristics of p-n junctions. Depending on the angle of incidence of an individual fragment, damage occurs either in the space charge region or on the surface, which leads to changes in the forward or reverse branches of the current-voltage characteristic. There are also cases of simultaneous damage to the surface and the space charge region. References 7: 2 Russian, 5 Western.

1/1
At high current densities in a semiconductor with impact ionization, the space charge responsible for the S shape of the current-voltage characteristic is restructured. Theoretical analysis of the current-voltage characteristics considering this mechanism has been performed on models assuming homogeneous distribution of current density in the structures with plane-parallel junctions. Agreement between theoretical and experimental current-voltage characteristics was observed only up to the cutoff currents on sections with negative differential resistance. The discrepancy between theory and experiment was attributed to formation of filamentary currents, but the distribution of current density was not experimentally studied. This paper deals with 1/2

analysis of such experiments on planar n-i-n and p-i-p structures. The experiments were performed by recording the recombination radiation from structures using a pulse image converter. It was found that the distribution of current density is heterogeneous and similar to the pattern of geometric current spread from a "point" region, the current density increasing in the direction from the emitter to the noninjecting contact. The experiments performed do not confirm the hypothetical filamentary currents a few μm in diameter mentioned in the literature. It is shown that consideration of spreading of current lines weakens the rigid requirement for ratio of hole and electron current at the boundary of the impact ionization region. References 8: 2 Russian, 6 Western.
A theoretical study is presented of the nature of the "negative" temperature dependence of equilibrium concentration of current carriers (dn/dT < 0) in a narrow, low-resistance surface area in a high-resistance semiconductor. It is shown that in a semiconductor with one row of compensating acceptor levels it is very difficult to realize a negative temperature dependence. However, when a heterojunction is present between the low-resistance surface and the high-resistance volume of the semiconductor, a negative dependence may obtain; the equilibrium conductivity is decreased by $1/2$ several orders of magnitude as the temperature increases by about 100 K, which agrees with the available experimental data on the conductivity of CdS and CdSe films. References 6: 3 Russian, 3 Western.
DETECTION OF LARGE ELECTRON-HOLE BUBBLES IN GERMANIUM AND DETERMINATION OF THEIR PARAMETERS FROM SHF CONDUCTIVITY MEASUREMENTS

Moscow PISMA V ZHURNAL EXPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 24, No 3, Aug 76 pp 141-144 manuscript received 28 Jun 76

[Abstract] The basic parameters of large electron-hole bubbles in nonuniformly compressed germanium were determined by the shf conductivity and breakdown method, which had also been used earlier for small bubbles. The germanium specimens for this study were disks 4.0 mm in diameter and 2.0 mm thick, free of dislocations and with a residual impurity concentration less than 2.6 \times 10^{-11} \text{cm}^{-3}, under a pressure of 950 kgf/cm^2. The shf conductivity and its kinetics were measured at 10 GHz under laser excitation at the 1.06 \mu m wavelength, at temperatures from 4.2 to 1.3 K. The amplitude of the quasisteady signal was found to decrease rapidly with decreasing temperature, approaching zero at 2.8 K, while the quasisteady period became longer. Below 2.8 K the signal was found to decrease exponentially with a time constant 750 \mu s, with a polarity reversal and shorter time constant at 1.3 K. Evaporation from a bubble was found to become negligible only at or below 2.8 K, with Auger emission becoming the dominant process. A "hot" shf breakdown was found to occur in the presence of a large bubble, the characteristics of the exciton breakdown being here radically different than in undeformed germanium. The absence here of a peak and a valley indicates that one large bubble, with a surface much smaller than that of a cloud of small bubbles, does not influence the buildup of an electron avalanche. The results of these measurements confirm the existence of a large electron-hole bubble in deformed germanium 1.0 mm in diameter, with a particle concentration \( n_0 = 2.5 \times 10^{16} \text{cm}^{-3} \), a bond energy \( E_0 = 4.6 \text{meV} \), and a lifetime \( \tau_0 = 500 \mu \text{s} \). Figures 2; references 14: 6 Russian, 8 Western. 

2/2
[Abstract] A study was made concerning the crystallization of stratified He³-He⁴ solutions, with a lower He³ concentration and a higher He³ concentration. On the basis of nuclear-magnetic-resonance measurements, phase diagrams have been plotted in temperature-pressure coordinates within the 0.25-0.38 K and 25-28 atm range as well as in temperature-concentration (He³,%) coordinates. The experiment has produced new evidence about the phase constitution and the critical points. The three-phase He³(liqu)₁<sub>c</sub>-bcc-He³(liqu)ₙ<sub>c</sub> equilibrium line was found to split at 0.38 K into an He³(liqu)₁<sub>c</sub>-bcc₁<sub>c</sub>-bccₙ<sub>c</sub>-He³(liqu)ₙ<sub>c</sub> line and an He³(liqu)₁<sub>c</sub>-bccₙ<sub>c</sub>-He³(liqu)ₙ<sub>c</sub> line (₁<sub>c</sub> = lower concentration, n<sub>c</sub> = higher concentration). Only crystals with the same approximately 52% He³ concentration were found to grow above 0.38 K. The experiment has also confirmed the bcc structure of crystals with a higher than about 4% He³ concentration down to that splitting equilibrium line and the transition here to hcp crystals at approximately 0.3 K. Figures 3; references 8: 4 Russian, 4 Western.
STUDYING THE DIELECTRIC-SEMICONDUCTOR INTERFACE BY THE METHOD OF THERMALLY STIMULATED DISCHARGE AFTER B⁺ ION IMPLANTATION

Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 21, No 7, Jul 76 pp 1197-1201 manuscript received 27 Oct 75 (final version 12 Jan 76)

[Abstract] The method of thermally stimulated discharge is useful for studying the changes in the electrophysical characteristics of MOS structures after ion implantation, inasmuch as neither current-voltage curves nor capacitance-voltage curves yield sufficient information about the radiation defects and about the energy distribution of traps. Such a study was made on Me-SiO₂-Si and Me-Al₂O₃-SiO₂-Si structures with an oxide layer 1000-2000 Å thick. The specimens were doped with B⁺ ions of sufficient energy to reach the dielectric (oxide)-semiconductor interface and in amounts varying from 0.1 to 10 µC/cm².

The temperature spectra of the discharge current were measured, and two peaks were recorded: at 84 and 216 K for Si-SiO₂ at 133 and 250 K for Al₂O₃-SiO₂-Si, their widths and heights depending on the implantation dose. The results, combined with theoretical calculations, indicate that implantation of boron ions has established a system of energy levels in two-layer as well as in three-layer structures within the upper half of the forbidden band. Some of these levels seem to be analogous to those caused by radiation defects, but their true nature is not known yet. Figures 3; references 24: 8 Russian, 16 Western.
Electricity and Magnetism

KARPLYUK, K. S., Kiev State University imeni T. G. Shevchenko

EXCITATION OF SURFACE WAVES DURING DIFFRACTION OF A PLANE WAVE AT A HALF-PLANE PLASMA-DIELECTRIC BOUNDARY

Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 21, No 7, Jul 76
pp 1167-1173 manuscript received 5 Jan 76

[Abstract] A nonhomogeneous plasma-dielectric interface may, unlike a homogeneous one, serve as a receiver antenna for surface waves excited by a plane wave impinging on it and diffracted at an inhomogeneity. This situation is analyzed here for the case of a plane electromagnetic wave which, coming from the dielectric side, impinges on and is diffracted at an ideally conducting half-plane boundary with the plasma. The problem is solved on the basis of Maxwell's fundamental field equations with appropriate boundary conditions. In the simplest model one assumes the motion of ions and the thermal motion of electrons to be negligible in the plasma, with the latter being regarded as another dielectric. It is sufficient to calculate only the tangential component of the electric field intensity, all other E and H components being expressible in terms of the latter. An exact analytic solution is found which, with the 1/2 given boundary conditions, leads to paired integral equations and these in turn are solved by the factorization method. Generally it is necessary to use numerical methods for evaluating the integrals. The method of steepest descent may be used in some cases such as, for instance, the far-field zone of the dielectric. Figures 3; references: 5 Western.
ON THE PRINCIPLES GOVERNING MOTION OF GAS BUBBLES IN A FLUIDIZED BED

Minsk INZHENERO-FIZICHESKIY ZHURNAL in Russian Vol 31, No 2 Aug 76 pp 323-327 manuscript received 10 Aug 75

[Abstract] An experimental study is done on the dimensions of gas bubbles in a nonhomogeneous fluidized bed of sand (particle size $d = 0.23$ mm, velocity at onset of fluidization $u_0 = 6$ cm/s) and silica gel ($d = 0.19$ mm, $u_0 = 2$ cm/s). The experiments were done in a column 300 mm in diameter by a dynamometer sensor method similar to that described by A. I. Tamarin, I. Z. Mats and G. G. Tyukhay in the collection "Teplo- i massoperenos v dispersnykh sistemakh" [Heat and Mass Exchange in Dispersed Systems], Minsk, 1968.

Experimental data in the literature on bubble sizes are generalized on the basis of the proposed model of bubble expansion in a fluidized bed. The formula derived for bubble size is

$$D_b = \frac{q}{g} [(u - u_0)h]^{1/2}$$

where $g$ is the acceleration of free fall, $h$ is the height above the screen, and $q$ is a dimensionless coefficient that does not depend on $h$ or $u - u_0$; $u$ is the gas filtration rate. The value of $q$ can be taken as 1.3 for bubbles in equipment with porous screens at distances of at least 200 mm from the gas distributor. References 11: 2 Russian, 9 Western.
ON A NONLINEAR THEORY OF CAVITATING FLOW AROUND OBSTACLES

[Abstract] Based on the example of steady-state cavitating flow of an infinite stream of ideal incompressible weightless fluid around a plate, the author shows the feasibility of single-valued construction of potential flow assuming only the physically justified conditions relative to the pressure in the cavity and liquid respectively

\[ p = p_0 = \text{const}, \quad p > p_0, \]

and the condition

\[ \Phi d\alpha = 0, \]

showing that a continuous closed curve \( L \) can be found that encloses the cavity and the barrier. It is theoretically shown that steady-state potential cavitating flow is parted, whereas in reality only one-sheeted flow is possible. This contradiction may be eliminated in unsteady flow. The unsteady process at the end of the cavity is very complicated, and as yet cannot be mathematically treated. However, the departure from the steady state is local, and has no appreciable influence on the average hydrodynamic and geometric characteristics of flow close to the plate. The theory implies that a certain amount of liquid is periodically entrained by the cavity and returned to the main flow, which is borne out by cavitating flow in actual liquids. References 5: 3 Russian, 2 Western.
SHINKIN, G. P., Moscow

INTERACTION OF A LAMINAR MIXING ZONE WITH AN EXTERNAL FLOW

Moscow IZVESTIYA AKADEMII NAUK SSSR, MEKHANIKA ZHIDKOSTI I GAZA in Russian No 1, Jan/Feb 76 pp 147-150 manuscript received 12 Feb 75

[Abstract] Pressure-induced interaction of a laminar mixing zone with an external flow is considered in the hypersonic approximation. It is assumed that homogeneous flows of perfect gases are mixed, and that they have high Mach numbers (\(M_\infty \gg 1\), \(M_{-\infty} \gg 1\), the subscripts \(\infty\) and \(-\infty\) corresponding to the undisturbed parameters of the upper and lower flows respectively). The viscous mixing zone is treated separately from the inviscid shock layer. The boundary streamline is found from the condition of equality of the induced pressure on either side of the mixing zone. Analytical solutions are found in the asymptotic regions of weak and strong interaction for displacement thicknesses, boundary streamline and induced pressure in the local-similarity approximation. References 4: 3 Russian, 1 Western.

FRANKFURT, M. O.

INVESTIGATION OF THE EFFECTIVENESS OF A 'JET FLAP' DIFFUSER

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 31, No 2, Aug 76 pp 248-252 manuscript received 4 May 75

[Russian abstract provided by the source]

[Text] The paper gives the results of an experimental study of a diffuser device formed by a thin turbulent jet blown out of a tapered plug nozzle at the outlet of a cylindrical channel. The author defines the way that the energy characteristics of such a device depend on the momentum of the jet and the flow section of a nozzle with continuous and interrupted annulus as the flow escapes from the channel into free space. Interpolation formulas are proposed for approximate evaluation of the aerodynamic effectiveness of the given device, which can be used in installations with high-temperature flows or aggressive media. References 2: 1 Russian, 1 Western.
LAMINAR BOUNDARY LAYER IN A SWIRLING FLOW

An investigation is made of a three-dimensional non-self-similar laminar boundary layer of compressible gas in a swirling flow. The boundary layer equations are written in variables that ensure constant coefficients of the highest derivatives, and are solved by a numerical finite-difference method. An examination is made of singularities of the boundary layer that arise when there is a retrograde-circulation region in the channel. References: 7 Russian, 3 Western.

ON THE INFLUENCE THAT VISCOELASTIC PROPERTIES OF A LIQUID HAVE ON THE DYNAMICS OF SMALL OSCILLATIONS OF A GAS BUBBLE

A search of the literature reveals that many papers have been devoted to questions of the dynamics of gas bubbles in viscoelastic liquids. Several of them have made a numerical study of the radial oscillations of a gas bubble in an incompressible viscoelastic Oldroyd liquid. Others are concerned with an exact solution to the equation of small oscillations of a cavity in an Oldroyd medium with periodic change of pressure at infinity. Analysis of the oscillations of a bubble in a viscoelastic liquid is complicated by singularities of passage to the limit in the rheological equation of the medium which are of considerable interest for this problem. The authors discuss these features and on the basis of a numerical analysis of the precise solution they investigate the characteristics of small oscillations of a bubble in an
Oldroyd medium. Linear analysis of the problem shows that oscillations of bubbles in viscoelastic liquids close to resonant frequencies should develop more intensively than in Newtonian liquids. Figures 7; references 11: 4 Russian, 7 Western.

OREL, V. R., Moscow

ON THE OSCILLATIONS OF AN IDEAL LIQUID ACTED ON BY THE FORCES OF SURFACE TENSION. THE CASE OF A DOUBLY CONNECTED FREE SURFACE

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKNICHESKOY FIZIKI in Russian No 3(97), May/Jun 76 pp 64-71 manuscript received 22 May 75

[Text] Any number of works have been devoted to problems of small oscillations of an ideal liquid with regard to the forces of surface tension. Several of these have examined the oscillations of a liquid with one free surface. Others have investigated the oscillations of an arbitrary number of immiscible liquids, which are separated by equilibrium surfaces, assuming that only zero oscillations are possible on each interface. In this article the author examines the problem of oscillations of an ideal liquid with two free surfaces, on each of which perturbations of a non-zero amount are kinematically allowable. The perturbations satisfy the condition of constancy of the total volume. A method of solution is proposed. As an example a problem of axisymmetrical
oscillations of a liquid osculating sphere of the circular opening under conditions of weightlessness is considered. The first two normal frequencies and modes of the oscillations are found. Figures 4; references: 11 Russian.
heating relations in calculating the plasma parameters. The discharge process is found to be periodic and attenuating within 3-4 half-periods. The structure of a discharge is found substantially different between two electrodes of the same material and between two electrodes of different materials, with the plasma found leaning toward the cathode in the latter case. Figures 6; references 34: 31 Russian, 3 Western.
Lasers and Masers

USSR

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

A CHEMICAL CO-LASER ON A MIXTURE OF CS₂ + O₃ WITH PHOTOINITIATION

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3, No 2(44), Feb 76 pp 362-368

manuscript received 5 Aug 75

[Russian abstract provided by the source]

[Text] A study is done on the feasibility of using ozone as the oxidant in a chemical CO-laser based on the reaction of oxidation of carbon disulfide. It is found that SF₆ is a more effective diluent than He or Ar. An energy density of 4.5 MJ/cc is achieved — double the value attainable on a CS₂ + O₂ mixture under optimum conditions. References 19: 3 Russian, 16 Western.

1/1

USSR

IL'INSKIY, YU. A. and KHOKHL0V, R. V., Moscow State University

ON THE FEASIBILITY OF DEVELOPING A GAMMA LASER

Gor'kiy, IZVESTIYA VUZov, RADIOFIZIKA in Russian Vol 19, No 5-6, 1976 pp 792-800

[Abstract] A state-of-the-art survey on the feasibility of developing lasers that emit on wavelengths of 1 Å and shorter. It is shown that limitations due to the strong absorption of gamma radiation in matter can be overcome by using the Borrman effect. However, for effects of forced emission to become appreciable the resonant gain B would have to be of the order of 1 cm⁻¹. To achieve high gains with short-lived isomers would require an excessive number of nuclei on the upper level, although neutron pumping may be a possible approach to solution of this problem. The use of long-lived isomers with separation by conventional methods requires suppression of mechanisms leading to line broadening. These two approaches are examined in some detail, and ways of overcoming the inherent difficulties are considered. A third approach is discussed as a compromise in which isomers with intermediate lifetimes of 0.01 s up to a few dozen seconds are used. References 24: 20 Russian, 4 Western.

1/1
An experimental study is done on parametric emission in a spatially incoherent pumping field (emission from a ruby laser in multimode operation). It is shown that when the ratio $l_r/l_n$ of the lengths of the correlation between the resonant and nonresonant waves and the pumping wave is small, the incoherence of the pumping wave has little influence on the spectral and spatial characteristics of resonant wave emission. An investigation is made of the way that the self-excitation threshold and the conversion factor depend on the correlation length $l_n$ and the transparency of the mirrors of the parametric light generator. Conversion of spatially incoherent pumping to frequency-tunable emission is achieved with a divergence close to the diffraction limit (which is approximately an order lower than the pumping divergence), and with a conversion factor close to that for coherent pumping (up to 20% with respect to the number of photons of the resonant wave, and up to 40% with respect to the photon flux). References 24: 15 Russian, 9 Western.
An investigation is made of optical pumping in a rubidium vapor laser. A technique for calculating rubidium laser characteristics is considered for general assumptions on the spectral makeup of the pumping light, the structure of the microwave field in the cavity and the re-emitted light. The results are in close agreement with experimental data. References 11: 10 Russian, 1 Western.
ON THE SECOND APPROXIMATION OF THE AVERAGING METHOD IN ELECTRON MASER THEORY

Nonlinear differential equations with a single fast phase that describe oscillations of electrons in masers are examined within the framework of the second approximation of the averaging method. The necessity of accounting for the nonresonance wave with any interaction length is demonstrated on the basis of an example of a cyclotron resonance maser with a Fabry-Perot resonator having its axis parallel to the static magnetic field. The second approximation of the averaging method is used to account for this wave. References 3 Russian.

A nonlinear analysis is made of the steady-state operation of a cyclotron resonance maser with Fabry-Perot resonator, the axis of the resonator coinciding with the direction of the static magnetic field. It is shown that there are four amplification branches. Optimum values of efficiency, cavity length and mismatch are calculated for a number of longitudinal and transverse electron velocities. References 7 Russian.
An investigation is made of the frequency dependence of true optical breakdown of fused and crystalline quartz and NaCl in the wavelength range of \( \lambda = 0.26-1.06 \mu m \). It is found that in the visible and infrared region, the threshold of true optical breakdown in these materials is weakly dependent on wavelength, evidencing the predominant role of avalanche ionization. With a transition to the ultraviolet band, a breakdown threshold reduction was observed in all investigated materials. In NaCl crystals this effect is attributed to a sharp increase of absorption in the ultraviolet by non-homogeneities. This is confirmed by analysis of the morphology of fractures.

The reduction of the breakdown threshold in quartz can be attributed to the contribution of many-photon ionization.

The paper gives considerable attention to procedural problems involved in the elimination of the influence of self-focusing and stimulated Mandelstam-Brillouin scattering on the results of breakdown studies. It is shown that strong prefocusing (lenses with \( F = 1.5-2 \) cm) is a reliable deterrent to self-focusing in the investigated materials for nanosecond pulses in the investigated wave band. It is pointed out that filamentary fractures are not necessarily the result of self-focusing. References 11: 5 Russian, 6 Western.
ACHIEVEMENT OF EMISSION IN A CS₂-O MIXTURE IN A SHOCK TUBE WITH HYPERSONIC NOZZLE

The paper gives the first results of experiments on generation of emission by CO molecules formed as a result of chemical reaction between CS₂ and O in a shock tube installation. A three-section shock tube with hypersonic nozzle was used. The optical cavity was formed by a spherical opaque gold-sputtered mirror and a flat dielectric mirror with 2% transmission. A mixture of oxygen and argon heated in the shock tube expanded in the hypersonic nozzle and was mixed in the ejector with CS₂. With an active cavity length of 7 cm, emission was achieved with 10 W of power in a 1.8 ms pulse. Research is now in progress on optimizing the cavity, mixture composition and shock tube regime. References 3 Western.

A POWERFUL SOURCE OF UV RADIATION ABOUT 1 µs IN DURATION FOR PUMPING OF GAS LASERS

The source of UV radiation suggested consists of a brass rod 1.8 cm in diameter, covered with a thin polyethylene tube. The rod is return current lead carrying a row of rings 0.4-0.6 cm wide with small projections on two sides. A sliding discharge is initiated by feeding a short pulse of voltage with an amplitude of up to 300 kV to one of the rings and the brass rod. Total discharge length is 93 cm. The discharge circuit is made so as to achieve the minimum inductance. With a stored energy of 50 kJ, a brightness temperature of over 50,000 K is achieved in the 240-340 nm spectral range, pulse duration about 1 µs. References 11: 8 Russian, 3 Western.
THE POSSIBILITY OF INCREASING THE EFFICIENCY OF GAS DYNAMIC LASERS: CARBON DISULFIDE GAS DYNAMIC LASERS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3, No 8, 1976 pp 1833-1836

manuscript received 16 Jun 76

[Abstract] The authors note that there is an as-yet unused method of increasing the low efficiency of GDL: the use of working molecules and pumping molecules with low levels. This allows the production of the same population inversion as for molecules with high laser levels, but at low gas temperatures. The drop in the stagnation temperature for the GDL suggested in comparison with ordinary CO

2

GDL is of great significance for practice, since it reduces the demands placed on materials of nozzles and high pressure chambers and obviously simplifies the design of a closed cycle. Calculations for the CS

2

molecule show that inversion should occur for a number of transitions in the 11.4-117.0 μm range with CS

2

pumped by ordinary N

2

or CO molecules as well as O

2

or CO

2

. The maximum efficiency theoretically possible, considering relaxation losses, is 10%. The calculations are confirmed by experimental emission on the 00° 1-10° 0 transition with wavelength of 11.4 μm.

References 12: 2 Russian, 10 Western.
STUDY OF VIBRATIONAL EXCITATION OF THE COS MOLECULE AND STIMULATED EMISSION WITH PUMPING BY A CO₂ LASER PULSE

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3, No 8, Aug 75 pp 1771-1781

[Abstract] This work is dedicated to experimental investigation of processes of excitation, relaxation and stimulated emission on the example of one of the simplest molecules, the carbonyl sulfide molecule COS, when it is pumped by the radiation of a pulsed CO₂ laser. As a result of the studies performed on pumping of the harmonic of the COS molecule on the P(22) wavelength, it was established that the frequency of pumping radiation about 0.01 cm⁻¹ off center relative to the transition v = 0, J = 5 → v₂ = 2, J = 4 of the deformation mode of the COS molecule. The time of the vibration-vibration exchange in this mode \( \tau_{vv} = (1.3 \pm 0.25) \times 10^{-6} \) s·mm Hg, while the time of rotational relaxation \( \tau_{rp} = (2.9 \pm 0.6) \times 10^{-8} \) s·mm Hg. The powerful CO₂ laser pulse forms a population inversion between levels \( v₂ = 2 \) and \( v₂ = 1 \) of the deformation mode of oscillation, stimulating emission on this transition at a wavelength of \( \lambda = 18.92 \mu \text{m} \). The absence of visible luminescence in the molecule at significant incident CO₂ laser energy densities indicates that the excitation mechanism of this rather simple molecule is different from the case of more complex molecules. References 16: 8 Russian, 8 Western.
SELECTING AN UNSTABLE OPTICAL CAVITY FOR A GAS DYNAMIC LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3, No 8(50), Aug 76 pp 1715-1720

manuscript received 4 Jan 76

[Abstract] Energy calculations are done for an unstable gas dynamic laser cavity comprised of two spherical mirrors with axis perpendicular to the gas flow (fig. 1). The analysis is based on the geometric approximation for the quasi-steady state, assuming that the mirrors are rectangular (the shape corresponding to maximum energy coupled out). The distributions of gain and field throughout the cavity are calculated by the method of iterations, and numerical results are given for a laser using a CO₂-N₂-H₂O mixture. The cavity is optimized by varying its magnification \( M \) and the lengths of the left and right sections \( l_1 \) and \( l_2 \) (see fig. 1). For each design, the resonator efficiency \( X \) is calculated, defined as the ratio of the number of quanta leaving the cavity in the form of useful emission to the total number of excited molecules entering the cavity in the same time period. It is found that the efficiency of energy conversion can be maximized by taking the total length of the cavity just short of the relaxation length of the medium, the 1/3 length of the left section about an order of magnitude shorter, and cavity losses such that the threshold value of the gain \((\log M - \log R)/L\) (where \( R \) is reflectance) is about half the value at input to the cavity. Although specific calculations show that the simplest unstable cavity with spherical mirrors can provide satisfactory energy conversion efficiency, the uniformity of field distribution over the mirrors is poorer than for the two-dimensional case (with cylindrical mirrors). It is shown that high conversion efficiency can be combined with uniform field distribution in prism cavities where the influence of wave aberrations of odd order is appreciably attenuated as compared with the ordinary telescopic cavity shown in fig. 1. A possible arrangement is shown in fig. 2. The cylindrical mirror of variable curvature \( l \) varies the magnification of the cavity, and the ratio between the overall length of the resonator and \( l_1 \) is varied by shifting plates \( 3 \) and \( 4 \) parallel to the gas flow, and by the inclination of the mirrors. References 6 Russian.

USSR

ANAN'YEV, YU. A., TRUSOV, V. P. and SHERSTOBITOV, V. YE., KVANTOVAYA ELEKTRONIKA, Vol 3, No 8(50), Aug 76 pp 1715-1720
STUDY OF A MANGANESE VAPOR PULSED LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3, No 8, Aug 76, pp 1802-1805
manuscript received 10 Jul 75

[Abstract] A study is made of the emission characteristics of a pulsed manganese vapor laser. Discharge tubes were used with working portions of alundum 60-70 cm in length, internal diameter 1.5-2.0 cm. Quartz windows glued to the ends of the discharge tube at a slight angle to the axis and the electrodes were located outside the heated zone. The discharge tube was excited by the discharge of a capacitor through a TGII-2500/50 hydrogen thyatron. The pulse repetition frequency varied between 2 and 21 kHz. The best emission parameters were achieved with helium as the buffer gas. The average emission power was 2.1 W, peak power 24 kW, efficiency 0.2%. The volumetric peak power was about 140 W/cm², volumetric emission pulse energy -- 2.5 μJ/cm³. References 7: 5 Russian, 2 Western.
DESTRUCTION OF MKP CRYSTALS BY ULTRASHORT LASER PULSES

An investigation was made of the action of ultrashort laser pulses on nonlinear MKP crystals. It is shown that crystal destruction is discrete and independent of crystal orientation or the focal length of the lenses. The threshold energy of destruction increased with an increase in the focal length of the lenses. With a transition from \( \lambda_1 = 1.06 \mu m \) to \( \lambda_2 = 0.53 \mu m \), a reduction by a considerable factor was observed in the threshold energy of destruction. It is shown by the method of two-frame pulse holography that destruction increases in both directions away from the focal plane. The rate of increase in destruction counter to the laser pulse was estimated at \( 1.6 \times 10^{10} \text{ cm/s} \). Figures 5, references 7: 6 Russian, 1 Western.

A PLASMA-SHEET CO\(_2\) LASER

An experiment is done on using a plasma sheet as the cathode for cavity discharge in the working mixture of a CO\(_2\) laser. The plasma sheet is formed by sliding discharge channels in the incomplete stage on a Mylar film surface. An energy input of about 1-2 J into the sliding discharge produced a homogeneous plasma surface measuring 6 x 40 cm, ensuring formation of a cavity discharge in a 3.5 cm gap with gas pressures from 0.5 to 1.5 atm in a gas mixture with component ratio CO\(_2\):N\(_2\):He = 1:2:3. Emission energy of \( 20 \text{ J} \cdot \text{l}^{-1} \cdot \text{atm}^{-1} \) was achieved at half-height in pulses of standard shape with energy input of 165 J \cdot l^{-1} \cdot atm^{-1} to the cavity discharge. References 15: 12 Russian, 3 Western.
COUPLING THE RADIATION OF A SEMICONDUCTOR LASER INTO THIN-FILM AND FIBER-OPTICS WAVEGUIDES

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 41, No 1, Jul 76
pp 143-145 manuscript received 9 Apr 75

[Abstract] The prospects of utilizing semiconductor lasers as small coherent light generators for integrated-optical circuits is causing research to be conducted for effective methods of coupling their radiation to thin-film waveguides. Possible ways of doing this by means of diffraction-lattice devices have been previously studied. The authors of this article suggest and demonstrate one new way to couple the radiation from a semiconductor laser to such waveguides on the basis of an optical tunneling effect.

A four-sided semiconductor laser in which all faces are mirrors of the optical cavity enables direct tunneling of the luminous energy from the active region of the laser into an optical waveguide, appreciably reducing the dimensions of the coupling device and simplifying manufacture. The emission of such a laser is a set of closed ring modes that undergo total internal reflection on all four faces of the active region. The emission energy of the laser placed a distance of the order of fractions of a wavelength above the surface of a film is optically tunneled into the waveguide, the laser itself serving as the input device. The paper gives the results of experiments on coupling laser emission into thin-film and fiber-optics waveguides. The authors state that it is necessary to ensure a high degree of optical quality of the surfaces between which the tunneling of light energy takes place in order to achieve maximal effectiveness. Figure 1; references 5: 4 Russian, 1 Western.
ISAYEV, A. A., KAZARYAN, M. A., LEMMERMAN, G. YU., PETRASH, G. G. and TROFIMOV, A. N., Physics Institute imeni P. N. Lebedev, Academy of Sciences, Moscow

PULSED EMISSION ON TRANSITIONS OF THE COPPER ATOM IN A DISCHARGE IN COPPER BROMIDE AND CHLORIDE VAPORS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3, No 8, Aug 76 pp 1800-1802 manuscript received 10 Jul 75

[Abstract] The purpose of this work was to determine the peculiarities of laser generation using vapors of copper by injection of these atoms into a halide discharge. Studies with copper chloride were performed in an installation with a TGI1-2000/35 thyratron in quartz tubes 11 and 18 mm in diameter with a length of the heated portion of 40 and 90 cm. The copper bromide discharge was studied with a TGI1-2500/50 thyratron in tubes 30 mm in diameter and 50 cm in length. Emission was achieved with a pulse recurrence rate of up to 20 kHz. An investigation is made of the way that emission power depends on discharge conditions. The experiments indicated that

the emission characteristics of the copper bromide and chloride lasers were comparable to the characteristics achieved with copper vapor lasers. References 13: 5 Russian, 8 Western.
The paper gives the results of an experimental study of two-dimensional turbulence resulting from interaction between a magnetic field and a flow of electrically conductive fluid. It is shown that under certain conditions in flow with shear the energy of pulsation motion may be tapped off by the averaged flow. The experiments were done on a horizontal mercury loop in a nonconductive channel of 50 x 60 mm rectangular cross section placed in the gap of a DC electromagnet. Shear flow was produced by a flat gap 3 x 50 mm at the inlet to the working section with the long side parallel to the magnetic field. Measurements were taken at a fixed flowrate of 20 cm/s. It was found that the gradient of the averaged velocity and its maximum value are increased by application of a magnetic field to the flux, beginning at a distance of 360 mm from the initial section. This is attributed to the two-dimensional structure of turbulence beyond this distance. This effect is accompanied by energy flux from small-scale to large-scale perturbations, up to and including energy transfer to the averaged flow. This is confirmed by turbulent stress measurements, which show that in the absence of a magnetic field the pulsation motion takes energy from the averaged motion, and when the magnetic field strength becomes sufficiently great the energy transfer of turbulent pulsations to the averaged flow appreciably exceeds the generation of energy by the averaged flow. References: 8 Russian, 3 Western.
INVESTIGATION OF THE CHARACTERISTICS OF A PLASMOTRON WITH A CHANNEL OF VARIABLE RADIUS

Minsk INZHENERNIO-FIZICHESKII ZHURNAL in Russian Vol 31, No 2, Aug 76
pp 295-299 manuscript received 13 Nov 75

[Abstract] An experimental study is done on the thermal and electrical characteristics of a plasmotron with an arc chamber that becomes narrower in the direction of the gas flow, and the peculiarities of these characteristics are discussed. It is shown that heat flux, enthalpy, electric field strength and efficiency are appreciably dependent on the law of variation in the rate of flow of the plasma-forming gas lengthwise of the arc chamber, and that the profile of the arc chamber and law of variation in gas flow-rate can be optimized by improving the plasmotron characteristics. References 4 Russian.

1/1
CONCERNING THE INFLUENCE OF VARIOUS LOSSES ON THE CHARACTERISTICS OF HIGH-POWER MHD GENERATORS

[Text] A discussion of the flow peculiarities of MHD generators for first generation open-cycle MHD electric power plants: boundary layer development, conduction nonhomogeneity in the channel cross section, Hall effect in a flow with nonhomogeneous conduction, end effect, etc. It is shown that nonhomogeneity of conduction appreciably increases the necessary channel length without much effect on conversion efficiency. Inattention to this circumstance in the simplified techniques for MHD generator calculations used in the literature on technical and economic estimates of MHD electric power plants may result in considerable inaccuracy in determination of the competitiveness of MHD generators as compared with other kinds of power plants. It is concluded that the flow regime must be carefully optimized in order to achieve acceptable characteristics of MHD electric power plants.

References 9 Russian.
The paper gives the results of an experimental study of the thermal and electrical characteristics of a subsonic MHD Hall generator (distribution of temperature, pressure, velocity and specific heat stresses through the walls of the electrodes, and Hall potential lengthwise of the channel).

The first test series on the annular Hall generator was done outside the magnet with external applied voltage to evaluate the equivalent internal resistance of the generator and the electrical resistance of the insulation, and to work out the design of the channel.

A second series of experiments was done in the magnetic field to determine the electrical characteristics of the Hall generator (effective Hall parameter, current-voltage characteristics of the generator).

Conclusions are drawn from the experimental data on the workability of the channel design, and on the influence that additive deposits on the cold walls of the channel have on the stability of the electrical characteristics of the Hall generator. The theoretical and experimental current-voltage characteristics of the generator are compared for different values of the potential drop near the electrodes.
An investigation is made of the feasibility of using an rf plasmatron with capacitive discharge to apply refractory dielectric coatings to metallic and nonmetallic surfaces. A discharge chamber is designed for effective utilization of a filamentary capacitive discharge configuration. A qualitative analysis is made of commercial alumina coatings applied to metal backings. References 6: 5 Russian, 1 Western.
THE INTERACTION OF VIBRATIONALLY EXCITED DIATOMIC MOLECULES WITH TRIATOMIC MOLECULES

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3, No 8, Aug 76 pp 1733-1742
manuscript received 16 Jan 76

[Russian abstract provided by the source]

[Text] A study is made of the vibrational interaction of diatomic molecules with combination levels of triatomic molecules. The analysis considers V-V and V-T process as well as intramolecular exchange. Simple expressions are produced relating the vibrational temperature of the \( \nu_3 \) mode of the triatomic molecule to the vibrational temperature of the diatomic molecule under quasi-equilibrium conditions. It is shown that under certain conditions, the \( \nu_3 \) mode may be heated by energy stored in oscillations of the diatomic molecule. Estimates of this effect are produced for the systems HF-CO\(_2\), DF-CO\(_2\), D\(_2\)-CO\(_2\) and CO-CS\(_2\). Experimental measurements are presented of the gain in a supersonic D\(_2\)-CO\(_2\) stream on the 00\(^0\) 1-10\(^0\) transition. The measured gain confirms 1/2

that in the system D\(_2\)-CO\(_2\), heating of the \( \nu_3 \) mode of CO\(_2\) occurs due to the energy stored in the D\(_2\) vibrations. References 29: 6 Russian, 23 Western.
SEPARATION OF ISOTOPES BY THE METHOD OF DISSOCIATION OF POLYATOMIC MOLECULES IN A STRONG INFRARED FIELD

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3, No 8, Aug 76 pp 1845-1846

[Summary of a paper delivered at an expeditionary session of the Council of the Soviet Academy of Sciences on the Problem of Coherent and Nonlinear Optics held 15-17 January 1976 at Tsakhkadzor near Yerevan]

[Abstract] An investigation is made of processes of rapid dissociation of SF₆ molecules in a strong infrared field. An analysis is made of the way that dissociation rate and isotopic selectivity depend on initial gas pressure and the IR frequency. It is shown that the dissociation rate is determined by vibrational-vibrational exchange during the IR pulse. The behavior of selectivity with pressure is also determined chiefly by this mechanism. The upper limit of dissociation selectivity is fixed at 13 by the imperfection of the chemical cycle of separation. The lower limit of dissociation of SF₆ was found to be 23 MW/cm². The author has developed a theory of overcoming anharmonicity of oscillations by an appropriately chosen sequence of transitions: first the molecule goes through a P-transition \( \nu = 0 \to \nu = 1 \), then a Q-transition \( \nu = 1 \to \nu = 2 \) and an R-transition \( \nu = 2 \to \nu = 3 \), and then goes up to the limit of dissociation through a quasi-continuum of vibrational levels of molecules. It is suggested that the mechanism responsible for selective processes is dissociation in a two-frequency IR field — \( \nu_1 \) in resonance with the vibrational transition is the weaker component that excites the first few levels of the molecules, and \( \nu_2 \) off-resonance from the absorption frequency is responsible for dissociation of the pre-excited molecules. The dispersion characteristic of the quasi-continuum is plotted, and it is shown that the rate of dissociation in SF₆ with frequency detuning by 130 cm⁻¹ from the \( \nu_3 \) band is 40 times below the rate when detuning is only 20 cm⁻¹, where the dissociation rate is about 1.2-1.3 times lower than for high-Q single-frequency exposure. The author feels that the results confirm the proposed theory of anharmonicity compensation.
A critical analysis is made of a number of experimental papers on measurement of Einstein's coefficient $A^{nm}$ and the cross sections of collisional broadening of line $P(20)$ of the $00^{0}1-10^{0}0$ transition in the CO$_2$ molecule. As a result, a value of $A^{nm} = 0.187$ s$^{-1}$ is recommended for the line $P(20)$, while values of 7.58, 5.56 and 4.86 MHz/mm Hg are recommended as quantities defining broadening of lines at 300 K due to collisions between CO$_2$ molecules and CO$_2$, N$_2$ and He respectively. References 23: 8 Russian, 15 Western.
The nonlinear interaction force between laser fields and cold plasma shells efficiently transforms radiant energy into mechanical energy of implosion. This transfer of energy has been considered before in numerical experiments and is treated here analytically in a didactic example starting with the inhomogeneous Rayleigh density profile. Up to 50% of the laser energy could be transferred into the energy of compression if a single, untailored pulse of $2.5 \times 10^{16} \, \text{W/cm}^2$ intensity and of only a few picoseconds duration is used for spherical illumination of the shell. If the pulse is short enough to reduce collisional thermalization, then the collapse and compression of the plasma can remain both at the threshold of Fermi degeneracy and adiabatic. This results in nuclear reaction gains $G$, based on the deposited energy $E_0$, and without $\alpha$-particle reheating, of $G = 400$ for $E_0 = 2.25 \, \text{kJ (DT)}, 900 \, \text{kJ (DD)}, 13 \, \text{MJ (HB)}$. About 1000 times less laser energy is necessary than in the case of gasdynamic ablation resulting in the same nuclear reaction yields. References 21: 2 Russian, 19 Western.
The authors analyze the physical conditions that arise in the plasma of thermonuclear targets in laser-driven fusion on the thermonuclear combustion stage. Assuming laser emission energy of the order of $10^6$ J and a target with deuterium-tritium fuel content of $10^{-3}$ g, the following values are estimated for the characteristic parameters of the thermonuclear plasma in the combustion process: pressure $10^{14}$ atmospheres, combustion time $2 \times 10^{-11}$ s, average ion temperature 0.6 MeV, and time of energy transfer from $\alpha$-particles and neutrons to ions $10^{-11}$ s. It is shown that there should be a group of hot ions with temperature of the order of 1 MeV or more about equal in number to the neutron production (14 MeV) of $10^{19}$. The characteristic neutron density is $10^{24}$ cm$^{-3}$, and the neutron flux is of the order of $10^{30}$ s$^{-1}$. Thus neutron-neutron scattering is possible with the production of 28 MeV neutrons. The parameters found in this numerical experiment would be useful in a variety of experiments, and could be registered by analysis of ion, neutron and x-ray spectra. References 2 Russian.
In the Laboratory of Mathematical Physics of the Institute of High Energy Physics, Acad. Sci. KazSSR, in the analysis of bubble chamber measurements a mapping system is used with processing of the data by the method of least squares on a BESM-4 computer. The structure of the system utilizes the standard BESM-4 hardware and specialized software. A flow chart of the software is presented. The system has been used for methodological work related to debugging of measurements and geometric reconstruction utilizing the Mirabel's new generation bubble chamber. The effects of a large number of various factors defining the motion of the particle in the hydrogen bubble chamber result in a complex form of the particle trajectory on stereo projections in the plane of the film. In order to produce a high quality representation, the track is described on the plane of the film by an m-power polynomial. As this curve approaches the "true" trajectory, the mean-square deviation S of the polynomial from the measurements decreases (approaching a certain limit). The statistical analysis of the results of measurements gives an idea of the nature of the trajectory of the particles in the stereo projection in the plane of the film. References: 5 Russian.
THE NAP-M PROTON ACCUMULATOR. I. THE MAGNETIC AND VACUUM SYSTEM

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 4, Jul/Aug 76 pp 31-34
manuscript received 17 Jul 75

[Russian abstract provided by the source]

[Text] The paper describes the magnetic and vacuum system of a proton accumulator designed for experiments on electron cooling [see G. I. Budker, Atomnaya energiya, 1967, Vol 22, p 346; V. V. Anashin et al., Doklad na IV Vsesoyuznom soveshchani po uskoritelyam zaryazhennykh chastits (Report to the Fourth All-Union Conference on Charged Particle Accelerators), 1975, Vol 2, p 304, "Nauka"]. The arrangement of the accumulator -- magnets with homogeneous field and edge focusing, and long straight intermediate gaps -- is determined by the specific nature of electron cooling. The vacuum chamber is exhausted by magnetic discharge and sorption pumps, and can be heated to 300°C. The working vacuum is $2\cdot10^{-10}$ mm Hg. References 5 Russian.

USSR
ANASHIN, V. V., BUDKER, G. I. et al., PRIBORY I TEKHNIKA EKSPERIMENTA, No 4, Jul/Aug 76 pp 31-34

is exhausted by magnetic discharge and sorption pumps, and can be heated to $300^\circ$C. The working vacuum is $2\cdot10^{-10}$ mm Hg. References 5 Russian.

A description of the systems for stabilizing currents in the windings of the magnets for the controlling field and 24 correcting elements. Current instability in the windings of the magnets for the controlling field does not exceed $1 \times 10^{-1}$; the relative magnitude of pulsations is no greater than $2 \times 10^{-5}$ at currents up to 7.5 kA. The current instability of the correcting elements for each of the 24 channels is less than $1 \times 10^{-3}$ for correction currents up to 30 A. References 3 Russian.

A RECUPERATOR WITH INTENSIVE ELECTRON-BEAM DECELERATION

A recuperator is proposed in which beam deceleration involves flattening of the cylindrical electron beam followed by deceleration in a hollow slotted collector. A quadrupole lens is used for transformation of beam shape. The authors investigate a consequent-pole lens of circular cross section in which the conductors are spaced around the periphery with density varying as $\cos 2\varphi$. It is shown that a lens current of 0.5 A flattens the beam to $h/l = 0.05$. Experiments show that beam transformation increases percentage recuperation to 99% as compared with 95% without the lens. References 6 Russian.
THE NAP-M PROTON ACCUMULATOR. III. THE ACCELERATING SYSTEM. MONITORING BEAM PARAMETERS

Moscow Pribory I Tekhnika Eksperimenta in Russian No 4, Jul/Aug 76 pp 37-40
manuscript received 17 Jul 75

[Russian abstract provided by the source]

[Text] The frequency in the NAP-M accelerating system is tuned with respect to a Hall pickup signal proportional to the magnetic field. Precision frequency tuning is done with respect to the radial and phase coordinates of the beam. Monitoring of beam parameters consists in measurement of the position of the equilibrium orbit and beam current. The beam current is measured at particle injection, during acceleration, and also during an experiment where beam bunching is absent. The systems use electrostatic pickups, Rogowski loops and a magnetic-modulation current sensor. References 6 Russian.

1/1
Neutral currents were experimentally observed but recently—in late 1973. Their discovery led to a redefinition of the weak interaction; in particular, it has been found to be not universal: its constants differ for different particles. Neutral currents are also important for an understanding of astrophysical phenomena. The study of the weak interaction with neutral currents is essentially just beginning. This review provides a systematic presentation of experimental results up to mid 1975 and their theoretical implications. The analysis is limited to processes involving neutrinos, doubtless related to the weak interaction. Many experiments are also presented allowing in principle detection of the effects of nonconservation of parity. Results to date indicate clearly that when muon neutrinos interact with nucleons and electrons, processes occur which do not involve emission of muons and therefore result from the weak interaction with neutral currents. Neutrino 1/2

and antineutrino spectra are presented from experiments at Argonne, the CERN group, at Serpukhov, the HPW group and Caltech-Fermilab. Two versions of the calibration theory of weak interaction are discussed which correspond to the Weinberg-Salam model and the so-called vector model. Both versions agree with experiment when free parameters of the Weinberg angle type are appropriately selected. References 112: 14 Russian, 98 Western.
KOLTOCHNIK, S. N., and KUCHIN, I. A.

CALCULATION OF THE CONTRIBUTION OF DOUBLE DIFFRACTION PRODUCTION AND CHECKING OF FACTORIZATION OF CROSS SECTIONS OF DIFFRACTION PROCESSES OF pp SCATTERING

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSKOY SSR SERIYA FIZIKO-MATEMATICHESKAYA in Russian No 4, 1976 pp 34-39 manuscript received 23 Mar 76

[Russian abstract provided by the source]

[Text] A model of simultaneous exchange, parametrized with respect to data on reactions of elastic scattering of protons and diffraction excitation of nucleon isobars in pp collisions is used to calculate the cross section $\sigma_{pp}^{DD}$ of double diffraction production in the momentum range from 5 to 300 GeV/c. The results of the calculations are compared with available experimental data. It is shown that the assumption of factorization of cross sections of elastic scattering and diffraction production is not confirmed by calculation: the factorization relationship is some 2.5 times greater than the value of $\sigma_{pp}^{DD}$. References 13: 5 Russian, 8 Western.

KAZACHA, V. I. and KOZHUKHOV, I. V.

USE OF RADIAL LINES IN PULSE-TYPE ACCELERATORS

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 21, No 7, Jul 76 pp 1477-1483 manuscript received 11 Mar 75

[Abstract] High-energy electron beams (10-15 MeV) can be generated in multigap rather than in more costly and difficult to design single-gap accelerators. A system of twin radial lines for a multigap accelerator had been proposed earlier. Here the transient characteristic of such a line is calculated, for the ultimate purpose of optimizing its design in terms of maximum pulse amplitude with minimum pulse distortion over a period of several tens of nanoseconds. The fundamental transmission-line equations are first solved for the general case of simple electrodes in the form of parallel disks or coaxial cylinders. Each twin line in the proposed radial system consists of one line shorted at the center and one not. The transient characteristic here depends on the degree of asymmetry. Calculations and E-wave measurements have shown that the performance in this case may be improved by having the characteristic impedance of the shorted line vary more appreciably with the radius than its unshorted counterpart. Figures 5; references 8: 3 Russian, 5 Western.
INSTALLATIONS FOR THE INVESTIGATION OF FREE NEUTRINOS

Moscow USPEKHI FIZICHESKIH NAUK in Russian Vol. 119 No. 4, 1976 pp 633-639

[Abstract] Several tables are presented which the author prepared for lectures on neutrino-physics in order to give an impression of the scale and achievements of this section of physics. The tables list existing installations for the investigation of free neutrinos. They include the overwhelming majority of installations for which funds have been allocated. The four tables list: 1) installations for the investigation of artificial "low" energy neutrinos; 2) installations for the investigation of artificial high energy neutrinos; 3) installations for the investigation of cosmic "low" energy neutrinos; and 4) installations for the investigation of cosmic high energy neutrinos. References 33: 1 Russian, 15 Hungarian, 17 Western.

ON SPONTANEOUS TRANSITIONS OF NUCLEI TO THE SUPERDENSE STATE

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKIH FIZIKI in Russian Vol 24, No 2, 20 Jul 76 pp 114-117 manuscript received 18 Jun 76

[Abstract] A search was made for spontaneous transitions of nuclei to the superdense state. Two scintillation counters were used at a depth of 600 m in the neutrino station of the Soviet Academy of Sciences. One counter contained sodium iodide, and the other contained hexafluorobenzene. Tungsten shielding and an anticoincidence system were used to cut down the external background. Gamma quanta were registered in the 3-10 MeV range. No effects associated with transition to the superdense state were observed. An estimate is made of limitations on the parameters of the superdense state. References 3: 2 Russian, 1 Western.
A new method is proposed for nonlinear laser spectroscopy without direct use of Lamb shifts. The physical basis of the technique is in the competition of effects of spectral and spatial burnouts of the gas line, and the phase interaction between traveling waves in a ring laser. The procedure was applied to investigation of the hyperfine structure of the absorption line of excited neon on the transition $4p'[^3P_2]_2 \rightarrow 5s'[^1P_1]$ due to the presence of isotopes in the absorbing medium. The ring laser is shown to have the following advantages over a linear laser: it has much higher sensitivity and simpler registration (up until now research of this kind has not been done at all on a linear laser). A ring laser was used for precision measurement of Zeeman splitting of the methane absorption line belonging to $1/2$. 

The $F_1$ component of branch $P(7)$ of group $v_3$ with resolution of $2 \times 10^{-6}$ cm$^{-1}$. The authors demonstrate the feasibility of improving sensitivity and accuracy of the nonlinear spectroscopy based on a ring laser for studying the hyperfine structure of weakly absorbing gases by using self-oscillatory emission modes. References 22: 13 Russian, 9 Western.
KIRSANOV, V. P., TROSHKIN, S. V. and BYKOV, I. V.

INFLUENCE OF AN ILLUMINATOR HOUSING ON THE ELECTRICAL AND LOAD CHARACTERISTICS OF FLASH LAMPS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 3, No 2(44), Feb 76 pp 431-433 manuscript received 25 Feb 75

[Abstract] An investigation was made of the electrical and load characteristics of IFP-8000 flash lamps operating in free space and in three types of illuminators: a closed metal cylinder filled with magnesium oxide powder in a layer about 1 cm thick; a less restrictive quartz tube covered on the outside with a similar magnesium oxide layer; a four-lamp illuminator with ceramic reflector having part of the space filled with a neodymium glass plate 1.5 cm thick. It was found that lamps with a reflective coating on the envelope and those located in the center of the multiple-lamp illuminator have maximum energy reduced by about 1.5 times as compared with the open lamp; the corresponding energy reduction is about 20% when the diameter of the reflector is doubled. The electrical conductivity of the gas discharge plasma increases by 30% in illuminators, and the discharge temperature increases by 15%. A reduction in service life by a factor of about 30 can be expected if they are enclosed in illuminators. References 10: 8 Russ., 1 West. 1/1
ON CALCULATING THE SURFACE RESISTANCE OF SUPERCONDUCTORS

[Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 46, No 8, Aug 76 pp 1638-1643 manuscript received 24 Jan 74]

[Abstract] Expressions convenient for practical use are derived for calculating the surface resistance of superconductors of the first and second kind. The analysis is based on certain implications of BCS theory. Calculations are compared with exact results of the Mattis-Bardeen and Abrikosov-Gor'kov-Khalatnikov microscopic theories. The comparison shows good agreement with the microscopic theory for the proposed temperature and frequency dependences of surface resistance. The proposed analytical formulas also show good agreement with experimental data. References 12: 10 Russian, 2 Western.
Theoretical Physics

USSR

LIPATOV, L. N., Institute of Nuclear Physics imeni B. P. Konstantinov
Academy of Sciences USSR

CALCULATION OF THE GELL-MANN-LOW FUNCTION IN SCALAR THEORY WITH A STRONG NONLINEARITY

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian
Vol 24, No 3, Aug 76 pp 179-183 manuscript received 31 May 76

[Abstract] The Gell-Mann-Low function is calculated for the class of scalar models in the quantum field theory which are described by the Lagrangian

\[ L = \int d^Dx \left[ \frac{(\partial \mu \varphi)^2}{2} - g \frac{\varphi^n}{n!} \right] \]

In order to render the theory renormalizable, the dimension of the space is assumed

\[ D = \frac{2n}{n-2} \quad (n=4,6,8,...) \]

The invariant charge is first defined in terms of the propagator of a scalar particle using the Feynman diagram method. The method is applicable to perturbation theory of every order, and is used here in the extreme case of a very strongly nonlinear interaction \((n \rightarrow \infty\) and thus \(D \rightarrow 2\)). As the charge increases, the GML function of the charge reverses sign and an ultraviolet stability point appears. The number of such points increases as \(\sqrt[2]{n}\). Most interesting, from the physical standpoint, are the cases \(n=4\) and \(n=6\).

This method of calculation yields for these cases results which differ from the true values by amounts of the order of \(1/n\). Figures 1; references 6: 3 Russian, 3 Western.
FREE OSCILLATIONS OF AN ELASTIC RING OF PERIODIC STRUCTURE

Based on Reisner's variational principle a solution is found for the problem of free oscillations of a thin elastic ring that has a periodic structure. A ring is considered that is made of two materials with different elastic moduli and densities. The spectrum of the first five natural frequencies and vibrational modes of the ring is found. It is shown that in a ring with nonhomogeneous structure the separation of oscillations into two types — flexural and longitudinal — is fundamentally impossible.

References 3: 2 Russian, 1 Western.

DYNAMIC CHARACTERISTICS OF DISCRETE PARTICLES IN AN EFFERENT HELICAL FLOW OF HEAT-TRANSFER AGENT

The authors determine the dynamic characteristics of a discrete particle falling under the influence of gravitational force into an efferent helical flow of heat-transfer agent and a uniform flow of heat-transfer agent based on Chen's equation and the results of numerical calculation. In the case where the particle falls into a uniform flow the calculations are compared with experimental results. References 5 Russian.
CASCADE PROCESSES IN PHENOMENA OF PARAMETRIC INTERACTION IN A PLASMA

GALEYEV, A. A., Space Research Institute, Academy of Sciences USSR

GOR'KIY IZVESTIYA VUZOV, RADIOFIZIKA in Russian Vol 19, No 5-6, 1976 pp 653-660

[Abstract] A brief survey article on development of a nonlinear theory for parametric plasma instabilities. Parametric absorption of emission close to the critical density is considered in the elementary process of resonant interaction between an electromagnetic waveform on frequency $\omega \approx \omega_p$ with finite amplitude on the one hand, and a Langmuir-sonic wave of infinitesimal amplitude on the other hand. A cascade model of energy transfer is examined in an isothermal plasma, disregarding nonlinear interaction of "sonic" density oscillations. Approximate equations are derived for the Langmuir oscillations, and an expression is found for the effective frequency that describes the rate of dissipation of the pumping wave:

$$\nu_{\text{eff}} \approx \frac{\pi \omega_p E_0^2}{4 p_0^2 n_0^2 T_e}.$$  

Determination of this quantity is the purpose of the nonlinear theory of parametric instability.

Models of parametric backscatter are discussed for an isothermal plasma, and for a nonisothermal plasma with hot electrons. References 19: 10 Russian, 9 Western.
An investigation is made of modulation instability as a mechanism of dissipation in a heated plasma when the density of Langmuir noises $W/nT$ exceeds $(\Delta k \delta E_0)^2$ (where $\Delta k$ is the spectral width) in a broad spectrum $\Delta k \sim k$. The physical meaning of modulation instability is as follows. When there is a rise in the local density of noise energy the averaged force $V e E^2/2m_e^2$ acting on the electrons of the plasma pushes them out of the localization region. The charge separation field extracts ions as well, so that a minimum plasma density is formed where Langmuir noises are blocked. This is a favorable process from the energy standpoint as the frequency of Langmuir waves drops. It is shown that modulation instability leads to localization of the energy of Langmuir oscillations in separate spatial regions.

Contents

1. Introduction
2. Langmuir solitons
3. Dynamics of formation and interaction of solitons
4. Resonant interaction of Langmuir solitons with plasma particles
5. Nonlinear interaction of Langmuir solitons with plasma particles
6. Development of turbulence. One-dimensional model
7. Collapse of Langmuir waves
8. Development of turbulence. Three-dimensional theory
10. Self-similar solution of the problem of turbulent heating
11. Appendix. Some exact solutions of strong Langmuir turbulence equations

References 20: 16 Russian, 4 Western.
[Abstract] A method is outlined for reducing the problem of absolute parametric instability excited by a monochromatic pumping field of arbitrary amplitude in a nonhomogeneous magnetoacoustic plasma to the problem of parametric excitation of volumetric oscillations in a homogeneous isotropic plasma. Parametric stimulation of a low-frequency wave with dispersion completely determined by the rf field is examined in a strong magnetic field where the cyclotron frequency of ions appreciably exceeds the frequency of the excited waveforms. Increments in the buildup of oscillations are determined, and it is shown that spatial nonhomogeneity of the plasma has a stabilizing effect on parametric instability. References 5: 2 Russian, 3 Western.