[12] R. V. Ambartsumyan, V. S. Letokhov, G. N. Makarov, and A. A. Puretskiĭ, ZhETF Pis. Red. 17, 91 (1973) [JETP Lett. 17, 63 (1973)]; Dokl. Akad. Nauk SSSR 211, 365 (1973).
[13] V. S. Letokhov, Chem. Phys. Lett. 15, 221 (1972).
[14] E. S. Yeung and C. B. Moore, Appl. Phys. Lett. 21, 109 (1972).
[15] V. S. Letokhov, A. A. Makarov, and V. A. Semchishen, ZhETF Pis. Red. 18, 515 (1973) [JETP Lett. 18, 303 (1973)].
[16] L. S. Vasilenko, V. P. Chebotaev, and A. V. Shishaev, ibid., 12, 161 (1970) [12, 113 (1970)].

D. N. Mirlin. Optical Studies of Surface Vibrations in Ionic Dielectrics and Semiconductors. This paper sets forth the results of a joint study made with V. V. Bryksin, Yu. M. Gerbshteĭn, and I. I. Reshina. A spectroscopic method was used to observe surface optical vibrations in crystals and investigate them in detail. In accordance with the phenomenological treatment, such vibrations arise in the frequency range between ω_{TO} and ω_{LO}—the limiting frequencies of transverse and longitudinal optical phonons—where the dielectric constant is negative (the range of "residual rays"). The studies were made on a series of ionic dielectrics and semiconductors with the structure of NaCl, CaF_2, and TiO_2, and on InSb and α-SiO_2. The experimental part of the work was done using a modification of the disturbed total internal reflection (DTIR) method, which made it possible to investigate the absorption in a nonradiative region of the spectrum, i.e., at $k_x > \omega/c$ (where k_x is the wave vector of the surface vibrations). DTIR spectra were calculated for the configuration of the experiment. Dispersion relations for the surface vibrations were obtained experimentally for the first time, and the influence of anharmonicity on their characteristics was studied. It was shown that satisfactory agreement between the calculated and observed frequencies requires consistent consideration of the anharmonic contribution to the dielectric constant of the crystal. Splitting of the surface-vibration frequencies was detected in thin films: in this case, two surface-phonon branches were observed. Mixed surface plasma-phonon modes were investigated in degenerate semiconductors, dispersion and concentration dependences of the frequencies were recorded, and the damping of the surface plasmons was measured. (In InSb, it was found to be 2—3 times stronger than the damping of bulk modes.)

The influence of anisotropy on the conditions under which surface vibrations appear and on their characteristics was investigated. The existence of two types of surface-vibration branches in uniaxial crystals was established experimentally: one of them exists only in the polariton region of the spectrum and has no analog in isotropic crystals. As the k_x of these "anomalous" surface excitations increases, they mix with the bulk spectrum and attenuate.

Surface waves at the boundary between two dielectrics were also investigated, and extinction of these waves at a boundary with a metal was observed. "Boundary" plasmon-phonon modes at metal (semiconductor)-dielectric boundaries were studied. Various manifestations of the surface phonons can be expected in study of transport phenomena in thin films, in the surface layers of single crystals, in multilayered structures, in tunnel spectroscopy, etc. In particular, surface-phonon manifestations can be expected in Raman spectroscopy of semiconductors with excitation beyond the edge of the fundamental band, where the light penetrates only to a small depth.

The basic results discussed in the paper were set forth in the following articles:

V. V. Bryksin, Yu. M. Gerbshteĭn, and D. N. Mirlin, Fiz. Tverd. Tela 13, 2125 (1971); 14, 543 (1972) [Sov. Phys.-Solid State 13, 1779 (1972); 14, 453 (1972)]; Phys. Stat. Sol. B51, 901 (1972).

V. V. Bryksin, D. N. Mirlin, and I. I. Reshina, ZhETF Pis. Red. 16, 445 (1972) [JETP Lett. 16, 315 (1972)]; Fiz. Tverd Tela 15, 1118 (1973) [Sov. Phys.-Solid State 15, 760 (1973)]; Sol. State Comm. 11, 695 (1972).

I. I. Reshina, Yu. M. Gerbshteĭn, and D. N. Mirlin, Fiz. Tverd. Tela 14, 1280 (1972) [Sov. Phys.-Solid State 14, 1104 (1972)].

G. A. Askar'yan, V. A. Namiot, and M. S. Rabinovich. Use of Ultracompression of Matter by Light Reaction Pressure to Obtain Microcritical Masses of Fissile Elements, Ultrastrong Magnetic Fields, and Particle Acceleration. The possibility of obtaining very high pressures by vaporizing metal[1] with a powerful light or charged-particle flux ($p \approx I/v$, where I is the power density of the incident radiation causing vaporization and v is the outflow velocity of the matter) has recently been put to use to obtain ultracompression[2]—an increase in the density of matter by hundreds and thousands of times—under quasismooth (without shock-wave formation) isostatic compression by a vaporization pressure $p \approx 10^{11}$—10^{12} atm. At such densities and pressures, matter behaves like a degenerate electron gas whose pressure is determined by quantum motion of the electrons: $p \sim n_e\epsilon$, where we have from the indeterminacy principle: $\epsilon \approx (\Delta P)^2/2m \approx \hbar^2/2m(\Delta x)^2 \approx \hbar^2 n_l^{2/3}/2m$ and the pressure $p \approx \hbar^2 n_e^{5/3}/2m$, i.e., the effective adiabatic exponent $\gamma = 5/3$ unless the total number of electrons changes appreciably.

The paper[2] proposed the use of ultracompression to lower the threshold for initiation of controlled thermonuclear fusion and to increase its efficiency. We shall consider other aspects of ultracompression—the formation of microcritical masses of fissile elements[3], ultrastrong magnetic fields[3], and acceleration of particles[3].

1. Microcritical masses of ultracompressed fissile elements. Back in 1943, Neddermeier (a reference to his work appeared only recently, in[4]) took note of the possibility of lowering the critical masses of fissile elements by explosive compression, but modest blast pressures did not open the possibilities inherent in ultracompression, which produces critical dimensions and masses so small that they can be accommodated in the small regions occupied by concentrated high-density radiation.

In fact, the critical dimension $R_{cr} \approx l_f \sim 1/n_i$, while the critical mass $M_{cr} \sim n_i R_{cr}^3 \sim 1/n_i^2$, whence it follows that even hundredfold density increases reduce the critical mass by a factors in the tens of thousands. The concentration of the nuclei then reaches $n_i \approx 10^{25}$ cm^{-3}, which corresponds to an ionization multiplicity $Z_{eff} \approx 10$. Ultracompression permits the use of an ultradense reflecting layer to reduce the critical size still further. The equation describing the development of the neutron avalanche is