2. High plasma density (weak magnetic fields). When

$$\omega_H/\omega_p \sim k^2c^2/\omega_p^2 \sim \Omega_0^2/\omega_p^2 \sim (\omega/\omega_p)^{1/2} \ll 1 \qquad (6)$$

the solution of (4) is

$$\lambda^2 = -\omega_p^2 \{1 + \delta \pm \sqrt{\delta^2 - \omega_H \Omega_0^2 / \omega_p^3}\}; \qquad \delta \equiv \frac{k^2c^2 + \omega_H\omega_p}{\omega_p^2} .$$

The instability has therefore a threshold character in this case ($\Delta > 0$), too 1).

We can analyze similarly the case of finite wavelength for the perturbation of the longitudinal field and of the velocity. In the latter case the instability conditions and the increments obtained above are altered. In addition, the order of Eq. (4) increases, and this can lead to new instabilities, similar, for example, to those considered in [1].

It must be noted that the problem of stability of curvilinear beams of charged particles, which likewise constitute beams of excited oscillators, was first considered in [2]. Unlike the conditions considered there, in our problem the amplitude of the oscillator is uniquely determined by the wave amplitude. Therefore the instability remains in our case even when the plasma density is zero (as noted above, this corresponds to the instability of a particle moving in an external field), whereas in [2] the increment vanishes at zero beam density.

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1) In this case the instability has a decay character.

EFFECT OF HYDROSTATIC PRESSURE ON THE ELECTRON EFFECTIVE MASS IN InSb

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It was established in the experiments of Long [1] and Keyes [2] that the electric resistivity ρ and the Hall coefficient R of indium antimonide increase exponentially with the pressure P in the intrinsic-conductivity region. This result was attributed to the linear increase of the forbidden band ϵ_g of the crystal with increasing pressure (up to 12,000 kg/cm^2), the proportionality coefficient being 1.5×10^{-5} eV-cm^2/kg. A consequence of this increase of ϵ_g is the exponential increase of the concentration of the intrinsic carriers. For a numerical determination of the proportionality coefficient in the dependence of ϵ_g on P from

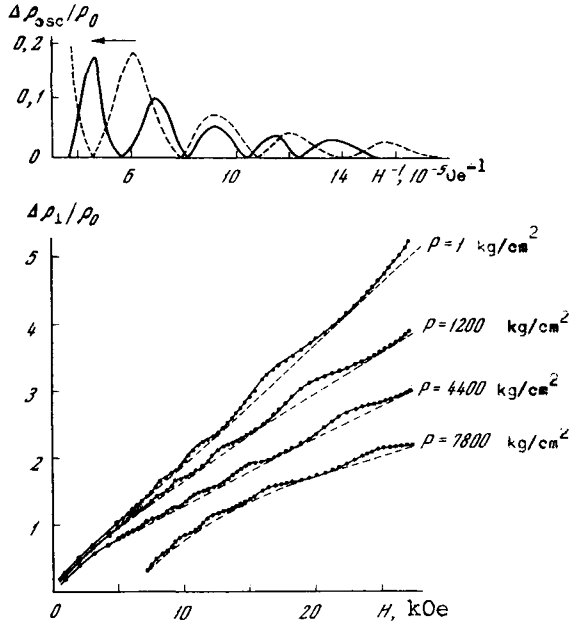

Fig. 1. Transverse magnetoresistance vs. magnetic field intensity at various pressures.

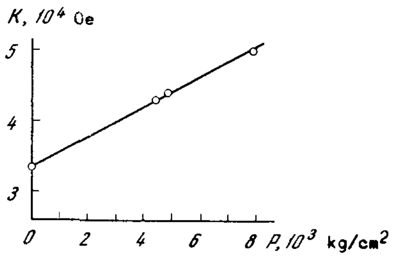

Fig. 2. Plot of the reciprocal period K against pressure, from which $m^*(P)$ can be determined.

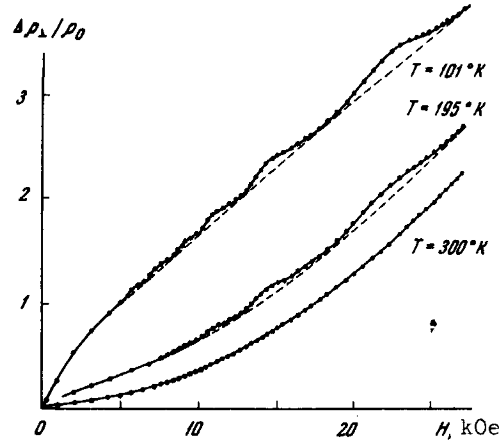

Fig. 3. Magnetoresistance vs. field for different temperatures. P = 4400 kg/cm² for T = 101 and T = 195°K, and P = 8000 kg/cm² for T = 300°K.

the experimental values of ρ and R, it is necessary to take account of the effect of pressure on the carrier effective mass. Long used for this purpose experimental data on the variation of the Hall mobility ($R\sigma$). Keyes has assumed that the effective mass of the electrons varies with pressure in the same manner as the width of the forbidden band of the crystal, $m^* \sim \epsilon_g$. This simple relation was then theoretically proved in the well known paper by Kane [3], devoted to a calculation of the energy-band structure in the InSb crystal. It followed from the experimental data that the effective mass of the holes is independent of pressure.

We have investigated experimentally the direct influence of hydrostatic pressure up to 8000 kg/cm² on the electron effective mass. We used for this purpose a direct method based on the new Gurevich-Firsov magnetophonon resonance phenomenon. It is shown in an experimental paper devoted to an investigation of this phenomenon in n-InSb [4] that if the limiting frequency ω_0 of the optical oscillations of the crystal is known, then the electron effective mass can be reliably determined from the resonance condition

$$\omega_0 = M \frac{eH}{m^* c} \qquad (M = 1, 2, 3 \ldots). \tag{1}$$

The magnetophonon resonance is experimentally manifest in oscillations of the dependence of the magnetoresistance $\Delta\rho/\rho_0$ on the magnetic field intensity H, the situation being simplest in the case of transverse magnetoresistance.

The single-crystal n-InSb investigated by us had dimensions 2 x 2.5 x 16 mm, a density 8×10^{13} cm^{-3}, and a conductivity 7×10^{5} cm^2/V-sec at T = 77°K. The hydrostatic pressure was produced with the aid of the apparatus described in [5].

In our experiments the pressure did not exceed 8000 kg/cm^2. Since the linear compressibility of the InSb crystal amounts to 7×10^{-13} cm^2/dyne, the relative reduction in the linear dimensions of the crystal did not exceed 0.6%. We shall assume henceforth that at so small a lattice compression the change in the limiting optical frequency does not go beyond the limits of the accuracy of the method used to determine the effective mass (3 - 5%) and that $\omega_0 = 3.7 \times 10^{13}$ sec^{-1} = const [6].

From the experimental plots shown in Fig. 1, we see how the pressure affects the period and the phase of the transverse-magnetoresistance oscillation curves at T = 105°K. The dashed lines show the proposed smooth background, on which magnetoresistance peaks brought about by magnetophonon resonance are superimposed. In the upper part of the figure is shown the oscillating part (periodic in the reciprocal field) of the magnetoresistance, reckoned from this background; the horizontal arrow shows the shift of the second maximum (M = 2) when the pressure is increased from 1 kg/cm^2 (dashed) to 4400 kg/cm^2 (solid line).

The effective mass of the electrons participating in the magnetophonon resonance can be determined both from the oscillation period

$$\Delta\left(\frac{1}{H}\right) = \frac{e}{m^*\omega_0 c} , \qquad (2)$$

and from the positions of the individual maxima on the oscillating curve.

The experimental results for the reciprocal $K = [\Delta(1/H)]^{-1}$ of the period (2), given in Fig. 2, show this quantity to be linear:

$$K(e) = 3.3 \times 10^4 + 2.4P \quad (kg/cm^2). \qquad (3)$$

With the aid of (2) we obtain for the effective mass a change from $m^* = 0.016m_0$ (H = 15 - 25 kOe) at 1 kg/cm^2 to $m^* = 0.025m_0$ at 8000 kg/cm^2. Inasmuch as in accordance with [1,2] the width of the forbidden band also increases in this interval by 1.5 times, the result serves as an experimental confirmation of the theoretical deduction that the effective mass of the electrons is directly proportional to the width of the forbidden band of the InSb crystal in the investigated pressure range.

It was shown in [4] that as the temperature of the experiment is increased to 195°K the oscillations of the transverse magnetoresistance practically disappear. A decrease in mobility and the onset of intrinsic conductivity at T = 195°K were advanced as possible causes of this damping. The curves shown in Fig. 3 cast some light on this question. The plot of $\Delta\rho/\rho_0$ at 4400 kg/cm^2 exhibits distinct oscillations also at T = 195°K, in spite of the fact that under these conditions the mobility is reduced not only by the rise in temperature, but also by the rise in pressure [2]. Only further increase in temperature, to 300°K, causes the magnetoresistance oscillations to become indistinguishable even at P = 7800 kg/cm^2.

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SPECTRAL COMPOSITION OF GENERATION OF NEODYMIUM GLASS IN A DISPERSION RESONATOR

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Generation of the ruby R_2 line was previously attained in a dispersion resonator [1] by suppressing the usually observed R_1-line generation. As is well known [2], both lines in the luminescence spectrum of ruby are homogeneously broadened, and thermodynamic equilibrium is established between the $\bar{E}$ and $2\bar{A}$ levels, the transitions from which cause these lines.

We present here preliminary results on the spectral composition of the radiation and on the threshold parameters of a neodymium-glass laser, with an inhomogeneously broadened luminescence band in the 1.06 μ region.

A glass prism with angular dispersion ~1 sec/Å was used in the dispersion resonator. The reflection coefficients of the dielectric mirrors were constant within the limits of the luminescence band. Polished cylindrical glass rods with ~2% Nd^{3+} ion concentration were used. The spectrum was registered by photographing the image from the screen of an electron-optical converter installed in the cassette part of an STE-1 spectrograph (dispersion 18 Å/mm).

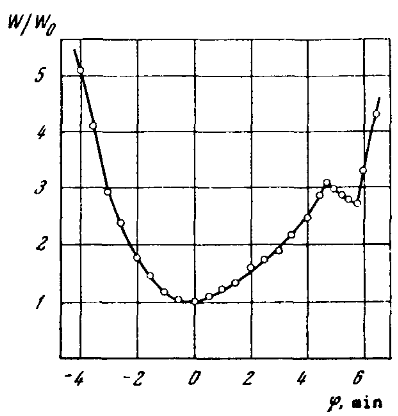

Fig. 1. Relative threshold pump energy W/W_0 vs. angle of inclination of mirror φ in a dispersion resonator.

At the generation threshold in an ordinary plane resonator, there appear near 9440 cm^{-1} under our conditions emission lines whose number increases with increasing above-threshold pumping. At the maximum attainable pump energy, amounting to 6 times threshold, emission lines spaced more or less uniformly 3 - 5 cm^{-1} apart were observed in the spectral interval from 9390 to 9470 cm^{-1}. Misalignment of the resonator had practically no effect on the position of the generation region in the spectrum. In the case of a dispersion resonator, with the mirrors inclined, a shift took place in the operating generation frequency. A plot of the threshold pump energy against the inclination of the end mirror is shown in Fig. 1. We note that the curve has a