but substitute ρ for ρ_n. An exact experimental determination of these quantities for $\delta \sim 1$ is made difficult by the large absorption.

Figure 2 shows the temperature dependence of the ratio of the pulse amplitude at T = 1.5°K (A_0) to the amplitude at a temperature T (A_T). Curve 1 corresponds to fourth sound ($\delta << 1$), and curve 2 corresponds to first sound with very weak dispersion ($\delta \sim 2$, these conditions were realized in corundum powder with average particle size $\sim 60\ \mu$; in this case the speed of sound almost coincided with u_1); curve 3 corresponds to sound in the region of strong dispersion ($\delta \sim 1$). The quantity A_0/A_T represents the temperature dependence of the absorption coefficient, and it follows from the figure that the absorption has a stronger temperature dependence in the dispersion region. The ratio A_0/A_T does not depend on the amplitude up to $\sim$2.0°K; the determination of this dependence at higher temperatures is hindered by the strong absorption, which leads to an unfavorable signal/noise ratio.

Thus, the described experiments confirm that when the normal component is substantially clamped (i.e., when the dimension of the channel is comparable with the depth of penetration of the viscous wave), dispersion of first sound sets in.

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*These types of oscillation are independent only if thermal expansion is neglected.

**To calculate λ_b, we used the values of ρ_n and η for He^4, given in [7, 8].

NONLINEAR INTERACTION OF OSCILLATIONS IN A PLASMA-BEAM SYSTEM

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When an electron beam interacts with a transversely-bounded plasma in a magnetic field under conditions when $f_p > f_H$, simultaneous excitation of microwave oscillations in two frequency regions becomes possible [1]. The first of these regions lies close to f_p and is governed by the polarization interaction between the beam and the plasma, whereas the second is lower than f_H and is governed by the interaction between the slow space-charge wave and the direct plasma-waveguide wave. Both instabilities have a collective character and their amplitudes increases in the direction from the electron gun to the collector.

It is to be expected that when several oscillations are excited in a nonlinear medium such as a plasma, they interact. Our purpose was to observe and study the properties of such an interaction.

The investigations were made with a setup described in an earlier paper [2]. An electron beam with current up to 25 mA and particle energy up to 1.5 keV was injected in the interaction space, which was in a longitudinal magnetic field of intensity up to 300 Oe. The oscillations were received with a loop that could me moved from the gun to the collector. The oscillation spectrum was investigated with a set of narrow-band measuring receivers or with S4-5 spectrum analyzers.

In the initial section of the tube (distance from electron gun $z < 70$ mm), where the oscillation intensity was low, the oscillation spectrum consists only of two peaks at frequencies f_1 and f_2 corresponding to the two oscillation regions indicated above. In those tube cross sections where the oscillation intensities was sufficiently large at these frequencies ($z > 100$ mm), the oscillation spectrum becomes more complicated (Fig. 1). It contains a large number of new oscillation peaks that can be identified with certain higher harmonics or combinations of the frequencies f_1 and f_2 and are evidently due to nonlinear effects.

When allowance is made for the nonlinear interaction of the oscillations (as was done, for example, in [3]), it can be concluded that a close relation exists between the oscillation amplitudes of such a spectrum. It is thus to be expected that an induced change in the amplitude of any of the oscillation peaks should affect the magnitude of all the others.

To check on this assumption, we modulated the electron beam emerging from the gun with the aid of a small additional loop, using a monochromatic signal of a certain frequency f_M, and registered the amplitudes of the oscillations at frequencies f_1 and f_2 in the section $z = 70$ mm. The case when f_M varied in the vicinity of the sum combintation frequency $f_b = f_1 + f_2$ is shown in Fig. 2a. So long as the frequency f_M is far from f_b, modulation of the beam has no noticeable effect on the oscillations at frequencies f_1 and f_2 . When $f_b = f_M$, the

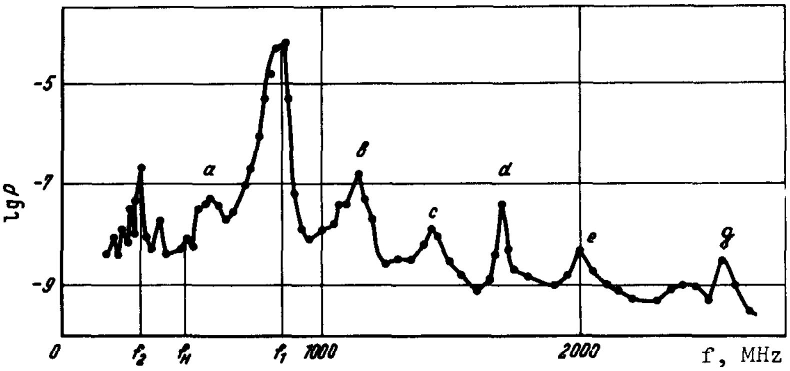

Fig. 1. Oscillation spectrum measured at distance $z = 150$ mm from electron gun. Beam current 17.5 mA, $u_a = 820$ V, $H = 166$ Oe, $p = 3 \times 10^{-2}$ mm Hg, $f_1 = 850$ MHz, $f_2 = 300$ MHz. Peak identification: a) $f_1 - f_2$, b) $f_1 + f_2$, c) $2f_1 - f_2$, d) $2f_1$, e) $2f_1 + f_2$, g) $3f_1$.

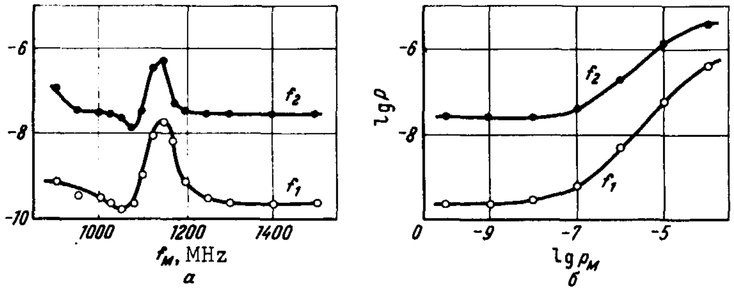

Fig. 2. Intensity of oscillations at frequencies f_1 and f_2 vs. modulating signal frequency ($P_M = 3\mu W$) (a) and vs. modulating-signal power when $f_M = f_b$.

intensity of the f_1 and f_2 oscillations increases noticeably. A similar effect (albeit less intense) can be observed when f_M coincides with any of the other combination frequencies. Figure 2b shows the amplitude dependence of this effect. When the modulating signal with frequency $f_M = f_b$ is large enough, an increase by two or three orders of magnitude can be obtained at f_1 and f_2. It should be noted here that the experimentally observed increase in the peaks at the frequencies f_1 and f_2 was accompanied, as expected, by an increase in the intensities of the remaining combination and higher-harmonic frequencies of the spectrum.

The observed effect can be regarded as a three-plasma interaction that leads to the decay of the wave with $f_M \sim f_b$ into two other waves into two others with frequencies f_1 and f_2 corresponding to the most intense oscillations present in the spectrum [4].

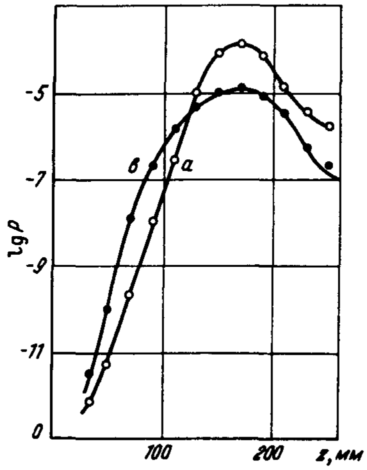

Fig. 3. Oscillation intensity distribution along tube at frequency f_1 without beam modulation (a) and with beam modulated by a monochromatic signal of frequency f_b (P_M = 3 μW).

It must be noted that these phenomena are observed only in the first half of the tube, where the intensity of the oscillations increases exponentially with increasing distance from the gun (Fig. 3). In that part of the tube where the oscillation intensity approaches the maximum value ($z > 130$ mm), the initial modulation of the beam at the frequency f_b leads not to an increase but to a decrease of the oscillations of frequency f_1. This effect is similar apparently to the suppression of microwave oscillations which was observed by the authors of [5] when an electron beam was modulated by a monochromatic signal.

In conclusion, I consider it my pleasant duty to thank S. M. Levitskii and V. N. Oraevskii for many valuable hints and suggestions.

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DEPENDENCE OF EPR SIGNAL WIDTH ON EXTERNAL CONSTANT ELECTRIC FIELD

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Two of the present authors have shown earlier [1] that the width of the EPR signal of paramagnetic impurities in crystals without an inversion center can depend strongly on an external constant electric field. It has turned out that the electric field influences the