We recall that considerable anomalies are observed near the superconducting transition at the given orientations of $\vec{q}$ and $\vec{\varepsilon}$ [5]. These anomalies have in our opinion the same nature as the effects described here.

The reasons for the observed phenomena are not clear at present. It can be assumed, however, as already stated earlier in [5], that in multiband metals such as tin there can exist weakly bound Fermi surfaces, with essentially different characteristics and different carrier relaxation times, pertaining to different bands. By introducing in addition the interband relaxation time it becomes possible to describe the observed anomalous phenomena with the aid of three parameters. The distinctive role of sound waves in this case is that it becomes possible to realize selective interaction of the sound with different electron groups because of the peculiarities of the deformation-potential components. This hypothesis is favored, e.g., by the fact that the singularity in the behavior of α_t in a strong magnetic field takes place at an orientation ($\phi = 62.5°$) such that contact is produced between the central sections of the 4-th electron and 4-th hole bands of tin in the "neck" region [6].

In conclusion, we are sincerely grateful to I. O. Kulik, V. M. Kontorovich, and N. A. Sapogovaya for useful discussions.

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1) The vector $\vec{H}$ is rotated in the plane of the axes [001] and [110].

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STRUCTURE OF NONLINEAR WAVES PRODUCED WHEN INSTABILITY DEVELOPS IN ION-ION OR ELECTRON-BEAM PLASMA

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The electric field of a nonlinear wave excited in a synthesized ion-ion or electron-beam plasma and connected with the bunching of the charged particles and their capture by the wave field has been measured directly for the first time.

The question of the amplitude and waveform of the waves during the nonlinear stage of the instabilities developed in a two-beam or plasma-beam system was considered in a large number of theoretical papers [1 - 5]. We have measured directly, for the first time, the electric field of a wave excited in a synthesized ion-ion [6] and electron-beam plasma [7]. We used a probing electron beam (Fig. 1) that passed through the investigated system at right angle without perturbing it. The time of flight of the probing electrons was much shorter than the period of the investigated oscillations. Beam 5 was deflected in the plasma-oscillation field, which was directed along the z axis, and in the sinusoidal field between plates 7, which was directed along the x axis, and traced on the screen 8 a figure from which the time dependence of the electric field of the wave was determined.

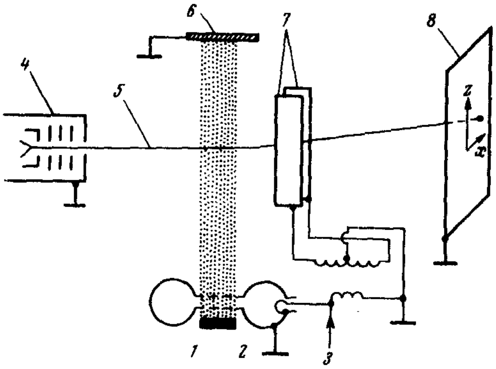

Fig. 1. Experimental setup for electron-beam plasma: 1 - cathode, 3 - microwave power input, 4 - electron gun, 5 - collector.

The synthesized ion-ion plasma was obtained in the manner described in [6]; the energy of the interacting beams of positive and negative hydrogen ions making up the plasma was $W_0 = 13$ keV, and the current in each component reached mA. The beams were velocity-modulated with amplitude $\tilde{v}_0$ on entering the interaction chamber and propagated along the z axis with a low adjustable relative velocity $2\Delta v$ ($\tilde{v}_0 \ll \Delta v$).

The electron-beam plasma was produced in argon by an electron beam of energy on the order of 100 eV and

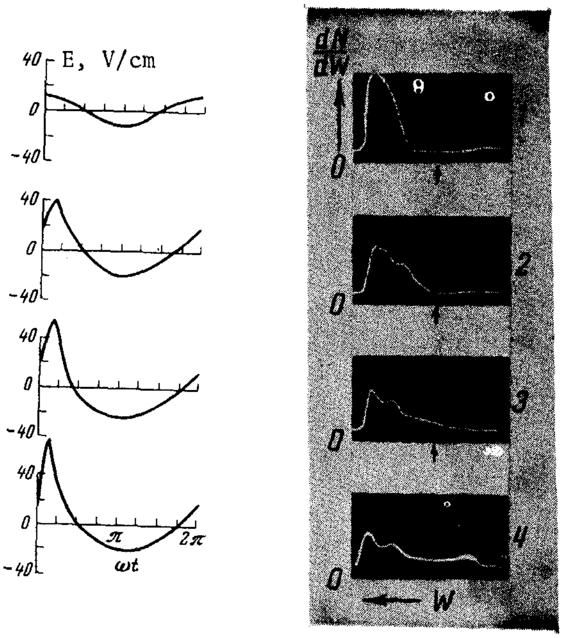

Fig. 1

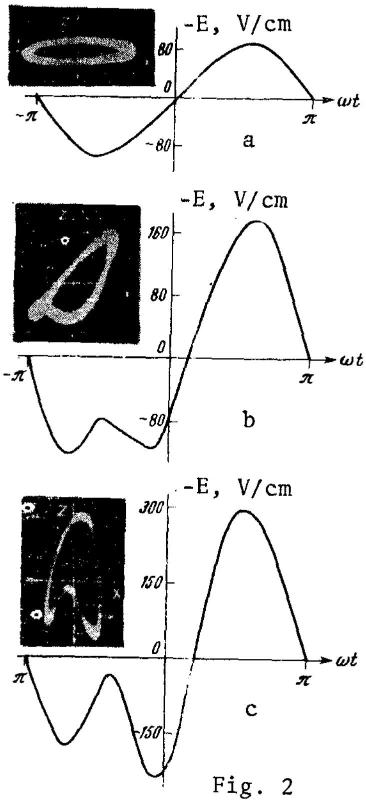

Fig. 2

Fig. 2. Variation of wave profile and of positive-ion distribution function with increasing initial-modulation amplitude: $f_{mod} = 28$ MHz, $z = 120$ cm, $2\Delta W = W_+ - W_- = 1.6$ keV. The values of v_0 are 1 (1), 1.6 (2), 2.2 (3), and 3.3 relative units (4).

Fig. 3. Oscillograms and corresponding time profiles of the wave electric field in the linear (a) and nonlinear (b, c) stages of instability of electron-beam plasma. The plasma frequency (f_p) and modulation frequency (f_{mod}) in MHz are: a) $f_p = 675$, $f_{mod} = 454$; b) $f_p = 500$, $f_{mod} = 325$; c) $f_p = 750$, $f_{mod} = 460$.

current ≈10 mA. The plasma concentration was $n_p = 2\times10^9 - 10^{10}$ cm^{-3} and exceeded by approximately one order of magnitude the beam electron density n_e. A growing monochromatic wave was excited in this case by modulating the beam velocity with high-frequency resonator 2 at a frequency lower than the plasma frequency (Fig. 1).

In the case of an ion-ion plasma near the optimal relative velocity of its components, corresponding to a maximum instability increment [6], a nonlinear wave is produced in the system and is characterized by sharp electric-field pulses of large amplitude (Fig. 2). The direction of this field is determined by the sign of the relative velocity: the field decelerates the particles of the fast beam and accelerates those of the slow one. The change in the form of the wave is accompanied by an asymmetrical smearing of the energy distribution function of each beam (Fig. 2), evidencing slowing-down and reflection of some of the particles by the wave potential, i.e., capture of the particles by the wave. The distribution function of each beam, averaged over the time, was determined with a Hughes-Rojansky analyzer (the arrow in Fig. 2 marks the energy W_0 corresponding to the wave velocity). Bearing in mind the bunching of each beam into plasmoids [8], we can estimate the maximum electric field intensity in the wave as the field between flat layers of charges of opposite sign: $E = 2\pi en\lambda$. The maximum field $E = 120$ V/cm calculated for the experimental conditions ($n \approx 2\times10^7$ cm^{-3}, $\lambda = 5.7$ cm) agrees satisfactorily with the measured mean value $E \approx 50$ V/cm. It can be concluded that the observed structure of the nonlinear wave is connected with formation of plasmoids in each beam and their capture by the wave field. Such a field structure leads to the previously shown energy exchange between beams [8].

Figure 3 shows photograph of some typical figures on a luminescent screen and the corresponding electric-field time profiles obtained in the case of a beam-plasma system. If the probing beam crosses the plasma in the section where the oscillations increase exponentially, then the wave profile is sinusoidal (Fig. 3a). On the other hand in the region of nonlinear saturation of the oscillations (the meniscus) the high-frequency field is already anharmonic, and a characteristic singularity is observed clearly in the negative half-cycle (Figs. 3b, 3c). An analysis based on [9] allows us to conclude that the observed wave structure is the consequence of strong bunching of the beam electrons in the wave field.

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STABILIZATION OF CONICAL TYPE INSTABILITY IN A MIRROR TRAP

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Plasma stability in a mirror trap occupies a central point among the problems that will decide whetehr the development of a thermonuclear reactor of this type is feasible or not. The theory predicts that the main danger in the case of a collision-governed plasma lies in the instabilities connected with the loss cone [1]. Experiments with the PR-6 apparatus were devoted to this question. It was established in prior studies [2, 3] that the decay of a plasma with $n \gtrsim 10^{12}$ cm^{-3}, $\langle\varepsilon_i\rangle \gtrsim 100$ eV, and $T_e \simeq 5$ eV is accompanied by an instability at a frequency $\omega \simeq 0.7\omega_{Bi}$, which gives rise to large losses. The distinguishing property of the instability is its strong dependence on the value of the ambipolar potential.

The accumulated data indicate that the primary cause of the instability is an inversion of the "cone" type. It is most likely that the considered instability is none other than the "drift cone mode" of Post and Rosenbluth [1]. In its actual realization, however, it exhibits many differences from the prototype. Principal among them are the conditions under which the instability occurs. For the real stability to develop it is necessary to have a stronger deformation of the distribution function in the cold part than in the case of a simple cone. This additional deformation is brought about by the ambipolar potential ϕ and consists of a conversion of the conical loss surface into a single-cavity hyperboloid with a hole corresponding to the energy $e\phi/(R - 1)$. The behavior of the observed instability offers evidence that it becomes noticeable only in the presence of a sufficiently large hole; with further increase of the hole, the level of the steady-state oscillations increases almost exponentially.

We describe in this paper experiments in which stabilization was effected by application of microwaves near ω_{Be}. When microwaves interact with a plasma under such conditions the result is, besides a certain general rise of T_e, the formation of a small group of electrons that acquire anomalously large transverse energies. The degree to which such a partial superheat is pronounced depends strongly on a number of conditions. In the experiments with the PR-6, the superheat was intense enough, and the apperance of the anisotropic electrons led to elimination of the instability.

A microwave pulse (λ = 2 cm) of 50 μsec duration and a generator power on the order of 10^4 W was "injected" into the trap 200 microseconds after the start of the decay, during the stage when the instability reached a strong development. Figure 1 shows oscillograms illustrating the result. Oscillogram (a) represent a birst of unstable potential oscillations in free decay. Oscillogram (b) illustrate the suppression of the instability by the microwave pulse. Oscillogram (c) shows the signals from a floating probe placed in the central section of the trap on the plasmoid periphery, with and without a microwave pulse. This second signal has a deep negative spike that is produced when the microwave pulse is applied. The spikes signals the appearance of superheated electrons that strike the probe. We see also that the superheated group