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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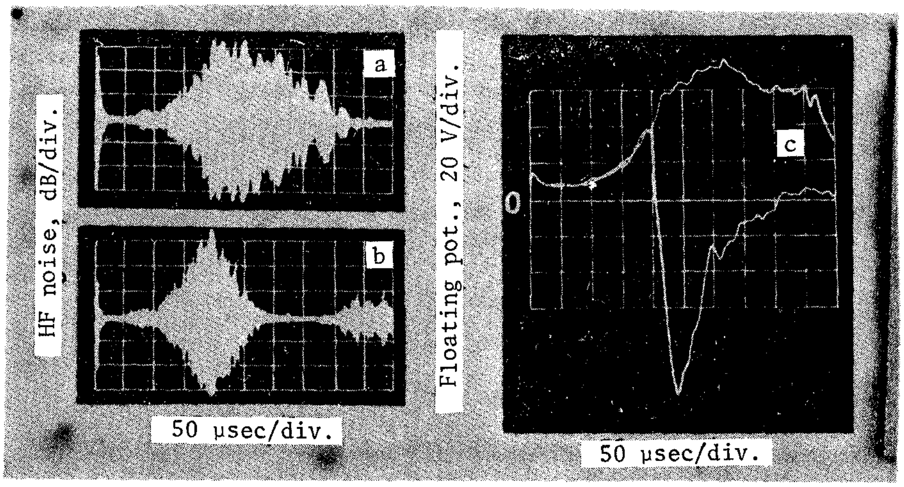
Plasma stability in a mirror trap occupies a central point among the problems that will decide whetehr the development of a thermonuclear reactor of this type is feasible or not. The theory predicts that the main danger in the case of a collision-governed plasma lies in the instabilities connected with 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 ($\lambda = 2$ 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



a) Instability development in free decay; b) the same following application of a microwave pulse; c) potential of floating probe in the central section with and without a microwave pulse.

relaxes quite rapidly, so that the quenching effect is temporary. An estimate of the electron energy from the relaxation time yields a value on the order of 100 eV, assuming a Coulomb relaxation mechanism. The relative fraction of the density of the superheated electrons, estimated from the change of the probe characteristic, can be as high as 30%. A signal similar to (c) was observed only in the central section of the trop; if the probe is shifted towards one of the mirrors, then the the signal from the superheated electrons is lost and the probe readings indicate a small change in the plasma potential. The total increase in T_e is also small.

The described stabilization effect is apparently based on a reverse deformation of the loss hyperboloid, so that the hole becomes smaller or is even completely closed; as indicated above, this suppresses the instability. The deformation is caused in turn by the change in the longitudinal profile of the potential in the central part of the trap, due to the appearance of anisotropic electrons. Prior to the microwave pulse, all the plasma electrons are contained mainly by a high electrostatic barrier ($\sim 5T_e$) and have an almost Maxwellian distribution; the potential profile is therefore connected with the density profile by Boltzmann's law. When a certain fraction of the electrons in the region of the central section becomes anisotropically superheated and is subsequently contained by the magnetic field, the density of the cold Maxwellian electrons decreases by the same amount, and according to Boltzmann's law this leads to a certain decrease of the potential in the central section relative to the lateral regions, where there are no superheated electrons. The longitudinal potential profile becomes flattened at the center, and may even become locally concave, and this causes the indicated deformation of the hyperboloid [4].

The described method of suppressing the instability is closely related in character to Post's idea of the possibility of stabilizing conical instabilities by adding small amounts of "thermal" ions [5]. In this case these are the ions gathered in the small volume of allowed v-space added following the microwave pulse. This volume becomes filled by diffusion within a time on the order of 10 μsec. It is clear from geometrical considerations that the relative amount of these added ions is quite small.

If the potential in the central part of the trap is locally concave, the "hot" component can result also from accumulation of ions produced by charge exchange and ionization in this potential well. The depth of the well relative to its edges is $\Delta\phi \approx (T_e/e)\ln[(1 - c\gamma)/(1 - \beta)]$, where β is the relative fraction of anisotropic electrons, $\gamma = \varepsilon_{\parallel}/\varepsilon_{\perp}$ is their anisotropy index, and c is a coefficient on the order of two. The lifetime of an ion produced with zero energy at the center of the well is determined by its diffusion in v-space as a result of collisions with the hot ions; a study of this process leads ultimately to an expression for the equilibrium density n* of the ions accumulated in the well, in the form

$$n^* \approx n_0 \frac{\tau_{ii} T_e}{\tau_{gas} T_i} \ln \frac{1 - c\gamma}{1 - \beta} .$$

Here n_0 is the density of the hot ions, τ_{ii} is the "ion relaxation time," and τ_{gas} is the time characterizing the intensity of the charge exchange and the ionization. Substitution of the numerical values shows that under the conditions of the described experiments n^*/n_0 can reach

5%, which can produce, according to [5], a large stabilizing effect.

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PAIR CORRELATIONS IN THE INTERACTION OF COSMIC RAYS OF ENERGY ∿400 GeV

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We investigate pair correlations between the rapidities of the secondary particles in interactions of cosmic rays with energy ∿400 GeV. We show that if pionization is the main interaction mechanism, then the clearest ideas on the behavior of the correlation function can be obtained by investigating it in the rest system of the pionization particles.

It has recently become clear that no progress can be made in investigations of multiple generation without a study of the correlations between the particles.

Several recent papers are devoted to the correlation between the rapidities of the secondary particles in π^+p and π^-p interactions at energies 8 and 18 GeV [1], in pp collisions with energies 13, 18, 21, 24, and 28 GeV [3], and in K^+p interactions at 12 GeV [2]. Data on the correlations in pp collisions with energy ∿500 GeV are given in [4]. The correlations are estimated quantitatively in the cited paper by using a correlation function similar to

$$\left(\frac{d^2\sigma}{dy_1dy_2} - \frac{1}{\sigma_{tot}}\frac{d\sigma}{dy_1}\frac{d\sigma}{dy_2}\right)\Bigg/\frac{1}{\sigma_{tot}}\frac{d\sigma}{dy_1}\frac{d\sigma}{dy_2},$$

where y_1 and y_2 are the rapidities of the investigated particles and σ_{tot} is the total interaction cross section.

We wish to call attention in this paper to the need of taking into account the singularities of the multiple-generation mechanism when concrete use is made of a correlation function. We have in mind the following.

If in addition to the fragments of the incident particle there are produced in the interaction process also pionization particles, then the system in the latter has an appreciable collective motion as a whole in the rest system of the colliding particles. The fact that the collective motion has in the C-system a different velocity in each individual interaction act leads to a broadening of the single rapidity spectrum $d\sigma/dy$ in comparison with the $d\sigma/dy$ in the c.m.s. rest system of the pionization particles. It is obvious here that the quantity $(d\sigma/dy_1)(d\sigma/dy_2)$ decreases for small differences $y_1 - y_2$ and increases for large ones, whereas $d\sigma^2/dy_1dy_2$ remains the same in both reference frames. This results in considerable distortions in the correlation function C_2. We emphasize that in the considered interaction picture the quantity $(d\sigma/dy_1)(d\sigma/dy_2)$ has no physical meaning in the C-system. We assume on this basis that the correlation function should be determined not in the C system, but in the rest system of the investigated group of particles, i.e., not in an inclusive process but in exclusive ones. By way of example we present the correlation function C_2 determined from material obtained with the Tskhra-Tskaro installation in interactions between cosmic rays in a polyethylene target, as registered with a cloud chamber and an ionization calorimeter.

Figure 1 shows the correlation function C_2 as a function of Δy for an inclusive process