crystal is direct proof of the existence of the effect of suppression of the inelastic channel of the nuclear reaction.

For a quantitative estimate of the effective suppression of the inelastic channel of the nuclear reaction, we compared the intensities of the diffracted beam off resonance and at resonance (curves IIa and IIb). In this case the influence of the radiation incident on the crystal at angles far from the Bragg angle is completely excluded. To increase the statistical accuracy, we summed the intensities of the diffracted radiation for all the angles on curves IIa and IIb. The experimental value of the resonant absorption in the diffracted beam amounts to (22.6 ± 6)%, which agrees well with the theoretical value of this quantity for single-crystal tin. Owing to the suppression of the inelastic channel of the nuclear reaction, the resonant absorption is weakened by a factor 1.7.

It should be noted that suppression of the inelastic channel of the nuclear reaction was observed in a tin single crystal having Mossbauer-effect anisotropy. When the Bragg conditions are satisfied in such a crystal, the nuclei are not nodes of the magnetic field (M1 transition in Sn^{119}), but for γ quanta having the same polarization the probability of formation of an excited nucleus is equal to zero. The observed effect does not take place in irregular systems, and consequently, we have shown experimentally for the first time that the result of a nuclear reaction depends significantly on how the nuclei are arranged in space.

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OBSERVATION OF PLASMA INSTABILITY IN A STRONG ALTERNATING ELECTRIC FIELD

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It was shown theoretically in [1-3] that an instability connected with excitation of small-scale high-frequency oscillations is produced in a plasma in the presence of currents perpendicular to the external magnetic field and caused by a strong alternating electric field, provided the electrons and the ions of the plasma acquire a sufficiently large relative velocity $u_\perp$. The reaction of the oscillations on the beam causes deceleration of the beam and heating of either the ions or the electrons or both, depending on the relation between $u_\perp$, T_e, and T_i [1,4,5].

The development of instabilities of this type is apparently the cause of the rapid heating of the plasma by a strong high-frequency field, which takes place in a number of experiments [2,6,7], and also of the anomaly in the absorption of ion cyclotron and fast magnetosonic waves [6-9]. However, these instabilities, which play a fundamental role in high-frequency turbulent plasma heating [1,4,5] have not yet been observed directly. We present in this communication preliminary results of experiments aimed at observing and investigating current instability in a hydrogen plasma situated in the electric field of a fast magnetosonic wave of large amplitude [7] (plasma density $n \sim 5 \times 10^{13}$ cm^{-3}, intensity 500 Oe of constant electric field H_0, amplitude $H_z \sim 300 - 500$ Oe of axial alternating magnetic field produced in the plasma by a surge circuit at frequencies 7 MHz; the electric field intensity on the periphery is ~300 V/cm, corresponding to a maximum electron drift velocity $u_{\perp max} \sim 6 \times 10^7$ cm/sec). The electrostatic oscillations in the plasma were registered by three double electric probes at a floating potential. Each probe consisted of two tungsten wires 0.3 mm in diameter and 2 mm long; the distances between the wires were l = 0.75, 1.5, and 4 mm. The electronic circuitry of each probe made it possible to register oscillations of the electric field in the plasma at frequencies 20 - 120 MHz and intensity $E \gtrsim 50$ V/cm.

When the surge circuit was turned on, the heating of the decaying plasma after the glow was accompanied by intense noise ($E_r \sim E_\varphi \sim 100 - 300$ V/cm) with characteristic frequencies on the order of 30 - 80 MHz. The amplitude of the noise was determined by the low-frequency electric field at the location of the probe. This is illustrated in Fig. 1, which shows oscillograms of the noise and of the field H_z in the plasma, measured by means of a magnetic probe. Figure 1a pertains to the case when the probes are located on the periphery of the discharge, at a radius of 2.7 cm, where the low-frequency electric field is large and attenuates slowly. The oscillograms of Fig. 1b correspond to the case when both probes are placed near the axis, where the low-frequency electric field is weak and attenuates rapidly.

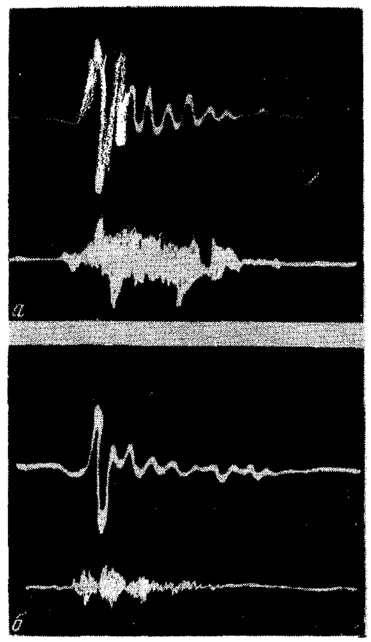

Fig. 1

Figure 2b shows a typical oscillogram of the noise and the plasma, obtained with the aid of a probe with l = 4 mm, located at a distance 2.7 cm from the axis. Figures 2a and 2c show respectively the field H_z in the plasma and a 20 MHz sinusoidal calibration wave. It follows from Fig. 2 that the noise is produced practically simultaneously with the appearance of the low-frequency field, and

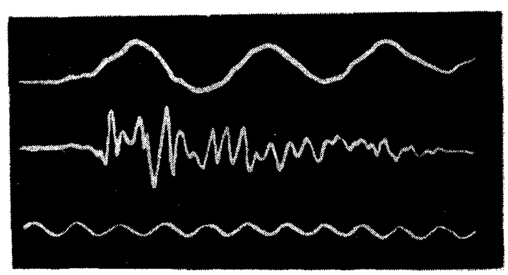

Fig. 2

reaches its maximum value within a time $\Delta t \sim (2 - 3) \times 10^{-8}$ sec.

The characteristic frequency of the noise received by the probe increases with decreasing l. When the probe is oriented along the constant magnetic field, the amplitude of the noise decreases approximately one-third ($E_z \sim 50 - 100$ V/cm).

Estimates show that the electron temperature of the plasma should increase after the surge circuit is turned on to a value ~10 eV, owing to the Joule heating by the field of the wave, within a time on the order of several nanoseconds. The temperature of the electrons then becomes different from that of the ions, which remain cold. In such a plasma, in the presence of a beam whose velocity reaches by that time $u_\perp \sim 10^7$ cm/sec $\gg \sqrt{T_i/m_i}$, it is possible to excite either ion-sound oscillations [1], or hydrodynamic oscillations with frequency and increment on the order of $\omega_k \sim \gamma_k \sim \sqrt{\omega_{He}\omega_{Hi}} \sim ku_\perp$, propagating almost transversely to the magnetic field [3]. Within a time Δt, the ion-sound oscillations with maximum increment $\gamma_{max} \sim 0.1\sqrt{\omega_{He}\omega_{Hi}}$ do not have time to develop $(\gamma_{max}\Delta t \lesssim 1)$. The hydrodynamic oscillations are capable of increasing within that time, in accordance with the linear theory, by a factor $\exp(\gamma_k\Delta t) \sim 10^3$; their frequencies $\sqrt{\omega_{He}\omega_{Hi}} \sim 2 \times 10^8$ sec^{-1} coincide in order of magnitude with the observed frequencies. The amplitude of the oscillations is limited by the nonlinear interaction of the waves at the level when the oscillation energy is

$$W \simeq \frac{\omega_{pe}^2}{\omega_{He}^2}\frac{E^2}{8\pi} \sim \frac{1}{2} nm_e u_\perp^2.$$

From this we get

$$E \sim (u_\perp/c)H_0 \sim 100 \text{ V/cm},$$

in agreement with the experimental data. These oscillations propagate in an angle interval $\theta_0 < \theta < \pi/2$ towards the magnetic field, where $\theta = \theta_0$ is estimated from the condition that

$$\frac{\omega}{k \cos \theta_0} \sqrt{T_e/m_e} \equiv v_{Te}$$

(when $\theta < \theta_0$ the excitation of the oscillations is impossible, owing to the strong Cerenkov damping by the electrons). Thus,

$$\cos \theta_0 \sim u_\perp/v_{Te} \sim 0.2.$$

Since the oscillations are potential, we have $(E_z/E) \sim \cos\theta \sim \cos\theta_0 \sim 0.2$. The experimental value $(E_z/E)_{meas} \sim 0.2$ agrees with this estimate.

It should be expected that the probes have a maximum sensitivity to the wavelength $\lambda = 2l$, i.e., the probe should register frequencies $\omega = ku_\perp = 3u_\perp/l$. Since $l \sim 2$ mm and $u_\perp = (1 - 6) \times 10^7$ cm/sec, frequencies $\omega/2\pi \sim 20 - 150$ MHz should be received. The observed frequencies lie in this interval.

The agreement between the performed theoretical estimates and the experimental data leads to the conclusion that the high-frequency oscillations observed by us should be identified with the hydrodynamic instability considered theoretically in [3].

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STABILIZATION OF HYPERFINE STRUCTURE OF THE MOSSBAUER LINE IN PARAMAGNETS IN A WEAK EXTERNAL MAGNETIC FIELD

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It is known that a distinct magnetic hyperfine structure (hfs) of the Mossbauer line should be produced in a paramagnet, in the absence of an external field, if the relaxation time of the electron spin of the Mossbauer atoms is sufficiently large [1,2]. Under certain conditions, however, such a structure may turn out to be quite sensitive not only to the relaxation time, but also to very weak static magnetic fields. Naturally, under real conditions this should lead to a smearing of a part or perhaps even the entire hfs, owing to random magnetic fields produced by the ions of the surroundings [3]. It turns out, and it will be demonstrated below, that it is possible to obtain again a clear-cut hfs from such an unresolved structure by applying to the paramagnet a small external magnetic field (we emphasize that we are dealing with fields weak enough for the direct interaction of the field with the nucleus to be negligibly small), i.e., we are faced with a unique effect of hfs stabilization.

To describe the hyperfine structure of the ion in the presence of an external magnetic field H and in the absence of quadrupole interaction, we can use the spin Hamiltonian in the form

$$\hat{\mathcal{H}} = A_{ik} I_i S_k + g_{ik}\mu_0 S_i H_k . \qquad (1)$$

Here $\vec{I}$ - spin of the nucleus and μ_0 - Bohr magneton. For a free ion, $\vec{S}$ is the total angular momentum of the electron shell and A_{ik} and g_{ik} are proportional to δ_{ik} (here g is the usual Lande factor). In the case of a crystal, when the energy of the Stark splitting