encountered for reasons similar to those discussed above in connection with the assignment of the 216.3-keV line to Tl^{189} decay, although the reliability of such an assignment is decreased by the large error in the determination of the lifetime.

The summary results of the study of the three new lines are given in the table.

Results obtained for the new isotope Tl^{191}

E_γ, keV	I_γ	$T_{1/2}$, min	
216.3 ± 0.7	100	1.5 ± 0.5	
229.0 ± 1.5	~40	1.2 ± 0.6	1.4 ± 0.4
335	~70	~1.5	

The agreement in the half-lives of the analyzed lines indicates, in all probability, that they belong to the decay of one and the same isotope having a state with a half-life $T_{1/2}$ = 1.4 ± 0.4 min. In view of the procedure used to obtain this isotope, it is identified as Tl^{189}.

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MECHANISM OF PLASMA HEATING BY AN ELECTRON BEAM IN A MIRROR TRAP

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It is universally conceded at present that plasma heating under beam-instability conditions is the result of the interaction of particles with electromagnetic oscillations excited by a beam of electrons in the plasma.

In spite of the similarity of the experimental results obtained in different investigations, there is still no meeting of the minds concerning the plasma heating mechanism and the origin of the hot particles [1 - 2]. The reason for the various opinions concerning the heating mechanism is that the

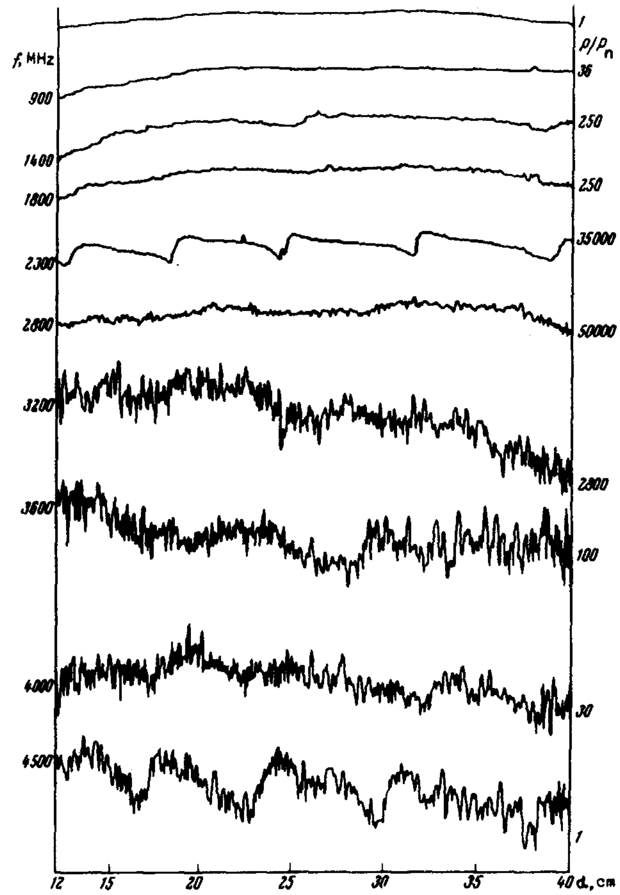

Fig. 1

Fig. 2

Fig. 1. Distribution of oscillation intensity along the system in a homogeneous magnetic field. The left-hand ordinates represent the frequency in MHz, and the right-hand ones the ratio of the power P of the received oscillations to the noise power P_n. Curve 1 - saturation ion current in probe. H = 1700 Oe. Beam current I = 60 mA, beam energy V = 1 keV, pressure P = 7×10^{-5} mm Hg.

Fig. 2. Distribution of oscillation intensity along a mirror trap with mirror ratio R = 2.8, I = 60 mA, V = 1.5 keV, P = 7×10^{-5} mm Hg. Curve 1 - saturation ion current.

experiments were confined as a rule mainly to the macroscopic plasma parameters. The present paper is devoted to a detailed investigation of the spectra of the oscillations excited by a beam in a plasma and to the mechanism of their absorption in an open magnetic trap.

Plasma heating under beam-instability conditions was investigated in a magnetic trap of the "probkotron" type, in which an electron beam was injected from an external source along the magnetic-field force lines. The plasma was produced by the beam itself in a glass chamber of 6 cm diameter and 60 cm long by ionization of the working gas (hydrogen, nitrogen) at a pressure 10^{-4} - 10^{-5} mm Hg. The beam current could be varied from 10 to 200 mA at an energy up to 5 keV in continuous regime. The oscillations were picked up by movable coaxial probes, the signals from which were fed to measuring receivers and to

Fig. 3. Distribution of oscillation intensity along the system at 3000 MHz, plotted at different receiver sensitivities. Curve 2 was obtained with a sensitivity 10^3 larger than curve 1.

an x-y recorder whose horizontal sweep was synchronized with the probe displacement. The bremsstrahlung was registered by a photomultiplier with an NaI(Tl) crystal.

The experiments have shown that the electron beam excites in the plasma a broad spectrum of oscillations in the plasma and hybrid frequency regions. In the case of an homogeneous magnetic field, no significant changes in the intensity and in the spectrum width of the excited oscillations is observed along the system (Fig. 1). The spatial distribution of the oscillation intensity was investigated at a length 28 cm, starting with 12 cm from the entry of the beam into the plasma. The slight change in the oscillation intensity and in the spectrum width along the system shows that nonlinear attenuation plays a relatively minor role in this region. The nonlinear effect that appears under the conditions of this experiment is the decay of the Langmuir wave into a Langmuir wave and a low-frequency wave. Excitation of a low-frequency oscillation spectrum in the 10 kHz - 3 MHz band is observed experimentally [3]. The amplitude of the saturated probe ion-current oscillations could exceed the dc component by one order of magnitude, depending on the conditions. The observed broad frequency spectrum is connected, to a considerable degree, with the low-frequency density oscillations.

The wave distribution and damping in the inhomogeneous magnetic field of the probkotron trap may differ greatly from the case of a homogeneous field. When waves propagate in an inhomogeneous medium [4], conditions may arise wherein the wave energy is effectively absorbed by the plasma particles. The increased absorption may be due either to the strong slowing down of the waves and hence to the increased Landau damping, or to cyclotron absorption in the region of cyclotron resonance in the inhomogeneous magnetic field.

Figure 2 shows the spatial intensity distribution of the oscillations excited by the beam in a probkotron trap under optimal heating conditions. The most characteristic feature of the curves is the strong wave-energy absorption at frequencies $\omega \sim \omega_p$ in the region of cyclotron resonance and its harmonics on the decreasing section of the probkotron magnetic field. The oscillation intensity decreases by two or three orders of magnitude after passing through the cyclotron-absorption region, then absorption at harmonics of the cyclotron frequency is observed following further propagation along the decreasing magnetic field. Absorption up to the third harmonic of the cyclotron frequency was observed experimentally. By way of an example, Fig. 3 shows the damping of the oscillations at the cyclotron frequency and its harmonic. The oscillation intensity in the region of the upper hybrid frequency was low under the experimental conditions.

We investigated experimentally the efficacy of heating the electron plasma component as a function of the high-frequency oscillation spectrum excited by the beam. The optimal conditions for plasma heating occur when the intensity maximum of the frequency spectrum excited by the beam lies in the region of resonant absorption in the inhomogeneous magnetic field of the probkotron. In this case, intense x-rays are observed, with energies greatly exceeding the beam energy (the average x-ray energy for the conditions of Fig. 2 is 30 keV). On deviating from optimal conditions, i.e., when the spectrum of the maximally excited frequencies is shifted above or below the probkotron cyclotron frequencies, the heating efficacy decreases sharply. The efficacy increases with increasing mirror ratio, as does the hardness of the plasma x-rays [2], owing to the broadening of the resonance-absorption band. It is seen from Fig. 2 that the oscillation intensity in the region of the growing field of the second mirror is low. It can therefore be assumed that the most effective energy transfer from the high-frequency oscillations to the plasma particles occurs in the decreasing-field region of the first mirror, whereas the second mirror serves to capture the particles into the trap. The particles that have acquired in the resonance-absorption region an energy sufficient for reflection from the second mirror, are captured in the trap. They travel many times through the region of resonance absorption, as a result of oscillations between the mirrors, and continuously gain in energy. Stochastic cyclotron resonance is thus the plasma-heating mechanism.

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NUCLEAR QUADRUPOLE DIFFRACTION OF RESONANT GAMMA RADIATION IN A TELLURIUM SINGLE CRYSTAL

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The diffraction of resonant gamma radiation by nuclei situated in intracrystalline fields has a number of distinguishing features [1 - 6] due to the dependence of the Mossbauer-scattering amplitude on the magnetic field direction and on the orientation of the electric field gradient (EFG) axes at the location of the scattering nucleus.

We report here the results of diffraction experiments on the scattering of the resonant gamma radiation from Te^{125m} by a tellurium single crystal. It was previously suggested [7] that pure nuclear Bragg quadrupole reflections can appear in such a case. The kinematic theory of diffraction in nuclear γ-resonance scattering in crystals containing Mossbauer nuclei with an inhomogeneous electric field was developed earlier by Aivazyan and Belyakov [4], who also analyzed the conditions for the occurrence of nuclear quadrupole reflections. No experimental studies of this unique feature of Mossbauerography were made so far, however.

The tellurium crystal has trigonal syngony (space group $P3_121$). The principal EFG axes at the tellurium nuclei make a constant angle to the C axis, but are differently oriented in a helical chain of tellurium atoms [8], so that the chemically equivalent tellurium atoms become non-equivalent scatterers in