larger than 3×10^{-2} Torr, the first to be excited is the oscillation with $m = 1$ and $k = 3$ (the plasma is inhomogeneous along the tube axis). At lower pressures, the first to be excited was the oscillation with $m = 2$, and excitation a the mode with $k = 3$ was observed in a mercury plasma. The longitudinal wavelength was approximately six times larger than the azimuthal one.

Finally, it was established that the wave travels in the direction of electron rotation in the magnetic field. At a field much stronger than critical, when there is a well developed turbulence (noise), the correlator was used to determine the spatial correlation coefficient of the noise $R(\phi)$. It turns out that the noise is well correlated in the entire volume of the plasma, i.e., the "mixing scale" postulated in [6] does not exist here.

We have thus shown that the critical magnetic fields, the diffusion, the characteristic oscillation frequencies, the structure of the unstable oscillations, and the direction of their motion, in a wide range of electron temperatures and ion masses (H_2, He, Ar, and Hg), are in good agreement with the theory of ion acoustic instability of an inhomogeneous plasma [5, 6].

We note that the instability considered here differs noticeably from the ion acoustic instability of a discharge with an incandescent cathode [8], in which a buildup of longitudinal "ambipolar" sound was observed, and the diffusion remained classical.

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HALL COEFFICIENTS OF FERROMAGNETS IN THE PARAPROCESS REGION

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To describe the Hall effects in ferromagnets in the paraprocess region, a three-term expression was used in [1]:

$$E = R_0 H + R_J J_s + R_i J_i , \tag{1}$$

where E is the Hall emf per unit current through the sample and per unit sample thickness, R_0 and R_J are the ordinary and anomalous Hall coefficients, R_i is the Hall coefficient corresponding to the true magnetization J_i (equal to the difference between the total magnetization (J) and the spontaneous magnetization (J_s) of the sample), and H is the true magnetic field intensity in the sample, $H = H_e - NJ$, where H_e is the intensity of the external magnetic field and N is the demagnetizing factor of the sample. It was stated in [1] that the coefficients R_J and R_i of gadolinium and of an alloy of the invar type are comparable in magnitude but have different temperature dependences.

We shall show on the basis of an analysis of the experimental data that, with good accuracy, $R_J = R_i$ in the relation for the Hall effect of ordinary ferromagnets in the paraprocess region, so that two terms suffice to describe the Hall effect.

The ordinary term in (1) should be written in the form R_0B ($B = H + 4\pi J$ is the magnetic induction, which is the averaged microscopic field in the ferromagnet), and the coefficient R_0 should be determined directly from measurement below the Curie point. A method for calculating the Hall coefficient of ferromagnets in the paraprocess region is proposed below.

We write the expression for the Hall emf in the form

$$E = R_0 B + R_F\sigma + R_j\sigma_i\ , \tag{2}$$

where R_0 and R_F are the ordinary and ferromagnetic Hall coefficients, R_j is a certain coefficient (to be determined), $\sigma = J/\rho$ and $\sigma_i = J_i/\rho$ are respectively the specific total and true magnetizations, and ρ is the density of the material. We take into account the fact that in the region of the paraprocess, with the possible exception of a small vicinity of the Curie point θ_f itself, we have

$$H = \alpha\sigma + \beta\sigma^3, \tag{3}$$

where α and β are thermodynamic coefficients that depend on the temperature and on the pressure [2].

It is easy to verify that the value of the constant R_0 of the sample at a given temperature can be determined with good accuracy from the ratio of the slopes of the linear plots of E/σ and of H/σ vs. σ^2 in strong magnetic fields. The constants R_F and R_j are calculated from the dependence of $E - R_0B$ on σ_i. Extrapolation of the straight line $E - R_0B$ to the value $\sigma_i = 0$ yields the product $R_F\sigma_s$. The spontaneous magnetization σ_s is determined by the thermodynamic-coefficient method. It follows from (2) that the slope of the experimental straight line in the coordinates σ_i and $E - R_0B$ yields the value of the sum $R_F + R_j$.

When calculating the coefficients R_0, R_F, and R_j of gadolinium, we also processed the data of [3]. The experimental data of [1] could not be used, since the measurements on Gd in [1] were made at insufficient magnetic field intensities H. Figure 1 shows plots of the magnetization J against H for Gd at 230°K, obtained in [3] (curve I) and in [1] (curve II). It is seen from the figure that the paraprocess region of interest to us was not investigated in [1].

Figure 2 shows the dependence of the difference $E - R_0B$ on σ_i for Gd at 290°K. The values of R_F and R_j/R_F, determined from this plot for a temperature $T/\theta_f = 0.983$, are listed in the table. The table lists also the results of the reduction of the experimental data on the Hall effect in the ferromagnetic alloys CrTe [4] and MnSb [5].

The table lists in parentheses, for each of the ferromagnets, the values of the ferromagnetic Hall coefficient R_F, determined for the maximum value of T/θ_f relative to low temperatures by extrapolating the lines $E(B)$ from larger values of B to $B = 0$ (or, what is

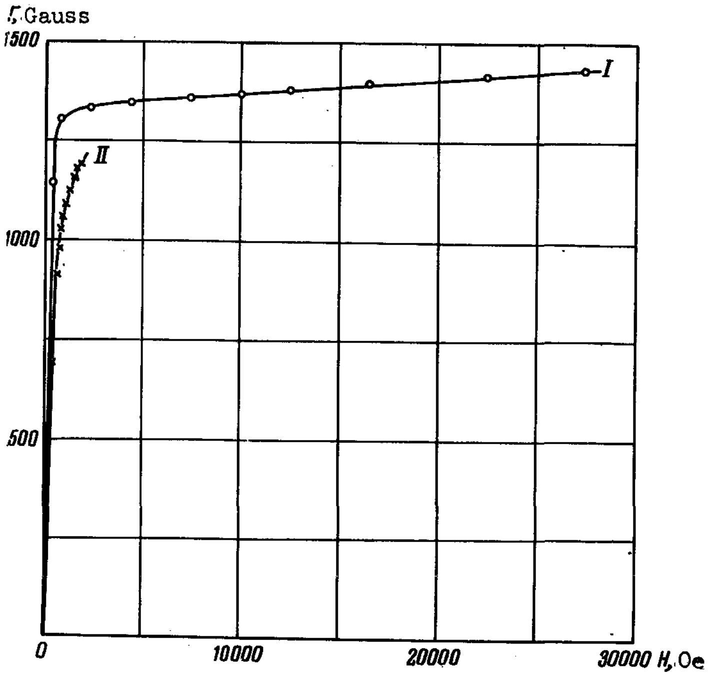

Fig. 1

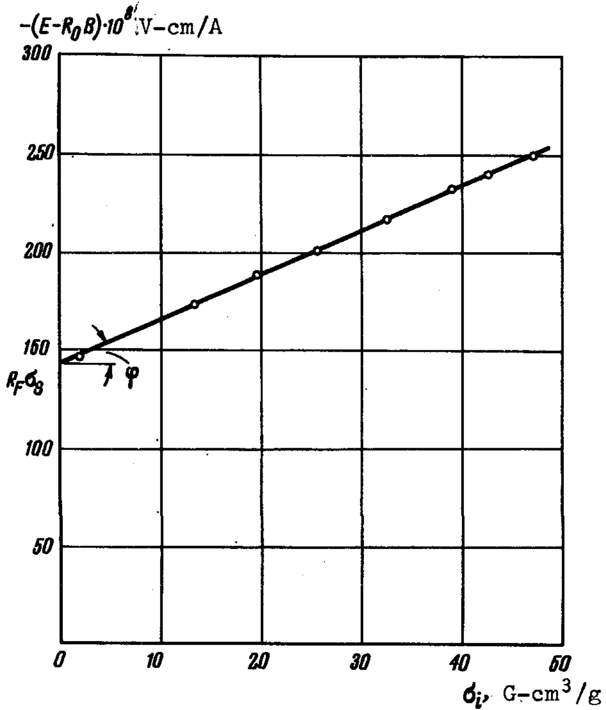

Fig. 2

Substance	θ_f, °K	T/θ_f	$R_F\cdot 10^9\ \frac{\text{V-g}}{\text{A-cm}^2\text{-G}}$	R_I/R_F, %
Gd[3]	295	(0,7695)	(−25.2)	
		0.983	−24	−5.4
		>> 1	−21	
CrTe[4]	327	(0.905)	(−286)	
		0.905	−289	+2.2
		0.927	−306	+0.6
		0.957	−335	+0.8
		>> 1	−325	
MnSb[5]	589	(0.9438)	(+48.3)	
		0.9438	+48	−3.7
		0.9671	+55	+2.5
		0.9920	+60	+17.5
		>> 1	+67	

the same for samples with $N = 4\pi$, by extrapolating the lines $E(H_e)$ to $H_e = 0$). Further, the values of R_F and R_j/R_F obtained from Eqs. (3) and (4) by the above-described method are listed for a number of temperatures near the Curie point. The table shows that the coefficients R_F determined by two methods at identical T/θ_f for the aforementioned samples coincide, within the limits of measurement accuracy, and furthermore the ratios R_j/R_F are close to zero. Similar results were obtained for an Ni-Cu alloy (23.4 at.% Cu) [6].

Thus, the method described above makes it possible to determine with a sufficient degree of accuracy the Hall coefficients of ferromagnets in the paraprocess region, and the presented data show convincingly that there is no need to introduce a third term in (2) for the investigated samples.

It is interesting that the ferromagnetic Hall coefficient R_F does not experience a jump on going through the Curie temperature. This is seen from the table, which shows for comparison the values of R_F obtained in [3 - 5] on the basis of measurements in the paramagnetic temperature region $T/\theta_f >> 1$.

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ION HEATING IN THE TOKAMAK-3 SETUP

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In toroidal magnetic traps of the Tokamak type, the plasma loop with longitudinal annular current is heated by Joule heat and is stabilized by a strong magnetic field, the intensity of which exceeds the intensity of the current field by many times.

Experiments [1, 2] have shown that the main magnetohydrodynamic instabilities of a plasma are efficiently suppressed in Tokamak setups. A possible index of the stability is the average particle lifetime in the plasma. In the largest Tokamak in operation (T-3, in which the plasma pinch cross section radius is 12 - 15 cm, and the major axis of the toroidal chamber is 100 cm), the charged-particle lifetime exceeds 10^{-2} sec.

We describe in this paper the results of ion temperature measurements made recently with this setup.

The measurements were made at a longitudinal magnetic field intensity 25 - 38 kOe, a longitudinal current 60 - 120 kA, and a process duration 30 - 70 msec. The plasma density