placement of the sublattices, it can be assumed that it is just the change of this parameter which is decisive in the case of Sb.

In conclusion, we are grateful to Yu. A. Pospelov for valuable discussions and to E. I. Skidan and N. A. Mikryukova for help with the measurements.

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PARA PROCESS IN YTTRIUM IRON GARNET IN A HIGH-FREQUENCY MAGNETIC FIELD IN THE VICINITY OF THE CURIE POINT

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Relaxation processes and corresponding relaxation energy losses should take place in ferro- and antiferromagnets near the Curie and Neel points, owing to the intense development of the spin fluctuations [1]. The action of an external magnetic field on the spin system (both constant and alternating), i.e., the para process, should change these losses [2]. These phenomena have not yet been observed experimentally in ferro- and antiferromagnets. Yet the development of methods for their measurement would afford an additional opportunity of investigating magnetic phase transitions.

The susceptibility of the para process in alternating magnetic fields should have near the Curie point the complex form $\chi_p = \chi'_p - i\chi''_p$. The imaginary part of the susceptibility χ'_p determines the para-process losses. According to [1], anomalies should be observed in the temperature dependence of this parameter near the Curie point.

The purpose of the present study was to observe experimentally the aforementioned phenomena in yttrium iron garnet in a high-frequency magnetic field. The ferrite single crystal had the form of an ellipsoid of revolution with axes 25, 8, and 8 mm. The choice of yttrium iron garnet was dictated by the fact that it has low eddy-current losses and a low magnetostriction and small internal friction in the vicinity of the Curie point, thereby ensuring a low level of interfering effects. Furthermore, this material has a relatively high magnetization, giving rise to a large para process near the Curie point.

The measurement coil containing the investigated sample was placed in a cylindrical quartz oven with bifilar winding, which was placed in turn in a dewar. The temperature stabilization (with allowance for the temperature gradient) was accurate to ±0.5°. A special winding produced in the investigated sample, along the [111] axis, a weak magnetic field of intensity $H_\sim$ = 10 mOe, of frequency 3.174 MHz, and a constant magnetizing field of intensity ranging from 0 to 525 Oe. The change of the parameters of the measurement coil was recorded with a Q-meter and by the reaction on the generator. The values of χ' and χ'' were determined by calculation.

Figure 1 shows the temperature dependences of χ' in the vicinity of the Curie point, obtained in different constant magnetic fields. We see that a maximum of χ'_p occurs at the Curie point and is produced by a field $H_\sim$ = 10 mOe of frequency 3.174 MHz. The maximum decreases with increasing H_0, i.e., the effect of the field $H_\sim$ on the spin system weakens as the spin fluctuations are suppressed by the field H_0. Of particular interest is the curve plotted in a zero field H_0, all the more since such a plot cannot be obtained in the static mode. The curve is none other than the plot of the initial susceptibility of the para process, distorted at temperatures below the Curie point by the domain processes. In spite of the strong influence of these processes, we were still unable to observe a clear-cut maximum of

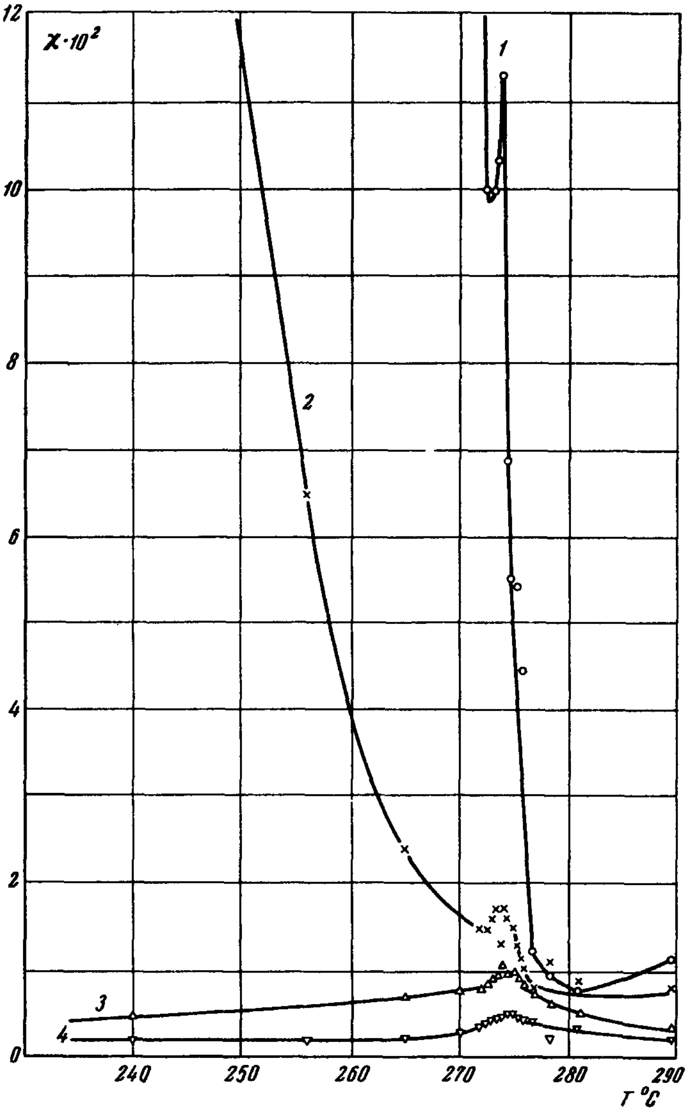

Fig. 1. Temperature dependence of the real part of the susceptibility, obtained for single-crystal yttrium iron garnet near the Curie point in a field $H_\sim$ = 10 mOe (f = 3.174 MHz) at constant magnetizing fields : 0 Oe (1), 87 Oe (2), 175 Oe (3), and 525 Oe (4).

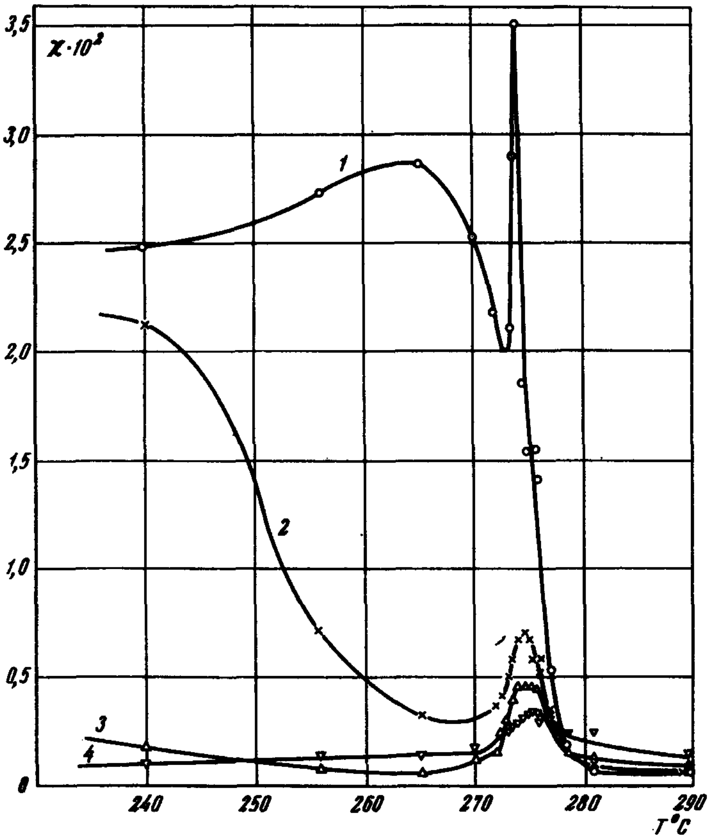

Fig. 2. Temperature dependence of the imaginary part of the susceptibility of single-crystal yttrium iron garnet, plotted near the Curie point in a field $H_{\sim}$ = 10 mOe (f = 3.174 x 10^6 Hz) and in constant magnetizing fields: 0 Oe (1), 87 Oe (2), 175 Oe (3), and 525 Oe (4).

the high-frequency susceptibility of the para process, the position of which on the abscissa axis yields the exact value of the Curie temperature [2]. However, we did not succeed in obtaining an experimental confirmation of the so-called "rule of two," owing to the strong interference by the domain processes (displacement and rotation).

With increasing H_0, the value of the maximum of χ'_p decreases approximately exponentially, and the position of the maximum shifts along the abscissa axis towards higher temperature, as is the case for the static characteristics of the para process.

Figure 2 shows the temperature dependences of the imaginary susceptibility χ'' at the same fixed constant magnetic fields. The magnitude of this maximum decreases with increasing H_0 (i.e., with suppression of the spin fluctuations) and at the same time shifts somewhat towards higher temperatures.

We propose that the maximum of the high-frequency losses at the Curie point, due to the action of the field $H_{\sim}$ on the spin system, is caused essentially by relaxation processes in this system, whose intensity increases at the Curie point. As to the influence of the spin lattice relaxation, it apparently also makes a contribution to the maximum of χ'' near the Curie point. More detailed data on the physical nature of the loss to the para process at the Curie point can be obtained only by performing a cycle of investigations with ferromagnetic crystals doped with additives that influence the relaxation mechanisms indicated above.

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TUNNEL EFFECT IN LEAD UNDER PRESSURE

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We investigated the tunnel characteristics of lead under pressure up to 15 kbar* at 1.3°K. We determined the change in the width Δ of the gap in the energy spectrum of the electrons of the superconductor and the shift of the characteristic frequencies of the phonon spectrum of lead under pressure. The results were used to verify the theory of superconductors with strong coupling [1].

The object of the investigation was a system of $Al-Al_2O_3-Pb$ films prepared by sputtering on glass [2]. The Pb film thickness was $\sim 10^{-5}$ cm, and the resistance of the tunnel junction was ~ 100 ohm/mm^2. The tunnel characteristics were used to select for the pressure tests samples having no defects in the Al_2O_3 layer. The hydrostatic pressure was produced by the method described in [3]. The pressure was calculated from the changes in the critical temperature T_c of a tin wire located in the high-pressure chamber, using the formula [4] $\Delta T_c = -4.95 \times 10^{-5} p + 3.9 \times 10^{-10} p^2$ (p is in bars). During the course of the experiment, just as in [5], we registered the characteristics $dU/dI = R(U)$ and $d^2U/dI^2 = r(U)$ of the investigated junctions.

Application of a pressure up to 10 kbar usually produced no irreversible changes in the characteristics of the junctions. A noticeable deterioration of the junctions occurred only at the maximum pressure, ~15 kbar.

The present communication is based on data that could be obtained without quantitative amplitude measurements. We discuss in this paper only the pressure-induced shift of the voltage U, at which the main singularities of the fully reversible tunnel characteristics of Pb were observed. Singularity A (Fig. 1) is due to the appearance of the gap Δ in the characteristics, and singularities B, C, and D are due to the appearance of the Van Hove singularities of the phonon spectrum of lead [6]. B corresponds to the maximum of the phonon state density, or more accurately to the function $\alpha^2(\omega)F(\omega)$ [7]; this maximum is due to transverse oscillations $\omega_\perp = U_B - \Delta \approx 4.5$ meV. The singularity C is due to the density maximum caused by the longitudinal oscillations $\omega_\parallel = U_C - \Delta = 8.5$ meV. Singularity D is due to the upper limiting energy for the phonon density state $\omega_K = U_D - \Delta \approx 10$ meV [7].

Figure 2 shows the positions of the aforementioned singularities of the tunnel characteristics at different pressures. The value of $2\Delta_0$ was calculated from the R(U) characteristics, and the value of $\omega = U - \Delta_0$ was determined from the average of the corresponding r(U) singularity and the value of Δ_0. The same figure shows the shift of the corresponding spectrum frequencies under pressure in the 3 kbar region, both in accordance with neutron-diffraction measurements [8] and in accordance with tunnel-effect data [9] with which we