cordance with the agreement in Basle. Since the radiation of the 2.14-Mev γ quanta investigated in our experiment is a pure M1 transition[5] and the first excited level of B^{11} has a spin $I = 1/2$, the connection between the circular polarization and the polarization of the final nucleus is of the form $P_f = -2P_\gamma$. At the present state of the measurements, the statistical error is considerable, so that we are continuing our measurements to accumulate adequate statistics.

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CAUSES OF ANOMALOUS BROADENING OF FERROMAGNETIC RESONANCE ABSORPTION LINE IN FERRITES NEAR THE CURIE POINT

K. P. BELOV

Moscow State University

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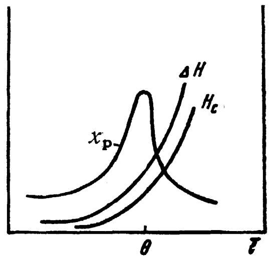
In measurements of the temperature dependence of ferromagnetic resonance in ferrites (both mono- and polycrystals) it was noted many times that as the Curie point is approached the width of the resonance-absorption line increases anomalously. In the theories of de Gennes, Kittel and Portis[1] and of Skrotskii and Kurbatov[2] this increase is ascribed to the influence of thermal fluctuations of the spontaneous magnetization, which, as is well known, reach a maximum near the Curie point. According to reference 2, this last circumstance leads to inhomogeneities of the internal (exchange) field, causing a spread in the resonance frequencies and consequently a broadening of the resonance line.

Making use of an analysis of the experimental material, we propose here arguments that indicate that the thermal fluctuations of the spontaneous magnetization are not the principal cause of the marked increase in the width of the ferromagnetic-resonance line near the Curie point; the main cause of the anomalous broadening of the resonance line near the Curie point is masked by the influence of structural factors. These arguments are as follows.

1. The quantitative manifestation of the intensity of thermal fluctuations of spontaneous magnetization near the Curie point may be the maximum (see Fig. 1) of the susceptibility of the para process, χ_p (inasmuch as χ_p is measured in a field, the fluctuations of the magnetization are somewhat suppressed by this field). According to the foregoing theories, it might appear that the temperature dependence of the line width $\Delta H(T)$ should essentially duplicate the course of the $\chi_p(T)$ curve, i.e., a maximum should be observed on the $\Delta H(T)$ curve in the vicinity of the Curie point. This, however, is not observed experimentally. Near the Curie temperature, where thermal fluctuations of the spontaneous magnetization take place, ΔH increases continuously (see the figure).

Temperature variation (schematic) of the width ΔH of the resonance curve, the coercive force H_c, and the susceptibility of the para process χ_p in ferrites in the vicinity of the Curie point.



In addition, the maximum increase in ΔH does not coincide with the position of the maximum of χ_p. This suggests that the thermal fluctuations of the spontaneous magnetization influence little the width of the resonance line, if at all.

2. In our opinion, a more influential factor causing the broadening of the resonance line near the Curie point are the structural inhomogeneities in the ferrites, which, in turn, lead to inhomogeneities in the spontaneous magnetization through the body of the specimen (volume fluctuations of the spontaneous magnetization). In ferrites (both mono- and polycrystals) such structural inhomogeneities may be the following: disordered distribution of the magnetic ions over the octohedral and tetrahedral sites,* the presence of atomic vacancies, dislocations, etc. As shown by us in earlier papers,[3] the spontaneous magnetization is particularly sensitive to the structural inhomogeneities in the region of the Curie point, where the

least changes in the atomic distances and locations of the atoms influence the value of the magnetization. This circumstance leads to the formation of "tails" of spontaneous magnetization in the region of the Curie point.[3] For the same reason, an increase in the coercive force[4] is observed in many ferrites near the Curie point (as a result of the magneto-heterogeneous state, caused by the volume fluctuations of spontaneous magnetization). The same factor is responsible for the broadening of the ferromagnetic-resonance line near the Curie point. The volume fluctuations of spontaneous magnetization produce in the ferrite an inhomogeneous internal field and this leads to a spread in the resonance frequencies, and consequently to the broadening of the resonance-absorption line.

It is interesting to note that measurements of ΔH and H_c, made on single crystals of magnesium and magnesium-manganese ferrites,[5] give approximately the same temperature variation of these quantities in the region of the Curie point (see the figure). Naturally, the mechanisms of the phenomena connected with the coercive forces and the width of the ferromagnetic resonance-absorption line are different, and there is hardly any deep meaning in a comparison of the temperature variations of the indicated quantities. It should be noted here, however, that the temperature intervals where ΔH and H_c increase are the same, indicating that both phenomena are caused by one and the same (structural) factor.

3. In connection with the anomalous width of the resonance line in ferrites near the Curie point, it is of interest to consider also the anomalies in the width of the resonance line of ferrites near the points of compensation of magnetic sublattices. As is well known, ΔH broadens greatly (in garnet-ferrite of gadolinium[6] and in chromite-ferrite of lithium[7]) as the point of compensation is approached from the high- and low-temperature sides. At the same time, an anomalous increase in H_c was observed in the same temperature region for the same ferrites.[4] (It should be noted that on approaching the point of compensation the magnetic-anisotropy constant not only fails to increase, but even decreases somewhat in absolute magnitude.[8]) We propose that the anomalous increase in ΔH and H_c on approaching the compensation point is also explained by the occurrence of magneto-heterogeneous state of the ferrite in the vicinity of this point. It should be noted that, unlike the case of the Curie point, there are practically no thermal fluctuations of the spontaneous magnetization in the region of the compensation point (the susceptibility of the para process has no maximum), so that the point of compensation is not a point of second-order magnetic phase transformation. One can therefore speak with assurance of the small role of thermal fluctuations of the spontaneous magnetization in the broadening of the resonance line of ferromagnetic absorption, and that the main cause of the broadening of the resonance line are the magnetic inhomogeneities of the ferrites.

4. Everything said above regarding the causes of the anomalous broadening of the resonance line in ferrites near the Curie point applies probably to metallic ferromagnets, too. An anomalous increase in the width of the ferromagnetic resonance absorption line[9] on approaching the Curie point is observed in many metallic ferromagnets. On the other hand, in the same temperature interval one observes in these ferromagnets "tails" of spontaneous magnetization[3] and, frequently, an increase in the coercive force.[10] The experimental material, however, is too scanty for analysis.

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*The influence of structural inhomogeneities in ferrites on the broadening of the reasonance line in the region of temperatures below the Curie point was recently considered by Clogston, Suhl, Walker, and Anderson [11]

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