I. K. Kamilov. *Magnetic critical phenomena.* In 1971 V. L. Ginzburg classified the problem of phase transitions and critical phenomena as being especially important and interesting.[1] Since then enormous progress has been achieved in this area. Theoretical achievements in the exact and approximate solution of some model systems and in the application of the hypothesis of scale invariance of scaling, renormalization-group representations, and ε and $1/n$ expansions[2] to the study of critical and multicritical phenomena have been widely recognized. The methods of the theory of critical phenomena turned out to be so general that they are already widely used in many areas of modern physics.[3] However, the experimental aspect of this problem has not been adequately studied, especially in the case of magnetic phase transitions and critical phenomena. In this report, special attention is devoted to the study of experimental and theoretical studies of magnetic critical phenomena, performed at the Dagestan University, which were among the first studies to confirm the existence of a magnetic critical state and enabled the most complete check of the results of the modern theory of critical phenomena. The results of studies in the following directions are of great interest.

1. *Magnetic critical phenomena.* The most important aspect of the study of critical phenomena is the interpretation of the anomalous change in the physical parameters in the vicinity of a phase-transition point and its quantitative description with the help of critical indices and amplitudes and determining on their basis the nature of the phase transitions and critical phenomena.

Estimates of the static and dynamic critical indices and amplitudes are given for an entire class of magnetic crystals—ferrites with the structure of garnet and spinel, orthoferrites, gadolinium and nickel. These indices and amplitudes are calculated from measurements of the field and temperature dependences of the magnetization, the magnetic and magnetoelastic susceptibility, the heat capacity, the coefficient of thermal expansion, magnetostriction, the magnetocaloric effect, nuclear gamma resonance, the Faraday magnetooptical effect, the velocity of propagation and absorption of sound, and the thermal conductivity. The relations of the similarity theory (scaling), a series of magnetic equations of state, and the equations of state of the heat capacity are checked experimentally based on these data. Magnetoelasticity in the critical region is described theoretically based on the ideas of the similarity theory and scaling functions are constructed for the magnetostriction, the magnetoelastic susceptibility, and the thermal expansion and they are checked experimentally. The equation of state (scaling function) for the magnetic susceptibility is also checked experimentally.

The anomalies in the dynamic properties in the critical region are explained based on two mechanisms: relaxational and fluctuational. The scaling function for the fluctuational and relaxational parts of the coefficient of absorption of sound, describing its temperature, frequency, and field dependence is constructed.

The discussion of the experimental data shows that the anomalies in the velocity and absorption of sound, owing to the spin-lattice interaction, are linked to the dissipation of elastic energy in fluctuations of the spin-energy density. The main mechanism for the spin-photon coupling in the ferrite studies is the exchange-magnetostriction coupling, which arises from the phonon modulation of the exchange interaction between magnetically active ions. The qualitative features of the thermal conductivity in the magnetic critical region turned out to be closely related to the scattering of thermal phonons by thermodynamic critical fluctuations of the spin system or of the order parameter, which is an additional scattering mechanism added to those already known: three-phonon, impurity, boundary, etc. We obtained information on the role of critical fluctuations in the thermal resistance from measurements of the thermal conductivity in a magnetic field. A strong magnetic field, which suppresses fluctuations, removes these anomalies.

2. *Magnetic critical phenomena in isotropic and anisotropic ferro- and ferrimagnets in weak magnetic fields.*[4] Studies in this area essentially concern the fundamental questions of magnetism. Studies of phase transitions in the presence of a magnetic field showed that the H-T diagram contains not a point, but rather a line of phase transitions. For weak magnetic fields, comparable to the demagnetizing field of the sample, phase transitions from the nonuniformly magnetized state into the uniformly magnetized state are observed. In the nonuniformly magnetized region, the magnetization, the susceptibility, the magnetooptical effect, and magnetostriction are observed to be temperature independent.

Based on these studies, the most accurate estimates of the spontaneous magnetization and of the Curie point are presented and a new method for determining the spontaneous magnetostriction is proposed. The results obtained are of both theoretical and practical interest.

3. *Multicritical phenomena.* Based on measurements of the temperature and field (weak fields) dependences of the magnetic susceptibility,the H-T phase diagrams are constructed for hexagonal gadolinium, yttrium ferrite-garnet, and yttrium orthoferrites, and samarium. They reveal a new sequence of phase transitions: from the nonuniformly magnetized state into the uniformly magnetized state into a phase transition associated with the crystallographic magnetic anisotropy.

In addition, a somewhat different picture is observed in orthoferrites, because of the fact that the Dzyaloshinskiĭ field is much higher than the demagnetizing field. Thus, based on the experimental data on the magnetic properties, it is shown that multicritical phenomena can be observed in orthoferrites. The discussion of the experimental phase diagrams of samarium and yttrium orthoferrites shows that there exist phase transitions with a Lifshitz point, owing to a rearrangement of the domain structure as well as spin reorientation.[5]

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