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Magnetic Phase Transitions and Modulated Magnetic Structures

Yuldasheva Nilufar Bakhtiyorovna, Mavlonov Ulug'bek Mirzoqulovich
Lecturer of Department of Physics Bukhara State University

ABSTRACT: The magnetooptic properties of FeBO_3are determined by the limits in the dielectric absorption tensor, which depend on the ferro and antiferromagnetism vectors. The theory of phase transitions is based on the ordering field that arises due to the interaction of particles. The theory is simplified if we consider the area equal to the average area. It is this mean-field theory that is often the focus of attention.

KEYWORD: Phase transitions, MMS, spinorientation, crystal, ferromagnetic moment.

It is known that in magnetically ordered media, the spatial modulation of a magnetic device under certain conditions remains an energy advantage. To date, modulated magnetic structures (MMS) have been found in a large number of magnetically ordered crystals of various types, and the main mechanisms leading to the modulation of the magnetic order, for example, in magnetic dielectrics, are clear. atoms and their consequences. In the last decade, MMS antiferromagnetic dielectrics have attracted the attention of researchers by the fact that the use of such materials as an active substance in the element base of functional elements of spin electronics has great prospects. In these studies, it was found that many properties of the MMS in magnets of this class (for example, the local depth of modulation of the antiferromagnetism azimuth vector and the dependence of the period on the external field, temperature, pressure, etc.) are always a consequence of the spatial inhomogeneity of the above magnetic order. theory based on the mechanisms of crystals In $FeBO_3$:Mgand α – Fe_2O_3:Ga) is not possible, in the course of the study, a transition from a homogeneous magnetic state to a modulated one was recorded. For example, when studying in weak ferromagnets during the MMS period, since its value decreases with increasing magnetic field H, at the same time, it follows from the existing theory of magnetic spatial transitions that the d(H)-coupling is inverse. The behavior of the MMS parameters of $FeBO_3$:Mg and α – Fe_2O_3:Gacrystals in their magnetic structure from a homogeneous state to a modulated state indicates that this state has a deep meaning. Therefore, revealing the mechanism leading to the modulation of the magnetic order in antiferromagnets of this class is one of the topical problems in the physics of magnetic phenomena. Iron borate has a spontaneous magnetic moment at room temperature and is the only available crystal that is transparent in the field of view of the spectrum. The combination of such properties in it makes it possible to consider the $FeBO_3$ crystal as an active substance in the element base of various integrated optical devices as a material with a great future. In addition, these samples serve as a convenient model object for the visual study of magnetization processes and domain structures occurring in this class of magnets. In addition, $FeBO_3$ is one of the known photosensitive crystals in limited quantities today. It reveals new, non-existent properties under the influence of light. A

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comprehensive study of the physical processes that occur during the transition of known substances from one state to another, which is widely used in science and technology and can be applied in the future, is inextricably linked with great results. Among these spatial transitions, magnetic phase transitions occupy a special place, since a comprehensive in-depth study and analysis of these processes is the main memory for storing and transmitting data in information technology, which has led to the rapidly developing data era today. the possibility of improving the elements. Therefore, this article discusses the fundamental ideas about the mechanism of magnetic phase transitions.

It should be noted that the study of the magnetic properties of matter is one of the most important tasks of modern physics, since it is based on systems consisting of a large number of interacting particles.

Spatial transitions associated with sorting occur in various physical systems: in binary alloys, in ferromagnetism and antiferromagnets, in dipole moments in ferroelectrics, in electrons in superconductors, in helium in the superconducting state, etc.

The behavior of macroscopic (thermodynamic) systems at one or another point of spatial transition (for example, at temperature T) is of particular interest, since at these points the properties of the system change dramatically. Since the requirement for the continuity of the thermodynamic potential follows from the requirement of thermodynamic equilibrium (for example, the continuity of energy and free energy from the condition of positive heat capacity C (C = dE/dT)), then the thermodynamic potential at the spatial transition point The change should be small. This can happen in the following cases:

1) either in the appearance of an infinitely small number of new phases, the properties of which certainly differ from the old properties;
2) Or in the formation of an "infinitely small" change in the properties of the entire volume at the same time, corresponding to a new phase.

The first case, phase separation, is a phase transition of the first type (because it is observed as a jump, which manifests itself in a first-order product derived from the corresponding thermodynamic potential, for example, the entropy C). During phase transitions of the first circle, hypothermia and overheating are possible in the absence of such an initial volume. Examples of such transitions are phase separations (vapor-liquid, liquid-solid, vapor-solid), in particular boiling and melting, superconducting transitions in a magnetic field.

In the second case, the appearance of new properties is not associated with surface energy and therefore does not overheat and does not heat up. Of particular interest are such phase transitions, which are called phase transitions of the second type. Examples of such transitions are: changes in the structural order that occur in crystals at certain temperatures; order-random transitions in alloys; ferromagnetic-paramagnetic or ant ferromagnetic-paramagnetic transitions in spin systems and ferromagnetic metals and alloys; the formation of ferroelectricity, superconductivity and superconductivity, the second type of "mixed" in "solid" superconductors, etc.

The theory of phase transitions is based on the ordering field that arises due to the interaction of particles. The theory is simplified if we consider the area equal to the average area. It is this mean-field theory that is often the focus of attention.

Thus, on the basis of the magnetic properties of matter, the spin magnetic moment of the electrons of its constituent elements is determined by its orbital motion, and the nuclear magnetic moment is generated by the spin moments of protons and neutrons.

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It should also be noted that if matter consists of several elements, then this is a system consisting of a large number of interacting particles.

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