

Magnetic ordering, magnetic anisotropy and the mean-field theory

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In this lecture we will consider different types of magnetic ordering. Starting from the simplest cases of collinear magnetic structures, such as ferromagnets and antiferromagnets, we will then proceed to more complex noncollinear (i.e. weak ferromagnets) and even incommensurate (helical magnets) magnetic structures.

Using classical yet powerful mean-field theory we will consider how materials with different types of magnetic ordering behave as their temperature changes and in applied magnetic field. In particular, we will analyze the temperature dependencies of magnetization and magnetic susceptibilities below, in a vicinity, and above magnetic ordering temperatures.

Important part of the lecture will be devoted to a phenomenon of magnetic anisotropy. Employing phenomenological approach we will consider the most common types of anisotropies – uniaxial and cubic. We will see how the magnetic anisotropy along with the exchange interactions contributes to formation of particular types of magnetic structures. We will discuss main mechanisms contributing to anisotropy of bulk magnetic media, and also consider how the magnetic anisotropy changes in thin- and ultrathin films.

During the lecture we will also briefly discuss interesting and technologically-relevant examples of materials with different types of magnetic ordering.

References

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4. L. D. Landau, E. M. Lifshitz, Course of theoretical Physics. Vol. 8, Electrodynamics of continuous media, Pergamon Press (1960).