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ABSTRACTS

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EB – 11/1 APPLICATION OF NUCLEAR MAGNETIC RELAXATION TO STUDY FUNCTIONAL MAGNETIC MATERIALS

G.N. Abelyashev[1], V.N. Berzhansky[1], S.N. Polulyakh[1], N.A. Sergeev[2]

[1]V.I. Vernadsky Taurida National University, Crimea, Simferopol, Ukraine
[2]Institute of Physics, University of Szczecin, 70-451 Szczecin, Poland

Application of nuclear magnetic resonance (NMR) to study magnetic materials has two main directions. First direction is based on NMR spectroscopy. The aim of spectroscopic investigations is to analyze hyperfine magnetic fields at nuclei. In the case of quadrupole nuclei the electric field gradient is the studied parameter too. Method of multiquantum echo-spectroscopy developed for NMR in magnetic materials gives a possibility to divide electric and magnetic interactions. In any case, the spectroscopic investigations are based on the study of static hyperfine fields.

The second important direction of NMR application consists in the study of nuclear magnetic relaxation. As a rule, the relaxation investigations are based on the spin-echo decay experiments. The mechanisms responsible for the spin-echo decay are well known now. These mechanisms can be divided into two types. The mechanisms of the first type are based on nuclear-nuclear interactions. The magnetic dipole interactions determinate relaxation processes in magnetic materials such well as in non-magnetic solids. The interaction between nuclei through virtual magnons (Suhl-Nakamura interactions) is a mechanism of nuclear-nuclear interactions in magnetic solids only.

Theories of nuclear magnetic relaxation caused by nuclear-nuclear interactions suppose the model of rigid lattice. In the scope of the rigid lattice model the question about reversibility of magnetization decay is the discussing question now. But we have shown that the nuclear-nuclear interactions give spin-echo decay independently on the reversibility on magnetization decay.

The theories based on the fluctuations of magnetic fields at nuclei are used to describe the spin echo decay too. Using NMR signals from protons in ferrofluids, we have demonstrated the contribution of such mechanism into spin-echo decay.

Studying spin-echo decay in magnetic solids we have found the new mechanism of magnetic field fluctuation. The local field fluctuations are caused by fluctuations in orientation of electron magnetization and take place for nuclei in lattice positions of non-cubic symmetry.

We have developed fluctuation theory for the case of quadrupole nuclei. This theory describes relaxation both Hahn and multiquantum echoes in magnetic solids. The difference in relaxation rates of different signals gives a possibility to estimate contributions caused by fluctuations of magnetic fields and fluctuations of electric quadrupole interactions. The developed theory has been applied to the relaxation of echo signals from ^{53}Cr, $^{63,65}Cu$ nuclei in the chromium spinels.