Study of Spin Reorientations by Nuclear Forward Scattering in Fe and Ir Containing Compounds

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One of the interesting properties of the Mössbauer spectroscopy (MS), as well as its time analogue Nuclear Forward Scattering (NFS) of Synchrotron Radiation (SR), is the dependence of the cross-section on the nuclear spins orientation relative to the X-ray beam direction and polarization. This feature allows for measurements of the type and direction of the magnetic ordering in the single crystals or multilayer structures. However, such studies are rare with MS due to the typically small size of the single crystals. On the other hand, due to the high brilliance of the SR, NFS is appropriate method for such investigations as shown in the talk with several examples.

The first example is the study of the spin reorientations occurred in the Fe-superconductors, like $TlFe_{1.6}Se_2$ [1]. Here, the orientation of the Fe magnetic moments shows temperature driven transitions between *c*-axis and *ab*-plane directions as revealed by NFS and by the magnetic neutron scattering.

Another example is the coupling of the Eu and Fe magnetic moments orientations in the compounds $EuFe_{2-x}Ni_xAs_2$ as seen by NFS on Fe and Eu. Here, the orientation of the Eu magnetic sublattice jumps from *ab*-plane to the *c*-axis when the ordering of the Fe moments disappears.

The last example is the study of the metamagnetic transition in Sr_2IrO_4 via NFS on Ir [2]. Here, using unusual properties of the nuclear transition on ^{193}Ir, it becomes possible to obtain not only average direction of the spins orientation, but also characteristic dispersion for the spins distributions, that help to investigate the nature of the transition.

References

[1] - A. May et al, Phys. Rev. Lett., **109**, 077003 (2012).
[2] - P. Alexeev et al., Scientific Reports, **9**, 5097 (2019).