High pressure studies on magnetism and lattice dynamics by Nuclear Resonance Scattering.

Ilya Sergeev, DESY, Hamburg

Nuclear Resonance Scattering rapidly developed with the advent of third generation synchrotron radiation sources to a method covering a field of the hyperfine and phonon spectroscopy. High pressure applications are one of the domains where the technique is extremely powerful. The electronic, magnetic and vibrational properties of the solid state at high pressures can be studied by nuclear forward and inelastic scattering. Forthcoming upgrade of ESRF and other synchrotron sources to the extremely brilliant sources will extend the method in several directions. The application of the technique to study magnetic and lattice properties of compounds under high pressures will be presented in the talk with possible improvement of the results after upgrade.

The first part of the talk will be devoted to the study of the magnetism in Ni metal [1] and NiO [2] under applied pressure up to 260-280 GPa. The hyperfine magnetic splitting was observed up to the highest pressure which confirms that the compounds stay magnetic. Thus, the applied pressure above 300 GPa is required in order to identify critical pressure where magnetism is suppressed in Ni and NiO. This step in the experimental setup might be possible after improvement of the synchrotron source.

Lattice dynamics in the iron based superconductors under high pressure will be presented in the second part of the talk. The general scaling on Fe-As distance was found for the phonon modes in *L*FeAsO [3]. On the other hand, the significant change of the lattice dynamics across the tetragonal to collapsed tetragonal isostructural phase transition was found in RFe_2As_2. The explanation of this change can be related to the suppression of the magnetism and transition to the non-magnetic state in the collapsed phase. The investigation of the lattice dynamics in such compounds can gain significantly by improvement of the monochromator energy resolution which is expected after upgrade of the synchrotron source and nuclear resonance beamline.

Literature:

[1] I.Sergueev et al., *Phys. Rev. Lett.* 99 (2007) 097601.
[2] V. Potapkin et al., *Phys. Rev. B* 93 (2016) 201110(R).
[3] I.Sergueev et al., *Phys. Rev. B* 87 (2013) 064302.