XIIth INTERNATIONAL CONFERENCE ON MOLECULAR SPECTROSCOPY

From Molecules to Nano– and Biomaterials

Organized and Sponsored by

Faculty of Materials Science and Ceramics
AGH – University of Science and Technology, Kraków, Poland

Sponsored by

Kraków – Biała Tatrzańska
8–12 September 2013
Iron–based superconductivity: Mössbauer research

A. Blachowski¹, K. Ruebenbauer¹ and J. Żukrowski²

¹Mössbauer Spectroscopy Laboratory, Institute of Physics, Pedagogical University PL–30–084 Kraków, ul. Podchorążych 2, Poland, sfrueben@cyf-kr.edu.pl
²AGH University of Science and Technology, Faculty of Physics and Applied Computer Science Av. A. Mickiewicza 30, PL–30–059 Kraków, Poland, zukrow@agh.edu.pl

Recent discovery of high temperature superconductors based on iron pnictides and chalcogenides generated flurry of scientific activity concerned with relations between magnetism and superconductivity. These materials could be used to test for other bosonic fields than phonons responsible for coupling of the Cooper pairs like e.g. magnons or spin fluctuations. The $^{57}$Fe Mössbauer spectroscopy (MS) is very useful to study magnetic order in iron–based superconductors, as iron is the major component of the compounds. The fundamental question is concerned with the iron magnetic moment in the superconducting state. MS measurements in the high magnetic field and at low temperature revealed no magnetic moment in superconducting FeSe [1]. Another question could be asked about the character of magnetism in the parent compounds. MS is found to be particularly sensitive to the shape of spin density wave (SDW) incommensurate with the lattice period. SDW of the unconventional shape with many harmonics evolving with temperature was found in parent compounds $\text{AFe}_2\text{As}_2$ ($\text{A = Ca, Ba, Eu}$) [2]. Superconductivity emerges due to doping of the parent compounds with the gradual suppression of SDW. Superconducting regions of filamentary shape are free of the 3d magnetic moments. On the other hand, $^{151}$Eu MS revealed that Eu orders magnetically in both kinds of regions. Therefore coexistence of the 4f magnetic order and superconductivity in EuFe$_{2–x}$Co$_x$As$_2$ was confirmed and one can see transferred hyperfine field from Eu on the iron atoms [3]. SDW is coupled to the interstitial localized 3d magnetic moments as observed in Fe$_{1+x}$Te, as the shape of SDW varies with the concentration of interstitial high–spin iron. Localized iron moments suppress superconductivity [4]. Recently obtained results on the very unconventional magnetism in FeAs are to be presented as well.

This project was financially supported by the National Science Center of Poland under the Grant No DEC–2011/03/B/ST3/00446.