Unique Determination of Complex Magnetic Structures by Spherical Neutron Polarimetry

M. Janoschek[1,2], V. Pomjakushin[2], P. Fischer[2], B. Roessli[2], M. Medarde[2], G.A. Petrakovskii[3], S. Klimko[4], C. Pfleiderer[1], P. Böni[1]

[1]TUM, Physics Department E21, D-85748 Garching, Germany
[2]LNS, ETHZ & PSI, CH-5232 Villigen PSI, Switzerland,
[3]Institute of Physics SB RAS, Krasnoyarsk 660036, Russia
[4]CEA-Grenoble, SPSMS-MDN, 38054 Grenoble, France,

Complex magnetic structures are of great importance in a large number of correlated condensed matter systems, e.g. frustrated and itinerant magnetic systems, multiferroics or superconductors. Due to the loss of phase-information that is common to all scattering techniques the unambiguous determination of magnetic structures is in many cases not possible. A method that has been used successfully to identify magnetic structures which were intractable before, is spherical neutron polarimetry (SNP)[1,2,3]. SNP has been used, e.g., multiferroic systems such as $LiCoPO_4$ and $MnGeO_3$ [1].
Until now CryoPAD (Cryogenic Polarization Analysis Device) at the Institute Laue Langevin (ILL) [4] and JAERI [5] was the only device to perform routine SNP measurements. It employs a zero field chamber based on a superconducting shield. In June 2004 we successfully tested a prototype of MuPAD (Mu-Metal Polarization Analysis Device) at the ILL, that uses a zero-field chamber made of highly permeable mu-metal [6]. Since 2005/2006 MuPAD SNP devices are in operation at the Paul Scherrer Institute (PSI) and the Physics Department E21 at the Technical University Munich, where the latter is associated with the FRM-II. Because of its modular design MuPAD can be readily adapted to different instruments, notably triple-axis spectrometers, small-angle scattering, reflectometry and diffraction.
Here we present an introduction to MuPAD along with results on MnSi and $NdFe_3(^{11}BO_3)_4$, that demonstrate the great potential of MuPAD for the field of correlated electron systems in general.

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