Bulk Properties and Neutron Diffraction of the Magnetic Phase Diagram of MnSi

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The transition metal compound MnSi develops itinerant-electron magnetism below T_N=29.5 K that supports a long-wavelength helical modulation. In recent years the properties of MnSi have attracted great scientific interest [1]: (i) well above T_N chiral magnetic fluctuations have been observed; (2) as function of hydrostatic pressure the metallic ground state appears to switch abruptly from a weakly spin-polarized Fermi-liquid to an extended non-Fermi liquid (NFL) phase at a pressure of 14.6\,kbar; (3) neutron scattering experiments show that large magnetic moments survive far into the NFL-phase, where the scattering intensity observed everywhere on the surface of small sphere seems analogous to liquid crystals. Motivated by recent efforts [2] to unravel the transition from chiral fluctuations well above T_N to helical order well below T_N and the nature of the enigmatic A-phase we revisit the origin of reorientational processes in MnSi as function of field. We combine in-situ AC susceptibility measurements with small angle neutron scattering at the diffractometer MIRA at the new neutron source FRM2, as well as DC and torque magnetization data. This provides new insights into the nature of the helical modulation and its possible connection with the NFL phase and the partial magnetic order at high pressure.

[1] B. Roessli et al., Phys. Rev. Lett. (); C. Pfleiderer et al., Nature 414, 427 (2001); N. Doiron-Leyraud et al., Nature 425, 595 (2003); C. Pfleiderer et al., Nature 427, 227 (2004).
[2] A. I. Okorokov et al., Physica B 356, 259 (2005).