The influence of a magnetic field on chiral magnetic correlations

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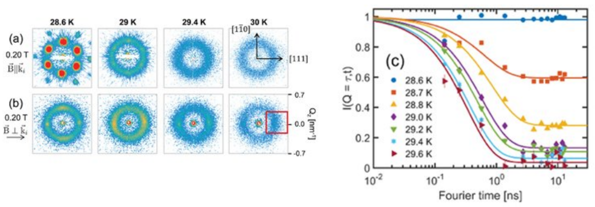

SANS scattering patterns obtained for a magnetic field of 0.20 T [(a) and (b)] applied parallel to the neutron beam wavevector k ?_i and perpendicular to it. Panel (c) shows the intermediate scattering function I(Q=?), with ?=2?/l and l the pitch of the helix, at a magnetic field of 0.24 T illustrating the abrupt change, within 0.2 K, associated with the first order transition. Credit: C. Pappas et al. *Phys. Rev. Lett*. 119, 047203 (2017)

Chiral magnetism attracts a great amount of attention since the observation of chiral skyrmion lattices in the reference system MnSi. These chiral skyrmions have dimensions significantly larger than the lattice constant, are topologically protected, and may have applications in spintronics and novel devices for information storage. In systems like MnSi the non-trivial behavior emerges from a relativistic effect, the Dzyaloshinsky-Moriya (DM) interaction, that twists the magnetic moments with respect to each other.

This interaction becomes noticeable in the absence of a center of symmetry of the crystallographic structure and it is usually weak. Nevertheless, it induces a qualitatively different behavior that is not limited to the skyrmion lattice correlations. This is one of the outcomes of the work recently published in *Physical Review Letters* involving researchers from the Institute Laue Langevin in France, ISIS at the UK, Ames Lab in USA and Delft University of Technology. By combining Small Angle Neutron Scattering (SANS) and high resolution Neutron Spin Echo (NSE) spectroscopy, as shown in the figure, the team monitored the influence of a magnetic field on the chiral magnetic correlations both in space and in time. The SANS measurements were performed on the newly commissioned instrument LARMOR, which is a UK-NL joint venture supported by a NWO-Groot grant of the Dutch Science foundation.

The results reveal that the twisted, helical conical or skyrmionic, long range magnetic order (dis)appears abruptly with increasing temperature, as a first order phase transition, also under magnetic fields. The origin of this abrupt change is not clear and cannot be only attributed to precursor chiral fluctuating correlations, as was assumed so far. Indeed, these fluctuating correlations build up only at low magnetic fields and their gradual suppression by magnetic fields should induce a tricritical point, for which the neutron scattering results published in *Physical Review Letters* show no evidence. In this light, the newly published experimental findings challenge established approaches to chiral magnetism and call for additional theoretical work to understand its subtleties including effects neglected so far, such as anisotropic magnetic interactions.

More information: C. Pappas et al. Magnetic Fluctuations, Precursor Phenomena, and Phase Transition in MnSi under a Magnetic Field, *Physical Review Letters* (2017). DOI: 10.1103/PhysRevLett.119.047203

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