

Experimental report

24/08/2022

Proposal: DIR-255

Council: 4/2021

Title: Search for topological magnetic order in GdSbTe_{2-x} square-net antiferromagnet

Research area: Physics

This proposal is a new proposal

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Experimental team: Igor PLOKHIKH

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Samples: natGdSb_{0.53}Te_{1.45}

Instrument	Requested days	Allocated days	From	To
D9	10	5	30/09/2021	07/10/2021

Abstract:

Ongoing research on antiferromagnetic topological semimetal system GdSbTe_{2-x} suggests that this material is an ideal platform to study the interplay between crystal symmetry, band filling, charge density wave, and magnetism in a topological semimetal.

By establishing the nature of magnetically ordered phases evolving in well characterised single-crystal of GdSbTe_{2-x} with temperature and field, we plan to uncover the skyrmion state supposedly existing in this material based on bulk macroscopic measurements. As Gd is a strong neutron absorber we ask for the hot neutron diffractometer D9 with 0.5 neutron wavelength.

Search for topological magnetic order in $\text{GdSb}_x\text{Te}_{2-x}$ square-net antiferromagnet

$\text{GdSb}_{0.46}\text{Te}_{1.48}$, a nonsymmorphic Dirac semimetal with Dirac nodes at the Fermi level, has a rich magnetic phase diagram with one of the phases predicted to be an antiferromagnetic skyrmion state. In the current work, we investigate $\text{GdSb}_{0.71}\text{Te}_{1.22}$ through bulk magnetization measurements, single-crystal and synchrotron X-ray powder diffraction, as well as single-crystal neutron diffraction. At 2 K the magnetic structure is modulated with two propagation vectors, $k_I = (0.45 \ 0 \ 0.45)$ and $k_{II} = (0.4 \ 0 \ 0)$, with all their arms visible. While k_I persists up to the transition to the paramagnetic state at $T_N = 12$ K, k_{II} disappears above an intermediate magnetic transition at $T_1 = 5$ K. Whereas magnetic field applied along the c -axis has only a weak effect on the intensity of antiferromagnetic reflections, it is effective in inducing an additional ferromagnetic component on Gd atoms. We refine possible magnetic structures of $\text{GdSb}_{0.71}\text{Te}_{1.22}$ and discuss the possibility of hosting magnetic textures with non-trivial 3D+2 topologies in the $\text{GdSb}_{1-x}\text{Te}_{1+x}$ series.

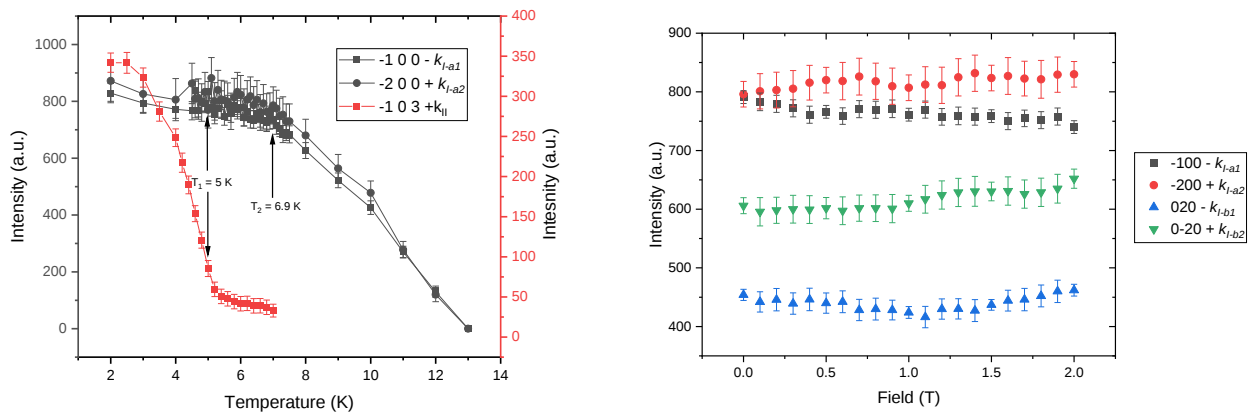


Figure 1. (left) temperature dependence of the intensities of selected magnetic reflections for k_I and k_{II} and (right) field dependence of selected magnetic reflections corresponding to different arms of k_I .