Néel-type Skyrmions in Multiferroic Lacunar Spinels – Mapping out a Stability Phase Diagram using Dynamic Cantilever Magnetometry

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A skyrmion is a topologically protected spin texture, which is considered a potential candidate for future high-density storage devices. Most common are Bloch-type skyrmions (cf. Fig. 1 a), but also Néel-type skyrmions (cf. Fig. 1 b) exist, hosted e.g. in the lacunar spinels GaV_4S_8 and GaV_4Se_8 [1]. They show a different orientation of the spin rotation, but also differ from their Bloch-type counterparts in that their orientation is determined by uniaxial anisotropy instead of an externally applied magnetic field. This anisotropy is apparent in a strong dependence of the magnetic phases on field orientation.

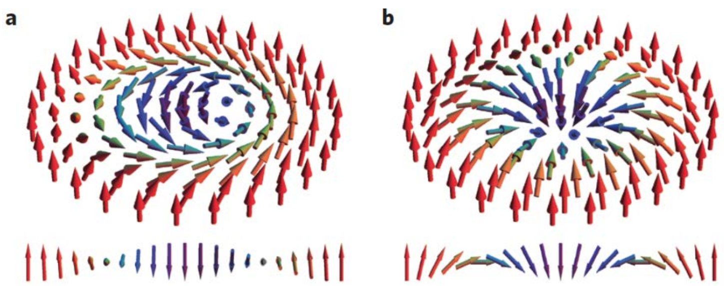
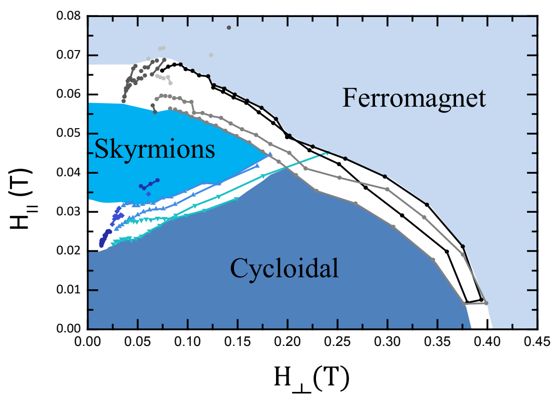


Figure 1: a Bloch-type skyrmion, the spins rotate perpendicular to the radial direction **b** Néel-type skyrmion, the spins rotate along the radial direction [1].

In order to quantify and understand the role of anisotropy in materials hosting Néel-type skyrmions, we perform dynamic cantilever magnetometry (DCM) [2] on single crystal samples of GaV_4S_8 and GaV_4Se_8. In particular, we compare DCM results with a theoretical model of the magnetic phase diagram as a function of applied magnetic field magnitude and direction. By collecting magnetic torque signal for a series of applied field orientations, DCM reveals the magnetization, anisotropy, and magnetic phase diagram of our sample (Figure 2). Our results, which are in good agreement with the model, allow the extraction of a uniaxial anisotropy energy.

Figure 2: Phase diagram obtained by DCM for GaV_4S_8 as a function of the magnetic field parallel to the anisotropy axis and perpendicular to it.



[1] I. Kézsmárki et al., Nat. Mat. 14, 116 (2015).
[2] B. Gross et al., Phys. Rev. B 93, 064409 (2016).