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JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Theory of Condensed Matter: Hard Condensed Matter

July 3, 2018 at 2 p.m.
Galilei Raum, 01-128 (Staudinger Weg 9)

Laura Köhler
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Topological domain walls and dislocations in helimagnets

The Dzyaloshinskii-Moriya interaction in chiral magnets stabilizes a magnetic helix with a wavelength set by the spin-orbit coupling. We study domain walls of helimagnetic order both theoretically and experimentally using micromagnetic simulations and magnetic force microscopy studies on surfaces of FeGe. We find that such domain walls are distinctly different from those in ferromagnets and rather similar to grain boundaries of liquid crystals. Three types of domain walls are realized depending on the relative domain orientation: a curvature wall, a zig-zag disclination wall and a dislocation wall.
Disclinations are vortex defects in the helix axis orientation, and they can be combined to form dislocations. We discuss the topological skyrmion charge associated with these dislocations which can be finite. This leads to an emergent electrodynamics and thus a coupling to spin currents as well as to a contribution to the topological Hall effect. We discuss the dislocation profile using both micromagnetic simulations and an effective elasticity theory known from liquid crystals [2]. A single dislocation causes long-range distortions of the perfect helix. As a consequence, impurities that pin the Goldstone mode have a strong impact on the dislocation motion.
References
[1] Schnherr et al. Topological domain walls in helimagnets. Nat. Phys. 14, 465 (2018)
[2] Smalyukh, I. I., Lavrentovich, O. D. Physical Review E 66, 0511703 (2002)

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