Seminar: Hard Condensed Matter Theory

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Room: Galilei room, 01-128 (Staudinger Weg 9)
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Magnon-skyrmion scattering in chiral magnets

Chiral magnets support topological skyrmion textures due to the Dzyaloshinskii-Moriya spin-orbit interaction. After an introduction to the topic, we discuss the interaction between such a magnetic skyrmion and its small-amplitude fluctuations, i.e., the magnons in a two-dimensional chiral magnet. The magnon spectrum includes two magnon-skyrmion bound states corresponding to a breathing mode and, for intermediate fields, a quadrupolar mode, which will give rise to subgap magnetic and electric resonances. Due to the skyrmion topology, the magnons scatter from an emergent flux density that leads to skew and rainbow scattering, characterized by an asymmetric and oscillating differential cross section. As a consequence of the skew scattering, a finite density of skyrmions will generate a topological magnon Hall effect. Using the conservation law for the energy-momentum tensor, we demonstrate that the magnons also transfer momentum to the skyrmion. As a consequence, a magnon current leads to magnon pressure reflected in a momentum-transfer force in the Thiele equation of motion for the skyrmion. This force is reactive and governed by the transport scattering cross sections of the skyrmion; it causes not only a finite skyrmion velocity but also a large skyrmion Hall effect. While at small energies the transversal momentum transfer is negligible resulting in a large skyrmion Hall angle, we demonstrate that it dominates in the limit of high-energies leading to a universal relation between the magnon current and the skyrmion velocity.

[1] C. Schuette and M. Garst, Phys. Rev. B 90, 094423 (2014)
[2] S. Schroeter and M. Garst, arXiv:1504.02108

All interested are cordially welcome!

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