SFB 767
Colloquium

Universität Konstanz

Thu 20 July 2017
Coffee and tea 15:15
Talk 15:30
P 603

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Stabilization of (anti)skyrmions and magnon-mediated phenomena in Dzyaloshinskii-Moriya magnets

In the first part of my talk, I will discuss realizations of skyrmions and anitskyrmions in quasi-2D systems [1]. A stable (anti)skyrmion, representing the smallest realizable magnetic texture, could be an ideal element for ultra-dense magnetic memories. Here, we use the most general form of the quasi-2D free energy with Dzyaloshinskii-Moriya interactions constructed from general symmetry considerations. We predict that skyrmion and antiskyrmion phases are robust and can be present even when the system lacks the in-plane rotational symmetry. In fact, the lowered symmetry leads to increased stability of vortex-antivortex lattices with four-fold symmetry and in-plane spirals, in some instances even in the absence of an external magnetic field. Our results relate different hexagonal and square cell phases to the symmetries of materials used for realizations of skyrmions and antiskyrmions.
In the second part of my talk, I will discuss magnon-mediated spin Hall response in a collinear antiferromagnet with Dzyaloshinskii-Moriya interactions [1]. An experiment consistent with such prediction has recently been reported [2]. To address this problem, we develop a linear response theory based on the Luttinger approach of the gravitational scalar potential which gives a general condition for a Hall current to be well defined. As examples, we consider single and bi-layer honeycomb antiferromagnets where the nearest neighbor exchange interactions and the second nearest neighbor DMI are present. From our analysis, we suggest looking for the magnon-mediated spin Nernst effect in insulating antiferromagnets that are invariant under (i) a global time reversal symmetry or under (ii) a combined operation of time reversal and inversion symmetries. In both cases, the thermal Hall effect is forbidden by symmetry while the spin Nernst effect could be present. We also consider transport of magnons and its relation to non-equilibrium, magnon-mediated spin torques [3,4]. In case of a collinear antiferromagnet, such torques can become staggered and can control the dynamics of the Neel order parameter. The Onsager reciprocal effect suggests that it should be possible to pump magnon-mediated spin current by Neel order dynamics.

[1] Gungordu et al., Phys. Rev. B 93, 064428 (2016) [2] Zyuzin, Kovalev, Phys. Rev. Lett. 117, 217203 (2016) [3] Shiomi et al., arXiv:1706.03978 [4] Kovalev, Zyuzin, Phys. Rev. B 93, 161106 (2016) [5] Kovalev et al., Phys. Rev. B 95, 165106(2017)

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