MAR12-2011-002809

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

# Emergent electrodynamics from moving magnetic whirls in chiral magnets

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In chiral magnets a lattice of magnetic whirls – so-called skyrmions – is stabilized in a small temperature and field range by thermal fluctuations [1]. We discuss how electric and spin currents couple to these skyrmions. As the spin of the electrons locally adjusts to the magnetic texture, the electron picks up a Berry phase. The effects of these time-dependent Berry phases are best described by "artificial" electric and magnetic fields of an emergent electrodynamics which couple to the spin and the spin currents. The efficient Berry phase coupling together with a partial cancellation of pinning forces due to the stiffness of the skyrmion lattice allows to explain theoretically experiments [2], which show that skyrmion lattices can be controlled by ultrasmall current densities. Using tiny gradients of temperature or magnetic field it is also possible to induce rotations of the skyrmion lattice. The topologically quantized winding number of the skyrmions induces exactly one quantum of emergent magnetic flux per skyrmion. Therefore one can also determine quantitatively the emergent electric field induced by a moving skyrmion following Faraday's law of induction as has been measured in recent experiments [3].

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[3] *Emergent electrodynamics of skyrmions in a chiral magnet*, T. Schulz, R. Ritz, A. Bauer, M. Halder, M. Wagner, C. Franz, and C. Pfleiderer, K. Everschor, M. Garst, and A. Rosch, preprint 2011.