TRR 80 Sonderseminar

am Dienstag, 4.6.2013

spricht

um 14:00 Uhr

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über das Thema

Skyrmions, Topology and Interplay with Currents

Topologically stable whirl-lines (skyrmions) have been observed in several chiral magnets – among them metals, semiconductors and insulators – and at different temperature and length scales. Mathematically, skyrmions are homotopically non-trivial objects. After sketchily depicting the concept of homotopy, we will consider the consequences of the special winding of the magnetization in the skyrmion phase when subjected to a current. Electrons traversing a spatially or temporally inhomogeneous magnetization pick up a Berry phase which can be rewritten as an Aharonov-Bohm phase originating from emergent magnetic and electric fields acting on the electrons. The quantized winding number of skyrmions induces exactly one quantum of emergent magnetic flux per skyrmion. Therefore it is also possible to determine quantitatively the emergent electric field induced by moving skyrmions according to Faraday's law of induction.

On the other hand, electric currents induce forces on the magnetic texture. The special winding in the skyrmion phase leads to a very efficient coupling to electric currents with ultra-low critical current densities of 10^6 A/m^2. We study the current-induced dynamics of skyrmions, i.e., the translational motion as well as rotations of skyrmions within the frame work of the Landau-Lifshitz-Gilbert equation extended by extra damping terms in combination with a phenomenological treatment of pinning forces to develop a theory of the relevant forces and rotational torques.