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über

Elementary Collective Spin Excitations at Solid Surfaces

Abstract:

Elementary excitations play a fundamental role in condensed-matter physics. In a magnetically ordered solid, the elementary collective spin excitations are referred to as magnons. Magnons are the key for explaining many phenomena e.g. ordering at a finite temperature, electrical/heat transport, spin reversal and dynamics.

We have demonstrated that the spin-polarized high-resolution electron energy-loss spectroscopy can serve as a powerful tool to probe the elementary collective surface excitations and their spin dependence. The technique has, in particular, been implemented to investigate the high-energy (terahertz) magnons in low-dimensional ferromagnets. The key properties of magnons such as their dispersion relation and lifetime are measured over the entire Brillouin zone.

By presenting various examples, we discuss how the magnon properties change when reducing the dimension of the system from a three-dimensional bulk ferromagnet to a two-dimensional ultrathin film. We show how the full magnon dispersion relation can be used to quantify the fundamental magnetic exchange interactions in layered magnetic structures. We also illustrate how the magnons' properties can be tuned by engineering the electronic structures.

Finally we discuss the collective excitations at the surface of topological insulators. The unique character of these materials is that their electronic surface states are symmetry protected. We address the spin dependence of the elementary collective excitations of the topologically protected surface state electrons at the $Bi_2Se_3(0001)$ surface.

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