SFB/TRR 21 - Seminar

27. März 2014, Tübingen

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Topological Insulators and Ferromagnets: appearance of flat surface bands

The new class of materials called "topological insulatorsïs characterized by an insulating bulk, but conducting surface states. These surface states are topologically protected by time-reversal symmetry and thus cannot be destroyed by perturbations that respect time-reversal symmetry, like nonmagnetic impurity scattering. In this talk we study how these surface states are modified, if a time-reversal breaking ferromagnetic exchange field is applied to the topological insulator. Such an exchange field can be introduced either by doping with ferromagnetic dopants or by proximity to a ferromagnetic material. We show that ferromagnetism can "tune"the velocity of the surface electrons. A certain critical strength of the exchange field leads to a phase transition into a topological phase, in which the surface states become flat bands, i.e. the velocity of the electrons vanishes [1]. We discuss the necessary preconditions for such flat bands to appear and the topological invariants guaranteeing the existence of these flat bands [2]. Using known parameters of Bi2Se3, we show that there is a good chance that this phase can be achieved experimentally in thin Bi2Se3 strips covered by a ferromagnetic thin film.

[1] T. Paananen and T. Dahm, Phys. Rev. B 87, 195447 (2013) [2] T. Paananen, H. Gerber, M. Götte, and T. Dahm, New J. Phys. to be published

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