Magnetic Coupling and Spin Transport in Topological Insulators and Graphene

Abstract:

We review in this talk the spin and charge transport on the surface of 3D topological insulators and how it is affected by magnetic adatoms.
The strong spin orbit interaction in topological insulators (TI) binds the electron spin of the itinerant surface electrons tightly to their momentum.
The effect of Magnetic Dopants and Magnetic Adatoms which scatter the surface electrons, is therefore highly nontrivial. Classical magnetic moments break the time reversal invariance and are therefore expected to open a gap at the Dirac point. On the other hand, the Kondo Effect restores the time reversal invariance. The Kondo effect is however quenched by the Pseudogap, when the Fermi energy is close to the Dirac point, and the strong coupling of the electron spin to the momentum raises the question if the Kondo effect occurs at all at the surface of TIs. The RKKY Coupling between the magnetic impurities is strongly modified as well. At the Dirac point it is expected to become shorter ranged and decay as 1/Rˆ3 due to the Pseudogap. It is predicted to be isotropic and of ferromagnetic sign.
We outline the resulting magnetic properties, due to the interplay of the Kondo effect and RKKY coupling at the surface of TIs with magnetic Adatoms und magnetically doped TIs and the resulting Quantum Phase Diagram, and how it is expected to change the dispersion of the TI surface electroms.
We have previously studied the magnetic properties of graphene with magnetic adatoms [1,2,4]. Since there are some similarities
but important differenced with TIs, we will review the magnetic properties
of graphene. We will also briefly review the analytical and numerical methods which we developed in recent years to study magnetic properties
of dilute magnetic systems [3,4].

Refs.:

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