Prof. Dr. Jairo Sinova
Institut für Physik, SPICE
sinova@uni-mainz.de

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Theory of Condensed Matter: Hard Condensed Matter

July 2, 2014 at 10 a.m.
Medienraum (03-431), Staudinger Weg 7

Elio König
Karlsruhe KIT

Disordered surfaces of 3D topological insulators: interactions and/or strong magnetic field

The fate of the Dirac-like surface states of 3D topological insulators (TIs) under the influence of electron-electron interactions and/or a strong magnetic field is investigated.

First, a theory of combined interference and interaction effects on the diffusive transport properties of 3D topological insulator surface states is presented. We focus on a slab geometry (characteristic for most experiments) and show that intersurface interaction between the two major surfaces is relevant in the renormalization group (RG) sense and the case of decoupled surfaces is therefore unstable.
We predict a characteristic non-monotonic temperature dependence of the conductivity. In the infrared (low-temperature) limit, the system flows into a metallic fixed point. At this point, even initially different surfaces have the same transport properties.

Second, the unconventional (half-integer) quantum Hall effect for a single Dirac fermion is analyzed. The following important questions, which were not or only partially answered to present date, are discussed:

(i) How can half-integer Hall conductance g_{xy} be measured experimentally? (ii) Doesn¹t Laughlin¹s flux insertion argument forbid half-integer g_{xy}? (iii) What is the field theory describing the localization physics of the single Dirac fermion quantum Hall effect?

The RG flow and the resulting phase diagram are examined. Starting values of the RG flow are given by the semiclassical conductivity tensor which is obtained from the Boltzmann transport theory of the anomalous Hall effect.

References:

E. J. König, P. M. Ostrovsky, I. V. Protopopov, I. V. Gornyi, I. S. Burmistrov, A. D. Mirlin, PRB 88, 3, pp. 035106 (2013).

E. J. König, P. M. Ostrovsky, I. V. Protopopov, I. V. Gornyi, I. S. Burmistrov, A. D. Mirlin, arXiv:1406.5008 (2014).

Contact:
Hjördis Pusch
hjopusch@uni-mainz.de