O 53: Topological Insulators: Transport (HL with DS/MA/O/TT)

Time: Wednesday 11:45–13:00 Location: ER 270

O 53.1 Wed 11:45 ER 270

Surface Transport on a Bulk Topological Insulator — •Frederik Edler[1], Lisa Kühnemund[1], Marco Bianchi[2], Ellen M.J. Hedegaard[3], Martin Bremholm[3], Bo B. Iversen[3], Philip Hofmann[2], and Christoph Tegenkamp[1] — [1]Inst. f. Festkörperphysik, Uni. Hannover — [2]Dep. of Physics and Astronomy, Uni. Aarhus — [3]CMC, Dep. of Chemistry and iNANO, Uni. Aarhus

Topological insulators are guaranteed to support metallic surface states on an insulating bulk, and one should thus expect that the electronic transport in these materials is dominated by the surfaces states. Alas, due to the high remaining bulk conductivity, surface contributions to transport have mainly only been singled out indirectly via quantum oscillations, or for devices based on gated and doped topological insulator thin films, a situation in which the surface carrier mobility could be limited by defect and interface scattering. This issue was first overcome for Bi_2Te_2Se where compensation of defects leads to low bulk conductivity and surface-dominated transport could directly be observed [1]. Here we present a direct measurement of surface-dominated conduction on atomically clean surfaces of Bi_2Te_3. Using a four tip STM for nano-scale four point transport measurements with variable contact distance we show that the transport at 30 K is again two-dimensional rather than three-dimensional. The sheet conductivity is $7.9(3)\times10^{-4}\Omega^{-1}$ corresponding to a mobility of 505 cm^2/Vs. Besides, results regarding the temperature dependence of the conductivity and the influence of structural defects, e.g steps, present after cleavage will be discussed. [1] Barreto et al., Nano Lett. **14**, 3755 (2014)

O 53.2 Wed 12:00 ER 270

Aharonov-Bohm oscillations in quantum wire of topological insulator — •Louis Veyrat[1], Joseph Dufouleur[1], Romain Giraud[1], Emmanouil Xypakis[2], Jens Bardarson[2], Christian Nowka[1], Silke Hampel[1], and Bernd Büchner[1] — [1]IFW-Dresden — [2]MPIPKS

Studying Aharonov-Bohm (AB) effect in a nanowire of topological insulator is a convenient way to reveal the specific properties of the topological surface states (SS), which are spin-chiral Dirac fermions. In the short perimeter limit, we evidenced in a previous work the ballistic transport of the SS in the perimeter of the nanowire, revealed by the temperature dependance of the phase coherence length [1] and showing the weak scattering effect of disorder on Dirac fermions. The quantum transverse confinement of SS is further revealed by the observation of non-universal conductance fluctuations. In the longer perimeter limit, we surprisingly find that the transport remains ballistic in the perimeter, despite the presence of disorder. The interaction with disorder is revealed by specific phase-jump of the AB oscillations under transverse magnetic field.

[1] Dufouleur et al., Phys. Rev. Lett. 110, 186806 (2013)

O 53.3 Wed 12:15 ER 270

The effect of strain on the two-dimensional topological insulator HgTe — •Philipp Leubner, Andreas Budewitz, Christoph Brüne, Hartmut Buhmann, and Laurens Molenkamp — Experimentelle Physik III, Fakultät für Physik, Universität Würzburg, Germany

In the past years, HgTe quantum wells have been used extensively to study the magnetotransport signature of two-dimensional topological insulators, namely the quantum spin Hall effect. It has been shown that the band structure of those systems strongly depends on the thickness of the quantum well, and that, in particular, the topology changes from trivial to nontrivial at a critical thickness of 6.3 nm.

As an additional degree of freedom, the influence of strain on the band structure is investigated in this work. By using different CdTe-ZnTe superlattices grown on GaAs as virtual substrates, we are able to tune the strain of the HgTe quantum well layer from tensile to compressive, and thus modify the shape of the valence band.

Depending on strain, temperature dependent transport measurements on nominally identical wells reveal either features of topological insulators or semimetals, with the obtained fitting parameters nicely agreeing with band structure calculations. Further experiments focus on the correlation between the magnitude of the inverted bandgap and stability of the quantum spin Hall edge states.

O 53.4 Wed 12:30 ER 270

Transport measurements on Mn-doped HgTe quantum wells — •Andreas Budewitz, Kalle Bendias, Philipp Leubner, Christoph Brüne, Hartmut Buhmann, and Laurens W. Molenkamp — Universität Würzburg, Lehrstuhl für experimentelle Physik III

In 2007 HgTe quantum wells have been experimental identified as a quantum spin Hall system [1]. One open question is how quantum spin Hall states interplay with magnetic impurities. Especially the formation of the anomalous quantum Hall effect raises a lot of interest [2, 3]. Since Mn-doped HgTe is a paramagnetic topological insulator it is important to investigate the onset of the ν = -1 plateau at low fields. Here we present transport measurements on Mn-doped HgTe quantum wells. Therefore we show results on different temperatures, magnetic fields, Mn concentration and quantum well width. We discuss our results in comparison to undoped HgTe quantum wells.

[1] M. König, S. Wiedmann, C. Brüne, A. Roth, H. Buhmann, L. W. Molenkamp, X.-L. Qi and S.-C. Zhang, Science 318, 766 (2007)

[2] Chao-Xing Liu, Xiao-Lang Qi, Xi Dang, Zhong Fang and Shou-Cheng Zhang, PRL 101, 14682 (2008)

[3] Hsiu-Chang Hsu, Xin Liu and Chao-Xing Liu, Phys. Rev. B 88, 085315 (2013)

O 53.5 Wed 12:45 ER 270

Quantum hall states equilibration in lateral heterojunctions on inverted HgTe quantum wells — •M. Reyes Calvo[1,2], Christoph Brüne[3], Christopher Ames[3], Philipp Leubner[3], Hartmut Buhmann[3], Laurens W. Molenkamp[3], and David Goldhaber-Gordon[1] — [1]Department of Physics, Stanford Universtiy, Stanford, U.S.A. — [2]C.I.C. Nanogune, San Sebastián, Spain — [3]Physikalisches Institut (EP3), Universität Würzburg, Würzburg, Germany

We study lateral heterojunctions on HgTe quantum wells with inverted band structure. At high densities and fields, we can explore the equilibration between Quantum Hall (QH) states with different filling factor. The resulting resistance plateaus are particularly clear in the n-n'-n quadrant and fit the expected values for a 2D electron gas heterojunction. The low density and moderate magnetic field regime is of more interest, since due to the inverted band structure of HgTe, Quantum Spin Hall (QSH) edge states could be present. In this regime, we observe unexpected features in the Hall resistance, which could be associated with the interplay between chiral QH edge modes and helical QSH edge modes.