HL 23: Transport in high magnetic field/quantum-Hall-effect

Time: Tuesday 14:00–15:15 Location: BEY 154

HL 23.1 Tue 14:00 BEY 154

Landauer-Büttiker study of the anomalous Hall effect in a spin-orbit coupled two-degenerate electron gas — •maria silvia garelli and john schliemann — Institute for theoretical physics, Regensburg Universität, 93040 Regensburg

We study the anomalous Hall effect in a finite-size spin-orbit coupled two-degenerate electron gas with enclosed magnetic impurities. We focus on the investigation of the Charge Hall Conductance (CHC) at the bottom of the conduction band within the Landauer-Büttiker formalism. In the case of a uniform magnetization of the 2DEG, we find that for a fixed system size the CHC is characterized by a peak, whose position shifts with changing the magnetization coupling and the Rashba spin-orbit coupling. The investigation of the density of states (DOS) proves its accordance with the CHC.

HL 23.2 Tue 14:15 BEY 154

FQHE measurements on a GaAs/GaAlAs high mobility sample — •Lina Bockhorn[1], Annelene F. Dethlefsen[2], Frank Hohls[1], Werner Wegscheider[3], and Rolf J. Haug[1] — [1]Institut für Festkörperphysik, Leibniz Universität Hannover — [2]Centre for Atom Optics and Ultrafast Spectroscopy, Faculty of Engineering and Industrial Science, Swinburne University of Technology — [3]Institut für Experimentelle und Angewandte Physik, Universität Regensburg

We study the fractional Quantum-Hall effect in high mobility two-dimensional electron systems (2DES). Hall geometries are created by photolithography on a GaAs/GaAlAs heterostructure containing a 2DES. The mobility and the density of electrons are manipulated by illuminating the samples with a LED and by using a topgate. For a given density of electrons we study the Shubnikov-de Haas-oscillations for different temperatures to extract the activation energies.

We observe a Hall plateau at filling factor 5/2 for a mobility of electrons with $4 \cdot 10^6$ cm^2/Vs. We can detect the Hall plateau at 5/2 for temperatures up to 270mK. For several other filling factors we observe an astonishing linear magnetic dependence of the activation energy for small magnetic fields and a cross-over to square root dependence for high magnetic fields.

HL 23.3 Tue 14:30 BEY 154

Signatures of neutral quantum Hall modes in transport through low-density constrictions — •Bernd Rosenow[1] and Bertrand I. Halperin[2] — [1]Max-Planck Insitut für Festkörperforschung, D-70569 Stuttgart, Germany — [2]Physics Department, Harvard University, Cambridge, MA 02138, USA

Constrictions in fractional quantum Hall (FQH) systems not only facilitate backscattering between counter-propagating edge modes, but also may reduce the constriction filling fraction ν_c with respect to the bulk filling fraction ν_b. If both ν_b and ν_c correspond to incompressible FQH states, at least part of the constriction region is surrounded by composite edges, whose low energy dynamics is characterized by a charge mode and one or several neutral modes. In the incoherent regime, decay of neutral modes describes the equilibration of composite FQH edges, while in the limit of coherent transport, the presence of neutral modes gives rise to universal conductance fluctuations. In addition, neutral modes renormalize the strength of scattering across the constriction, and thus can determine the relative strength of forward and backwards scattering.

HL 23.4 Tue 14:45 BEY 154

Electron interference and dephasing in electronic Mach-Zehnder interferometer — Leonid Litvin, •Andreas Helzel, Hans-Peter Tranitz, Werner Wegscheider, and Christoph Strunk — Intitut für experimentelle und angewandte Physik, Universität Regensburg, D-93040 Regensburg, Deutschland

We study the visibility of Aharonov-Bohm interference in an electronic Mach-Zehnder interferometer (MZI) in the integer quantum Hall regime. The visibility is controlled by the filling factor ν and is observed only between $\nu \approx 2.0$ and 1.0, with an unexpected maximum near $\nu = 1.5$. Three energy scales extracted from the temperature and voltage dependences of the visibility change in a very similar way with the filling factor, indicating that the different aspects of the interference depend sensitively on the local structure of the compressible and incompressible strips forming the quantum Hall edge channels. The superposition of confining potentials, produced by gate of quantum point contact (QPC) and disorder potential from doping impurities, results in the formation of inadvertent quantum dot (QD) in one arm of interferometer. The phase of the QD transmission amplitude was directly observed in the MZI. This implies, that charge state of QD can be measured by detecting its transmission (reflection) phase with the interferometer, and may be used as more sensitive detectors for QD state, than the currently used QPCs.

HL 23.5 Tue 15:00 BEY 154

Optical manipulation of edge state transport in HgTe quantum wells — •Manuel Schmidt[1], Markus Kindermann[2], Alena Novik[3], and Björn Trauzettel[3] — [1]Department of Physics, University of Basel, Klingelbergstrasse 82, CH-4056 Basel, Switzerland — [2]School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332, USA — [3]Fakultät für Physik und Astronomie, University of Würzburg, 97074 Würzburg, Germany

We investigate the influence of electromagnetic radiation on edge state transport within an effective model for the band structure of a HgTe quantum well. This effective model describes the quantum well especially well near its mass inversion thickness [1], where it is sufficient to take the first pair of hole- and electron-like bands into account.

We show that, in an experimentally accessible regime, the motion of an electron which traverses one edge can be reversed. The mechanism behind this current direction inversion is the optical scattering of electrons in hole-like, counterclockwise moving states to electron-like, clockwise moving states.

[1] B. A. Bernevig, T. L. Huges, and S. Zhang, Science 314, 1757 (2006).