HL 45: Transport in high magnetic fields / Quantum Hall effect

Time: Tuesday 15:00–16:15 Location: H13

HL 45.1 Tue 15:00 H13

Evidence of low-lying gapped excitations in the 5/2 quantum fluid — •Ursula Wurstbauer[1,2], Aron Pinczuk[1], Ken West[3], and Loren Pfeiffer[3] — [1]Columbia University, New York, USA — [2]Walter Schottky Institut and Physik-Department, Technische Universität München, Germany — [3]Princeton University, Princeton, USA

The competition between quantum phases that dictate the physics in the second Landau level (SLL) results in striking phenomena. A highly fascinating state is the even denominator fractional quantum Hall (FQHE) state at filling ν=5/2 that is widely believed to support non-Abelian quasi-particle excitations. Our work explores the low-lying neutral excitation modes in the SLL by resonant inelastic light scattering measurements. At 5/2 the spectra revealed a band of gapped modes with peak intensity at energy of 0.07meV. These modes are interpreted as a roton minimum in the wave vector dispersion of spin-conserving excitations. The intensity of the roton band significantly diminishes by increasing the temperature to 250mK and it fully collapses for T>250mK. A long wavelength spin wave mode (SW) is seen at the bare Zeeman energy, indicating non-zero spin-polarization. Both, roton and SW modes appear only in a very narrow filling factor range. A gapless continuum of low-lying excitations emerges at filling factors slightly away from 5/2 demonstrating demonstrates a transition from an incompressible quantum Hall fluid at exactly ν=5/2 to compressible states at very close filling factors. Supported by the U.S. NSF and the AvH.

HL 45.2 Tue 15:15 H13

Negative Magnetoresistance induced by the interplay of disorder in a High Mobility 2DEG — •Lina Bockhorn[1], Igor V. Gornyi[2], Alexander D. Mirlin[2], and Rolf J. Haug[1] — [1]Institut für Festkörperphysik, Leibniz Universität Hannover, 30167 Hannover — [2]Institut für Nanotechnologie, Forschungszentrum Karlsruhe, 76021 Karlsruhe

We study magneto transport in a high mobility two-dimensional electron gas (2DEG). Hall geometries are created by photolithography on a GaAs/AlGaAs quantum well containing a 2DEG. The 2DEG has an electron density of n_e=3.1*10^{11}cm^{-2} and a mobility of μ_e=11.9*10^6cm^2/Vs. We observe a strong negative magnetoresistance around zero magnetic field, which consists of a peak around zero magnetic field and of a huge magnetoresistance at larger fields. The peak around zero magnetic is a two-dimensional effect, as concluded from tilted magnetic field measurements. The huge magnetoresistance vanishes by increasing the temperature to 800 mK, while the peak is left unchanged [1]. At low temperature (T<600 mK) the peak is induced by the interplay of smooth disorder and rare strong scatteres [2]. For higher temperature the temperature dependence of the peak is more complex, which is the result of a crossover between different regimes. At low temperature the density of the strong scatterers n_S is determined by the peak. The quality of a high mobility sample can be characterized on the basis of such magnetotransport measurements.

[1] L. Bockhorn, et al., Phys. Rev. B 83, 113301 (2011)
[2] A. D. Mirlin, et al., Phys. Rev. Lett. 87, 126805 (2001)

HL 45.3 Tue 15:30 H13

Magnetoresistance studies on two-dimensional electron gases in GaAs/AlGaAs heterostructures as a tool for sample quality investigation — •Eddy P. Rugeramigabo[1,2], Lina Bockhorn[1], and Rolf J. Haug[1] — [1]Institut für Festkörperphysik, Abteilung Nanostrukturen, Leibniz Universität Hannover, Deutschland — [2]QUEST Centre for Quantum Engineering and Space-Time Research, Leibniz Universität Hannover, Deutschland

Several GaAs/AlGaAs heterostructures of similar mobility have been grown by molecular beam epitaxy. The two-dimensional electron gases are located in single GaAs quantum wells. The samples were grown with the same layer sequence but under different growth conditions. Despite the similar mobility, we observed differences in the quantum Hall effect measurements. At small magnetic fields we found in all samples parabolic negative magnetoresistances. This is an indication for electron-electron interaction under influence of disorder. The curvatures of the parabolic magnetoresistance are different, as well as their temperature dependences. The parabolic magnetoresistance has been used as a tool to characterize the quality of the heterostructures.

HL 45.4 Tue 15:45 H13

Optically induced ballistic transport in edge channels — Christoph Kastl[1], Markus Stallhofer[1], •Christoph Karnetzky[1], Dieter Schuh[2], Werner Wegscheider[3], and Alexander Holleitner[1] — [1]Walter Schottky Institut and Physik-Department, TU München — [2]Institut für Experimentelle und Angewandte Physik, Universität Regensburg — [3]Laboratorium für Festkörperphysik, ETH Zürich, Switzerland

We use GaAs-based quantum point contacts as energy tunable and spin-sensitive detectors for an optically induced charge carrier ensemble in a two-dimensional electron gas. Using this technique, we recently investigated spatially resolved photocurrent flow patterns in a mesoscopic circuit with a moderate perpendicular magnetic field applied [1]. At high magnetic fields, where Landau-quantization applies, we find a substantially enhanced propagation length compared to zero field [2] along the boundary of the circuit. We explain the findings in the framework of charge carrier transport within one-dimensional quantum Hall edge states. The presented technique principally allows for the selective optical excitation and electronic detection of spin-degenerate edge channels [3].

[1] M. Stallhofer et al., Phys. Rev. B 86, 115315 (2012).
[2] M. Stallhofer et al., Phys. Rev. B 86, 115313 (2012).
[3] C. Kastl et al. (2013).

HL 45.5 Tue 16:00 H13

Modification to the central-cell correction of germanium acceptors — •Oleksiy Drachenko[1], Dmitry Kozlov[2], Anton Ikonnikov[2], Vladimir Gavrilenko[2], Harald Schneider[1], Manfred Helm[2], and Jochen Wosnitza[3] — [1]Helmholtz Zentrum Dresden Rossendorf, Inst Ion Beam Phys & Mat Res, D-01314 Dresden, Germany — [2]Russian Acad Sci, Inst Phys Microstruct, Nizhnii Novgorod 603950, Russia — [3]Helmholtz Zentrum Dresden Rossendorf, Dresden High Magnet Field Lab HLD, D-01314 Dresden, Germany

In this work, we report a correction to the model potential of the Ga acceptor in germanium, evidenced by high-magnetic-field photoconductivity measurements. We found that under high magnetic fields the chemical shift of the binding energy of Ga acceptors vanishes, contrary to the results given by the generally accepted theory. To fit our data, we found that the central-cell correction should contain a repulsive part (i.e., it must be bipolar), in contrast to the purely attractive screened point-charge potential widely used in the literature.