HL 27 Symposium New phenomena in edge transport of QHE systems

Time: Wednesday 14:30–16:30 Room: HSZ 01

Keynote Talk

HL 27.1 Wed 14:30 HSZ 01

Bending the quantum Hall effect: Novel metallic and insulating states in one dimension — •Matthew Grayson — Walter Schottky Institut, TU-Muenchen

One-dimensional conductors are the wires that will connect the circuits of tomorrow's nanoworld, so it is important to characterize their possible conducting phases. We study a novel one-dimensional wire state which arises at the corner of two quantum Hall systems joined at a 90 degree angle, and observe one-dimensional metallic and insulating states. Such non-planar confinement structures are unconventional for the quantum Hall effect and reveal the striking observation of a macroscopic one-dimensional state whose conductance increases with decreasing temperature. This single system can map out generic properties of disordered one-dimensional conductors since the metallic, critical, or insulating character is tunable with an external parameter, the magnetic field.

Keynote Talk

HL 27.2 Wed 15:00 HSZ 01

Particle-hole symmetric Luttinger liquids in a quantum Hall circuit — •Vittorio Pellegrini[1], Stefano Roddaro[1], Fabio Beltram[1], Lucia Sorba[2], Giorgio Biasiol [2], Loren N. Pfeiffer[3], and K.W. West[3] — [1]NEST CNR-INFM, Scuola Normale Superiore, Pisa — [2]TASC CNR-INFM Trieste — [3]Lucent Technologies, NJ USA

We report evidence of a novel class of one-dimensional Tomonaga-Luttinger liquids (TLLs) with tunable properties. These electron liquids are induced by a nanocostriction defined with metallic gates on a two-dimensional electron gas in the quantum Hall (QH) regime. TLLs occur in the QH edges and they are usually observed when the occupation of the lowest Landau level of the two-dimensional electron gas subjected to a magnetic field is equal to particular fractional values [1,2]. Our work shows that the observation of TLLs in edge states is not restricted to the extreme quantum limit of the fractional QH effects [3,4]. The evidences are based on the experimental and theoretical analysis of the out-of-equilibrium (finite-bias) current transmission and reflection characteristics through the split-gate constriction. Split-gate biasing drives inter-edge backscattering and is shown to lead to suppressed or enhanced transmission even in the integer QH regime, in marked contrast with the expected linear Fermi-liquid behavior. This evolution is described in terms of particle-hole symmetry and allows us to conclude that an unexpected class of gate-controlled particle-hole-symmetric TLLs can exist at the edges of our integer QH circuit [4]. These results highlight the role of particle-hole symmetry on the properties of TLL edge states.

[1] A.M Chang, Rev. Mod. Phys. 75, 1449 (2003), [2] S. Roddaro, V. Pellegrini, G. Biasiol, L. Sorba, R. Raimondi, G. Vignale, Phys.Rev.Lett. 90, 046805 (2003), [3] S. Roddaro, V. Pellegrini, F. Beltram, G. Biasiol, L. Sorba Phys. Rev. Lett. 93, 046801 (2004), [4] S. Roddaro, V. Pellegrini, F. Beltram, L.N. Pfeiffer, K.W. West Phys. Rev. Lett. 95, 156804 (2005)

Keynote Talk

HL 27.3 Wed 15:30 HSZ 01

The Detection and Spectroscopy of Millimeter Wave Radiation based on the Interference of Edge-Magnetoplasmons — •Jurgen Smet[1], Igor Kukushkin[1,2], Chunping Jiang[1], Sergey Mikhailov[1,3], and Klaus von Klitzing[1,2] — [1]Max-Planck-Institute for Solid State Physics, 70569 Stuttgart, Germany — [2]Institute of Solid State Physics, Russian Academy of Sciences, Chernogolovka, 142432 Russia — [3]Mid-Sweden University, ITM, Electronics Design Division, 85170 Sundsval, Sweden

A two-dimensional electron system patterned in a suitable shape and subjected to monochromatic microwave radiation exhibits a photovoltage, which oscillates periodically with an applied magnetic field. This phenomenon is distinct from the recently discovered microwave induced zero resistance effect and persists even in samples of moderate quality. The periodicity depends approximately linearly on the carrier density and is inversely proportional to the frequency of the incident radiation. This photovoltaic effect is ascribed to the interference of coherently excited edge magnetoplasmons. Its robustness up to liquid nitrogen temperatures offers interesting perspectives for using it for millimeter and sub-millimeter wave detection and spectroscopy.

Keynote Talk

HL 27.4 Wed 16:00 HSZ 01

Selective edge excitations - inter-edge magnetoplasmon mode and inter-edge spin diode — •Frank Hohls[1,2], Gennadiy Sukhodub[2], and Rolf J. Haug[2] — [1]Cavendish Laboratory, University of Cambridge, UK — [2]Abteilung Nanostrukturen, Institut für Festkörperphysik, Universität Hannover

The selective excitation and detection of quantum Hall edge states has opened access to several interesting phenomenons, two of which I will review in this talk: Firstly I will present time-resolved current measurements of edge magnetoplasmons. At filling factors close to $\nu = 3$ we observe two decoupled modes of edge excitations, one of which is related to the innermost compressible strip and is identified as an inter-edge magnetoplasmon mode [1]. From the analysis of the propagation velocities of each mode the internal spatial parameters of the edge structure are derived. Secondly we have studied the tunnelling between spin polarised edge states at high magnetic fields up to 28 T. Measurements of the inter-edge I-V characteristic in tilted magnetic fields B allow to determine the effective g-factor $g^*(B)$ [2]. We also observe a dynamical nuclear spin polarization.

[1] G. Sukhodub, F. Hohls, and R. J. Haug, PRL **93**, 196801 (2004).
[2] G. Sukhodub *et al.*, Int. J. Mod. Phys. B **18**, 3649 (2004).