# HL 53 Transport im hohen Magnetfeld/Quanten-Hall-Effekt

Zeit: Dienstag 15:00–16:45 Raum: TU P270

HL 53.1 Di 15:00 TU P270

**Edge states at corner junctions of two orthogonal quantum Hall systems** — •Lucia Steinke and Matthew Grayson — Walter Schottky Institut, TU München, D-85748 Garching, Germany

Recently Grayson et al. [1] succeeded in fabricating a new kind of GaAs/AlGaAs heterostructure with a high-mobility two-dimensional electron system bent at an atomically sharp 90° angle. When a quantizing magnetic field is applied to the structure with a tilt angle $\theta$, the system represents a corner junction of two orthogonal quantum Hall systems with filling factor ratio $\frac{\nu_1}{\nu_2} = \frac{n_1}{n_2} \tan\theta$, where $n_1$ and $n_2$ are the 2D electron densities on the respective facets. The bandstructure of this novel quantum Hall line junction in a tilted magnetic field was calculated in the Hartree approximation, revealing a non-trivial corner dispersion. Based on the calculated results for the edge channel spectrum, the corner state could be interpreted as a hybrid system of quantum Hall edges with a bound wire state at the corner. Repeated calculations at various tilted magnetic fields allowed predictions about the conductance properties of the corner states, yielding qualitative explanations for the experimental results presented in Ref. [1].

[1] M. Grayson, D. Schuh, M. Huber, M. Bichler, and G. Abstreiter, APL, to be published; M. Grayson, D. Schuh, M. Bichler, M. Huber, G. Abstreiter, L. Hoeppel, J. Smet, and K. von Klitzing, Physica E 22, 181 (2004)

HL 53.2 Di 15:15 TU P270

**Activation gaps of different fractional quantum Hall states** — •A.F. Dethlefsen[1], F. Schulze-Wischeler[1], R.J. Haug[1], and W. Wegscheider[2] — [1]Institut für Festkörperphysik, Universität Hannover, D-30167 Hannover — [2]Institut für Angewandte und Experimentelle Physik, Universität Regensburg, D-93040 Regensburg

The activation gap $\Delta$ of the fractional quantum Hall states at constant fillings $\nu = 2/3$, $2/5$ and $1/3$ has been measured as a function of the perpendicular magnetic field $B$ for various electron densities. For each density we measured the temperature dependence of the resistivity $\rho_{xx}(T)$. We observe activated transport $\rho_{xx} \propto \exp(-\Delta/2T)$. A linear dependence of $\Delta$ on $B$ is observed for $\nu = 2/3$ and $2/5$ while approaching the spin polarization transition for both fillings with different slopes. This allows a direct measurement of the $g$-factor of composite fermions (CFs).

To obtain a deeper insight in the dependence of the activation gap on the electronic filling factor we perform further measurements at filling factor $\nu = 1/3$ in a wider magnetic field range, where spin-effects should only play a role at small magnetic fields.

[1] F. Schulze-Wischeler, E. Mariani, F. Hohls and R. J. Haug, Phys. Rev. Lett. **92**, 156401 (2004

HL 53.3 Di 15:30 TU P270

**Spin Splitting Studied by Tunneling between Edge States** — •G. Sukhodub[1], R. Winkler[1], F. Hohls[1], R. J. Haug[1], D. K. Maude[2], D. Reuter[3], and A. D. Wieck[3] — [1]Institut für Festkörper Physik, Universität Hannover, Germany — [2]High Magnetic Field Laboratory, CNRS, Grenoble, France — [3]Lehrstuhl für Angewandte Festkörperphysik, Ruhr-Universität Bochum, Germany

A concept of selective population and detection of edge states (ES's) in the quantum Hall regime attracted considerable attention in recent years. Dependent on the width of an incompressible strip separating two ES's and on the length of the interaction region between them two different transport regimes, viz. equilibrated and adiabatic, can be realized. At filling factor three, for instance, decoupled transport in the innermost ES was recently demonstrated which allowed to identify an interedge magnetoplasmon mode [1].

At filling factor two, which is the subject of the present study, a transition from the adiabatic to the equilibrated regime was investigated as a function of the in-plane magnetic field. We found that the Zeeman energy with $|g^*| = 0.44$ mainly accounts for the observed threshold voltage. The deviation from the linear dependence on the magnetic field at higher fields is in good agreement with a self-consistent calculation of the subband structure. There are no indications of exchange interaction considerably affecting the measured energy gaps at the edge of a two-dimensional system.

[1] G. Sukhodub, F. Hohls, and R. J. Haug, Phys. Rev. Lett. **93**, 196801 (2004)

HL 53.4 Di 15:45 TU P270

**Parametric resonance of a two-dimensional electron gas under bichromatic irradiation** — •Christian Joas[1], Mikhail E. Raikh[2], and Felix von Oppen[1] — [1]Fachbereich Physik, FU Berlin, Arnimallee 14, D-14195 Berlin — [2]Department of Physics, University of Utah, Salt Lake City, UT 84112

In ultrahigh mobility 2D electron systems, even a weak nonparabolicity of the electron dispersion, by violating Kohn's theorem, can have a drastic effect on dc magnetotransport under ac (microwave) drive. We study theoretically the manifestation of this effect in the dc response to the combined action of two driving ac-fields (bichromatic irradiation) within a simple classical model. Compared to the case of monochromatic irradiation, which is currently intensively studied both experimentally and theoretically, the presence of a second microwave source provides additional insight into the properties of an ac-driven 2D electron gas. We show[1] that nonparabolicity gives rise to new qualitative effects specific to bichromatic irradiation, namely parametric resonance and multistability within certain frequency ranges. For suitable microwave frequencies, this parametric instability can manifest itself in the dc properties of the system.

[1] C. Joas, M. E. Raikh, F. von Oppen, preprint cond-mat/0405443, to appear in Phys. Rev. B

HL 53.5 Di 16:00 TU P270

**Spin-polarized Edge-States of Quantum Hall Systems on Silicon Basis** — •Carsten Kentsch, Wolfgang Henschel, and Dieter P. Kern — Institut für Angewandte Physik, Auf der Morgenstelle 10, 72076 Tübingen

Spin-polarized electrons exist in the edge-states of two-dimensional electron gases (2DEG) at high magnetic fields. They can be used to study the scattering between the spin-states by measuring the electric current. Recently 2DEG-systems in silicon have attracted attention as the main isotope of silicon has no nuclear spin. This means that the probability of spin scattering of the electrons with the base material is much lower than e.g. in GaAs based systems. As a consequence the life times of the spin-polarized electrons are expected to be longer. They can be used for the detection of nuclear spin states of specifically implanted phosphorus atoms which are suitable as quantum bits in quantum computers.

Here Hallbar structures on the basis of MOS-transistors with chromium split-gates below a Ti/Al topgate were fabricated to determine possible electron transfer between edge states. They were characterized at magnetic field strengths of up to 8 Tesla and a temperature of 1.5 Kelvin.

HL 53.6 Di 16:15 TU P270

**Einfluss der Spin-Bahn-Wechselwirkung auf den Magnetotransport in Elektronenkanälen** — •Ralf Dinter[1], Stephan Löhr[1], Stephan Schulz[1], Christian Heyn[1], Stefan Kettemann[2] und Wolfgang Hansen[1] — [1]Universität Hamburg, Institut für Angewandte Physik, Jungiusstr. 11, 20355 Hamburg — [2]Universität Hamburg, I. Institut für Theoretische Physik, Jungiusstr. 9, 20355 Hamburg

An Hallstreifen aus GaAs/AlGaAs-Heterostrukturen verschiedener Breite zwischen 100 und 2,7 Mikrometer wurde der Einfluss der Spin-Bahn-Wechselwirkung auf den Magnetotransport untersucht.

Bei der schwachen Lokalisierung handelt es sich um ein kohärentes Rückstreuphänomen, das zu einem negativen Magnetowiderstand führt. Entscheidend für die Beobachtung ist, dass die Phasenkohärenz entlang eines geschlossenen diffusiven Weges erhalten bleibt. Ändert sich zusätzlich der Spin-Zustand entlang des Pfades, so kommt es zu einem positiven Magnetowiderstand, der schwachen Antilokalisierung. Sie bietet eine Möglichkeit, die Stärke der Spin-Bahn-WW zu bestimmen. Es werden Messungen vorgestellt, die einen deutlichen Einfluss der Kanalbreite auf die Antilokalisierung in den GaAs/AlGaAs-Strukturen demonstrieren.

Alternativ wird die Spin-Bahn-WW anhand des charakteristischen Schwebungsmusters in der Shubnikov-de Haas-Oszillation bestimmt. Bei Verkleinerung der Kanalbreite unter 50 Mikrometer zeigt sich hier ein unerwartetes Verschwinden des Schwebungsmusters in der SdH-Messung, das nicht im Rahmen der üblichen Modelle zur Beschreibung der Spin-Bahn-WW verstanden werden kann.

HL 53.7 Di 16:30 TU P270

**First experiments in epitaxial growing of carbon doped two-dimensional hole gases (2DHGs) in GaAs/AlGaAs heterostructures resulting in mobilities beyond $10^6$cm$^2$/Vs**

— •Christian Gerl, Stefan Schmult, Hans Peter Tranitz, and Werner Wegscheider — Universität Regensburg, Institut für Experimentelle und Angewandte Physik, 93040 Regensburg

The almost perfect lattice match between Galliumarsenide (GaAs) and Aluminumarsenide (AlAs) yield some important developments in the heteroepitaxy within the last 30 years. Results are for example high electron mobility two-dimensional electron gases exceeding mobility values in the order of $10^7$cm$^2$/Vs. High electron mobilities are essential for the fractional quantum hall effect. Even if the epitaxial growth of low-dimensional high mobility electron systems in GaAs/AlGaAs heterostructures is a state of the art technique today, the growth of similar holes systems is still a fundamental challenge. Beryllium, for instance, acts like an acceptor in (001) GaAs and AlGaAs, with the disadvantage of the segregation for the underlying growth conditions. Silicon, acting as the standard donor in the considered material system for many growth directions, can also yield hole doping, e.g. on (311) GaAs. Recently, the signature of the quantum hall effect in carbon-doped 2DHGs has been reported. We will present our results on C-doped high mobility 2DHGs in the heterosystem GaAs/$Al_{0.33}Ga_{0.67}As$. Optimization has led to hole mobilities up to $1.1\times10^6$cm$^2$/Vs at densities of $2.5\times10^{11}$cm$^2$ determined in low temperature magnetotransport measurements.