Quantum point contacts in the fractional quantum Hall regime

S. Baer, **C. Rössler, T. Ihn, K. Ensslin, C. Reichl, and W. Wegscheider**
Solid State Physics Laboratory, ETH Zurich, 8093, Switzerland

Two-dimensional electron systems (2DES) at low temperatures and in strong magnetic fields show a rich spectrum of highly degenerate, incompressible ground states. Apart from the Laughlin sequence at filling factors ν = 1/m (m odd integer), other exotic states like the ν = 5/2 state have been observed [1]. Many properties of these states are unknown and of high interest for current research.

We investigate transport through quantum point contacts (QPCs) in the integer and fractional quantum Hall (FQH) regime. We study the influence of the potential shape of QPCs on the formation and the energy gap of fractional states in the channel. Fig.1a shows the transconductance of a tunable QPC on a high-mobility 2DES. Black regions correspond to integer and fractional quantum Hall states formed in the QPC or complete pinch-off. In the transition regime between different filling factors, resonances corresponding to the self-consistent formation of potential minima and maxima in the channel modulate the conductance. Finite bias measurements of these systems show a spectrum of conductance enhancement and suppression, currently not understood in detail. In the weak backscattering regime, we study the tunneling properties of the FQH states of the second Landau level. Fully quantized ν = 5/2 and ν = 7/3 states and pronounced reentrant integer quantum Hall states can be observed in the QPC (see Fig.1b). Finite bias measurements allow for an investigation of the tunneling properties of these states [2].

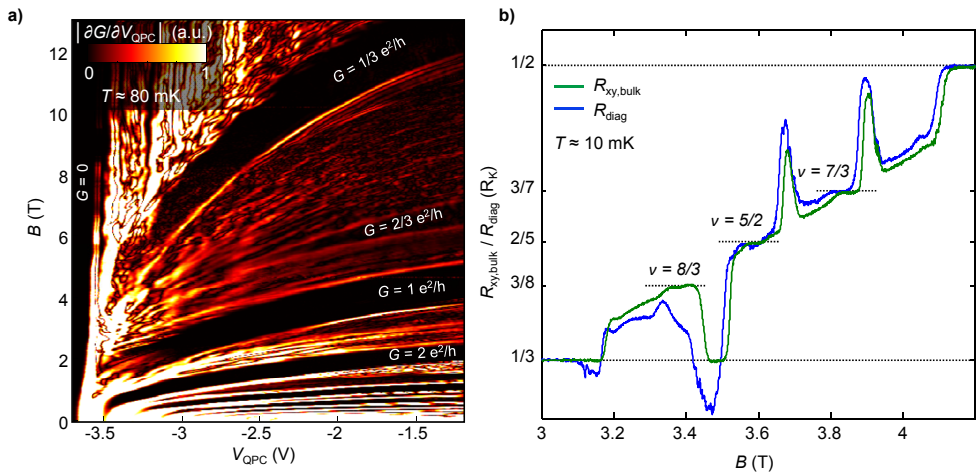

Fig. 1a: Transconductance through a QPC as a function of the gate voltage V_{QPC} and the magnetic field B. Black regions correspond to the transmission of integer or fractional quantum Hall states through the QPC. Fig 1b: R_{diag} and $R_{xy,bulk}$ (in multiples of R_K) as a function of the magnetic field. The diagonal resistance across the 1.2 µm wide QPC reveals a fully quantized ν = 5/2 and ν = 7/3 states with weak backscattering at the QPC constriction.

[1] R. Willett et al., Phys. Rev. Lett. **59**, 1776 (1987)
[2] I. P. Radu et al., Science **320**, 899 (2008)