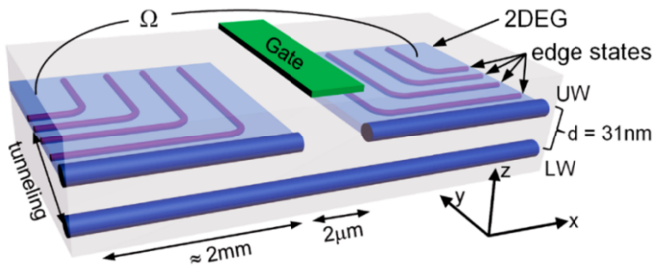


Edge state tunneling spectroscopy



Open position available

in the **Quantum Coherence Group (Zumbühl Group)** in Basel:



A surface-gate is used to control the electron density in the 2 dimensional electron gas (2DEG) below and the quantum wires (UW, LW) located at the sample edge (formed due to additional side dopants). This allows one to perform ultra-sensitive tunneling spectroscopy of the adjacent edge states and the quantum wires.

investigate the adjacent quantum Hall edge states with unprecedented resolution from their formation at low magnetic field, all the way up to magnetic depopulation. The measurements reveal interesting features, such as **exchange enhanced spin splitting, edge state reconstruction and Fermi-level pinning** which the suitable candidate will investigate in more detail and develop theoretical models in collaboration with several renowned theory groups. Furthermore, the project involves the study of **edge states driven out of equilibrium**, the search for **fractional quantum Hall edge states**, and investigation of other types of edge states.

This project involves

- Working in a low temperature lab with a He-3/He-4 dilution refrigerator at mK sample temperatures
- Tuning and controlling a CEO wire device and performing transport and spectroscopy experiments
- Physics of integer and fractional quantum Hall edge states, strongly interaction systems (Luttinger liquids), tunneling spectroscopy,
- Analyzing complex experimental data, developing theoretical models in collaboration with theory groups and performing numerical simulations.
- Presentation of the results at international conferences and publication in high quality journals

References

- [1] R. De Picciotto et al. „Four-terminal resistance of a ballistic quantum wire“, Nature **411**, 51 (2001)
- [2] O. M. Auslaender et al., „Spin-Charge Separation and Localization in One Dimension“, Science **308**, 88 (2005)
- [3] H. Steinberg et al., „Charge fractionalization in quantum wires“, Nature physics **4**, 116 (2008)
- [4] C. P. Scheller et al., „Possible Evidence for Helical Nuclear Order in GaAs Quantum Wires“, Phys. Rev. Lett. **112**, 066801 (2014)
- [5] O. M. Auslaender et al., „Tunneling Spectroscopy of the elementary excitations in a One-Dimensional Wire“, Science **295**, 825 (2002)
- [6] T. Patlatiuk, C. P. Scheller et al., „Evolution of the quantum Hall bulk spectrum into chiral edge states“, arXiv:1802.03847 (2018)

Contact

If you are interested to join our group, do not hesitate to send an email to dominik.zumbuhl@unibas.ch to initiate further discussions.

We are looking for a highly motivated and talented physicist for the study of integer and fractional **quantum Hall edge states** in GaAs by means of **tunneling spectroscopy** using an adjacent cleaved edge overgrowth (CEO) quantum wire.

CEO wires are arguably the best realization of a one-dimensional system and exhibit distinct 1D signatures such as ballistic transport [1], spin-charge separation [2], charge fractionalization [3] and helical nuclear order [4]. Tunneling spectroscopy has proven to be an extremely powerful tool to investigate those 1D systems [2,3,5] and has recently allowed us to