PAUL SCHERRER INSTITUT

Condensed Matter Theory Seminar

Quantum Hall Edge State Spectroscopy in GaAs Quantum Wires

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DATE: **Tuesday, September 4, 2018**
SEMINAR: **11:00 a.m.**
PLACE: **WHGA/121**

Abstract:
One of the most intriguing and fundamental properties of topological systems is the correspondence between the conducting edge states and thegapped bulk spectrum. So far, it has been impossible to access the full evolution of edge states with critical parameters such as magnetic field due to poor resolution, remnant bulk conductivity, or disorder.
Here, we use a GaAs cleaved edgequantum wire to perform momentum-resolved tunneling spectroscopy. An in-plane magnetic field provides a momentum kick and allows for spectroscopic imaging of more than the first ten Landau level edge states with nanometer real space resolution. This allows us to probe the evolution of the chiral quantum Hall edge states and their positions from the sample edge with unprecedented precision from very low magnetic fields all the way to high fields where depopulation occurs. As the magnetic field increases from zero field, we observe first compression of the edge states against the hard wall edge at low fields. At higher fields, motion of the edge states into the bulk is seen, followed by magnetic depopulation.
We present consistent analytical and numerical models, inferring the edge states from the well known bulk spectrum, finding excellent agreement with the experiment – thus providing direct evidence for the bulk to edge correspondence. In addition, we observe various features beyond the single-particle picture, such as Fermi level pinning, exchange-enhanced spin splitting and signatures of edge-state reconstruction. This novel type of tunneling spectroscopy presents a versatile new tool to study edge states in various systems such as nanowires, 2D materials and topological insulators

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