Evidence of Momentum Resolved Quantum Hall Edge Spectroscopy in a Bent Quantum Well Junction

Lucia Steinke (Technische Universitaet Muenchen, Physics); Matthew Grayson (Northwestern University, Electrical Eng. & Comp. Sci.)

Introduction

A novel system for coupling quantum Hall systems has recently been reported, whereby two perpendicular electron systems are joined at an atomically sharp corner junction [1]. The present experiment explores a different magnetic-field geometry which uses this same experimental device as a tool for energy spectroscopy of a single quantum Hall edge.

Experimental

The sample consists of a corner-cleave which is overgrown with a high-mobility heterojunction, effectively creating a two-dimension (2D) electron system bent by 90°. The junction between the two facets is reduced in length to about 10 μm by scribing by hand. When one facet is placed in a perpendicular magnetic field, this short junction serves as a weak link to couple the quantum Hall edge to a two-dimensional (2D) high-mobility Fermi-liquid probe. By applying a voltage bias across this weak link, momentum resolved spectroscopy is possible.

Results and Discussion

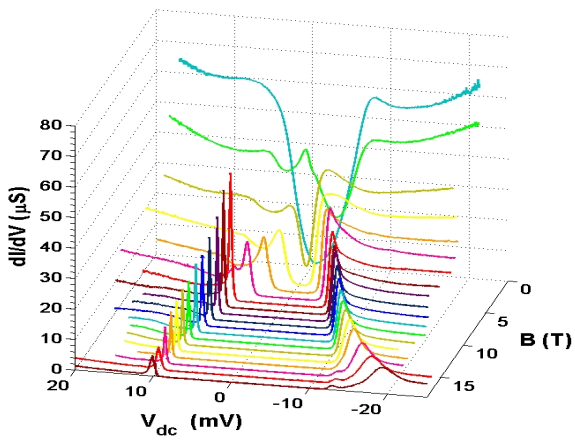

Fig. 1: Differential conductance dI/dV across the 10 μm junction as a function of dc bias voltage V_{dc} and magnetic field B

In Fig. 1, the differential conductance *dI*/*dV* is plotted as a function of bias voltage *V* and magnetic field *B*. One observes shifting structure in the conductance at low magnetic field, and a strong zero-bias conductance suppression for $B > 3$ T. Above 3 T, large peaks arise at positive and negative bias at the onset of conduction. The positive bias peak does not shift with B, whereas the negative bias peak shows a parabolic shift with B. The principle features of this data were reproduced in a second cooldown.

Preliminary Hartree calculations are able to identify the cause of this conductance suppression in terms of momentum resolved coupling of the two systems. These results may help shed light on the structure of quantum Hall edges in both the integer and fractional quantum Hall regime, as well as illuminate the electrostatics of the bent quantum well system.

Acknowledgements

This work was partially supported by the German DFG Grant GR 2618/1-1.

References

[1] M. Grayson, *et al.*, Phys. Rev. B **76**, 201304-07(R) (2007).