



Effect of Disorder on Fractional Quantum Hall State

Gregory S. Boebinger, National High Magnetic Field Laboratory

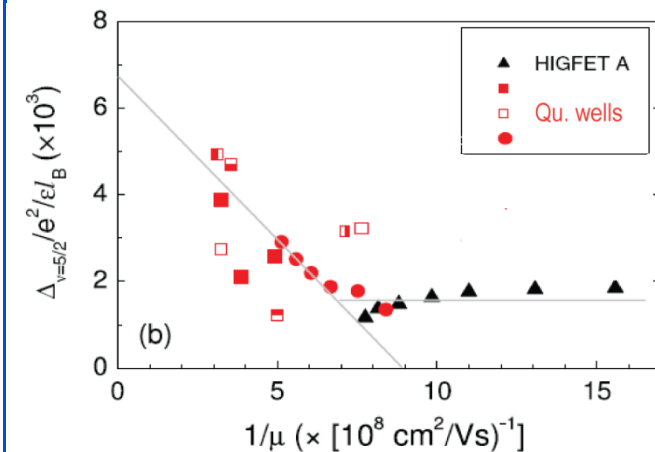
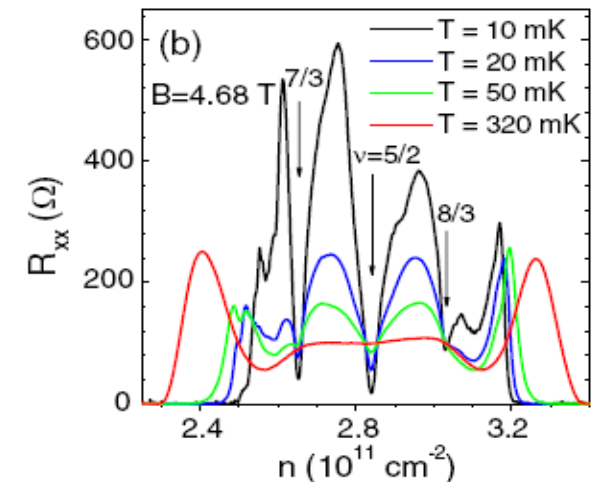
DMR-Award 0654118

High B/T Facility, University of Florida



The symmetry properties of the fractional quantum Hall states at Landau level fillings of $\nu=5/2$ and $12/5$ are of great interest because of the potential application in fault-tolerant quantum computing. To assess this potential it is critical to determine the impact of disorder on the low temperature properties of the $5/2$ state. **The activation energy gaps were therefore measured for two very different types of semiconductor structures for which the nature of the disorder is well characterized: (i) undoped hetero-junction field-effect transistors (HIGFETs), and (ii) symmetrically doped modulation quantum wells.** The variation of the normalized energy gap Δ with inverse mobility μ^{-1} of these devices was observed to be strikingly different: (i) For long-ranged disorder (modulation-doped samples), the gap Δ decreases sharply with increasing disorder (increasing μ^{-1}), (ii) For short range disorder (HIGFETs) only a weak dependence was observed.

Pan, W., Tsui, D.C., Baldwin, K. W. West, W., Pfeiffer, L. N., and Masuhara, N., Phys Rev. Lett. **106**, 206806 (2011).





Effect of Disorder on Fractional Quantum Hall State

Gregory S. Boebinger, National High Magnetic Field Laboratory

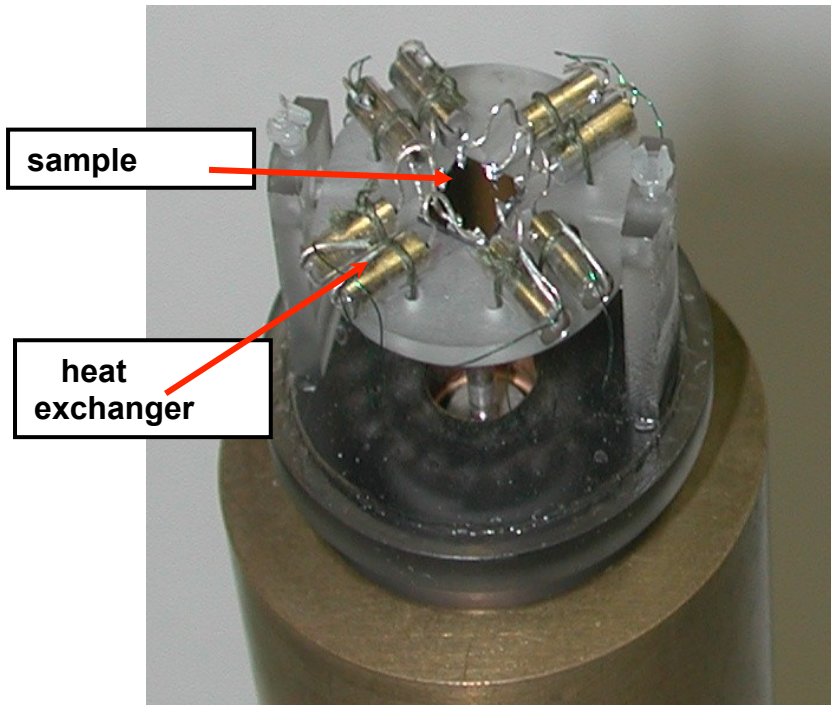
DMR-Award 0654118

High B/T Facility, University of Florida



This work was enabled by unique ultra-low temperature instrumentation designed to cool the electrons in semiconductor devices to milliKelvin temperatures .

The device shown at left employs socks of sintered silver to surround each electrical lead in a four-terminal conductivity measurement. The socks provide the required large surface area to a surrounding thermal bath of superfluid helium three. The helium bath temperature was typically 2 milliKelvin and the temperature of the electrons was determined (from measurements of the temperature dependence of the transverse resistivity) to be 4 milliKelvin. This work was a collaboration of scientists from Sandia National Laboratory and Princeton University with staff at the NHMFL High B/T Facility.



Pan, W., Tsui, D.C., Baldwin, K. W. West, W., Pfeiffer, L. N. , and Masuhara, N., Phys Rev. Lett. **106**, 206806 (2011).