

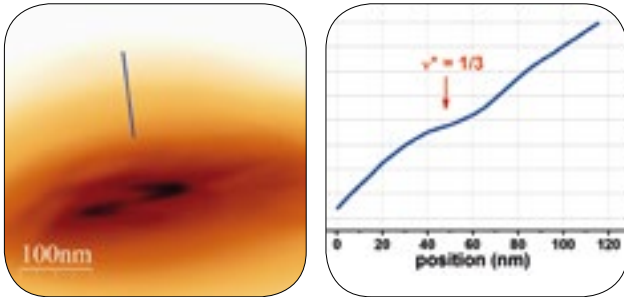
Selected Applications



Scanning Gate Microscopy at 300 mK

In this measurement, an attoAFM III was operated inside an attoLIQUID3000 cryostat at 300 mK in scanning gate microscopy mode (SGM) - investigating the trajectory and interaction of edge channels of a split-gate quantum point contact (QPC) device in the Quantum Hall (QH) regime. By scanning the SGM tip over the surface of the QPC at constant height and by simultaneously measuring and plotting the source-drain current, conductance maps were obtained. The image to the left is an example of such a conductance map depicting the characteristic branched-flow of electrons at zero magnetic field, which in turn shows electron interference fringes and the actual electron path ($T = 400$ mK, 2DEG density $n_{2D} = 3.37 \times 10^{11} \text{ cm}^{-2}$).

(Data and images were generously provided by S. Heun et al., NEST, CNR-INFN and Scuola Normale Superiore, Pisa, Italy.)



Imaging Fractional Incompressible Stripes in Integer Quantum Hall Systems

In newer measurements, the group performed SGM measurements at the temperature and magnetic field conditions required to observe the fractional quantum Hall effect. The goal is to image for the first time the presence of fractional incompressible stripes, i.e. the existence of an inner structure within the integer edge channel. The measurements were performed at bulk filling factor $\nu = 1$ ($B = 8.23$ T, $T = 300$ mK). The corresponding SGM map in the region close to the QPC center is depicted in the lower Figure (a). Analogously to the $\nu = 4$ case, one expects to find plateaus when the local electron phase is gapped, i.e. when the local filling factor ν^* equals a robust fraction. The scan profile depicted in the right figure reveals a clear shoulder for $G_{sd} = e^2/3h$ (corresponding to points where $\nu^* = 1/3$). A more careful analysis [1] allows to determine the occurrence of incompressible phases for $\nu^* = 1/3, 2/5, 2/3$, and $3/5$, i.e. the two most robust fractions and their hole-particle conjugates, respectively. The SGM maps allow not only to reveal the fractional incompressible stripes, but also to measure their width and correlate it with the local electron density slope. The agreement between the data and a reconstruction model is remarkable, especially in light of the uncertainty on the fractional-gap value, which is known to be rather sensitive to the details of disorder potential.

(Data and images were generously provided by N. Paradiso, S. Heun et al., NEST, CNR-INFN and Scuola Normale Superiore, Pisa, Italy.)

[1] N. Paradiso et al., *Phys. Rev. Lett.* 108, 246801 (2012). See also the Supplemental Material.