Imaging quantum Hall backscattering in graphene

Marco GUERRA
Akash PATIL[1], Kenji WATANABE[2], Takashi TANIGUCHI[2], Benjamin SACÉPÉ[1], Hermann SELLIER[1]
[1]*Univ. Grenoble Alpes, CNRS, Grenoble INP, Institut Néel, Grenoble, France*
[2]*National Institute for Materials Science, Tsukuba, Japan*
marco.guerra@neel.cnrs.fr

We report on a scanning gate microscopy (SGM) experiment that provides spatial information on the position and uniformity of the backscattering between chiral quantum Hall edge states in a high-mobility graphene Hall bar[1]. The electrically polarized tip of the microscope enables local manipulation of edge states, promoting tunneling of charge carriers between the counter-propagating modes, either directly or through localized quantum Hall islands[2]. This disorder-induced tip-mediated backscattering is revealed by deviations from the zero longitudinal resistance, as observed in narrow mesoscopic Hall bars. A local graphite back-gate allows us to characterize the electrostatic lateral confinement, showing a net reduction of backscattering for wider devices. We also identify a series of concentric rings which are typical of Coulomb blockade transport through a localized state gated by the tip[3]. The diamond-shaped stability diagram recorded at finite source-drain bias demonstrates the key-role of Coulomb blockade in the percolation of quantum Hall channels through a disordered potential landscape[4].

References

[1] K. Zimmermann, *et al.*, Nature Communications 8, 14983 (2017)
[2] H.S. Sim, *et al*., Physics Report 456, 127 (2008)
[3] N. Paradiso, *et al.*, Physical Review B 86, 085326 (2012)
[4] F. Martins, *et al.*, New Journal of Physics 15, 013049 (2013)

Figures

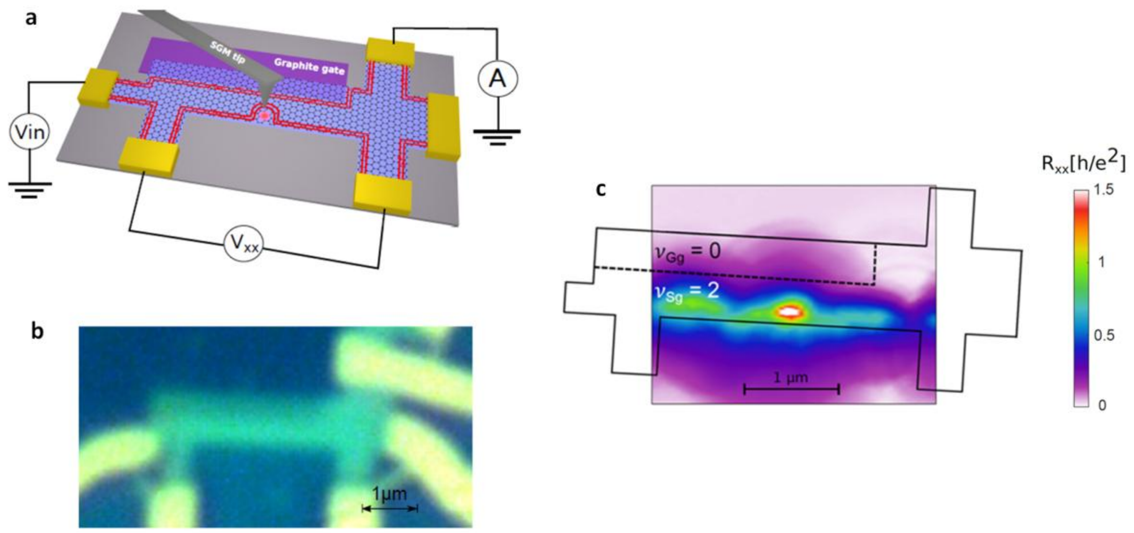

Figure 1: (a) Schematic of the transport experiment. The SGM tip and the graphite gate (violet flake) exert an electrostatic control on the edge channels in the device. (b) Optical micrograph of the device. (c) SGM map unravelling the backscattering process inside the Hall bar.