Evidence for chiral supercurrent in quantum Hall Josephson junctions

Hadrien Vignaud
David Perconte, Wenmin Yang, Bilal Kousar, Edouard Wagner, Frédéric Gay, Kenji Watanabe, Takashi Taniguchi, Hervé Courtois, Zheng Han, Hermann Sellier & Benjamin Sacépé
Institut Néel, 25 rue des Martyrs BP 166, 38042 Grenoble cedex 9, France
hadrien.vignaud@cnrs.neel.fr
Hadrien.Vignaud@icfo.eu

Hybridizing superconductivity with the quantum Hall (QH) effects has major potential for designing novel circuits capable of inducing and manipulating non-Abelian states. In this talk, we will present our recent results on quantum Hall Josephson junctions based on graphene nanoribbons. We will show that with suitably designed junctions, a robust supercurrent can develop on the quantum Hall plateau of normal state resistance $h/2e^2$ and withstand up to 8 teslas. The particular feature of those junctions is a chiral supercurrent with an unusual $2\Phi_0=h/e$ flux periodicity [1], indicating that the Andreev bound states propagate in a chiral fashion via the quantum Hall edge channels and form a loop along the sample periphery. The key parameters that limit the supercurrent in the quantum Hall regime and their consequences for more exotic quantum Hall states will also be discussed [2].

References

[1] Ma, M. & Zyuzin, A. Y., **Europhys. Lett.**, 21 (1993) 941-945
[2] Vignaud H., Perconte D., Yang W., Kousar B., Wagner E., Gay F., Watanabe K., Taniguchi T., Courtois H., Han, Z., Sellier H. & Sacépé B., **Nature**, 624 (2023) 545-550

Figures

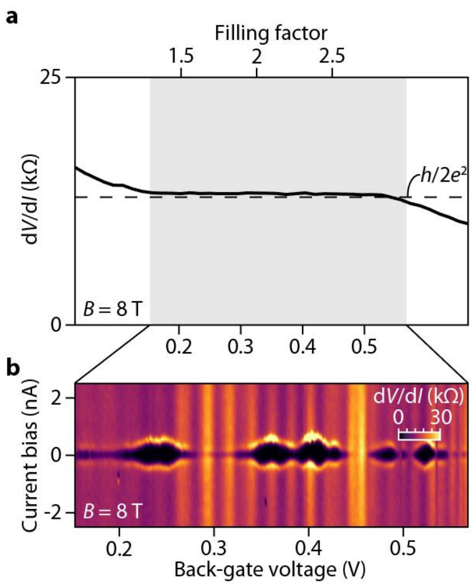

Figure 1: a) Differential resistance dV/dI of device HV88-B measured at 8 T with a d.c. current bias of 1.2 µA and plotted as a function of back-gate voltage, showing a well-quantized resistance plateau at ν = 2. **b)** dV/dI as a function of back-gate voltage and d.c. current bias over the plateau region (B = 8 T) ((**a**), grey area). Superconducting pockets (black) alternate with finite resistance regions.