Chiral supercurrent in quantum Hall Josephson junctions

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Abstract

Hybridizing superconductivity with the quantum Hall effects has major potential for designing novel circuits capable of inducing and manipulating non-Abelian states. In this talk I will present our recent results on quantum Hall Josephson junctions based on graphene nanoribbons. I 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, 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.

Figure

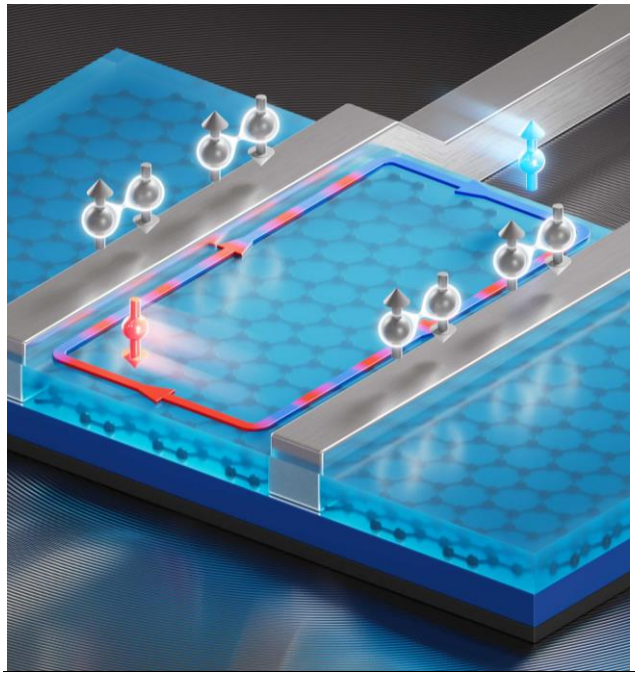

Figure 1: Artistic picture of a quantum Hall Josephson junctions in graphene. Cooper pairs are transferred between the superconducting electrodes (in grey) through the chiral quantum Hall edge channels (red and blue colours of the edge channel indicates electrons and holes)

Reference

[1] H. Vignaud, D. Perconte, W. Yang, B. Kousar, E. Wagner, F. Gay, K. Watanabe, T. Taniguchi, H. Courtois, Z. Han, H. Sellier, B. Sacépé, Nature 624, 545 (2023)