Superconducting Quantum Interference in Double-Layer Graphene Heterostructures

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Graphene is a highly versatile material with high electronic quality, for which the electronic properties can be reliably modified in van der Waals heterostructures. Here we study a compact double-layer graphene SQUID (superconducting quantum interference device), with the superconducting loop reduced to the superconducting edge contacts connecting two parallel graphene Josephson junctions. Independent gate control of the chemical potentials in both layers allows tuning the SQUID from a symmetric to an asymmetric configuration. In the latter, we measure a skewed current-phase relationship for both Josephson junctions, indicating the presence of superconducting modes with high transparency. In the quantum Hall regime, we engineer an artificial helical state where we observe a conductance plateau of $2e^2/h$, when the two layers are tuned to Landau levels $\nu=1$ and -1 respectively. [1] Finally, I will present our latest results where we align the two graphene layers and bring them further closer expecting to facilitate crossed Andreev reflection between the two layers.

References

[1] David I. Indolese, Paritosh Karnatak, Artem Kononov, Raphaëlle Delagrange, Roy Haller, Lujun Wang, Péter Makk, Kenji Watanabe, Takashi Taniguchi, and Christian Schönenberger, Nano Lett., 20(2020) 7129–7135

Figures

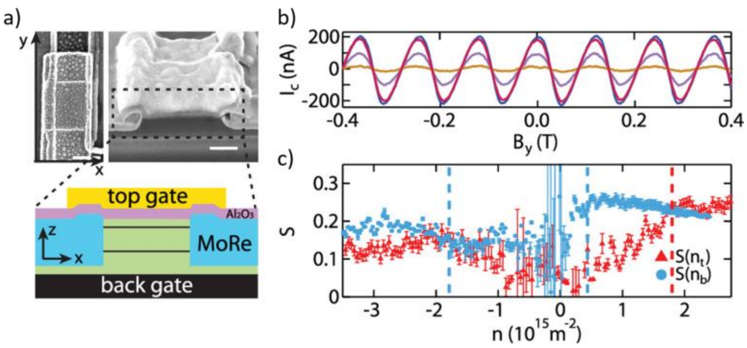

Figure 1: a) Device image and schematic b) Skewed current phase relation c) Skewness parameter as a function of number density.

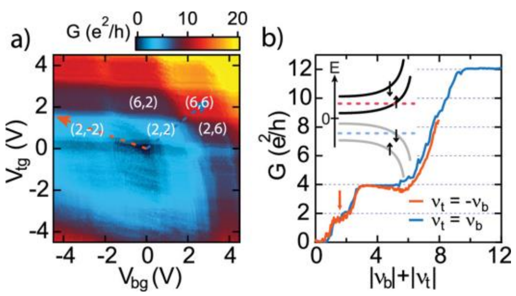

Figure 2: a) Quantum Hall map at 5 T b) Artificial helical state (orange arrow) at $\nu_t=1$ and $\nu_b=-1$.