Nonlocal conductance spectroscopy of Andreev bound states in 2DEG-based nanowires

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We present experimental measurements of local and nonlocal tunneling spectroscopy of Andreev bound states in a hybrid superconductor-semiconductor three-terminal device based on a gate-defined InAs two-dimensional electron gas (2DEG) with an epitaxial Al layer. Andreev bound states in a nanowire with 0.6 micrometers between probes are investigated as a function of parallel magnetic field. At magnetic fields of order 2 T, we observe low-energy Andreev bound states, which oscillate around zero bias as a function of gate voltage, revealing in the non-local signal the oscillating electron-hole character of the bound state, consistent with theoretical predictions [1,2]. An improved device geometry that allows for spatially resolved control of the electrostatic confining potential is presented.

Figures

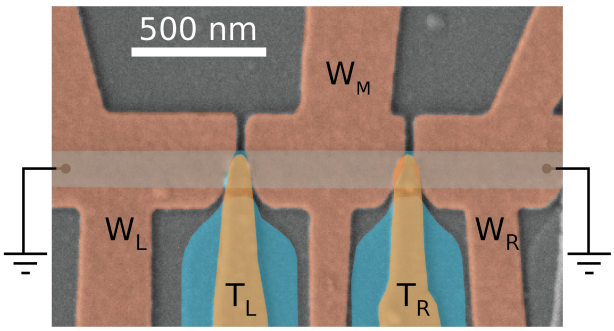

Figure 1: Three-terminal device based on Al-InAs superconductor-semiconductor hybrid heterostructure.

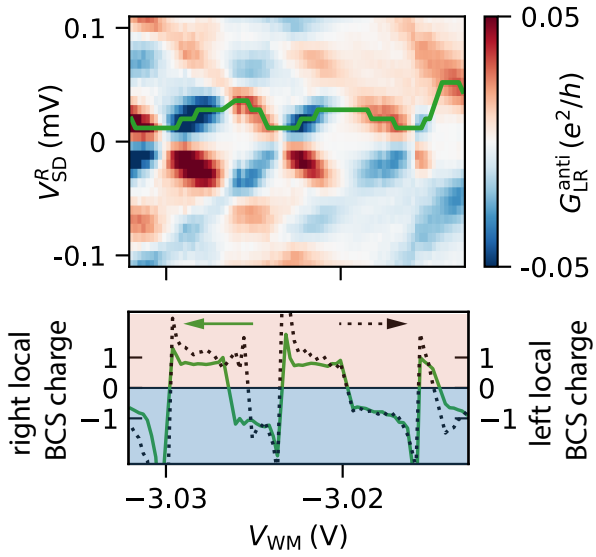

Figure 2: Nonlocal conductance of Andreev bound states at 2 T magnetic field parallel to the nanowire and extracted local Bardeen-Cooper-Schrieffer (BCS) charge.

References

[1] J. Danon et al., Phys. Rev. Lett. 124 (2020) 036801
[2] G.C. Ménard et al., Phys. Rev. Lett. 124 (2020) 036802