Distinguishing Andreev modes from Majorana modes via quasi-particle poisoning

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Substantial effort in recent years went into identifying and probing signatures of Majorana modes in superconductors that distinguish them from other zero-energy subgap states. However, many of these signatures have subsequently been shown to be explicable by physics unrelated to Majorana modes.[1]

This theoretical work shows how a continuous, time-resolved measurement of quasi-particle-poisoning induced parity flips of subgap states — via quantum-dot based parity-to-charge conversion and a capacitively coupled sensor dot[2] — can directly expose the property of Majoranas being an equal superposition of a particle and a hole. For the example of two separate Majorana- or Andreev type subgap modes coupling to the detector, we provide the key distinguishing features of the charge detector signal, and discuss how their measurability is constrained by charge- and flux noise, non-equilibrium and thermal excitations, as well as detector shot noise.

References

[1] Flensberg et al.: Nat. Rev. Mat **6**, 944–958 (2021)
[2] Munk et al.: Phys. Rev. Research **2**, 033254 (2020)

Figures

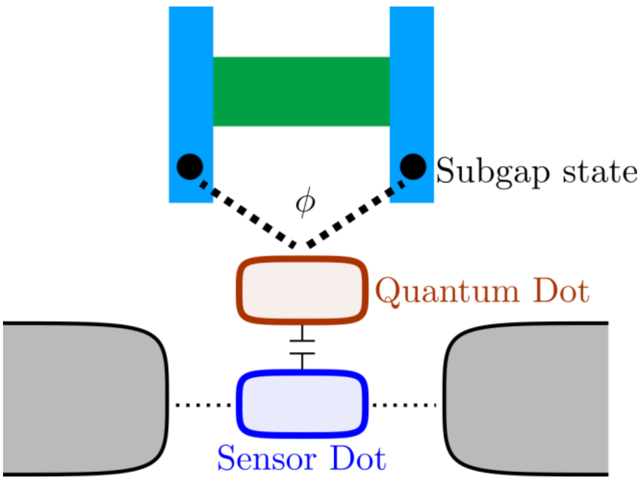

Figure 1: Parity of subgap states in superconducting wires converted to a charge in a tunnel coupled quantum dot, continuously measured by a capacitively coupled sensor.

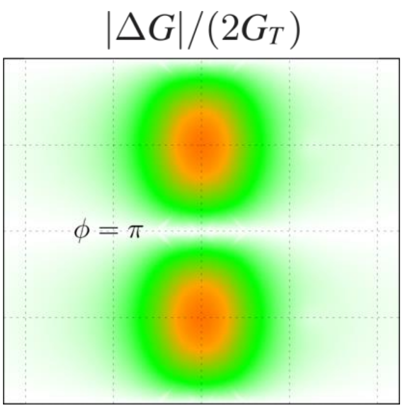

Figure 2: For Majorana modes, the sensor signal becomes independent of subgap parity for a specific coupling phase but otherwise arbitrary parameters.