Quantum-anomalous-Hall current patterns and interference in thin slabs of chiral topological superconductors

Llorenç Serra[1,2]
Daniele Di Miceli[1,3]

[1]*Institute for Cross-Disciplinary Physics and Complex Systems IFISC (CSIC-UIB) 07122 Palma, Spain.*
[2]*Department of Physics, University of the Balearic Islands, 07122 Palma, Spain*
[3]*Department of Physics and Materials Science, University of Luxembourg, 1511 Luxembourg, Luxembourg*

llorens.serra@uib.es

The chiral topological superconductor, which supports propagating nontrivial edge modes while maintaining a gapped bulk, can be realized hybridizing a quantum-anomalous-Hall thin slab with an ordinary s-wave superconductor. We show that by sweeping the voltage bias in a normal-hybrid-normal double junction, the pattern of electric currents in the normal leads spans three main regimes. From single-mode edge-current quantization at low bias, to double-mode edge-current oscillations at intermediate voltages and up to diffusive bulk currents at larger voltages. Observing such patterns by resolving the spatial distribution of the local current in the thin slab could provide additional evidence, besides the global conductance, on the physics of chiral topological superconductors.

References

[1] D. Di Miceli, L. Serra, Scientific Rep. **13**:19955 (2023); arXiv:2311.09664
[2] D. Di Miceli et al, Phys. Rev. B **108**, 035424 (2023); arXiv:2303.16261

Figures

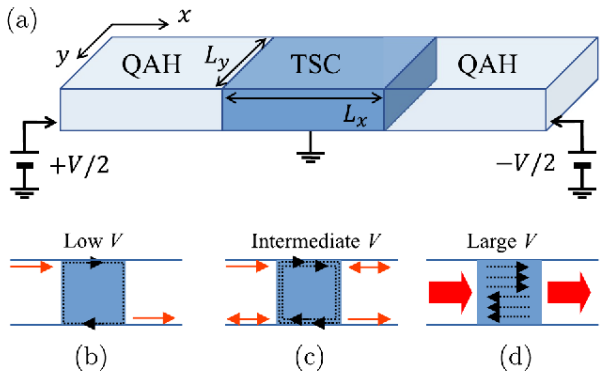

Figure 1: (a) Sketch of the QAH slab with a TSC hybrid sector proximitized by a superconductor (not shown). (b,c,d) Sketches of the currents (red arrows) for low, intermediate and large applied voltages. The dotted black lines represent the TSC quasiparticle modes.

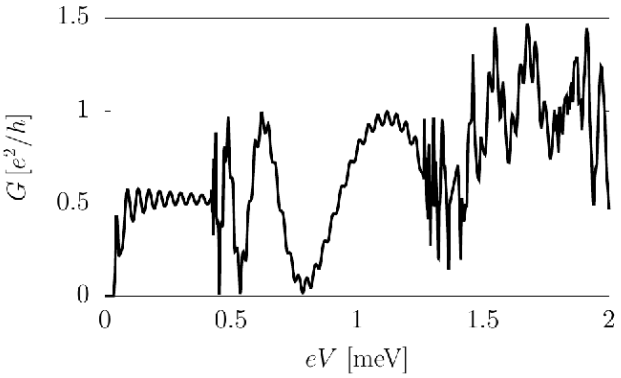

Figure 2: Electric conductance G in the normal leads of a NSN junction as a function of the total bias V . We assumed a magnetic TI thin slab of width Ly = 1 μm with a central sector long Lx = 20 μm. The superconducting pairings are Δ1 = 1.5 meV and Δ2 = 0, and the other parameters of the effective Hamiltonian are the same as in Fig. 2.