Electron transport through a Majorana wire subject to quasiparticle poisoning

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Majorana bound states (MBS) in semi-conductor quantum wires with proximity-induced superconductivity are promising candidates for storing and processing quantum information.[1,2] However, for such applications to become reality, several obstacles has to be overcome. One problem, common for all superconducting qubits, is quasiparticle poisoning.[3,4] Quasiparticle poisoning are processes where non-equilibrium quasi-particles interact with the superconductor, causing the total parity of the system to change. Such processes will destroy stored quantum information, and cannot be suppressed by increasing the spatial separation (hence decreasing the overlap) of a MBS pair.
We study electron transport through a quantum wire with MBSs, subject to an electrical bias via two leads with spin-momentum-locked electron channels. In an open systems approach, we find the current and the noise of the setup, with and without the quasi-particle poisoning present in the quantum wire. The quasi-particle poisoning is included as a phenomenological term in the Liouvillian of the master equation.
The results show how the current and noise behave in the presence of quasi-particle poisoning.

References

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