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TOPOLOGICAL KONDO ISLAND JOSEPHSON-COUPLED TO A SUPERCONDUCTOR

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Abstract:

Topological Kondo island Josephson-coupled to a superconductor
We propose a device architecture with Majorana fermions predicted to host a manifold of non-Fermi quantum impurity states. The device consists of a floating superconducting island carrying one-dimensional nanowires with Majorana end states. The Majorana are tunnel-coupled to normal leads while the island is Josephson-coupled to a bulk superconductor. In this system, the quantum impurity, nonlocally encoded by the Majorana fermions, experiences both Kondo screening and resonant Andreev reflection processes.

Surprisingly, we found that these two effects can coexist, leading to a ground state manifold with non-Fermi liquid continuous exponents. Our results were obtained using a combination of conformal field theory arguments, Abelian bosonization and an intuitive quantum Brownian motion analogy which explains the manifold in simple terms. We also found an illuminating analogy between our system and the two-channel two-impurity Kondo model.

The predicted manifold and its non-Fermi liquid nature can be identified in charge transport measurements, where we predict the appearance of nonlocal conductances with a power law temperature dependence. The power law exponent is continuously tunable within the manifold by changing gate voltages.