Dynamical parity selection in superconducting weak links

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Abstract

Excess quasiparticles play a crucial role in superconducting quantum devices ranging from qubits to quantum sensors. In this work we analyze their dynamics for phase-biased finite-length weak links with several Andreev subgap states, where the coupling to a microwave resonator allows for parity state (even/odd) readout. Our theory shows that almost perfect dynamical polarization in a given parity sector is achievable by applying a microwave pulse matching a transition in the opposite parity sector. Our results qualitatively explain key features of recent experiments on hybrid semiconducting nanowire Josephson junctions [1] and provide theoretical guidelines for efficiently controlling the parity state of Andreev qubits [2].

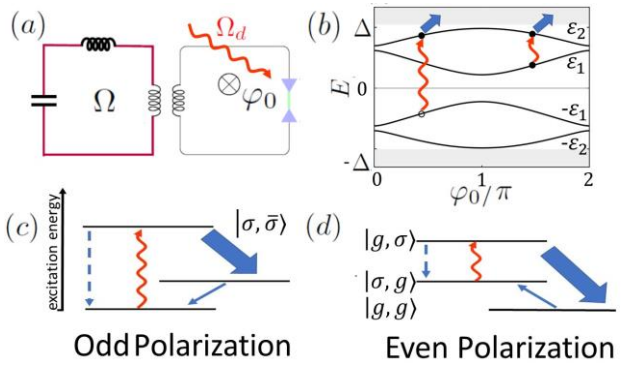

Figure: (a) Schematic setup: phase biased weak link coupled to a microwave resonator (b) Subgap states as a function of phase for a finite length weak link (c-d) Excitation of even/odd many-body states leading to polarization in the odd/even parity sector.

References

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[2] Nico Ackermann, Alex Zazunov, Sunghun Park, Reinhold Egger, Alfredo Levy Yeyati, "Dynamical parity selection in superconducting weak links", arxXv:2207.05782.