

Inductively Protected Andreev Spin Qubit (IPA)

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The susceptibility to environmental fluctuations of quantum spin qubits, leading to decoherence and relaxation, has motivated the search for protected qubits that minimize sensitivity to these perturbations, to extend coherence times, and improve the scalability of quantum processors.

Recent experiments implemented an Andreev Spin Qubit (ASQ): a quantum spin embedded in a superconducting circuit [1,2,3]. The system, implemented in semiconductor-superconductor platform, is susceptible to different sources of noise that limit the coherent times [2,3].

Here, we present a new Inductively Protected-Andreev-spin qubit design based on a superconductor-semiconductor hybrid platform of [4]. Shunting the ASQ with an inductor, see sketch in **Fig. 1**, enables to separate spin states into two different minima (double-well potential), controlled by the ratio (\tilde{E}_J / E_L). This wavefunctions disjunction illustrated in **Fig.2**, would increase magnetic field noise protection and enhance coherence times of the qubit.

References

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- [3] M.Hays et al., Science,373 (2021) 430
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Figures

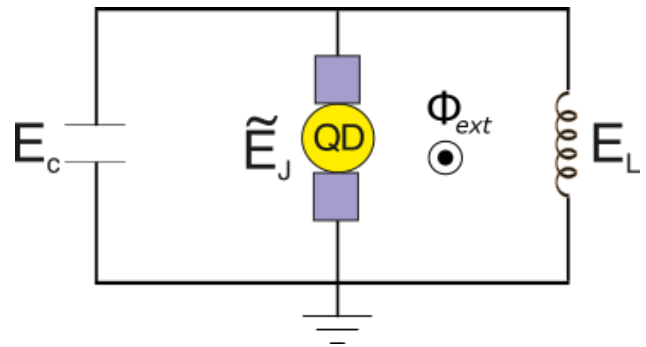


Figure 1: Schematic model of experimental setup with E_c , \tilde{E}_J and E_L the capacitive, Josephson and inductive energies, while Φ_{ext} is the flux threading the loop.

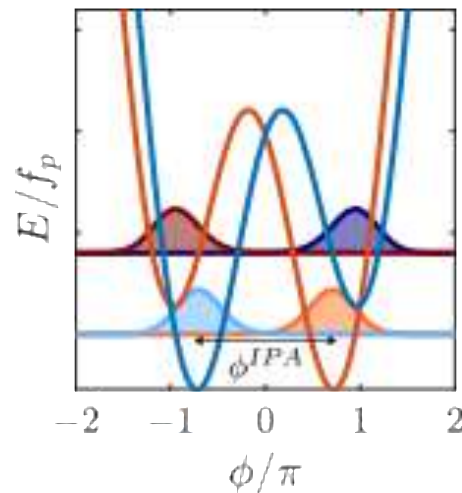


Figure 2: First four states of the system normalized by the plasma frequency. Protection is achieved when the harmonic potential separates the lowest spin ground states with high anharmonicity and the Josephson potential maintains a sufficiently high barrier to suppress inter-well tunneling.