Investigating Loss Mechanisms in Fluxonium protected from energy decay using bi-fluxon tunneling

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Abstract

In our previous work [1], we demonstrated the potential of fluxonium circuits to encode quantum information in wave-functions with disjoint support and noise-insensitive energies, achieving partial protection against relaxation and dephasing. Here, we extend this approach by improving coherence times through optimized fabrication and carry out a detailed investigation of loss mechanisms in a qutrit framework. We conduct a systematic study of energy relaxation and dephasing up to the state |2> that can be generalized to multilevel systems. While our results demonstrate significant improvements in coherence properties, they also hold the promise of a better understanding of loss mechanism, reinforcing the viability of partially protected fluxonium qubits as a pathway towards robust quantum computing.

References

[1] Ardati, Waël, et al. *Physical Review X* 14, 041014 (2024).

Figures

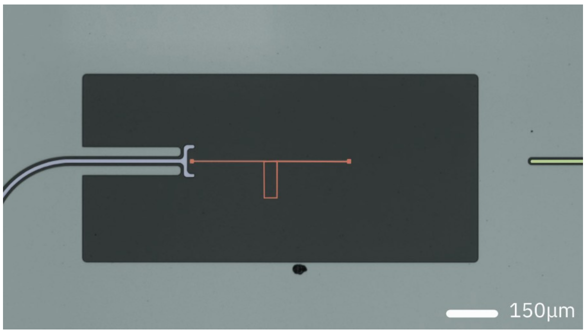

Figure 1: False-colored optical image of the fluxonium (red) coupled to a readout resonator (blue) and a charge control line (green).

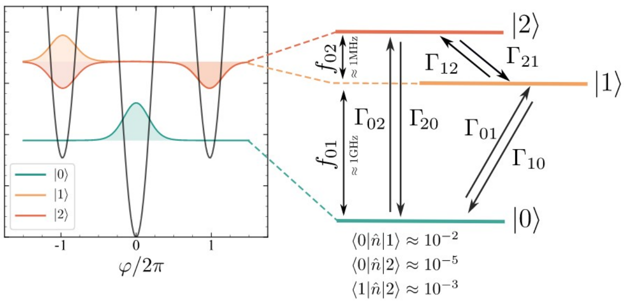

Figure 2: Spectrum of the bifluxon fluxonium seen as a multilevel system at the sweet spot, with all exchange rates between the 3 states.