Towards a dissipative cat qubit in a 3D circuit QED architecture

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Quantum systems are fragile by nature and suffer from decoherence due to uncontrolled coupling to the noisy environment, creating a major obstacle to building a large-scale quantum computer. As most sources of decoherence are believed to originate from local fluctuations, storing the information non-locally would suppress the occurring errors exponentially[1].

This work aims to encode a quantum bit in the fundamental bosonic mode of a weakly non-linear coaxial cavity[2] and protect it from decoherence with engineered two-photon dissipation. Here, the cavity non-linearity is inherited from a fluxonium qubit[3], which allows us to tune the memory-ancilla interaction in situ. In contrast to the conventional transmon ancilla, this qubit possesses higher protection against ancilla-induced dephasing. Furthermore, the larger anharmonicity of the fluxonium allows for faster gate operations on the qubit. Together with the engineered dissipation, the setup could be utilized as an improved building block for a fully protected logical qubit. In this poster, the progress of coupling a fluxonium qubit to a high coherence cavity is presented.

References

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Figures

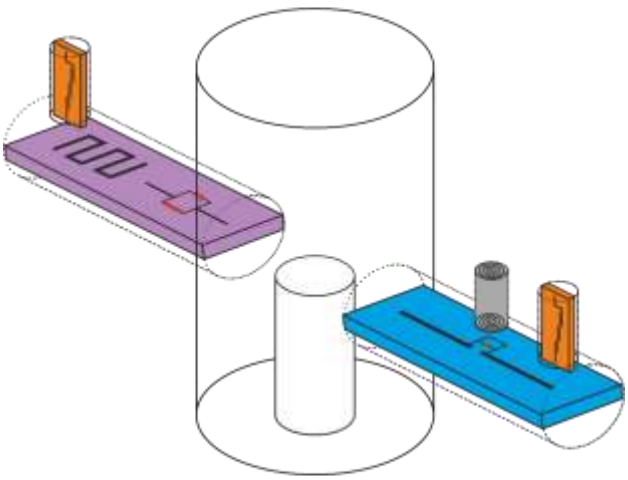

Figure 1: Setup schematic. The system consists of a coaxial cavity (white), fluxonium chip (blue), magnetic flux hose[4] (grey), a Purcell filter[5] (orange) and a 3-wave mixing element chip (violet).

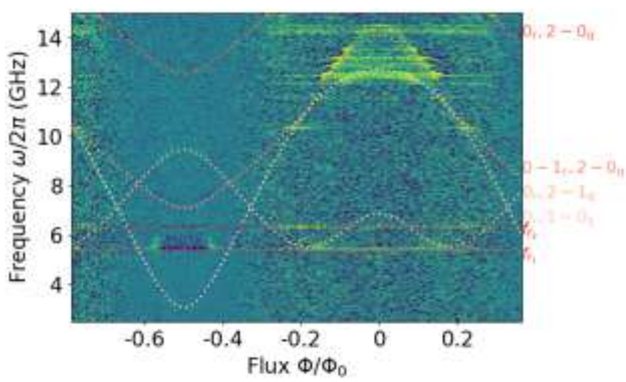

Figure 2: Two-tone spectroscopy of a fluxonium. The spectrum is fitted with the scqubits Python package[6] and includes single and multi-photon transitions.