A Superconducting Platform for Quantum Information Processing

Lucien Quebaud
Ian Yang, Desislava Atanasova, Stefan Oleshko, Teresa Hoenigl-Decrinis, Gerhard Kirchmair

(1) Institute for Quantum Optics and Quantum Information, 6020 Innsbruck, Austria
(2) Institute for Experimental Physics, University of Innsbruck, 6020 Innsbruck, Austria
lucien.quebaud@uibk.ac.at

Abstract

In the pursuit of advancing quantum information processing, high-Q coaxial cavities have emerged as a potential avenue to realize interactions in multi-qubit systems. In this work, we present such a platform involving transmon qubits coupled to a high-purity niobium $\lambda/4$ coaxial seamless design.
A modular magnetic hose is introduced for implementing fast magnetic flux control within the superconducting cavity, crucial for fast frequency changes of tunable transmon qubits. The magnetic hose offers a solution to the longstanding challenge of achieving high-coherence 3D cQED systems with fast magnetic flux control.
In order to achieve fast and accurate qubit readout, which is typically limited by the Purcell effect in the dispersive regime, we propose a novel Purcell filter design replacing the conventional readout pin. This design incorporates a modular band-pass filter centred at the resonator frequency, allowing fast qubit measurements while mitigating the impact of the Purcell effect on qubit lifetime.
All these quantum engineering tools enable the construction of a robust superconducting platform for quantum information processing applications.

References

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Figures

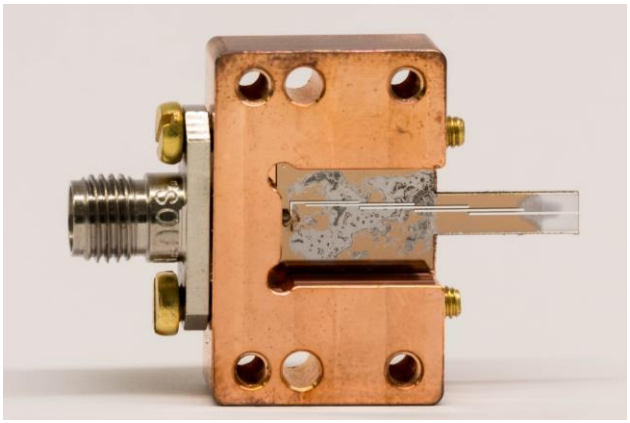

Figure 1: Picture of the Purcell filter

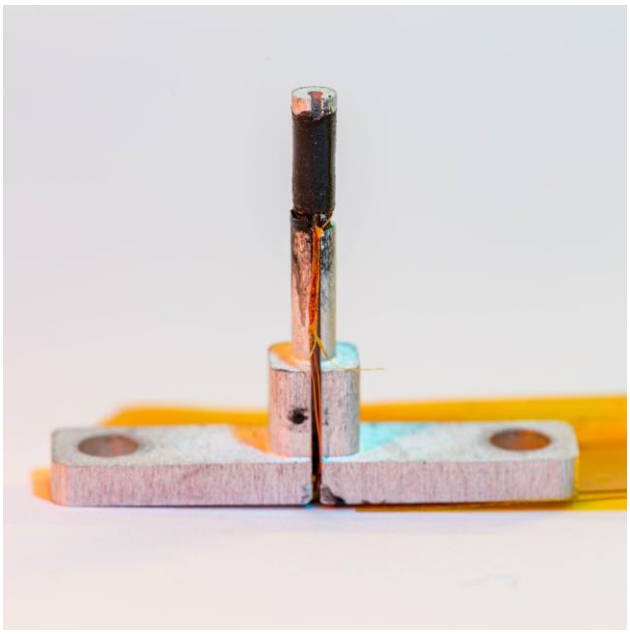

Figure 2: Picture of the flux hose