Direct detection of quasiparticle tunneling with a charge-sensitive transmon coupled to a waveguide

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Abstract

Non-equilibrium quasiparticles [1] generated by the absorption of high-energy radiation can influence the dynamics of superconducting quantum devices [2]. In this study, we investigate the statistics of quasiparticle tunneling events in a charge-sensitive transmon qubit, strongly coupled to a waveguide [3]. A second charge-insensitive qubit, coupled to the same waveguide, is used to measure the temperature of the radiation field at the qubit frequency [4]. In addition, by implementing careful infrared filtering and shielding, we observe a clear reduction in quasiparticle tunneling rates, demonstrating the effectiveness of these techniques in mitigating quasiparticle-induced effects. This multi-sensor approach provides a pathway for optimizing filtering and shielding strategies to improve the performance of superconducting quantum processors.

References

[1] Leonid I. Glazman et al., SciPost Physics Lecture Notes (2021)
[2] R. T. Gordon et al., Applied Physics Letters, Issue 7 (2022)
[3] Kazi R. Amin, arXiv:2404.01277 [quant-ph] (2024)
[4] Marco Scigliuzzo, Physical Review X, Issue 4 (2020)

Figures

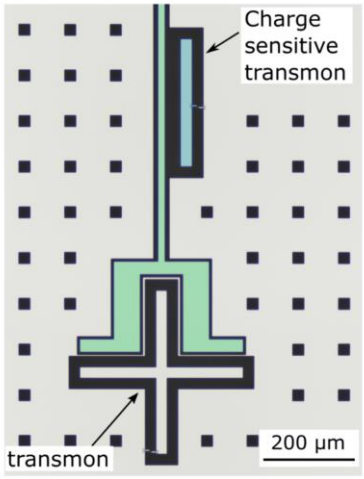

Figure 1: Micrograph of the device containing the charge sensitive quasiparticle detector and the transmon qubit acting as a radiation field thermometer.

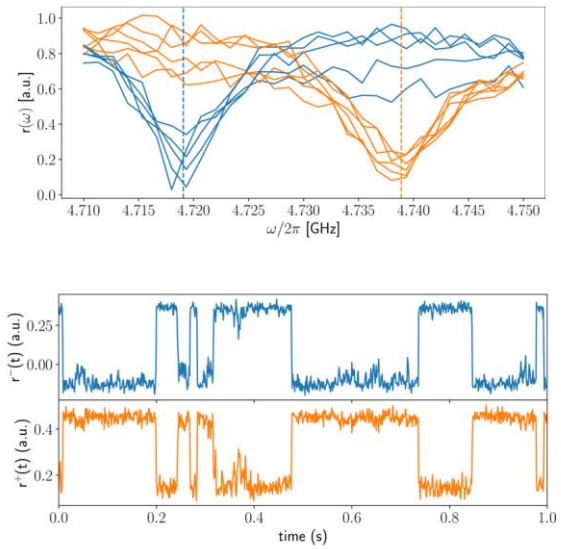

Figure 2: Charge parity switching in the frequency domain (top) and time response (bottom) of the quasiparticle detector, in which both parity states can be seen and monitored in real time.