TUNABLE ELECTROMAGNETIC ENVIRONMENT OF A SUPERCONDUCTING RESONATOR REALIZED THROUGH A QUANTUM-CIRCUIT REFRIGERATOR

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Quantum electric circuits enable precise control and manipulation of quantum degrees of freedom not available in the classical regime. In particular, superconducting circuits provide a scalable platform for quantum computing and simulations. We have recently demonstrated a quantum-circuit refrigerator (QCR) [1] in which we directly cool a superconducting resonator mode, and subsequently show that the QCR can be utilized as a cryogenic photon source [2]. Here, we present our latest study (Fig. 1 a—d) [3] of in-situ control of the strength of dissipation in a superconducting resonator using a QCR, revealed through a microwave reflection experiment. Coherent photons injected through a coplanar waveguide transmission line coupled to the resonator probe the remarkable controllability of the electromagnetic properties of the superconducting circuit, all through simple tuning of the dc operation voltage of the QCR. Namely, we show experimental data of the effective internal quality factor of the superconducting resonator as a function of the QCR bias voltage.

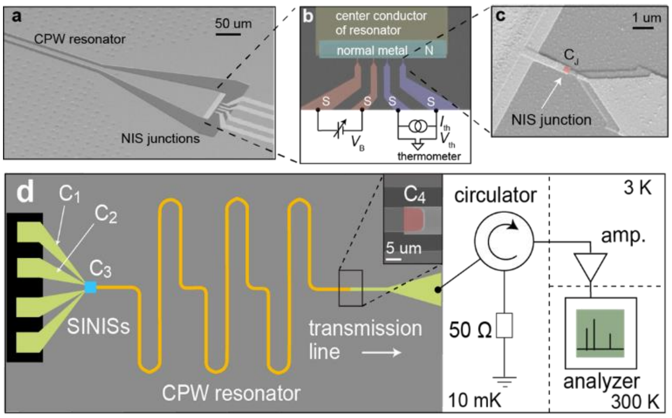

Fig. 1. Sample structure. **a-c** Micrographs of the sample. **d** Schematic diagram of the cryogenic photon source and the measurement scheme.

[1] K. Y. Tan, M. Partanen, R. E. Lake, J. Govenius, S. Masuda, and M. Möttönen, arXiv:1606.04728 (2016).
[2] S. Masuda, K. Y. Tan, M. Partanen, R. E. Lake, J. Govenius, M. Silveri, H. Grabert, and M. Möttönen, arXiv:1612.04160 (2016).
[3] S. Masuda, K. Y. Tan, M. Partanen, R. E. Lake, J. Govenius, M. Silveri, H. Grabert, and M. Möttönen, in preparation (2017).