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Robustness of superconducting quantum modes against direct quasiparticle injection U. PATEL, Department of Physics, University of Wisconsin, Madison, Wisconsin 53706, I. NSANZINEZA, Department of Physics, Syracuse University, Syracuse, New York 13244, M. G. VAVILOV, Department of Physics, University of Wisconsin, Madison, Wisconsin 53706, B. L. T. PLOURDE, Department of Physics, Syracuse University, Syracuse, New York 13244, R. MCDERMOTT, Department of Physics, University of Wisconsin, Madison, Wisconsin 53706 — Classical Josephson digital logic based on Single Flux Quantum (SFQ) pulses offers a path to high-fidelity coherent control of large-scale superconducting quantum machines. However, an SFQ pulse driver generates nonequilibrium quasiparticles that contribute to qubit relaxation, and steps must be taken to protect the qubit from this decoherence channel. Here we describe experiments to characterize the robustness of high-Q superconducting linear resonators and qubits against direct quasiparticle injection. We use NIS junctions and SFQ elements to controllably inject quasiparticles into the groundplane of superconducting resonator and qubit chips, and we characterize the quasiparticle contribution to dissipation. We examine the effectiveness of groundplane cuts, normal metal quasiparticle traps, and spatially-varying superconducting gaps at protecting the quantum modes against quasiparticle loss. Finally, we discuss strategies for the integration of multiqubit circuits with on-chip SFQ control elements.

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