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Fast Resonator Depopulation with a Simple Measurement Pulse Shape[1] DOUGLAS MCCLURE, HANHEE PAIK, LEV S. BISHOP, JAY GAMBETTA, MATTHIAS STEFFEN, JERRY CHOW, IBM Research — Recent innovations have enabled fast, accurate qubit readout in the circuit QED architecture, but often it is also important to quickly return the readout resonator to its ground state afterward: any residual photons continue to measure and Stark-shift the qubit, preventing high-fidelity gates. Simply waiting several times the resonator decay constant is inadequate for multi-qubit operations in which some qubits need to be measured and reused while others remain in superpositions, which would lose coherence during this time. Here we demonstrate fast, qubit-state-independent resonator reset using a readout pulse with a simple piecewise-constant envelope. The pulse differs from a square pulse only by the addition of two segments at the end, whose width and amplitude depend on the resonator linewidth and qubit-resonator coupling strength. To quantify the effectiveness of the pulse at resetting the cavity, we extract the residual photon population using a Ramsey experiment performed shortly after the pulse. Comparing the result to that obtained using a square pulse followed by a delay of the same length as the extra segments, we find that the extra segments shorten the total wait time needed to recover high qubit coherence by about 300 ns, more than twice the cavity time constant.

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