Abstract Submitted
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Observing quantum jumps of a transmon qubit with a Josephson parametric converter[1] S. SHANKAR, M. HATRIDGE, F. SCHACKERT, K. GEERLINGS, T. BRECHT, K. SLIWA, B. ABDO, L. FRUNZIO, R.J. SCHOELKOPF, M.H. DEVORET, Applied Physics Dept., Yale University — A high fidelity linear quantum non-demolition (QND) readout of a superconducting qubit opens up the possibility of observing quantum jumps and is a prerequisite for quantum feedback and error correction. This readout is challenging since the qubit, the readout resonator and the following amplifier chain have to be simultaneously optimized to achieve the desired performance. We fabricated a superconducting transmon qubit at 5.7 GHz coupled to a compact resonator at 7.5 GHz, designed to produce a dispersive shift (χ) of 6 MHz of the resonator frequency when the qubit is excited. The resonator linewidth matches χ to produce maximum readout contrast in a transmission measurement, while maintaining a Purcell limited T_1 of about 3 μs. Using a Josephson parametric converter that is tuned to match the resonator frequency, we achieved a system noise temperature of the following amplifier chain of about 0.5 K, roughly thrice the standard quantum limit. Using these optimized parameters, we measured the qubit state with about 5 photons in the readout resonator and observed quantum jumps with fidelity above 90 %. Further, by looking at the statistics of the jumps and the evolution of the qubit population in single shot traces, we find that the average qubit T_1 during the readout matches the Purcell limited T_1, as expected for a QND measurement.

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S. Shankar
Applied Physics Dept., Yale University

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