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Utilizing photon number parity measurements to demonstrate quantum computation with cat-states in a cavity A. PETRENKO, N. OFEK, B. VLASTAKIS, Yale University, L. SUN, Yale University; Tsinghua University, Beijing, China, Z. LEGHTAS, R. HEERES, K.M. SLIWA, Yale University, M. MIRRAHIMI, Yale University; INRIA Paris-Rocquencourt, L. JIANG, M.H. DEVORET, R.J. SCHOELKOPF, Yale University — Realizing a working quantum computer requires overcoming the many challenges that come with coupling large numbers of qubits to perform logical operations. These include improving coherence times, achieving high gate fidelities, and correcting for the inevitable errors that will occur throughout the duration of an algorithm. While impressive progress has been made in all of these areas, the difficulty of combining these ingredients to demonstrate an error-protected logical qubit, comprised of many physical qubits, still remains formidable. With its large Hilbert space, superior coherence properties, and single dominant error channel (single photon loss), a superconducting 3D resonator acting as a resource for a quantum memory offers a hardware-efficient alternative to multi-qubit codes [Leghtas et.al. PRL 2013]. Here we build upon recent work on cat-state encoding [Vlastakis et.al. Science 2013] and photon-parity jumps [Sun et.al. 2014] by exploring the effects of sequential measurements on a cavity state. Employing a transmon qubit dispersively coupled to two superconducting resonators in a cQED architecture, we explore further the application of parity measurements to characterizing such a hybrid qubit/cat state architecture. In so doing, we demonstrate the promise of integrating cat states as central constituents of future quantum codes.

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