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Quantum Non-Demolition Singleshot Parity Measurements for a Proposed Quantum Error Correction Scheme ANDREI PETRENKO, LUYAN SUN, ZAKI LEGHTAS, BRIAN VLASTAKIS, GERHARD KIRCHMAIR, KATRINA SLIWA, ANIRUDH NARLA, MICHAEL HATRIDGE, SHYAM SHANKAR, JACOB BLUMOFF, LUIGI FRUNZIO, Yale Univ. Depts. of Applied Physics and Physics, MAZYAR MIRRAHIMI, INRIA Paris-Rocquencourt, MICHEL DEVORET, Yale Univ. Depts. of Applied Physics and Physics, ROBERT SCHOELKOPF, Yale University Departments of Applied Physics and Physics — In order to be effective, a quantum error correction scheme(QEC) requires measurements of an error syndrome to be Quantum Non-Demolition (QND) and fast compared to the rate at which errors occur. Employing a superconducting circuit QED architecture, the parity of a superposition of coherent states in a cavity, or cat states, is the error syndrome for a recently proposed QEC scheme. We demonstrate the tracking of parity of cat states in a cavity and observe individual jumps of party in real-time with singleshot measurements that are much faster than the lifetime of the cavity. The projective nature of these measurements is evident when inspecting individual singleshot traces, yet when averaging the traces as an ensemble the average parity decays as predicted for a coherent state. We find our protocol to be 99.8% QND per measurement, and our sensitivity to parity jumps to be very high at 96% for an average photon number $\bar{n} = 1$ in the cavity (85% for $\bar{n} = 4$). Such levels of performance can already increase the lifetime of a quantum bit of information, and thereby present a promising step towards realizing a viable QEC scheme.

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