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Demonstrating real-time feedback that enhances the performance of measurement sequence with cat states in a cavity N. OFEK, A. PETRENKO, Y. LIU, 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 — Real-time feedback offers not just the convenience of streamlined data acquisition, but is an essential element in any quantum computational architecture that requires branching based on measurement outcomes. State-preparation, mitigating the effects of qubit decoherence, and recording the trajectories of quantum systems are just a few of the many potential applications of real-time feedback. Photon number parity measurements of cat states in superconducting resonators are a particularly useful platform for demonstrating the clear advantages of having sophisticated feedback schemes to enhance the performance a proposed error-correction protocol [Leghtas et.al. PRL 2013]. In a cQED architecture, where a transmon qubit is coupled to two superconducting cavities, we present a field-programmable gate array (FPGA) device capable of making decisions and calculations with latency times far shorter than the lifetimes of any of the system's constituents. This level of performance opens the door to realizing many complex, previously unfeasible, experiments in superconducting qubit systems.

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