MAR15-2014-020093

Abstract for an Invited Paper
for the MAR15 Meeting of
the American Physical Society

Tracking a Quantum Error Syndrome in Real Time: Quantum Jumps of Photon Parity[1]

ROBERT SCHOELKOPF, Yale University

Dramatic progress has been made in the last decade and a half towards realizing solid-state systems for quantum information processing with superconducting quantum circuits. Artificial atoms (or qubits) based on Josephson junctions have improved their coherence times more than 100,000-fold, have been entangled, and used to perform simple quantum algorithms. The next challenge for the field is demonstrating quantum error correction that actually improves the lifetimes, a necessary step for building more complex systems. I will describe recent experiments with superconducting circuits, where we store quantum information in the form of Schrodinger cat states of a microwave cavity, containing up to 100 photons. Using an ancilla qubit, we then monitor the gradual death of these cats, photon by photon, by observing the first jumps of photon number parity. This represents the first continuous observation of a quantum error syndrome, and may enable new approaches to quantum information based on photonic qubits. The performance of this error-monitoring system and the prospects for reaching "breakeven," where quantum error correction improves the lifetime of stored information, will be discussed.

[1]This worked performed with many collaborators at Yale University, and supported by the Army Research Office, the Laboratory for Physical Science, and the NSF.