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Reducing the impact of intrinsic dissipation in a superconducting circuit by quantum error detection YOUPENG ZHONG, ZONGLI WANG, HAOHUA WANG, Zhejiang Univ., China, JOHN M. MARTINIS, ANDREW N. CLELAND, UC Santa Barbara, USA, ALEXANDER N. KOROTKOV, UC Riverside, USA — A fundamental challenge for quantum information processing is reducing the impact of environmentally-induced errors. Quantum error detection and rejection (QEDR) provides one approach to handling such errors, in which errors are rejected when they are detected. Here we demonstrate a QEDR protocol based on the idea of quantum un-collapsing, using this protocol to suppress energy relaxation due to the environment in a three-qubit superconducting circuit. We encode quantum information in a target qubit, and use the other two qubits to detect and reject errors caused by energy relaxation. This protocol improves the storage time of a quantum state by a factor of roughly three, at the cost of a reduced probability of success. This constitutes the first demonstration of the extension of the effective lifetime of a quantum state using a quantum protocol. Using a similar protocol and a four-qubit superconducting circuit, we further demonstrate the protection of Bell-state entanglement against energy relaxation.

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