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Demonstration of Shor encoding on a trapped-ion quantum computer NHUNG NGUYEN, Joint Quantum Institute, Department of Physics, University of Maryland, College Park, MD 20742, USA, KEN BROWN, Departments of Electrical and Computer Engineering, Chemistry, and Physics, Duke University, Durham, NC 27708, USA, DAIWEI ZHU, CINTHIA ALDERETE, CHRIS MONROE, NORBERT LINKE, Joint Quantum Institute, Department of Physics, University of Maryland, College Park, MD 20742, USA — Quantum error correction is crucial for constructing a fault-tolerant quantum computer. By employing redundancy, error-correcting codes protect logical qubits against errors at the physical-qubit-level during state preparation, operations and measurement. Here we demonstrate an encoding of a logical qubit with the Shor code, which detects and corrects single-qubit bit-flip and phase-flip errors, on a trapped ion system. Using nine physical qubits, we prepare a logical state 0 with 98.75% fidelity and a logical state 1 with 98.51% fidelity after correction with majority voting. We further investigate the robustness of the logical qubit and shows data extrapolating its performance to deeper encodings.

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