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Protecting a Bosonic Qubit with Autonomous Quantum Error Correction

To make a universal quantum computer, we need an effective method for combining short-lived physical qubits into redundant encodings where quantum error correction (QEC) is possible. Existing demonstrations of QEC, based on active error syndrome measurements and adaptive recovery operations, are susceptible to additional errors and are hardware intensive. Using reservoir engineering, we construct a dissipative operator, acting on a multiphoton bosonic qubit, that corrects the dominant error of the system: single photon loss. This operator, Parity Recovery by Selective Photon Addition (PReSPA), which stabilizes the even-number fock state manifold, can be used for autonomous quantum error correction (AQEC).