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Autonomous Quantum Error Correction with Application to Quantum Metrology FLORENTIN REITER, Harvard University, ANDERS S. SORENSEN, Niels Bohr Institute, University of Copenhagen, PETER ZOLLER, CHRISTINE A. MUSCHIK, Institute for Quantum Optics and Quantum Information of the Austrian Academy of Sciences and University of Innsbruck — We present a quantum error correction scheme that stabilizes a qubit by coupling it to an engineered environment which protects it against spin- or phase flips. Our scheme uses always-on couplings that run continuously in time and operates in a fully autonomous fashion without the need to perform measurements or feedback operations on the system. The correction of errors takes place entirely at the microscopic level through a build-in feedback mechanism. Our dissipative error correction scheme can be implemented in a system of trapped ions and can be used for improving high precision sensing. We show that the enhanced coherence time that results from the coupling to the engineered environment translates into a significantly enhanced precision for measuring weak fields. In a broader context, this work constitutes a stepping stone towards the paradigm of self-correcting quantum information processing.

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