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Error threshold for the surface code in a superohmic environment[1] DANIEL A. LOPEZ-DELGADO, Universidade Estadual de Campinas - Brazil, E. NOVAIS, Universidade Federal do ABC - Brazil, EDUARDO R. MUCCIOLO, University of Central Florida, AMIR O. CALDEIRA, Universidade Estadual de Campinas - Brazil — Using the Keldysh formalism, we study the fidelity of a quantum memory over multiple quantum error correction cycles when the physical qubits interact with a bosonic bath at zero temperature. For encoding, we employ the surface code, which has one of the highest error thresholds in the case of stochastic and uncorrelated errors. The time evolution of the fidelity of the resulting two-dimensional system is cast into a statistical mechanics phase transition problem on a three-dimensional spin lattice, and the error threshold is determined by the critical temperature of the spin model. For superohmic baths, we find that time does not affect the error threshold: its value is the same for one or an arbitrary number of quantum error correction cycles.

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