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Surface code fidelity decay in the presence of a bosonic bath PEJMAN JOUZDANI, EDUARDO MUCCIOLO, University of Central Florida, EDUARDO NOVAIS, Universidade Federal do ABC (Brazil) — The surface code is a promising quantum computing environment that provides topological protection against errors, ensuring that the distance of the code grows as the physical sizes of the system increases. It has been recently proposed that a surface code in contact with a bosonic bath experiences an effective evolution that induces an constrained Ising-like interaction between qubits. As the coupling to the bosonic bath increases, the system may undergo a transition where the fidelity decays substantially after one quantum error correction cycle even for non-error syndromes. We investigate the manifestation of such a transition by evaluating numerically the fidelity of a surface code qubit system with the proposed Ising interaction. We carry out exact calculations for small systems and perform a finite-size scaling analysis using a cluster mean-field approach. We find a significant change in the fidelity at coupling constant values compatible with the mean-field transition point. Calculations performed with complex coupling constants yield the same behavior for the fidelity.

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