Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Error-threshold for topological subsystem quantum error-correcting codes RUBEN S. ANDRIST, Department of Physics, ETH Zurich, HECTOR BOMBIN, Perimeter Institute for Theoretical Physics, MIGUEL ANGEL MARTIN-DELGADO, Departamento de Fisica, Universidad Complutense, HELMUT G. KATZGRABER, Department of Physics and Astronomy, Texas A&M University and ETH Zurich — In general, stability against noise in a quantum computer can be achieved by storing quantum information redundantly. For instance, topological quantum error correction averts decoherence effects by encoding qubits in non-local degrees of freedom, while actively correcting for local errors. The key merit of these topological stabilizer codes lies in the intrinsic locality of the operations for syndrome measurement and error correction. Topological subsystem codes further facilitate practical applications by requiring only measurements of adjacent qubit pairs. We numerically determine the error threshold of topological subsystem codes for the depolarizing channel by mapping the problem onto a classical statistical spin model with bond disorder, which is analyzed via large-scale Monte Carlo simulations. In this picture, faulty qubits correspond to antiferromagnetic interactions between classical spins and the point in the disorder–temperature phase diagram where ferromagnetic order is lost corresponds to the error threshold of the underlying quantum bit system.

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Date submitted: 11 Nov 2011 Electronic form version 1.4