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Resilience of Topological Codes to Depolarization 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, Texas A&M University & ETH Zurich — Standard error correction is based on redundant storage of quantum information. However, in topological quantum error correction decoherence effects are prevented by encoding logical qubits in nonlocal degrees of freedom, while actively correcting for errors that occur locally in the system. Previous studies have shown that the two hallmark topological codes—the toric code and color codes—are stable against bit-flip/phase-flip and measurement errors. In this work we study the effects of the depolarizing channel to both the toric code and topological color codes. By mapping the quantum problem onto a disordered statistical-mechanical 8-vertex model we compute the error tolerance of these systems using large-scale Monte Carlo simulations. Our results show that the error threshold increases significantly for both the toric code and color codes.

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