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Finite-size scaling of the decoherence time of the Toric Code in contact with a thermal reservoir C. DANIEL FREEMAN[1], Univeristy of California at Berkeley, CM HERDMAN[2], University of Vermont, DYLAN GORMAN[3], BIRGITTA WHALEY[4], Univeristy of California at Berkeley — We present an analysis of the finite-size scaling of the decoherence time of a topological qubit in contact with a thermal bath. While the relaxation time of the toric code at finite temperature in the thermodynamic limit has a system size independent bound, we find nontrivial finite-size scaling of the decoherence time in the low temperature crossover regime on a finite lattice. Using a continuous-time Monte Carlo method, we explicitly compute the low temperature nonequilibrium dynamics of the toric code on finite lattices. We demonstrate how this nontrivial finite-size scaling is governed by the scaling of topologically nontrivial 2D classical random walks. As this finite temperature scaling competes with the scaling of the robustness to unitary perturbations, this analysis may elucidate the scaling of decoherence times of possible physical realizations of topological qubits.

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