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Error threshold of topological color codes and random three-dimensional color gauge models MIGUEL A. MARTIN-DELGADO, Departamento de Fisica Teorica I, Universidad Complutense de Madrid, RUBEN S. ANDRIST, Department of Physics, ETH Zurich, HELMUT G. KATZGRABER, Department of Physics, Texas A & M University & ETH Zurich, HECTOR BOMBIN, Perimeter Institute for Theoretical Physics — Sensitivity to noise makes most of the current quantum computing schemes prone to error and non-scalable. Topologically-protected quantum computing solves this problem and prevents decoherence effects at the hardware level by encoding quantum states and gates in topological properties of the hardware medium. Recently, a braid-less implementation using brane-net condensates in 3-colexes has been proposed that allows for the implementation of a universal set of quantum gates. The latter is an active scheme for error correction. In this work, we compute the error threshold for a topologically-protected quantum color code in two space dimensions. By mapping the problem onto a new triangular/hexagonal lattice gauge theory with Ising spins and gauge degrees of freedom, we compute the stability of the proposal by randomly perturbing the plaquette interactions between the gauge spins and verifying the existence of a stable broken symmetry phase using Wilson loops.

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