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Error threshold in topological quantum-computing models with color codes HELMUT KATZGRABER, ETH Zurich, HECTOR BOMBIN, MIGUEL A. MARTIN-DELGADO, Departamento de Fisica Teorica I, Facultad de Ciencias Fisicas, Universidad Complutense de Madrid, Spain — Dealing with errors in quantum computing systems is possibly one of the hardest tasks when attempting to realize physical devices. By encoding the qubits in topological properties of a system, an inherent protection of the quantum states can be achieved. Traditional topologically-protected approaches are based on the braiding of quasiparticles. Recently, a braid-less implementation using brane-net condensates in 3-colexes has been proposed. In 2D it allows the transversal implementation of the whole Clifford group of quantum gates. In this work, we compute the error threshold for this topologically-protected quantum computing system in 2D, by means of mapping its error correction process onto a random 3-body Ising model on a triangular lattice. Errors manifest themselves as random perturbation of the plaquette interaction terms thus introducing frustration. Our results from Monte Carlo simulations suggest that these topological color codes are similarly robust to perturbations as the toric codes. Furthermore, they provide more computational capabilities and the possibility of having more qubits encoded in the quantum memory.

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