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Computing error thresholds in topological quantum-computing models using exact zero-temperature algorithms CREIGHTON K. THOMAS, Department of Physics, Texas A&M University, HELMUT G. KATZGRABER, Department of Physics, Texas A&M University & ETH Zurich, HECTOR BOMBIN, Perimeter Institute for Theoretical Physics, MIGUEL ANGEL MARTIN-DELGADO, Departamento de Fisica, Universidad Complutense — Efficient error correction in quantum computing devices may be achieved by using topological codes that encode information in the hardware of the medium. Topological color codes allow for a braid-less implementation of the whole Clifford group. It is therefore of interest to understand the error stability of these proposals. In two space dimensions, the topological error correction process is mapped onto a 3-body Ising model on a two-dimensional triangular lattice. Errors correspond to local sign changes of the plaquette interactions, thus introducing disorder and frustration between the spins. Finite-temperature simulations are difficult. Furthermore, it is unclear if the phase diagram exhibits reentrance, where the critical error concentration decreases as the temperature is lowered from the tricritical point. To address these issues, we have developed an exact ground state algorithm to find the error threshold of this model at zero temperature. Numerical results on the triangular lattice are presented and compared to finite-temperature Monte Carlo simulations.

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