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String localization and delocalization in the disordered toric code[1]

PEJMAN JOUZDANI, EDUARDO R. MUCCIOLO, Department of Physics, University of Central Florida — Topological quantum memories based on the toric code model have the ability to protect quantum information by self correcting a large class of errors. However, excitations such as a string of spin flips, when allowed to perform a quantum walk, can change the logical state encoded in the system every time they wind around the torus. It has been proposed that by adding randomness to the local spin exchange couplings, one can localize these string excitations and avoid logical errors. In our work, we investigate this proposal numerically through the use of an efficient time-dependent numerical quantum evolution method. We determine the dependence of the winding time on the torus size and on the amount of randomness. We study the effect of dephasing in the quantum evolution of the string excitations and show that a transition to delocalization can occur.

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