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Simulating the Transverse Ising Model on a Quantum Computer: Error Correction with the Surface Code HAO YOU, MICHAEL GELLER, PHILLIP STANCIL, Department of Physics and Astronomy, University of Georgia
— We estimate the resource requirements for the quantum simulation of the ground state energy of the one-dimensional quantum transverse Ising model (TIM), based on the surface code implementation of a fault-tolerant quantum computer. The surface code approach has one of the highest known tolerable error rates ($\sim$1%) which makes it currently one of the most practical quantum computing schemes. Compared to results of the same model using the concatenated Steane code, the current results indicate that the simulation time is comparable but the number of physical qubits for the surface code is 1-2 orders of magnitude larger than that of the concatenation code. Considering that the error threshold requirements of the surface code is four orders of magnitude higher than the concatenation code, building a quantum computer with a surface code implementation appears more promising given current physical hardware capabilities. We would like to acknowledge valuable discussions with Joydip Ghosh, Matteo Mariantoni, Andrew Sornborger, James Whitfield and Zhongyuan Zhou. This work was supported by the National Science Foundation through grant CDI 1029764.

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