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Towards scalable quantum simulation of spin models with trapped ions E.E. EDWARDS, R. ISLAM, S. KORENBLIT, K. KIM, M.-S. CHANG, C. MONROE, Joint Quantum Institute, University of Maryland Department of Physics and National Institute of Standards and Technology, College Park, Maryland 20742, G.-D. LIN, L.-M. DUAN, MCTP, Department of Physics, University of Michigan, Ann Arbor, Michigan 48109, C. NOH, H. CARMICHAEL, Department of Physics, University of Auckland, Private Bag 92019, Auckland, NZ, C.-C. WANG, J. FREERICKS, Department of Physics, Georgetown University, Washington DC 20057, USA — We simulate the long-range transverse field Ising model using a collection of trapped ions. The phase diagram contains features such as quantum phase transitions and first order transitions due to frustration. In order to extend this quantum simulation to larger systems and other spin models, we must understand and minimize errors. One of the primary sources of error is unwanted scattering due to spontaneous emission and can be reduced by engineering the Hamiltonian using a far-detuned, pulsed laser system. This improvement paves the way for experiments with a greater number of spins where classical simulations of certain forms of the Ising model become intractable. This work is supported by grants from the U.S. Army Research Office with funding from the DARPA OLE program, IARPA, and the MURI program; the NSF PIF Program; the NSF Physics Frontier Center at JQI; and the European Commission AQUTE program.

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