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Quantum simulation of the transverse field antiferromagnetic Ising model with trapped ions SIMCHA KORENBLIT, WES CAMPBELL, EMILY EDWARDS, Joint Quantum Institute, University of Maryland- College Park, ZHEXUAN GONG, University of Michigan, Ann Arbor, DVIR KAFRI, KI-HWAN KIM, RAJIBUL ISLAM, AARON LEE, JACOB SMITH, Joint Quantum Institute, University of Maryland- College Park, JOSEPH WANG, Georgetown University, LUMING DUAN, University of Michigan, Ann Arbor, JIM FREERICKS, Georgetown University, JUNGSANG KIM, Duke University, CHRIS MONROE, Joint Quantum Institute, University of Maryland- College Park — We simulate a long range quantum Ising model with a chain of Yb-171+ ions, with two ground states in the hyperfine manifold representing the spin-1/2 states. The Ising interactions are generated by phonon mediated stimulated Raman excitations, and can be tuned in strength and sign by selectively controlling the coupling to various vibrational normal modes. We have recently observed emergence of a quantum phase transition and ferromagnetism due to the interplay of Ising interactions and an effective transverse magnetic field. In our current effort, we simulate long range antiferromagnetic couplings which potentially lead to spin frustration, and investigate the nature of spin ordering as we vary the range of the interaction. We are also investigating the generation of more exotic Ising graphs, even in 2D, by controlling the spectrum of the Raman lasers.

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