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Phonon Effects on Trapped Ion Quantum Simulators JEFFREY COHN, JAMES FREERICKS, Georgetown University — Trapped ion quantum simulators are beginning to scale in size further than the ability of classical computers to efficiently benchmark results. Nevertheless, if one examines a ferromagnetic coupling between spins, with an all-to-all coupling in a transverse field Ising model, then the system has extra symmetry, which allows simulators with 100s of spins to be described with a classical computer. Here, we examine the laser-driven coupling betweena center-of-mass (COM) phonon and the spins, which produces such an all-to-all coupling for the effective spin model, when one is detuned to the blue of the COM mode.We examine the full time dependence for different ramping profiles of the transverse field including a shortcut to adiabaticity called the bang-bang protocol. Our results show that keeping track of real phonon creation and the resultant phonon-spin entanglement, actually helps the system to be described by a static Ising model. But, this comes at a price. While the probabilities for the final state to be in the ground state improve over what is seen in a time-dependent spin system, the spin entanglement in the ground state is suppressed, when the phonons are not explicitly measured.

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