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A quantum phase transition in a quantum external field: The formation of a Schrodinger magnet[1] BOGDAN DAMSKI, Los Alamos National Laboratory, MAREK RAMS, University of Vienna, MICHAEL ZWOLAK, Oregon State University — Recent developments in manipulations of trapped ions allow for simulation of various spin models in ion chains (S. Korenblit et al., e-print arXiv:1201.0776). This motivates our work on novel types of quantum phase transitions, whose experimental studies could not have been performed in traditional condensed matter systems due to insufficient level of control. We focus on an Ising lattice undergoing a quantum phase transition in a quantum magnetic field. Such a field can be emulated by coupling the lattice to a central spin initially in a superposition state. We show that, by adiabatically driving such a system, one can prepare a quantum superposition of any two ground states of the Ising lattice. In particular, one can end up with the Ising lattice in a superposition of ferromagnetic and paramagnetic phases, a scenario with no analogue in prior studies of quantum phase transitions. Remarkably, the resulting magnetization of the lattice encodes the position of the critical point and universal critical exponents, as well as the ground state fidelity. The model that we study can be emulated in an ion chain. This research is summarized in M.M. Rams, M. Zwolak, and B. Damski, arXiv:1201.1932 (2012).

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