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Quantum measurement-based feedback simulation of complex dynamics of mean-field p-spin models[1] MANUEL MUNOZ-ARIAS, PABLO POGGI, Center for Quantum Information and Control, University of New Mexico, POUL JESSEN, College of Optical Sciences, University of Arizona , IVAN DEUTSCH, Center for Quantum Information and Control, University of New Mexico — We study a method for simulating the nonlinear dynamics of many-body spin systems based on measurement-based feedback. We focus on p-spin models describing an Ising-like model on a completely connected graph with p-body interactions. These models exhibit diverse critical phenomena. For $p = 2$ this recovers the Lipkin-Meshkov-Glick (LMG) model, exhibiting a continuous second-order phase transition between paramagnetic and ferromagnetic phases. For $p > 2$, the phase transition is a first order and discontinuous. Our protocol considers the collective spin of an ensemble on N qubits, and approximates the dynamics by weakly measuring one projection of the collective spin, followed by unitary evolution conditioned on the measurement outcome [1]. We numerically explore a variety of dynamical properties of phase transitions for different values of p, including our ability to recover the mean-field dynamics, and aspects of spontaneous symmetry breaking induced by the measurement. We characterize the simulated behavior in terms of the number of particles N, and study how the dynamics approaches the classical limit. Finally, we propose a possible experimental implementation of our p-spin simulation using an atom-light interface. [1] Munoz-Arias et al., arXiv:1907.12606

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