Abstract Submitted
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Emergent equilibrium in many-body optical bistability[1] MICHAEL FOSS-FEIG, Army Research Laboratory, PRADEEP NIROULA, Harvard University, JEREMY YOUNG, MOHAMMAD HAFEZI, ALEXEY GORSHKOV, Joint Quantum Institute, RYAN WILSON, United States Naval Academy, MOHAMMAD MAGHREBI, Michigan State University — Many-body systems constructed of quantum-optical building blocks can now be realized in experimental platforms ranging from exciton-polariton fluids to Rydberg gases, establishing a fascinating interface between traditional many-body physics and the non-equilibrium setting of cavity-QED. At this interface the standard intuitions of both fields are called into question, obscuring issues as fundamental as the role of fluctuations, dimensionality, and symmetry on the nature of collective behavior and phase transitions. We study the driven-dissipative Bose-Hubbard model, a minimal description of atomic, optical, and solid-state systems in which particle loss is countered by coherent driving. Despite being a lattice version of optical bistability–a foundational and patently non-equilibrium model of cavity-QED–the steady state possesses an emergent equilibrium description in terms of an Ising model. We establish this picture by identifying a limit in which the quantum dynamics is asymptotically equivalent to non-equilibrium Langevin equations, which support a phase transition described by model A of the Hohenberg-Halperin classification. Simulations of the Langevin equations corroborate this picture, producing results consistent with the behavior of a finite-temperature Ising model.

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