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Autonomous Stabilization of Photonic Many-Body Systems
BRENDAN SAXBERG, University of Chicago — Synthetic photonic systems are a promising platform for studying strongly interacting and highly correlated quantum materials. These systems pose a challenge for preparing finite photon-number states. Here we present on an autonomous stabilization scheme for incompressible photonic many-body states at non-zero chemical potential. The scheme is analogous to optical pumping - a single lattice site (qubit) is continuously driven to the second excited state and quickly loses a photon through coupling to a lossy resonator, stabilizing the qubit in the first excited state. Coupling this site to a larger target system fills the many-body system up to a target state if the system is incompressible w.r.t. particle number. We present numerical and experimental results on stabilizing a Mott Insulator phase in an eight-site Bose-Hubbard lattice implemented in the Circuit QED framework. We then investigate stabilization performance with two or more lattice sites being stabilized, and stabilization of different many-body systems. This work provides a potential route to topologically protected states, for example in a topological microwave cavity lattice with qubit mediated interactions.

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