Abstract Submitted
for the DAMOP17 Meeting of
The American Physical Society

Autonomous Stabilizer for Photonic Many-Body States BRENDAN SAXBERG, ALEX MA, CLAI OWENS, AMAN LACHAPELLE, DAVID SCHUSTER, JON SIMON, University of Chicago — Synthetic photonic systems are a promising platform for new physics in the regime of strongly interacting and highly correlated quantum materials. However, controlled population of system Hamiltonians in the absence of particle number conservation remains challenging. Here we present an autonomous thermalizer for incompressible photonic quantum materials at non-zero chemical potential to stabilize these photonic many-body states. The thermalizer is comprised of a pumping and a lossy site, where photons can spontaneously thermalize to the ground state of the lattice when driven on the pumping site and excess energy is dissipated via the lossy site. Using the Circuit QED platform, we connect our autonomous thermalizer to a one-dimensional lattice of coupled superconducting qubits and demonstrate a Mott Insulating phase of light in a strongly interacting Bose-Hubbard chain. This work explores a new approach for preparation of quantum many-body photonic phases, and provides a potential route to topologically protected states, for example in a topological microwave cavity lattice with qubit mediated interactions.

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Date submitted: 29 Jan 2017 Electronic form version 1.4