Abstract Submitted
for the DAMOP17 Meeting of
The American Physical Society

Towards a photonic Mott insulator in superconducting circuits RUICHAO MA, CLAI OWENS, BRENDAN SAXBERG, AMAN LACHAPELLE, DAVID SCHUSTER, JONATHAN SIMON, University of Chicago — Recent developments in circuit QED provide superconducting circuits as a unique platform for exploring quantum many-body phenomena with light. The absence of particle number conservation, however, makes creating and understanding of many-body photonic states challenging. Here we make a one-dimensional lattice of coupled superconducting qubits with an additional pumping site and a lossy site incorporated at the end of the chain, which serves as an effective chemical potential for photons. When driven on the pumping site, the photons can spontaneously thermalize into the ground state of the lattice while the excess energy is dissipated via the lossy site. In the presence of strong photon-photon interaction via the qubit non-linearity, we expect the creation of a Mott insulator state of light, which we can probe with temporal- and spatially-resolved measurements. The performance of such an autonomous stabilizer can be compared to both analytical and numerical results from a simple model. These experiments will give insights to the microscopic investigation of non-equilibrium thermodynamics in strongly-interacting quantum system, including the interplay between external driving and dissipation. The work also provides a new approach to preparation of more exotic quantum photonic states.

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Date submitted: 29 Jan 2017 Electronic form version 1.4