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Stabilizing a Quantum Photonic Many-Body State BRENDAN SAXBERG, RUICHAO MA, CLAI OWENS, DAVID SCHUSTER, JONATHAN 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. We build a 1D Bose-Hubbard lattice for photons where capacitively coupled transmon qubits serve as lattice sites and the transmon's anharmonicity mediates strong photon-photon interactions. However, loss present in photonic platforms makes many-body quantum state preparation on large systems problematic. To solve this we use reservoir engineering. We couple our lattice to an autonomous stabilizer – a lattice site (coupled to a resonator) that is continuously driven into the n=1 excited state. This scheme stabilizes the Mott phase, and indeed any many-body target state, so long as the phases are incompressible with respect to photon number. Individual readout resonators allow site-, time-, and occupancy-resolved microscopy of the photonic lattice. Recent improvements to our experiment will allow multi-site correlation measurements - potentially revealing the intricate interplay of correlations, entanglement and thermalization in these driven-dissipative systems.

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