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Exploring synthetic quantum matter in superconducting circuits RUICHAO MA, BRENDAN SAXBERG, CLAI OWENS, DAVID SCHUSTER, JONATHAN SIMON, University of Chicago — Superconducting circuits have emerged as a competitive platform for quantum computation because they offer controllability, long coherence times and strong interactions. Here we apply this toolbox to explore strongly correlated quantum matter by building a BoseHubbard lattice for photons in the strongly interacting regime. We develop a versatile method to prepare incompressible many-body phases using engineered dissipation and apply it to our system to stabilize a Mott insulator of photons against losses. Site- and time-resolved readout of the lattice allows us to investigate the microscopic details of the thermalization process through the dynamics of defect propagation and removal in the Mott phase. Our experiments demonstrate the power of superconducting circuits for studying strongly correlated matter in both coherent and engineered dissipative settings. Future prospects include the exploration of strongly correlated topological matter and quantum thermodynamics.

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