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Quantum Simulation with Superconducting Circuits

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Superconducting circuits and circuit quantum electrodynamics provide an excellent toolbox for non-equilibrium quantum simulation. In circuit QED, the strong interaction of light with a single qubit can lead to strong qubit-mediated photon-photon interactions. Recent theoretical proposals have predicted phase transitions in arrays of these cavities, demonstrating that complex matter-like phenomena can emerge with such interacting photons. Due to inevitable photon dissipation and the ease of adding photons through driving, these systems are fundamentally open and a useful tool for studying non-equilibrium physics. I will discuss recent experimental and theoretical progress towards realization of these non-equilibrium quantum simulators, including a localization-delocalization crossover in a pair of coupled cavities and preliminary measurements of large cavity arrays. I will show a variety of available measurements in these systems, including transport, photon number statistics, and a scanned local quantum probe.