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Simulation of a Non-Equilibrium Localization Transition of Photons in a Superconducting Circuit-QED Dimer DARIUS SADRI, JAMES RAFTERY, ANDREW HOUCK, HAKAN TURECI, Princeton University, SEBASTIAN SCHMIDT, ETH Zurich, DEVIN UNDERWOOD, WILL SHANKS, SRIKANTH SRINIVASAN, MIKOLA BORDYUH, Princeton University — The exponential scaling of Hilbert space dimension with number of quantum degrees of freedom, while serving as a resource for quantum computation, makes simulation of large quantum systems on classical computers prohibitive, particularly when interactions with an environment are included. Quantum simulation promises to make possible the investigation of rich quantum behavior on a controlled quantum mechanical device (effectively a specialized quantum computer), deepening our understanding of fascinating physics such as quantum phase transitions, non-equilibrium quantum dynamics, and quantum chaos. Superconducting circuit Quantum Electrodynamics (cQED) is a promising framework for the realization of such simulators. As a first step, we have constructed a quantum simulator for a conjectured dissipation-driven localization transition of light in a dimer using cQED techniques. A proper understanding of the physics and signature of this transition has been made possible by our development of a new classical simulator based on the stochastic quantum jump method, taking advantage of a fractal structure in our Hamiltonian to enable a study of the very large Hilbert spaces demanded by this problem. We present results of these simulations, and discuss possible future directions.

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