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Observation of a Dissipation-Induced Classical to Quantum Transition[1] JAMES RAFTERY, DARIUS SADRI, Princeton University, SEBASTIAN SCHMIDT, ETH Zürich, HAKAN TÜRECI, ANDREW HOUCK, Princeton University — The emergence of non-trivial structure in many-body physics has been a central topic of research bearing on many branches of science. Important recent work has explored the nonequilibrium quantum dynamics of closed many-body systems. With the rapid technological advances in solid state quantum optics, it is now possible to experimentally study strongly correlated photons, and to build model systems whose open nature gives rise to rich emergent behavior. We report the experimental observation of a novel dissipation driven dynamical localization transition of strongly correlated photons in an extended superconducting circuit. Interaction with an environment has been argued to provide a mechanism for the emergence of classical behavior from a quantum system. Surprisingly, homodyne measurements reveal the observed localization transition to be from a regime of classical oscillations into a macroscopically self-trapped state manifesting revivals, a fundamentally quantum phenomenon. This experiment also demonstrates a new class of scalable quantum simulators with well controlled coherent and dissipative dynamics suited to the study of quantum many-body phenomena out of equilibrium.

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