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Two-photon probe of the Jaynes-Cummings model and controlled symmetry breaking in circuit QED FRANK DEPPE, MATTEO MARIANTONI, E. P. MENZEL, A. MARX, R. GROSS, Walther-Meissner-Institut and TU Muenchen, Germany, S. SAITO, K. KAKUYANAGI, H. TANAKA, K. SEMBA, NTT Basic Research Laboratories, NTT Corp., Japan, T. MENO, NTT Advanced Technologiy, NTT Corp., Japan, H. TAKAYANAGI, Tokyo University of Science and International Center for Materials Nanoarchitectronics, Japan, E. SOLANO, Universidad del Pais Vasco - Euskal Herriko Unibertsitatea, Spain — Superconducting qubits behave as artificial two-level atoms. Coupling them to on-chip microwave resonators has given rise to the field of circuit quantum electrodynamics (QED). In this work, we report on the observation of key signatures of a two-photon driven Jaynes-Cummings model, which unveils the upconversion dynamics of a superconducting flux qubit coupled to an on-chip resonator. Our experiment and theoretical analysis show clear evidence for the coexistence of one- and two-photon driven level anticrossings of the qubit-resonator system. This results from the controlled symmetry breaking of the system Hamiltonian, causing parity to become a not well-defined property. Our study provides deep insight into the interplay of multiphoton processes and symmetries in a qubit-resonator system. We acknowledge support from SFB631, NIM, CREST-JST, JSPS-KAKENHI (18201018), MEXT-KAKENHI (18001002), EuroSQUIP, and the Ikerbasque Foundation.

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