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Time-Reversal Symmetry and Temporal Coherent Back-Scattering in a Driven Two-Level System SIMON GUSTAVSSON, Massachusetts Institute of Technology, MARK RUDNER, Harvard University, JONAS BYLANDER, LEONID LEVITOV, Massachusetts Institute of Technology, WILL OLIVER, MIT Lincoln Laboratory — Coherent backscattering, resulting from quantum interference of the paths related by time-reversal symmetry, is a phenomenon fundamental for quantum-chaotic dynamics. It manifests itself in diverse transport phenomena which were predicted and studied in mesoscopic electron systems in 1980's and 1990's: universal conductance fluctuations (UCF), weak localization and anti-localization, etc. Here we present first experimental realization of the essential physics of coherent backscattering in a driven quantum system, a two-level system repeatedly driven through an avoided level crossing. Our experiment is performed with a superconducting qubit driven through level crossing by a sequence of RF pulses. Each passage through the level crossing serves a Landau-Zener-type "scattering event," with the wave function splitting between the up and down qubit states in a coherent fashion and recombining at a subsequent passage through the level crossing. Time-reversal symmetry can be enforced in our system by the driving protocol, resulting in constructive interference in the up-down transition rates. We observe an enhancement of the speckle-like fringe contrast analogous to UCF, which is suppressed in the absence of time reversal symmetry.

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