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Resonance fluorescence trajectories in superconducting qubit[1]

MAHDI NAGHILOO, DIAN TAN, PATRICK HARRINGTON, Washington University, St. Louis, PHILIPPE LEWALLE, ANDREW JORDAN, University of Rochester, KATER MURCH, Washington University, St. Louis — We employ phase-sensitive amplification to perform homodyne detection of the resonance fluorescence from a driven superconducting artificial atom. Entanglement between the emitter and its fluorescence allows us to track the individual quantum state trajectories of the emitter. We analyze the ensemble properties of these trajectories by considering paths that connect specific initial and final states. By applying a stochastic path integral formalism, we calculate equations of motion for the most likely path between two quantum states and compare these predicted paths to experimental data. Drawing on the mathematical similarity between the action formalism of the most likely quantum paths and ray optics, we study the emergence of caustics in quantum trajectories—situations where multiple extrema in the stochastic action occur. We observe such multiple most likely paths in experimental data and find these paths to be in reasonable quantitative agreement with theoretical calculations.

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