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Exploring Quantum Dynamics of Continuous Measurement with a Superconducting Qubit ARIAN JADBABAIE, NEDA FOROUZANI, DIAN TAN, KATER MURCH, Washington University, St. Louis — Weak measurements obtain partial information about a quantum state with minimal backaction. This enables state tracking without immediate collapse to eigenstates, of interest to both experimental and theoretical physics. State tomography and continuous weak measurements may be used to reconstruct the evolution of a single system, known as a quantum trajectory. We examine experimental trajectories of a two-level system at varied measurement strengths with constant unitary drive. Our analysis is applied to a transmon qubit dispersively coupled to a 3D microwave cavity in the circuit QED architecture. The weakly coupled cavity acts as pointer system for QND measurements in the qubits energy basis. Our results indicate a marked difference in state purity between two approaches for trajectory reconstruction: the Bayesian and Stochastic Master Equation (SME) formalisms. Further, we observe the transition from diffusive to jump-like trajectories, state purity evolution, and a novel, tilted form of the Quantum Zeno effect. This work provides new insight into quantum behavior and prompts further comparison of SME and Bayesian formalisms to understand the nature of quantum systems. Our results are applicable to a variety of fields, from stochastic thermodynamics to quantum control.

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