Stochastic path integral formalism for quantum trajectories of continuously measured systems

Andrew Jordan

Department of Physics and Astronomy, University of Rochester – Rochester, New York 14627, United States

Abstract

There has been increasing interest in continuous quantum measurements and its application both in quantum information processing, as well as towards a theory of quantum thermodynamics. In this talk, I will reformulate the theory of continuous quantum measurement as a stochastic path integral, describing all possible quantum trajectories moving between initial and final quantum states as boundary conditions in time [1]. The introduced stochastic action encodes both the Hamiltonian and measurement dynamics. This formulation is well suited to finding the most-likely quantum path between the boundary conditions via a principle of least action. A diagrammatic expansion approach to calculate correlation functions of trajectory variables and the continuous readout will be discussed. Preliminary results for including feedback as well as two-qubit entangled trajectories will also be presented. Comparison to recent experiments with superconducting transmon qubits shows the theory is able to accurately and quantitatively explain the experimental results [2]. This formalism sheds new light on the conditional dynamics of monitored open quantum systems.
