Quantum trajectories without Lindblad

Howard Carmichael and Simon Whalen

Department of Physics, University of Auckland, Auckland 1142, New Zealand

Quantum trajectory simulations based on jumps are widely used in quantum optics, as a path to the numerical solution of a master equation, and for the physical insight they provide in the form of simulated photoelectron counting sequences for output fields. In their most commonly encountered version [1,2,3], quantum trajectory methods are tied to the Lindblad propagator of a Markov open system dynamic [4] and simulate a Davies photon counting process [5]. Although various non-Markovian trajectory equations have been written down [6,7], these are less widely used and, more importantly from a fundamental point of view, lack an immediate measurement interpretation drawn from photoelectron counting theory [8,9]. In this talk we formulate quantum trajectories for a subset of non-Markovian open systems where the non-Markov character arises from coherent feedback with time delay, as, for example, in a cascaded system [10] with backscatter and coupling in both directions. The formulation builds upon the standard treatment of photoelectron counting for free outgoing fields [11] and thus retains a clear measurement interpretation. The main idea is to numerically model both the open system and that part of the environment required to transmit the feedback signal; only those photons that have without doubt irreversibly escaped the system are viewed from the point of view of jumps. In broad terms the approach is the one taken by Imamoğlu [12] but allows for the fact that photons eventually leave the system through propagation rather than Lindblad/Davies-style absorption.

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