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Classical stochastic measurement trajectories for a continuously monitored multi-mode quantum system JANNE RUOSTEKOSKI, MARK LEE, University of Southampton — We formulate computationally efficient classical stochastic measurement trajectories for a multi-mode quantum system under continuous observation. Specifically, we consider the nonlinear dynamics of an atomic condensate contained within an optical cavity subject to continuous detection of the output photons. Analogous to quantum trajectories, these classical trajectories encode the backaction of a continuous quantum measurement process conditioned on a given measurement record. We argue that the dynamics can be unraveled into stochastic classical trajectories that are conditioned on the quantum measurement-induced backaction of the physical photon counting record of the continuously monitored system, and that these trajectories faithfully represent measurement records of individual experimental runs. As continuously monitored observables are expected to behave classically, the method provides a numerically efficient and accurate approach to calculate the measurement record of a large multi-mode quantum system. We show that the measurement backaction on the condensate is represented by a spatially-dependent phase decoherence rate, determined by the cavity mode shape and pump profile.

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