MAR15-2014-000466

Abstract for an Invited Paper
for the MAR15 Meeting of
the American Physical Society

Unravelling quantum jumps by watching the fluorescence of a qubit

PHILIPPE CAMPAGNE-IBARCQ, Laboratoire Pierre Aigrain, Ecole Normale Supérieure, Paris

When the main source of qubit relaxation comes from its coupling to a photonic channel, each relaxation event is associated with the release of a photon. The corresponding discrete quantum jumps of the qubit state can be observed by counting the number of photons emitted by fluorescence. This discreteness of the quantum jumps is in fact related to the nature of the light detector. What does the evolution of the qubit state become if fluorescence is measured using a heterodyne detector instead? In this talk, an experiment will be discussed, in which the records of heterodyne measurements of fluorescence is used to reconstruct the quantum trajectories of a qubit during relaxation. Using a large number of experiments, it is shown that these trajectories can be used to better predict the probability to find given measurement outcomes during the evolution. This heterodyne measurement of the fluorescence is a quantum demolition continuous measurement, which is very different from the more common dispersive measurement sensitive to qubit occupation. These trajectories are thus expected to exhibit some exotic properties, particularly when using past and future knowledge. Besides, using measurement based feedback based on the fluorescence signal alone, it is possible to stabilize any chosen qubit state. This work thus demonstrates that relaxation into an efficiently monitored channel is not a limit for quantum information protocols but can instead be a resource.