Tutorial – Cavity Quantum Electrodynamics: quantum trajectories, feedback and reservoir engineering

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Abstract

Cavity QED deals with the interaction of a single atom with a few photons stored in a high-quality cavity. It is thus particularly well suited for the exploration of fundamental quantum phenomena. Using circular Rydberg atoms and superconducting millimeter-wave cavities, we realize an ideal Quantum Non Demolition photon number counting. We can determine the number of photons in the mode without loosing them in the process. We can thus follow in real time the quantum jump trajectory of the photon number driven by cavity relaxation. We can fight this decoherence process by quantum feedback and stabilize a large photon number in the cavity. We shall discuss a few perspectives opened by these experiments, particularly for reservoir engineering, in which non-trivial quantum states are stabilized by a controlled source of decoherence.

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