Rydberg 2: Quantum Feedback Control

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In this talk, we present the groundbreaking experiments of Serge Haroche et al. on the stabilization of photon number states (Fock states) using quantum feedback control. By coupling highly excited (Rydberg) atoms to a superconducting microwave cavity, they are able to perform quantum non-demolition (QND) measurements to read out the Fock state within the cavity. A computer acts as the controller of the feedback loop and reconstructs the density matrix of the cavity by using the information from many QND measurements. In their papers, Haroche et al. studied two ways of how to physically implement state correction. First, by emission of coherent (classical) fields and second through the use of Rydberg atoms as single photon actuators. We will examine the two realizations of how the photon number in the cavity can be stabilized and discuss the results of the experiments. Finally, we will explain how this device can be used as a quantum memory and what the difficulties are of this approach to quantum feedback.