

Plenary Talk PV IV Tu 9:15 E 415 und E 214

Fundamental tests in Cavity Quantum Electrodynamics —

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At the dawn of quantum physics, Einstein and Bohr had the dream to confine a photon in a box and to use this contraption in order to illustrate the strange laws of the quantum world. Cavity Quantum Electrodynamics, a field to which Herbert Walther has made essential contributions, has now made this dream real, allowing us to actually achieve in the laboratory variants of the thought experiments of

the founding fathers of quantum theory. In our work at Ecole Normale Supérieure, we use a beam of Rydberg atoms to manipulate and probe non-destructively microwave photons trapped in a very high Q superconducting cavity. We realize ideal quantum non-demolition (QND) measurements of photon numbers, observe the radiation quantum jumps due to cavity relaxation and prepare non-classical fields such as Fock and Schrödinger cat states. Combining QND photon counting with a homodyne mixing method, we reconstruct the Wigner functions of these non-classical states and, by taking snapshots of these functions at increasing times, obtain movies of the decoherence process. These experiments open the way to the implementation of quantum feedback procedures aimed at preserving over long time intervals the quantum coherence of non-classical states of radiation in a cavity.