Non-Classical State Generation and Quantum Memories for Light

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A first part of the course will focus on the generation of non-classical states of light in the continuous variable-regime, where information is encoded into the quadrature components of a light mode. In particular, I will discuss the generation of entanglement, a critical resource for quantum information processing, and review different levels of correlations. I will then present experimental techniques to prepare non-Gaussian states of light, such as Fock states or Schrödinger cat states. These techniques usually rely on measuring one mode of an entangled state, which results in projecting the other mode according to this measurement. A special emphasis will be put here on the role of the heralding detector for such quantum state engineering. I will describe how the non-classical features of the detector translate into the preparation. Finally, the last part of the course will be dedicated to optical quantum memories. They are crucial blocks for quantum networking and for quantum repeaters, which enable to distribute entanglement over long distances. I will give an overview of the different techniques enabling a coherent and reversible transfer of quantum information between light and matter. Specifically, I will focus on approaches based on large ensembles of atoms.