Stationary and Non-Stationary Cavity Quantum Optomechanics of Ultracold and Rydberg Atoms

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In this work I review some of the results found recently on the stationary cavity quantum optomechanics with Bose-Einstein condensates (BEC) and non-stationary cavity quantum optics on the generation of atomic squeezed states of Rydberg atoms. In the first part of my talk, I discuss the energy exchange between the Bogoliubov modes of the BEC and the optical and mechanical mode leading to normal mode splitting. I then introduce the optomechanical Dicke model (Figure 1). I show that the hybrid system can be used as a novel quantum device to measure weak forces and can be used to cool either the mechanical oscillator or the BEC. In the second part of my talk I analyze the influence of periodically modulated cavity field (Figure 2) on the generation of atomic-squeezed states via the dynamical Casimir effect. The transfer of two-photon correlation of field mode to an ensemble of atoms to produce atomic squeezed or spin squeezed states (entangled states) is demonstrated.

Figure 1

Optomechanical system involving BEC confined within a high-finesse optical cavity driven by a transverse pump laser. It also shows an additional mechanical pump which further influences the mirror motion.

Figure 2

Optomechanical system involving two-level atoms confined within a high-finesse optical cavity with oscillating mirror driven by a longitudinal pump laser.

Gäste sind herzlich willkommen. Die Dozenten der Theoretischen Physik