INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Cavity optomechanics aims at understanding the radiation pressure induced interaction between photons and mechanical motion in a cavity. The radiation pressure force, arising due to the momentum carried by light, can displace a movable end mirror of the cavity. This in turn changes the length of the cavity, resulting in modification of the cavity frequency. With the rapid advances in micro and nanofabrication techniques, this nonlinear interaction has led to the exploration of a wide variety of interesting phenomena both theoretically and experimentally, such as squeezing of the light field and mechanical motion, entanglement between optical and mechanical modes, bistability, optomechanical normal mode splitting, optomechanically induced transparency, and so on. However, due to the inevitable coupling of the mechanical resonator to its surrounding, the quantum behavior gets masked by the thermal motion. Therefore, to observe quantum effects in mesoscopic mechanical resonators, it is necessary to cool them down to quantum ground state. In this thesis, we have proposed a scheme to cool the mechanical resonator to its ground state in the unresolved sideband regime by considering the interaction of the optical field with the excitons of a quantum well placed inside the cavity. Also, we have discussed the bistable behavior shown by the optical field and the mechanical motion in an optomechanical cavity, and the controllability of this behavior by coupling it to a feedback cavity containing an atomic ensemble. In the last part of the thesis, we have discussed the phenomena of photon and phonon antibunching in optomechanical setups induced via destructive quantum inference in two-photon and two-phonon excitation pathways.