



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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in Hybrid Optomechanical Systems:
A Theoretical Exploration**
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SHORT ABSTRACT

Optomechanical systems serve as a versatile platform for the study of classical and quantum phenomena both in the mesoscopic and macroscopic regime. They are also useful to analyze higher-order nonlinear effects or control the transmission, storage and retrieval of optical signals. Moreover, by integrating such systems into solid-state platforms and coupling other degrees of freedom to the optical and mechanical modes, one can study a multitude of phenomena arising in hybrid systems. In this thesis, we theoretically explore a handful of such classical and quantum phenomena that emerge due to the radiation-pressure-induced optomechanical interaction in different configurations of hybrid open quantum systems. Specifically, we analyze (i) the behavior of quantum synchronization in optically-coupled optomechanical systems, (ii) the transmission of a weak probe beam in an optomechanical analogue of annularly-trapped Bose-Einstein condensate placed inside a cavity, and (iii) the generation and the enhancement of entanglement and mechanical squeezing in modulated optomechanical setups. Our studies may find applications in optical sensing, quantum communication and quantum information processing with continuous variables.