INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: **Coherent control and manipulation of electromagnetic fields in novel quantum optical systems**

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SHORT ABSTRACT

The field of Light-Matter interaction has been an interesting area of research for many decades. Interaction of electromagnetic (em) fields with optical media can lead to various quantum coherence effects such as Electromagnetically Induced transparency (EIT), Double dark resonance (DDR), Phase induced transparency (PIT), etc. These effects have been used to manipulate the fundamental properties of the medium such as absorption and dispersion. Manipulation of absorption and dispersion of the medium is the key factor in controlling the properties of the interacting em fields. Control over both em fields and the optical properties of the medium using the above coherence effects have been used in various ways to create new quantum technologies which have potential applications in optical communications, biomedical optics, Quantum computing, etc. This thesis deals with manipulation of em fields using these coherence effects. One of the interesting technique developed in thesis is creation of atomic based tunable waveguide using EIT and DDR. The competition between these two effects can spatially modify the absorption and the refractive index so as to create a high contrast tunable waveguide like feature inside the atomic medium. This induced waveguide can lead to diffraction-less propagation of arbitrary modes to macroscopic lengths. Another interesting technique discussed is on creation and manipulation of structured beams using PIT and EIT phenomena. Using these phenomena, a spatial transparency windows are created in the medium at

arbitrary location. These transparencies can confine light to sub-wavelength region at different spatial positions. These above coherent light shaping and guiding technique have potential applications in optical communication, information processing, trapping and manipulation of particles, high contrast imaging, etc. Further, the EIT phenomena has been used to slow down the light propagation through an ultracold optical media to few meters per second which has application in stoppage and storage of light, optical communication, etc.