INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Name of Thesis Supervisor(s)	:	Prof. Tarak Nath Dey
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SHORT ABSTRACT

The kernel of the thesis is rooted in the interaction of lasers with atomic or molecular vapor. A quantitative explanation of the physics behind laser-atom interaction is given in terms of something known as "atomic coherence" in the literature. The value of atomic coherence depends on parameters such as the laser frequency, intensity, and temperature of the atomic vapor. The optical properties of the atomic vapor, such as refractive index, absorption, isotropy, anisotropy, and the group velocity of a pulse inside the medium, can be manipulated by controlling the atomic coherence. Based on the premise of "atomic coherence," four research problems are formulated in this thesis. The first problem proposes a pulse amplification method in atomic vapor, that preserves the initial pulse shape after amplification. The second problem is a similar study of pulse amplification in a vapor of polar molecules possessing permanent dipole moments (PDMs). The presence of PDMs leads to interesting phenomena that are forbidden in the atomic counterpart and can be utilized for pulse amplification purposes. The remaining two problems deal with the propagation of special laser beams called "vector beams" (VBs) through an atomic vapor medium. Vector beams have a nonuniform polarization distribution on their transverse plane, having applications in quantum computing, microscopy, laser cutting, etc. In this thesis, two schemes are proposed, that exploit atomic coherence to control the polarization rotation of VBs and realize waveguiding of VBs through the atomic vapor medium, respectively. In summary, this thesis aims to conglomerate a few applications of "atomic coherence" manipulation in different fields of optics.