INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Coherent control techniques make use of the quantum interference effects of probability amplitudes to control and manipulate optical properties of quantum systems. Different optical phenomena are found to be effectively controlled with this coherent preparation by engineering the dispersion and absorption properties of the medium. The development of new schemes for pulse shaping and control is important in many fields of optics and atomic physics, some of which includes preparation of atoms and molecules in desired quantum states, optical communication systems with tailored pulses, ultrafast spectroscopy and so on. One prominent example of coherent quantum control is electromagnetically induced transparency(EIT), a quantum interference effect that allows the propagation of light pulses through an otherwise opaque medium. In this thesis, we are dealing with the propagation of optical pulses through coherently prepared atomic media.

The first problem investigated is the propagation of a Gaussian pulse through a four-level N type atomic medium. The results shows that, weaker probe pulses may propagate through the medium with low absorption and pulse shape distortion, while increasing the probe pulse intensity leads to a splitting of the initially Gaussian pulse into a sequence of sub-pulses in the time domain. In our second work, by making use of microwave field coupling hyperfine levels in a three level Λ system, we could generate a frequency comb with frequencies of Raman sub harmonics. The sub-harmonics generated is found to be stable within the length of the medium. Frequency conversion from microwave to optical frequency is observed in third work, with the proper choice of couplings in a closed Λ system with a microwave pulse coupling the hyperfine levels. In fourth work, we have observed generation of gray and bright coupled soliton solutions in a system describing doped optical nonlinear fibers with three level atoms.