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Short Communication

Study the quantum coherence induced transparency of two separate light beams in atomic vapor

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Abstract

Quantum coherence has been explored in many interesting phenomena in the past two decades. Quantum coherence occurring in the interaction between light and atoms, can be produced by two orthogonal polarized laser beams coupling with a three-level system. Atoms simultaneously exposed by two overlapping laser beams generate a coherent state, which can make one of these laser beams transmit without any absorption. Coherent population transfer among quantum states of atoms and molecules has also been studied, which is named stimulated Raman adiabatic passage (STIRAP). The procedure of STIRAP relies on the initial creation of a coherence with subsequent adiabatic evolution. Xiao et al. observed this phenomena of atomic coherence production at one position and recovered the coherence at another location. So far, no experiment has shown that the atomic coherence can be generated with two spatially separated laser beams. Here, we experimentally investigate pattern formation with a hybrid vector beam (VB) passing though rubidium vapor. Specifically, we generated a hybrid VB using a Q-plate and a quarter wave plate. We observe that the hybrid VB can form a four-petal pattern upon passing through the atomic medium and the pattern can be controlled from four-petal to two-petal by varying the bias magnetic field. The maximum transmitted total intensity occurs in zero magnetic field. The mechanism for the pattern formation can be interpreted by the generation of atomic coherence. We perform a second experiment with two orthogonal circularly polarized laser beams to show that the atomic coherence can be generated with two spatially separated beams. A basic model including absorption and quantum coherence provides good agreement with the experimental results. Our results may have applications in optical manipulation, measurement of magnetic fields, and studying quantum coherence in atomic ensembles.

Biography:

Hong Gao's research interests are in quantum optics and quantum information. Specifically he focuses on the coherent and nonlinear interaction of light with atomic ensembles, such as slow light, light storage, laser cooling and four-wave mixing. He is interested in studying the fundamental physical basis during these interactions and would like to expand them for quantum information processing and quantum computation.