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Experimental and numerical study of EIT and FWM in an ensemble of cold rubidium atoms

Nonlinear interactions between lasers and cold atoms are of particular interest these days, as they are used to create entangled photons and control the optical properties of materials. We study two nonlinear aspects, viz. electromagnetically induced transparency (EIT) and four-wave mixing (FWM), using laser cooled rubidium. We are currently investigating entangled photon generation via FWM using a diamond configuration formed by four levels in rubidium. Two pump laser beams of different wavelengths drive the atoms from the 5S1/2 ground state to the 5D3/2 excited state via the 5P3/2 intermediate state. The atoms then return to the ground state via a 5P1/2 intermediate state. The resonant interaction between the various levels results in the generation of two additional correlated photon beams referred to as idler and signal photons. The characteristics of these additional photons are studied.

In EIT we use a lambda scheme involving two hyperfine levels at the 5S1/2 ground state and the 5P3/2 excited state of rubidium. A pump laser couples one hyperfine ground state to the excited state and a probe laser couples the other hyperfine ground state to the excited state. When the pump laser is present the cloud of atoms appears transparent to the probe and when the pump laser is off the cloud is opaque to the probe beam. We present preliminary numerical results of EIT and FWM, and give a proposed experimental setup. In addition, we provide details of the apparatus to cool the rubidium atoms.

Apply to be
 considered for a student
   award (Yes / No)?

Yes

Level for award
 (Hons, MSc,
   PhD, N/A)?

PhD

Primary author: Mr WYNGAARD, Adrian (Cape Peninsula University of Technology)

Co-authors: Dr GOVENDER, Kessie (Cape Peninsula University of Technology); Mr PENTZ, Rory (Cape Peninsula University of Technology)

Presenter: Mr WYNGAARD, Adrian (Cape Peninsula University of Technology)

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