

# Coherent population trapping and the control of light-induced torque on three-level atoms

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## Abstract

There is currently much interest in the interaction of atoms, ions, molecules and Bose-Einstein condensates with laser light endowed with orbital angular momentum, such as those known as Laguerre-Gaussian beams. Such beams can now be readily generated in the laboratory and one of the most striking effects on atomic systems in addition to translational forces is that they impose light induced torques. The light torque was first predicted in 1994 [1] for two-level atoms, leading to the creation of neutral currents as well and electric currents at the nanoscale [2, 3, 4]. Here we show that three-level atoms also experience a light-induced torque whose characteristics depend sensitively on the atomic parameters. The scenario involves two counter-propagating LG beams appropriately detuned from the atomic resonances, creating a torque influencing rotational motion, as well as leading to axial cooling of the atomic motion. We also show that the system is amenable to coherent population trapping [5] and in such a way that it is possible to create conditions in which the torque vanishes. The possible implications of this on the manipulation of cold atoms and condensates is pointed out and discussed.

**Keywords:**

## References

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