Stony Brook University
The Graduate School

Doctoral Defense Announcement

Abstract

Study of the Velocity Dependence of the

Adiabatic Rapid Passage (ARP) Optical Force in Helium

By

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The use of optical forces to precisely control the motion of atoms has played a major role in expanding the field of atomic physics. However, in a majority of experiments, these optical forces are limited in strength by the inherent properties of the chosen atoms, namely because the process relies on spontaneous emission to return the atom to its ground state. It has been shown that the process of absorption, followed by stimulated-emission, can be used to provide a more rapid return to the atomic ground state. Through careful design of the experiment, a coherent exchange of momentum can take place, exerting a force on the atoms.

Adiabatic Rapid Passage (ARP) is a commonly used technique in the magnetic resonance community, for the population inversion of a two-level spin system. This technique has been expanded to the optical regime and used to invert the electronic states of an atomic system, allowing for control over both absorption and stimulated emission. It has been previously demonstrated that this scheme can be used to generate large forces on stationary atoms.

An in depth study of this ARP force will be presented with a strong emphasis on experiments designed to measure the dependence of the ARP force on atomic velocity. The experiments take place on the 2^3S -2^3P transition in Helium, and results show, that by using a properly-tailored pulse sequence, the ARP force can exert a large force on atoms over a large velocity range. This makes the ARP force a good candidate to decelerate neutral atomic (or molecular) beams.

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