EXPERIMENTS WITH A METASTABLE HELIUM ATOMIC TRAP

By

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Dedicated to my wife, Agnieszka.

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Abstract

In this work I report on the development of a Magneto Optic Trap (MOT) for metastable helium atoms (He^*). The metastable helium atoms are produced in a discharge nozzle source and collimated, slowed and compressed to provide a slow bright beam for loading the trap. The trap confines approximately 10^7 atoms, has a diameter of about 3 mm and with temperature approximately 1 mK. The trap is used for intra-trap and electron-atom scattering experiments. The results from these two experiments are reported. The electron scattering experiment is unique and employs a He^* MOT for the first time, in combination with a new diagnostic technique (Phase Modulation Spectroscopy) to measure the trap loss. The results of these experiments have yielded the first total electron-metastable atom collision cross section measurements at intermediate (10-100 eV) electron energies.

It is the mark of an instructed mind to rest satisfied with that degree of precision which the nature of the subject admits, and not to seek exactness where only an approximation of the truth is possible.

Aristotle