The Creation of a Metastable Neon MOT for Electron-Atom Collision Experiments

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In this paper we present the progress on a new slow neutral atomic beam source for atomic physics experiments in particular, experiments which involve the application of the mechanical effects of light in electron-atom collision experiments.

Metastable neon atoms are created in a gas discharge system which is cooled to 77K, and are collimated via two standing wave fields following the source chamber. The two dimensionally compressed atomic beam is then slowed in a Zeeman slower which is a system of solenoids creating a spatially varying magnetic field. It is used in combination with a red detuned laser beam, counter-propagating to the direction of the atomic beam. The laser beam, averaged over many cycles, imparts linear momentum in a direction opposite to the direction of the atomic beam, hence reducing the velocity of the atomic beam. The spatially varying field tunes an atomic transition such that the laser remains in resonance with a dipole-allowed transition and hence a continual deceleration of the metastable atomic beam is achieved. The slowed atoms then pass into a magneto-optical trap (MOT) and are trapped using three sets of orthogonal standing wave laser fields.

The versatility of the MOT has been demonstrated by the application of the device to many new and exciting experiments in atomic physics research. To date, only one experiment has exploited the MOT to investigate electron atom collision processes [1] [2]. The first experiment that will be conducted and reported in this paper using this new apparatus will be the measurement of total absolute electron-atom collision cross sections. The measurement will be performed by the observation of the filling dynamics of the trap via the detection of decay fluorescence from excited state atoms. This will be the first such measurement conducted in a MOT for collisions involving atoms in metastable states with electrons.

Further experiments planned for this facility such as the investigation of the suppression of ionisation processes [3] involving trapped metastable neon atoms within the MOT will also be discussed.

[1] R. S. Schappe, P. Feng, L. W. Anderson, C. C. Lin and T. Walker, *Euro. Phys. Lett.* **29** 439 (1995).

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[3] H. C. W. Beijerinck, E. J. D. Vrendenbregt, R. J. W. Stas, M. R. Doery and J. G. C. Tempelaars, *Phys. Rev. A.* **61** 023607 (2000).