# Trapping ultracold argon atoms

P. D. Edmunds[1] and P. F. Barker[1]

[1] *Department of Physics and Astronomy, University College London, Gower Street, London WC1E 6BT, United Kingdom*

Presenting Author: p.edmunds@ucl.ac.uk

Thermalising collisions between molecules and laser cooled atoms are a promising general method for dissipative cooling, but typical laser cooled species are reactive and cannot generally be utilised [1]. Trapped noble gas atoms in their ground state appear to be ideal candidates for the sympathetic cooling as they are chemically inert and can be laser cooled to $\mu$K temperatures in an excited metastable state.

We describe the dipole trapping of both metastable and ground state argon atoms for sympathetic cooling. Metastable argon atoms are first Doppler-cooled down to $\sim$80 $\mu$K in a magneto-optical trap (MOT) and are loaded into a dipole trap formed within the focus of an optical build-up cavity. The optical cavity's well depth could be rapidly modulated [2]: allowing efficient loading of the trap, characterisation of trapped atom temperature, and reduction of intensity noise. Collisional properties of the trapped metastable atoms were studied within the cavity and the Penning and associative losses from the trap calculated.

Ground state noble gas atoms were also trapped for the first time by optically quenching metastable atoms to the ground state and then trapping the atoms in the cavity field (shown in figure 1) [3]. Although the ground state atoms could not be directly probed, we detected them by observing the additional collisional loss from co-trapped metastable argon atoms. This trap loss was used to determine an ultracold elastic cross section between the ground and metastable states and was shown to lead to type of sympathetic evaporation of the metastable atoms. Using a parametric loss spectroscopy we also determined the polarisability of metastable argon at the trapping wavelength of 1064 nm.

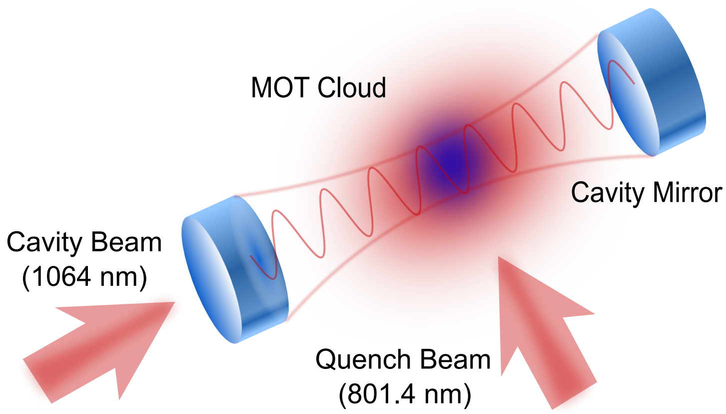


**Figure 1:** *Schematic of the optical cavity. Metastable argon is first cooled in a MOT, and then quenched down to the ground state. Both species can be trapped in the lattice formed within the optical build-up cavity.*

## References

[1] M. Lara *et al.*, Physical Review Letters **97**, 183201 (2006)
[2] P. D. Edmunds, P. F. Barker, Review of Scientific Instruments **84**, 083101 (2013)
[3] P. D. Edmunds, P. F. Barker, Physical Review Letters **113**, 183001 (2014)