Quantum metrology with triatomic molecules to probe physics beyond the Standard Model

UCL Lead department: Physics

Lead Supervisor: Dr. Luke Caldwell

Project Summary:

The Standard Model is known to be incomplete. One area in which it is deficient is explaining why the universe produced by the big bang consists almost entirely of matter with almost no anti-matter. Extensions to the Standard Model which could explain the imbalance predict new particles at energies beyond the reach of the Large Hadron Collider. Vacuum fluctuations of the quantum fields associated with these new particles can interact with known particles and make tiny modifications to their properties. A particularly powerful way to search for such effects is to look for tiny shifts in the energy levels of atoms and molecules where experimental developments in the last 30 years have realised near full quantum control over the internal and external degrees of freedom, enabling extraordinarily precise measurements. The energy levels of triatomic molecules containing very heavy, deformed nuclei combine extremely high sensitivity to new physics with resilience to many important sources of systematic error.

We are looking for a PhD student to join the group of Dr Luke Caldwell. You will be working in a new, small research group, building up a new experimental apparatus in a newly refurbished lab. The successful applicant will work on producing a source of exotic heavy atoms, developing techniques to laser cool them to the quantum ground state of optical tweezer traps, and studying their short-range interactions with polar diatomic molecules.

We are looking for bright, motivated and enthusiastic candidates with an interest in learning a diverse array of experimental skills; from ultra-high vacuum to laser technology and electronics. We particularly welcome applications from women, candidates in underrepresented groups, and/or candidates with non-traditional backgrounds.