Scientific Report: Matter-wave experiments in ring-shaped TAAP traps

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The principle scientific goal of this exchange was to achieve a toroidal trapping suitable for the confinement and manipulation of ultracold atoms. The toroidal geometry presents both interesting opportunities to study fundamental physics such as the nature of the decay of persistent currents, and also provides an arena for realising a highly accurate inertial sensing device with accuracies exceeding the best optical alternatives. At the culmination of this visit, a ring shaped potential for ultracold atoms was realised, providing a solid foundation for the topics of further study discussed above.

The time-averaged adiabatic potential (TAAP) was first proposed by researchers at the IESL FORTH in Crete, and first realised in Oxford. This visit provided an opportunity for a fluid exchange of methodologies, knowledge and experience between two leading centres pursuing research in this field, that proved highly fruitful to all parties.

The technical experience that I had collected during the course of my experimental PhD in Oxford proved invaluable as the decision was taken during the course of the visit update and improve the experimental capabilities of certain parts of the apparatus. A new source of rubidium, more powerful magnetic field generating electromagnets, and new, well characterised antennas to deliver the radio-frequency field were all installed. Following this a patient optimisation process was undertaken to integrate the new pieces of equipment into the experimental sequence that realises a Bose-Einstein condensate of approximately 100,00 atoms of rubidium. Finally, the delicate loading procedure of transferring the ultracold atoms from the more conventional harmonic trap into the ring shaped potential successfully navigated.

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