

## PhD position in Experimental Quantum Networking

**Closing date: 17 December 2017**

A 3 year PhD position is available in the Ion Trap Cavity-QED and Molecular Physics (ITCM) Group in the Department of Physics & Astronomy at the University of Sussex.

The position is part of a Marie Skłodowska-Curie European Training Networks and provides an unique experience for young researchers who benefit from secondments and travel opportunities as well as network based training and research. Successful candidates will receive an attractive salary package, including generous mobility and, if applicable, family allowances.

For more information please contact Dr Matthias Keller ([m.k.keller@sussex.ac.uk](mailto:m.k.keller@sussex.ac.uk)).

### **Introduction:**

The project unites two distinct areas of quantum information processing, single ions stored in radio-frequency traps, and single photons in optical fibres. In both fields, there have been spectacular advances recently. Strings of ions are presently the most successful implementation of quantum computing, with elementary quantum algorithms and quantum simulations realized. Photons are used to distribute entanglement over ever increasing distances.

The principal challenge in the field is to enhance quantum processing power by scaling up current devices to larger quantum systems. We are pursuing one of the most promising strategies, distributed quantum computation, in which multiple small-scale ion processors are interlinked by exchanging photonic quantum bits via optical fibres. It requires a coherent

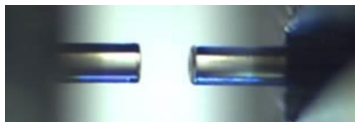
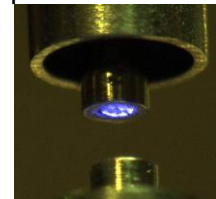


Photo of an optical micro-cavity.

quantum interface between ions and photons, mapping ionic to photonic quantum states and vice versa. To maximise fidelity and the success rate of the scheme, the interaction of ions and photons must take place in a microscopic optical cavity with high finesse, a technology in which the Ion Trap Cavity-QED and Molecular Physics group in Sussex has a leading role. To achieve ultra-small trap and cavity volumes, we use the fibre ends as cavity mirrors and tightly integrate them into the ion trap structure.



Ion trap with integrated cavity.

### **Project:**

The aim of the project is to demonstrate the strong interaction between trapped calcium ions and a single mode of an optical cavity and its use for generating entanglement between ion and photon and ultimately, between trapped ions. Using an existing ion-cavity system, the project will focus on achieving strong interaction between the trapped ion and the cavity mode to control the mapping of the quantum information stored in the ion onto the photon.

This mapping process will then be exploited to demonstrate the entanglement between the ion and a photon. Utilising a second ion-cavity system, the ion-photon state mapping will then be employed to demonstrate a small scale quantum network, a key building block for scalable quantum computers.

### **Skills and training:**

An important part of this PhD project is the skills development and training. Local training through lecture courses, transferable skills training modules and practical training in the laboratory will be complemented by network wide training events. These include secondments to industry and academic partners, workshops and training schools.

### **Training Network:**

LIMQUET, Light-Matter Interfaces for Quantum Enhanced Technology, is a network to provide training of skilled young researchers in innovative techniques to interface light and matter at the quantum level using atoms, nanostructures and photons, with applications in optics and quantum information processing. This European network combines the expertise of leading researchers in their respective fields from five countries and three industry partners to provide the best training environment.

### **Eligibility criteria:**

Given that the positions are funded by the European Commission on a H2020-MSCA-ITN, eligibility restrictions apply:

**Experience:** Early-Stage Researchers (ESRs) shall, at the time of recruitment by the host organisation, be in the first four years (full-time equivalent research experience) of their research careers and not yet have been awarded a doctoral degree. Full-time equivalent research experience is measured from the date when a researcher obtained the degree which would formally entitle him or her to embark on a doctorate, either in the country in which the degree was obtained or in the country in which the researcher is recruited.

**Mobility Rule:** at the time of recruitment by the host organisation, researchers must not have resided or carried out their main activity (work, studies, etc.) in the country of their host organisation for more than 12 months in the 3 years immediately prior to the reference date. Compulsory national service and/or short stays such as holidays are not taken into account.

Please contact Professor Matthias Keller ( [m.k.keller@sussex.ac.uk](mailto:m.k.keller@sussex.ac.uk) ) for more details and on how to apply for this position.