Spécialité de Master « Optique, Matière, Paris »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage

Date de la proposition : 12/10/2017

Responsable du stage / *internship supervisor*:

Nom / *name*:	Long	Prénom/ *first name* :	Romain
Tél :	01 44 32 34 18	Fax :	01 44 32 34 34
Courriel / *mail*:	long@lkb.ens.fr		

Nom du Laboratoire / *laboratory name*: Laboratoire Kastler Brossel

Code d'identification : UMR 8552 Organisme : ENS/CNRS/UPMC/Collège de France

Site Internet / *web site*: http://www.lkb.upmc.fr/atomchips/rubidium-cavity-qed/

Adresse / *address:* 24 rue Lhomond, 75005 Paris

Lieu du stage / *internship place*: Département de Physique de l'ENS

Titre du stage / *internship title*: **1D Cold Atom Array in a Fiber Microcavity under a Microscope**

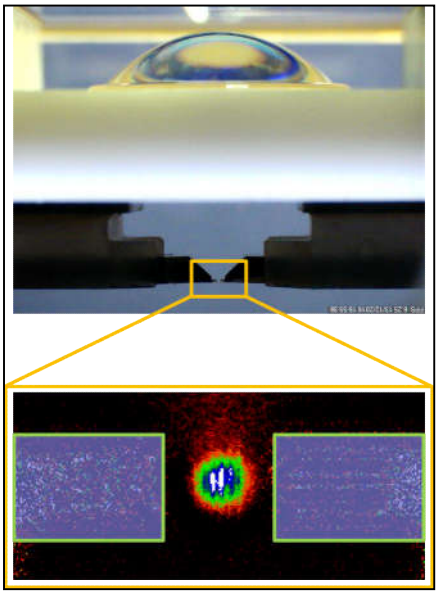
Résumé / *summary*

An exciting and fast-growing field of research in experimental quantum physics is the generation of multiparticle entangled states. This quest is driven by fundamental motivations and by the emergence of new quantum technologies (quantum-enhanced metrology, quantum simulations and quantum information) in which entanglement is the key ingredient.

Among the different systems that are explored, cold atoms platforms offer a unique combina- tion of high-fidelity control, large system sizes, and metrological precision. One parallel approach, recently successful in generating entanglement, relies on a high-finesse optical cavity to create an effective interaction that entangles the atoms. But so far, such atomic ensemble CQED systems lack the control and detection over individual particles.

The goal of this project is to extend the generation of multiparticle entanglement to "mesoscopic" ensembles of up to ~100 neutral atoms while keeping control and analysis at the single-atom level. To achieve this goal, we will combine methods of optical Cavity Quantum Electro- Dynamics (CQED) with quantum gas microscope techniques.

More precisely, we will realize a single-atom qubit register in a one-dimensional optical lattice. Each site of the lattice is strongly and identically coupled to the mode of a fiber-based high-finesse optical Fabry-Perot cavity, developed in our group. Single lattice site detection and addressing capabilities will be implemented by a high- resolution microscope, enabling local operations on individual atoms of the register. This system provides an ideal test-bed to investigate different methods for multiparticle entanglement generation and to study their fundamental limits.



During the internship, the student will participate to the development of the experiment by investigating different schemes to address the atoms in the lattice. One possible way is to use Digital Micromirror Device and/or (Acousto-Optical Deflector). After assessing the best scheme, he/she will build the required system and investigate the addressing method on the experiment. During the internship, he/she will have the opportunity to gain experiences in optics, lasers, and cold atoms physics.

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : YES**

Si oui, financement de thèse envisagé/ *financial support for the PhD***: EDPIF**

Lumière, Matière, Interactions	×	Lasers, Optique, Matière	×

*Fiche à transmettre (fichier pdf **obligatoirement**) sur le site http://stages.master-omp.fr*