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 octobre 2015

Responsable du stage

Nom : LAURAT Prénom: Julien

Tél : 0144273064

Courriel : Julien.laurat@upmc.fr

Nom du Laboratoire : **Laboratoire Kastler Brossel**

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

Site Internet : quantumnetworks.lkb.ens.fr

Adresse *:* UPMC, 4 place Jussieu, Paris

Lieu du stage : UPMC Campus

Nanofiber-trapped atoms for quantum information networks

Light-matter interfaces play a critical role in the context of quantum information networks, enabling for instance the reversible mapping of quantum states of light onto quantum states of matter or the efficient generation of single photons and remote entanglement. A promising approach for the realization of such interfaces is based on ensemble of neutral atoms. Due to the collective nature of the light-atom interaction the coupling of the ensemble and light modes can be very efficient.

In this context, recently developed techniques allow the **trapping of ensemble of atoms in one-dimensional array close to nanoscale waveguide**. Due to their small optical losses and strong field confinement, these waveguides open the promise of longer interaction length and potential non-linear interactions at low power level. This new paradigm for strong interaction of atoms and tightly guided photon offers therefore a versatile platform for research in quantum information, quantum metrology and simulations. Such arrangement of the atoms can also lead to super-radiance and efficient Bragg scattering, which have important implications for quantum memories and single-photon sources. Long-range interaction mediated by the waveguide coupling can also lead to novel unexplored phenomenon, such as self-organization of the atoms along the waveguide.

Recently, the LKB team developed such a platform based on **nanofiber-trapped atoms**. Optical nanofibers are obtained by stretching a fiber to a sub-wavelength diameter, close to 400 nm: they exhibit a strong radial confinement of the light and large evanescent field. By causing interactions between the traveling light and a few thousands atoms in the vicinity, the team demonstrated a first optical memory at the single-photon level, albeit with a limited efficiency and storage time. Atoms can also be trapped in the evanescent field, realizing a one-dimensional optical lattice. Optical depth above 70 has been obtained for the trapped ensemble, corresponding to an absorption per atom already around 10%.

The proposed research project will be based on this nanofiber-trapped atoms platform to develop quantum information protocols, including long-lived quantum memory, on-demand single-photon source and optical switch at the single-photon level. The project will also include the study of fundamental effects related to one-dimensional organization of the atoms.

Ce stage pourra-t-il se prolonger en thèse ? OUI

Si oui, financement de thèse envisagé: EDPIF

Lumière, Matière, Interactions	**X**	Lasers, Optique, Matière	**X**