Master 2: ***International Centre for Fundamental Physics***

INTERNSHIP PROPOSAL

Laboratory name: Laboratoire Kastler Brossel
CNRS identification code: UMR 8552
Internship director'surname: Romain Long
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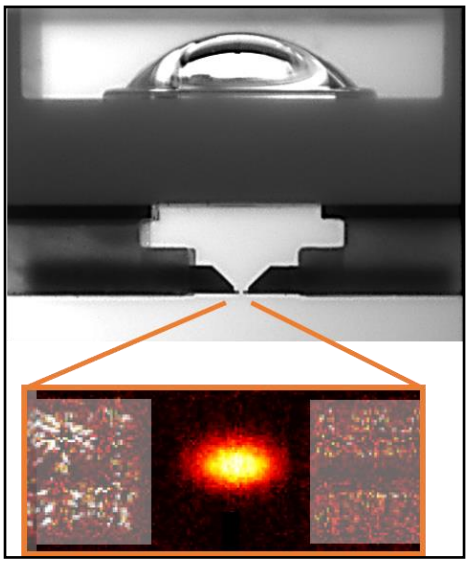
Web page: http://www.lkb.upmc.fr/atomchips/rubidium-cavity-qed/
Internship location : Département de Physique de l'ENS, 24 rue Lhomond, 75005 Paris

Thesis possibility after internship: YES
Funding: EDPIF If YES, which type of funding:

Single atom array in an optical cavity for many-body entanglement

The generation and control of large-scale multiparticle entangled states is an exciting and fast-growing field of research driven by fundamental motivations and by the emergence of quantum technologies. Among the different platforms, which are currently being investigated, trapped cold atoms are high-precision qubits par excellence, offering long coherence times as well as a comprehensive toolbox of highly controlled manipulation techniques.



In this context, we have developed recently an experimental platform for quantum metrology and simulation which combines cold atoms with an optical microcavity and a high-resolution microscope. The atoms are trapped along the cavity axis and positioned below the microscope (see figure): the cavity mediates an all-to-all long-range interaction between the atoms while the high-resolution microscope provides local manipulation and detection.

This unique combination opens the way to new generation of cavity-QED experiments such as the generation of spatially delocalized entangled states potentially useful for multiparameter quantum enhanced sensing or the robust generation of entangled by reservoir-engineering techniques. Another exciting possibility is the simulation of spin models featuring all-to-all interaction. Combined with the ability to tailor the coupling of each atom with the cavity mode, it allows us to explore fundamental aspects of quantum many-body dynamics.

Atoms are already trapped in the resonator and their coupling with the cavity mode has been fully studied. We are now implementing an optical tweezers array to get a register of single atoms. During the internship, the student will work on the manipulation of single atoms inside the cavity and on the flexible control of the atom-cavity coupling, allowing sequential non-destructive detection. She/He will be part of a small and highly motivated team in an inspiring, international research environment and will have the opportunity to gain experiences in optics, lasers, cavities, and cold atoms physics.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics:	YES	Soft Matter and Biological Physics:	NO
Quantum Physics:	YES	Theoretical Physics:	NO