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

# ***INTERNSHIP PROPOSAL***

*(One page maximum)*

Laboratory name: Kastler Brossel
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Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: EDPIF

**Atom interferometry with Bose-Einstein condensate: study of atom-atom interactions**

Summary (half a page maximum)

Atom interferometry is now widely used to perform high precision measurements for testing fundamental physics (equivalence principle, gravity at atomic scale…). At Laboratoire Kastler Brossel, we use an atom interferometer to precisely measure the recoil velocity of an atom that absorbs a photon [1]. Such a measurement leads to a precise determination the fine structure constant α. This fundamental constant is for great interest to test quantum electrodynamics theory and to probe dark energy or internal structure of electron.

We have recently built a new experimental setup and produced rubidium Bose Einstein condensate with more than $10^5$ atoms in 3 s. The goal now is to implement an atom interferometer based on a large momentum transfer beam splitter in order to increase its sensitivity by more than one order of magnitude [2]. But using Bose-Einstein needs to control the systematic affect due to atom-atom interactions. Recently, we have developed a theoretical model to understand how internal interaction affects atomic fringes [3]. The aim of the internship is:

1) Precise measurement of the shift induced by atom-atom interactions in an atomic interferometer based stimulated Raman transitions. The goal is to validate a theoretical model already developed by our team.

2) Transport of BEC using an atomic elevator based on a coherent acceleration in an optical lattice.

[1] R. Bouchendira et al. Phys. Rev. Lett. 106, 080801 (2011)
[2] P. Cladé et al. Phys. Rev. Lett. 102, 240402 (2009)
[3] R. Jannin, et al. Phys. Rev. A 92, 013616 (2015).

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

Condensed Matter Physics: YES Macroscopic Physics and complexity: NO
Quantum Physics: YES Theoretical Physics: NO