Spécialité de Master « Optique, Matière, Paris »

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

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 08/10/2018

Responsable du stage / *internship supervisor*:

Nom / *name*:	Longchambon	Prénom/ *first name* :	Laurent
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Nom du Laboratoire / *laboratory name*: Laboratoire de Physique des Lasers

Code d'identification : UMR 7538 Organisme : Université Paris 13/CNRS

Site Internet / *web site*: http://www-lpl.univ-paris13.fr/UK/Index.awp

Adresse / *address:* Institut Galilée, 99, avenue Jean-Baptiste Clément, 93 430 VILLETANEUSE FRANCE

Lieu du stage / *internship place*: same address

Titre du stage / *internship title*: Phase imprinting on a superfluid atomic ring

Résumé / *summary*

The rubidium project of the Quantum Gases division has been studying since a couple of years the superfluid properties of an ultracold quantum gas. We are particularly interested in the rotation of the superfluid in order to study the microscopic mechanisms underlying the rotation dynamics. We have achieved in 2017 an annular configuration trapping a degenerate superfluid gas by means of combined magnetic and optical traps. The internship project aims at building/setting up/using a complete optical system based on Spatial Light Modulators (SLM) to trigger dynamics on the atomic ring. This optical system will bring onto the atoms an optical intensity profile of the order of tens of micrometers and whose pattern will be easily modified. 2 types of SLMs could be used by the intern depending on the period of arrival and the current experiment status :

- a liquid crystal SLM will tailor the atomic wavefunction in the ring. By sending a light pulse with an helicoidal profile pattern, the imprinted atomic phase corresponds to the one of a rotating superfluid with quantized circulation. This technique will allow us to imprint more complex phase profiles leading to surface mode excitations theoretically described in this rotation context [1,2].
- We will also use a second SLM based on Digital Micromirrors Devices (DMD). This kind of SLMs has a much higher refresh rate than the liquid crystal ones and we will use it in a complementary way to achieve dynamical barriers in the ring to mimic in a quantum simulation approach Josephson junctions in superconducting solid-state physics. A full characterization of the modulator will be performed, followed by the optical system set-up and its implementation in the experiment.

This internship will give the appointed student the opportunity to enhance his/her experimental skills in optics and atomic physics.

[1] R. Dubessy, T. Liennard, P. Pedri, H. Perrin, « *Critical rotation of an annular superfluid Bose-Einstein condensate* », Phys. Rev. A **86**, 011602(R) (2012).

[2] A. Kumar, R. Dubessy, T. Badr, C. De Rossi, M. de Goër De Herve, L. Longchambon, H. Perrin, « *Producing superfluid circulation states using phase imprinting* », Phys. Rev. A **97**, 043615 (2018).

Toutes les rubriques ci-dessous doivent obligatoirement être remplies

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***: Doctoral School scholarship**

Lumière, Matière, Interactions		Lasers, Optique, Matière	

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