Spécialité de Master « Optique, Matière, Plasmas »

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

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 13/10/2014

Responsable du stage / *internship supervisor*:

Nom / *name*:	PERRIN	Prénom/ *first name* :	Hélène
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Nom du Laboratoire / *laboratory name*:

Code d'identification : UMR 7538 Organisme : CNRS – Université Paris 13
Site Internet / *web site*: www-lpl.univ-paris13.fr/bec
Adresse / *address:* 99 av J.-B. Clément, 93430 Villetaneuse
Lieu du stage / *internship place*: au laboratoire

Titre du stage / *internship title*: **Stirring a quantum gas in a ring trap**

Résumé / *summary*

A Bose-Einstein condensate with repulsive interactions is a superfluid. As a consequence, it presents a finite critical velocity for the generation of excitations, it supports vortices when excited by rotation, or it sustains a persistent flow in a toroidal pipe, in analogy with persistent current in superconducting devices [1]. The recent developments in atomic physics made it possible to produce and study this type of superfluid. The available trapping potentials also allow to confine the gas to a reduced number of dimensions and to produce experimentally 1D or 2D gases. Under these conditions of reduced dimensionality, the properties of superfluidity and quantum coherence and strongly affected. At LPL, we have built a setup aiming at the study of quantum gases confined in an annular trap with widely tunable parameters. This internship will be devoted to the experimental study of the excitation of the annular quantum gas with a stirrer, a focused laser beam rotating around the ring. The objective is to optimize the excitation scheme, and determine the critical angular velocity for imparting a quantum of circulation in the annular gas.

The fundamental tool which we use to obtain appropriate trapping potentials for the study of persistent flows is a magnetic trap dressed by a radiofrequency (rf) field [2], combined with a laser beam [3,4]. The experiment already allows the routine production of 2D gases. We are currently optimizing the transfer of the quantum gas into the ring trap. The objective of the internship is to install the stirrer beam, which has been developed in a previous internship on a separate breadboard, to optimize the excitation of the quantum gas and to analyze the results with advanced imaging and data analysis methods. The student will work on a day-to-day basis with a PhD student. He/she will be supervised Hélène Perrin and Laurent Longchambon. Beside the participation in the experiments, he/she will benefit from the weekly journal club, where the whole quantum gas community in the lab discusses a recent scientific paper.

Skills in quantum physics, optics and lasers, rf electronics or numerical simulation are appreciated.

[1] Mark Edwards, Nature Physics **9**, 68–69 (2013).
[2] K. Merloti et al., New J. Phys. **15**, 033007 (2013).
[3] O. Morizot, Y. Colombe, V. Lorent, H. Perrin, and B. M. Garraway, Phys. Rev. A **74**, 023617 (2006).
[4] R. Dubessy, T. Liennard, P. Pedri, and H. Perrin, Phys. Rev. A **86**, 011602(R) (2012).

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***: ED Galilée (or DGA depending on the candidate's curriculum).**

Lasers, Optique, Matière	**X**	Lumière, Matière, Interactions	**X**
Plasmas : de l'espace au laboratoire			

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