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 : 30/10/2018

Responsable du stage / *internship supervisor*:

Nom / *name*:	CHARRON	Prénom/ *first name* :	ERIC
Tél :	+33-1-69-15-61-14	Fax :	
Courriel / *mail*:	eric.charron@u-psud.fr		

Nom du Laboratoire / *laboratory name*: ISMO

Code d'identification : UMR 8214 Organisme : CNRS / Université Paris-Sud

Site Internet / *web site*: www.ismo.u-psud.fr

Adresse / *address:* Bât. 520 – Université Paris-Sud – 91405 Orsay cedex

Lieu du stage / *internship place*: Orsay et Hanovre (Leibnitz University, Allemagne)

Titre du stage / *internship title*: **Dynamics of quantum mixtures for precision measurements applications**

Résumé / *summary*

Quantum mixtures of atomic gases constitute a rich system to study microscopic interactions taking place in **degenerate quantum gases**. They are also a candidate of choice when two different species are needed for a **precision measurement**. This is the case for the test of the universality of free fall or for the test of the equivalence principle of Einstein. Indeed, a detected violation of this postulate would have dramatic implications on modern physics theories and on the fundamental interactions reunification attempts.

Recent proposals suggest the use of quantum mixtures in **atom interferometric measurements**. This puts stringent requirements on the assumed knowledge and manipulation speed of the dual-atomic source. The objective of this **theory project** is to devise theoretical recipes that would allow to manipulate two different ensembles of cold gases (Rb and K for instance) simultaneously by magnetic and/or optical forces. The preparation sequences should address the external degrees of freedom of the quantum gases (average position, average velocity, etc.) as well as their expansion rates.

Examples of methods considered during the internship include the implementation of optimal control theory for **fast transport on atom chips**, the investigation of **atomic lenses** to induce expansion temperatures in the pico-Kelvin regime, and solving of Gross-Pitaevskii equations for **interacting matter-wave dynamics in time-dependent traps**.

The candidate will perform this internship both at ISMO (Orsay) and at the Leibniz University of Hanover (Germany), where these techniques are investigated experimentally in **micro-gravity** (in a drop-tower) and in **space** experiments, in sounding rockets and on the international space station (ISS).

Funding opportunities to pursue a doctoral thesis are available from the Leibniz University Hanover.

Références / *references*

- R. Corgier et al., *Fast manipulation of Bose-Einstein condensates with an atom chip*, New Journal of Physics **20**, 055002 (2018) - http://doi.org/10.1088/1367-2630/aabdfc
- D. Becker et al., *Space-borne Bose–Einstein condensation for precision interferometry*, Nature **562**, 391–395 (2018) – http://doi.org/10.1038/s41586-018-0605-1

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*:
Funding opportunities to pursue a doctoral thesis are available from the Leibniz University Hanover

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

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