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: 02.10.2014

Responsable du stage / *internship supervisor*: Remi Geiger

Nom / *name*: Geiger **Prénom/ *first name* :** Remi

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Nom du Laboratoire / *laboratory name*: SYRTE, Systèmes de Référence Temps-Espace

Code d'identification : UMR 8630 **Organisme :** Observatoire de Paris, CNRS, LNE et UMPC

Site Internet / *web site*: http://syrte.obspm.fr/tfc/capteurs_inertiels/

Adresse / *address:* 61 avenue de l'Observatoire - 75014 Paris

Lieu du stage / *internship place*: Observatoire de Paris

Titre du stage / *internship title*: **Experimental development of a cold atom source for atom interferometery**

Résumé / *summary*

Atom interferometers offer interesting applications in geophysics, inertial sensing, metrology and fundamental physics. France is engaged in designing, building and operating a large-scale underground instrument based on optical and atom interferometry to study gravitation in general, for geophysics and gravitational wave detection applications in particular. This effort is coordinated in the framework of the MIGA project (*Matter-wave laser Interferometric Gravitation Antenna)* which involves 15 expert French laboratories in atom interferometry, laser physics, gravitational physics and geophysics, as well as private companies. The MIGA antenna consists of atom interferometers situated at different positions in a 300-meter long Fabry-Perot optical cavity. Within the MIGA project, SYRTE is in charge of the design and realization of the cold atom sources and of the coordination of the atom interferometry part of the project.

During this internship, which may be followed by a PhD thesis, you will realize a source of cold atoms for the MIGA instrument (the mechanical design has already been done). The atom source consists of a magneto-optical trap where Rubidium atoms are laser-cooled and then launched vertically at few meters per second using a moving optical lattice. You will characterize the cold atom source, the launching of the atoms and the detection system. You will also characterize the Raman transitions which are used for the improvement of the coherence of the atomic source and for the detection. You will be part of the MIGA team in the group at SYRTE and will extensively use your knowledge and skills in atomic physics, optics, and instrumentation. The goal will be to deliver a cold atom source at the end of the internship to our collaborators in Bordeaux (LP2N laboratory), for its use as the source of atoms in an atom interferometer.

The internship may be followed by a PhD thesis aiming at coupling an optical cavity to an atom interferometer to perform accurate inertial measurements. The coupling between the intracavity field and the atoms will be studied experimentally to realize beam-splitters for the matter-wave, using Bragg diffraction. This new technique requires extensive theoretical and experimental studies of the optical cavity and its coupling to the atoms, which will be very useful for the MIGA project, and will pave the way to future compact and performant atom interferometer inertial sensors.

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*: CIFRE, CNES, DGA, Equipex MIGA

Lasers, Optique, Matière	**x**	Lumière, Matière : Mesures Extrêmes	**x**
Plasmas : de l'espace au laboratoire			

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