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: 07.10.2013

Responsable du stage */ internship supervisor*: Arnaud Landragin / Remi Geiger

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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*: **Matter-wave interferometer of extreme sensitivity**

Résumé / *summary:* As a member of the excellence project MIGA (Matter wave Interferometer Gravitationnal wave Antenna), the inertial sensor team at SYRTE is responsible of developing **atom interferometers of extreme sensitivities**. In particular, the team developed a new cold atom gyrometer of high performance, able to detect rotations at the 10^{-9} rad.s^{-1} sensitivity level for an integration time of one second. Such a sensitivity level is required for applications to **precise geophysical studies and gravitational wave detection** as aimed by the MIGA project.

The experimental scheme is based on matter-wave interferometry using superpositions between different quantum states of an atom (Cesium or Rubidium). These superpositions are obtained with two (or more) photon transitions which transfer momentum to the atom and play the role of beam splitters and mirrors for the matter waves. The gyrometer at SYRTE is based on fountain geometry with an interrogation time of almost one second, allowing a very high sensitivity to inertial effects.

The internship, which may be followed by a PhD thesis, will aim at **improving the performances of this instrument for its application to fundamental physics**. You will be part of the Gyrometer team in the group and will use you knowledge and skills in atomic physics, optics and instrumentation.

You will compare different atom interferometer architectures (with 3 or 4 light pulses) and various implementations of the beam splitters with two photon transitions: Bragg transitions coupling two atomic levels corresponding to the same internal state (but different momentum) or Raman transitions, coupling two different internal states.

You will then study the possibility to use large momentum beam splitters based on multi-photon (2n) transitions and which may allow enhancing the sensitivity of the interferometer to inertial effects. For this purpose, you will investigate the influence of an optical cavity on an interferometer for the first time, in order to enhance the laser power and drive the atomic transitions with high efficiency.

Your work will both allow improving the performance of the matter-wave gyrometer and developing atom interferometers for their application to gravitational wave detection.

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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