PROPOSITION DE STAGE INGENIEUR / M2 - 4 mois minimum à partir de mars

Physique, Atomes froids, Optique, Lasers, Interférométrie Atomique

https://syrte.obspm.fr/spip/science/iaci/projets-en-cours/gravimetre/

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Nom du Laboratoire / *laboratory name*: SYRTE

Code d'identification : UMR 8630 — Organisme : Observatoire de Paris

Site internet / *web site*: https://syrte.obspm.fr/spip/science/iaci/

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

Lieu du stage / *intership place*: **Paris**

Titre du stage / *internship title*:

ULTRA COLD ATOM GRAVIMETER

Résumé / *summary*

Our team at SYRTE develops inertial sensors (accelerometers, gyrometers, …) based on atom interferometry technics. The development of this technology is linked to the use of cold atoms and laser beamsplitters, namely two photon transitions and more specifically stimulated Raman transitions. These methods allow now for the development of commercial products with applications in geophysics on the field, and of onboard instruments in ships or planes for inertial navigation and geoscience.

We have developed at SYRTE a state of the art cold atom gravimeter (CAG), based on these techniques. It uses free-falling ^{87}Rb atoms, which experience a sequence of Raman pulses driven by counter-propagating vertical lasers. The atom interferometer phase shift is proportionnal to *g*, the Earth gravity acceleration. Our instrument measures *g* with a sensitivity better than conventionnal state of the art absolute gravimeters (5.7*ng*@1s) and is more accurate (2*ng*).

Limits have been identified and several improvements will be made to reach the CAG in the $10^{-10}g$ domain both in term of accuracy and sensitivity.

The vacuum chamber will be modified to allow to use a new crossed dipole trap with a 50W laser at 1.1µm. As during this operation the chamber will be opened, we will take advantage to install a new Raman reflexion system which will rotate high optical quality Raman mirror to drive the atoms. Moreover, new MOT beams will be used and powered locked with an innovative fiber splitter to control the initial cloud position.

The intern will integrate the team and the project as it progresses. The internship can range from (i) the implementation and optimization of the optical trap to (ii) the characterization and optimization of the reflexion system and/or (iii) the implementation and tests of the locked MOT source.

The ultimate aim is to improve the evaluation of Coriolis acceleration and wavefront distortions effects even further, by performing measurements at very low temperature, and with more atoms. This will require to optimizse the evaporation sequence, by increasing the capture volume of the trap using modulation techniques. Yet, a drawback when using dense samples of ultracold atoms, eventually Bose-Einstein condensed, instead of a more dilute laser cooled source, arises from the effect of interatomic interactions, which are expected in our configuration to impart small biases to the measurement.

Ce stage pourra-t-il se poursuivre en thèse ? / *Possibility of a PhD ?:* **Oui**

Si oui, financement de thèse envisagé / *financial support for the PhD* : **EDPIF, own ressources (ANR)**