M1/M2 Stage de master de physique / *Physics Master Internship (M1/M2)*

Date de début */ starting date: March - April 2024*

Responsable(s) du stage */ internship supervisor(s)*:

Nom / *name*: Corgier Sidorenkov	Prénom/ *first name* :	Robin Leonid
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Nom du Laboratoire / *laboratory name*: SYRTE

Code d'identification : UMR8630 Organisme : Observatoire de Paris - PSL
Site Internet / *web site*: https://syrte.obspm.fr/spip/science/iaci/
Adresse / *address:* 61, avenue de l'Observatoire, 75014 PARIS
Lieu du stage / *internship place*: Paris

Titre du stage / *internship title*: **Quantum metrology for atom-interferometric inertial sensing**

Expertise of the team:

Our team at SYRTE develops ***inertial sensors*** (gyroscopes, accelerometers…) based on ***atom interferometry*** technics. Benefiting from the maturity of ultra-cold atom technology and fine manipulation of atomic wave-packets with laser pulses, these instruments demonstrate ***record precision and accuracy levels*** in laboratory. An efficient technology transfer in our domain has led to the recent development of commercial products with applications in geophysics on the field, and of onboard instruments in ships or planes for inertial navigation and geoscience.

Research context:

A significant increase in the performance of atomic inertial sensors remains possible, in particular by using advanced ***quantum metrology*** methods to surpass the standard quantum limit due to atom-shot noise. The aim of this internship is to study how the "***Delta-Kick squeezing***" (DKS) technique - recently proposed by Robin Corgier and his collaborators [1] - can be implemented experimentally. The DKS relies on the engineering of atom-atom interactions in a BEC in free fall. Such interactions induce strong correlations between the atoms, and lead to squeezing in the population difference between the two arms of the interferometer, and, eventually, to ***phase sensitivity below the standard quantum limit of precision***, when engineered adequately.

Internship:

The intern will first focus on the key concepts of the DKS method and then study, from a theoretical point of view, adequate experimental sequences to realize ***strongly spin-squeezed states*** through atomic lensing methods that employ pulsed off-resonant optical potential. The second part of the internship will then focus on the study of the phase extraction in a ***differential measurement configuration*** that uses dual spin-squeezed (via DKS) atomic source.

On the overall, the candidate will benefit from the expertise of a world-known research group. She/He will conduct theoretical studies that will directly influence the development of future experimental research. She/He will have an extensive theoretical support at each step, at the same time staying in contact with experimental projects of the team. Finally, the candidate will extend her/his knowledge in the field of Quantum Metrology, a key resource for any Quantum job opportunities including PhD and company positions.

The potential candidate should have a ***good background in quantum mechanics and atomic physics***.

External Collaborations:

L. Pezzè (LENS, Florence, Italy)

[1] Robin Corgier *et al.*, « Delta-Kick Squeezing », Phys. Rev. Lett. **127**, 183401 (2021)

Ce stage pourra-t-il se prolonger en thèse? / *Possibility of a PhD?* : Conditional Yes

Si oui, financement de thèse envisagé / *Financial support for the PhD* : EDPIF / Group ressources