Spécialité de Master « Optique, Matière, Plasmas »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage

Date de la proposition :

Responsable du stage / *internship supervisor*:

Nom / *name*:	Cohadon	Prénom/ *first name* : Pierre-François
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Nom du Laboratoire / *laboratory name*: Laboratoire Kastler Brossel

Code d'identification : UMR 8552 Organisme : ENS, UPMC, CNRS

Site Internet / *web site*: http://www.lkb.ens.fr/-Mesure-et-bruits-fondamentaux-

Adresse / *address:* UPMC Case 74, 4 place Jussieu , 75252 Paris Cedex 05 / 1323-209

Lieu du stage / *internship place*: Campus UPMC, Paris 5ème

Titre du stage / *internship title*: Squeezed light to beat quantum limits in optomechanical systems

Résumé / *summary*

Technological advancements over the last quarter-century have led to interferometric experiments nearly reaching the quantum radiation-pressure noise (QRPN) limit. These experiments have achieved the most sensitive displacement measurements to date, in both table-top interferometers and large-scale gravitational-wave interferometers, such as the LIGO and Virgo instruments.

In such experiments, even if classical noise has been reduced, two quantum-noise sources are still present: quantum phase noise and QRPN. For a given optical power, these two noises result in a limit to displacement sensitivity that one can achieve with a coherent laser beam: the standard quantum limit (SQL). Quantum noise can however be surpassed using quantum squeezed states of light: the application of squeezing can theoretically reduce QRPN and quantum shot noise simultaneously, thus surpassing the SQL.

The quest to observe the SQL is of keen interest to the field of optomechanics. A number of small-scale experiments have recently been performed, seeing QRPN effects and reaching the quantum mechanical ground state of an optomechanical resonator. The application of squeezed states to an SQL resonator would, for example, be a macroscopic test of quantum measurement theory. The SQL and the application of squeezed states to surpass the SQL are also of keen interest for gravitational-wave interferometers. The current generation is limited by quantum phase noise at high frequency, and the second-generation (Advanced LIGO and Advanced Virgo) are also expected to be limited by QRPN at low frequency. The goal of this PhD project is to develop the hardware, techniques and expertise to experimentally realise these scientific goals, in collaboration with a group at the Australian National University in Canberra.

The Measurement and Quantum Noise group at Laboratoire Kastler Brossel is one of the very few optomechanics experimental groups with connections to both macroscopic resonators (within the Virgo collaboration) and microresonators with table-top experiments. The LKB group has a unique expertise to perform such a project, including the optomechanical resonator based upon the micropillar geometry that has been recently optimized and is rapidly reaching SQL operation.

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***: ED support**

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