Spécialité de Master « Optique, Matière, Paris »

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

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 11 octobre 2016

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Nom du Laboratoire / *laboratory name*: Matériaux et Phénomènes Quantiques,

Code d'identification : UMR 7162 Organisme : CNRS/Université Paris Diderot

Site Internet / *web site*: http://www.mpq.univ-paris-diderot.fr/spip.php?article496&lang=en

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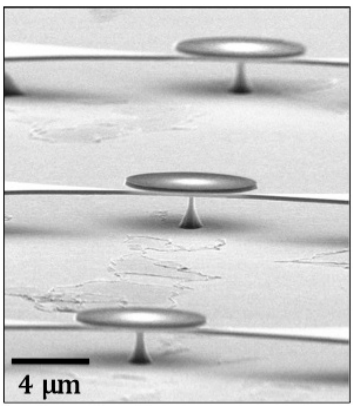
Lieu du stage / *internship place*: Université Paris Diderot, Paris

Hybrid Quantum NanoOptoMechanics

Optomechanics studies the coupling between light and mechanical oscillators. It is a burgeoning field of research at the interface of quantum optics, mesoscopic physics and mechanical micro/nano devices [1]. Analog to laser cooling of atoms, mechanical oscillators can be optically cooled to ultra-low temperature and reveal their quantum behavior, despite their macroscopic mass scale, opening a new area of quantum physics with implications in metrology, communications, sensing and gravitation physics.

Our optomechanical resonators are miniature semiconductor disks that combine lightweight mass, very high frequency (GHz), strong optomechanical coupling and ultra-low dissipation on a photonic chip (see picture [2]). Because they are made of active semiconductors, they allow hybridization with elementary quantum systems like quantum wells or quantum dots, inserted into the resonator. Such hybrid systems allow controlling elementary optomechanical interactions, and generating non-classical behaviors like entanglement and single quanta generation [3], both for photons and for phonons, the quanta of mechanical vibrations.

The perspective of this PhD project is to explore light-matter interactions in hybrid quantum optomechanics, and reach the level where a single photon can mechanically act on mechanical matter, and vice-versa where mechanical motion can influence single photons. Such regime has remained out of reach of past researches, but strategies are now making this horizon accessible to our devices. This implies the possibility of single photon counting with optomechanics, quantum light preparation and routing, mechanical memories for quantum light, and quantum sensing in complex environments [4].



[1] I. Favero, and K. Karrai. Nat. Phot. 3, 201 (2009). M. Aspelmeyer et aL Rev. Mod. Phys. 86, 1391 (2014)

[2] L. Ding, C. Baker, P. S., A. L, S. Ducci, G. Leo and I. Favero. Phys. Rev. Lett. 105, 263903 (2010).

[3] J. Restrepo, C. Ciuti, and I. Favero, Phys. Rev. Lett. 112, 013601 (2014).

[4] E. Gil-Santos, C. B, D. T. N, W. H, C. G, A. L, S. D, G. L and I. Favero. Nature Nano 10, 810 (2015).

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*: **Europe**

Lumière, Matière, Interactions	**YES**	Lasers, Optique, Matière	**YES**

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