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 : 04/11/2014

Responsable du stage / *internship supervisor*:

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Code d'identification : UMR 8552 Organisme : Laboratoire Kastler Brossel
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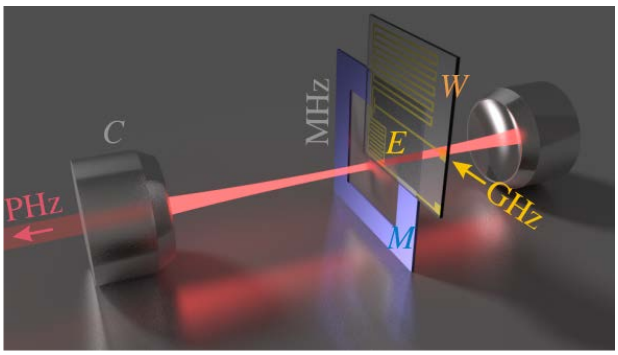
Lieu du stage / *internship place*: LKB Jussieu

Titre du stage / *internship title*: **Quantum nano-optomechanical transducer**

Résumé / *summary :* Progress in quantum networks and quantum information relies on our ability to combine two essential technological challenges: on the one hand, realizing efficient quantum gate operations by coupling individual quantum systems very well isolated from their environment, and on the other hand, being able to store and transfer individual bits of quantum information for long times and over large distances. These challenges are about to be overcome thanks to the quickly growing fields of quantum information processing with superconducting qubits and microwave circuits, and quantum communication with optical fibers. Hence, bridging the gap between those technologies, that is, achieving quantum coherent transfer of information between microwave photons in a cryogenic apparatus and propagating optical fields, appears as a central challenge in the field of quantum information.



Optomechanical systems, which benefit from a universal coupling of a mechanical resonator to microwave or optical fields are likely to be a key ingredient of such systems. The present project aims at implementing a hybrid quantum link by coupling a nanomechanical resonator to electromagnetic modes at various frequencies. A view of principle of the envisioned setup is given on the figure. The mechanical resonator is a 2D high-tensile-stress membrane placed in the middle of a high-finesse optical cavity and also coupled to a resonant LC circuit. Although the principle of each element has already been demonstrated separately, combining a high-finesse cavity with state-of-the-art electromechanical system inside a dilution fridge is a technological endeavor that requires a careful validation at each step of the project.

Methods and techniques: The *Optomechanics and Quantum Measurements* group at Laboratoire Kastler Brossel has a unique expertise to perform such a project, including collaborations with nanofabrication laboratories, availability of quantum-limited laser sources, detection setups, and a dilution refrigerator compatible with optical operation. The hybrid platform envisioned here will be based on an all-integrated design with a high-Q dielectric nano-membrane suspended above a Bragg mirror grown by epitaxial techniques and above a coplanar waveguide (CPW) superconductive cavity.

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***: Doctoral School**

Lasers, Optique, Matière	**X**	Lumière, Matière, Interactions	**X**
Plasmas : de l'espace au laboratoire	**X**		

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