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 :

Responsable du stage / *internship supervisor*:

Nom / *name*: Vasanelli — Prénom/ *first name* : Angela

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

Code d'identification : UMR7162 — Organisme : Univ. Paris Diderot / CNRS

Site Internet / *web site*: http://www.mpq.univ-paris7.fr/

Adresse / *address:* 10 rue A. Domon et L. Duquet 75013 Paris

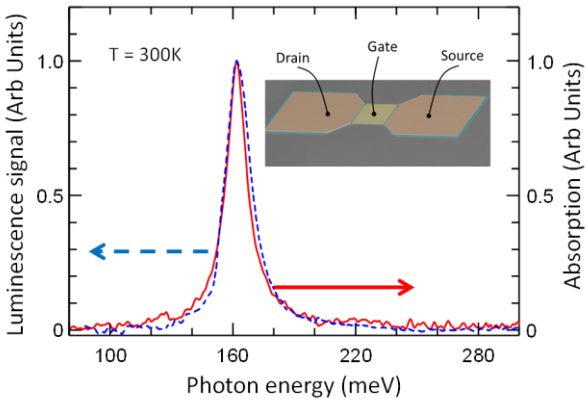
Lieu du stage / *internship place*: Bâtiment Condorcet, 10 rue A. Domon et L. Duquet 75013 Paris

Titre du stage / *internship title*: **Superradiant semiconductor emitters**

Superradiance [1] is a well-known phenomenon in atomic physics, occurring when a dense ensemble of two-level emitters is placed in a small volume. The spontaneous emission becomes in this case a cooperative effect, resulting in a dramatic increase of the spontaneous emission rate.

In semiconductor nanostructures it is very easy to achieve electronic densities that can be several orders of magnitude higher than in an atomic system. We have recently demonstrated [2] that a dense electronic gas confined in a semiconductor quantum well reacts to an electromagnetic solicitation as an ensemble, like a macroscopic atom with a coupling strength proportional to the number of particles participating to the interaction. As a result, the system is characterized by a radiative lifetime that depends on the electronic density and that is several orders of magnitude shorter than that of a single emitter. This unique property will be at the heart of our investigation to prove the superradiant nature of our system.

The aim of this work will be to conceive, realize and characterize optoelectronic devices exploiting superradiant phenomena. Recently we have demonstrated electroluminescence (see figure below) from a superradiant mode excited in the channel of a field effect transistor.



Experimental evidence of a collective optical mode of a dense two-dimensional electron gas. Red line: absorption spectrum measured at room temperature.
Blue line: Electroluminescence spectrum measured at room temperature when applying a current in the plane of the quantum well. This spectrum corresponds to the electrical excitation of the same collective mode as measured in absorption. The inset shows an image of our electroluminescent device, based on the same geometry as a field effect transistor.

References:

[1] M. Gross, S. Haroche, Physics Reports **93**, 301 (1982)

[2] A. Delteil, A. Vasanelli, Y. Todorov, C. Feuillet-Palma, M. Renaudat St-Jean, G. Beaudoin, I. Sagnes and C. Sirtori, Phys. Rev. Lett. **109**, 246808 (2012)

Toutes les rubriques ci-dessous doivent obligatoirement être remplies

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*: **ANR project DOMANY**

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

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