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 : 15/10/2012

Responsable du stage / *internship supervisor*:

Nom / *name*: DUCCI   Prénom/ *first name* : Sara

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

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

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

Adresse / *address:* 10 rue Domon et Duquet 75013 PARI

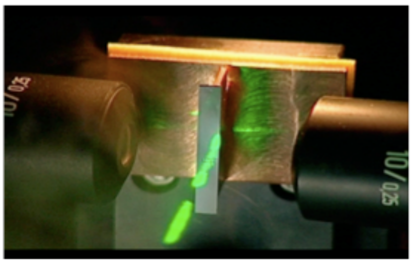
Lieu du stage / *internship place*: 10 rue Domon et Duquet 75013 PARIS

Titre du stage / *internship title*: ***Photonic devices for quantum information***

This project is the development of the work done by our group on semiconductor sources of quantum light at room temperature[1]. The work is organized in 3 main objectives: the development of the sources, the characterization of the entanglement properties of the generated two-photon state, and the integration of the sources with nano-photonic circuits. Our approach is to use parametric down-conversion in semiconductor waveguides to generate non-classical two-photon states at room temperature and at telecom wavelength, taking advantage of the huge potential in terms of integration offered by the 3-5 semiconductors platform.

This internship / PhD thesis is focused on two kinds of original devices: a microcavity based on a counterpropagating phase matching and an active device based on modal phase matching.

In the first device, a pump beam impinging onto an AlGaAs waveguide produces photon pairs on two counterpropagating and orthogonally polarized modes. The indistinguishability of the emitted photons has been tested via a Hong-Ou-Mandel interference[2], and the demonstration of polarization entanglement has been done via a density matrix reconstruction[3]. The objective is to go on with the quantum characterization of the photon pairs to control frequency correlations via the spectral and spatial properties of the pump beam to generate hyper-entangled states. In the second device the phase matching is obtained by playing with guided modes of different orders; this geometry allows the insertion of a quantum well within the heterostructure to realize an electrically pumped ultra compact source [4]. New designs will be explored in order to add flexibility to the device. The demonstration of the quantum properties of the generated two-photon state opens the way to their application in more complex architectures of quantum communications and to the integration at a nanometric scale of quantum photonic functions. This work will benefit from national and international collaborations for the device fabrication and their application in quantum information.



[1] A. Orieux, et al. 'Semiconductor sources of two-photon states at room temperature in the telecom range ' in Proc. SPIE, vol. 8268, p. 826824, (2012). [2] X. Caillet et al. "Two-photon interference with a semiconductor integrated source at room temperature," Opt. Express ***18****, 9967 (2010). [3]A. Orieux et al., "Entangled photon generation on a semiconductor chip at room temperature', submitted. [4] A. Orieux et al' A laser diode for integrated photon pair generation at telecom wavelength' in CLEO : QELS-Fundamental Science Conference Digest, p. JW4A.114, Optical Society of America, 2012.*

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***:** Fellowship from Doctoral School, preparation of projects to be submitted to ANR, C'Nano, DGA

Lasers et matière	**YES**	Lumière, Matière : Mesures Extrêmes	**NON**
Optique de la science à la technologie	**YES**	Plasmas : de l'espace au laboratoire	**NON**