MASTER DE PHYSIQUE ET APPLICATIONS - 2ème année

Spécialité Sciences des Matériaux et Nano-objets

UPMC Paris 6, ENS, ENS Cachan, Chimie ParisTech, ESPCI et l'École Polytechnique

Proposition de stage 2011-2012

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Titre du sujet proposé : **Semiconductor quantum dots for the generation of non classical states of light**

Projet scientifique :

Reliable single-photon sources are of great interest for applications in the emerging fields of quantum information processing, but also for fundamental quantum optics experiments. For instance, in quantum cryptography it is necessary to ensure a perfectly secure transmission of information and for this purpose, one needs a single-photon source able to emit on demand, one and only one photon. The simplest idea for realizing a single-photon source is to use the fluorescence of a two-level quantum system. The main practical challenge for achieving a high-performance single-photon source remains to increase the probability to detect a photon per excitation cycle. This probability depends both on the optical properties of the emitter and on the extraction efficiency of the optical device. The aim of this work is to address both of these issues from the fundamental point of view and propose an optimized optical device for single-photon sources applications. We propose to improve the emission properties of the source (high emission rate, high degree of coherence) as well as the light extraction efficiency by building new devices. Semiconductor quantum dots will be used as non-classical light sources for realizing quantum optics experiments. Single semiconductor quantum dots will be addressed and coherently manipulated *at resonance* in order to minimize decoherence processes due to interaction between the dot and its environment characteristic in solid state systems. Thus, the emitted photons will have a maximum degree of indistinguishability. New structures will be developed in order to enhance the spontaneous emission rate of the source while improving the source extraction efficiency. Entanglement of two quantum bits will be demonstrated either using independent photons emitted by a single dot or two photons each one emitted by independent quantum dots. The possibility of entangling two exciton states created in two independent quantum dots will also be investigated. The achievement of two qu-bits operations is an important and challenging task to accomplish towards the implementation of logic gates for quantum computation within the solid-state. Up to now, triggered independent sources of indistinguishable single photon are lacking.
During this internship, the student will participate in the realization of the photons correlation setup for characterizing the coherence properties of the semiconductor quantum dots.

Techniques utilisées : Spectroscopie optique picoseconde à basse température
Qualités du candidat requises :
Rémunération éventuelle du stage : Oui
Possibilité de poursuivre en thèse ? Oui
Si oui, quel est le mode de financement envisagé : ED

Ne pas dépasser une page, svp.