


Internship proposal 2011-2012

<p>Laboratory : Laboratoire Pierre Aigrain</p> <p>Address : 24 rue Lhomond, 75005 Paris</p> <p>Laboratory director : Jean-Marc BERROIR</p>	
<p>Internship supervisor : Carole DIEDERICHS</p> <p>Phone : +33 (0)1 44 32 25 86 / 38 42</p> <p>e-mail: carole.diederichs@lpa.ens.fr</p>	

Resonant excitation of single semiconductor quantum dots for the generation of single indistinguishable photons

Scientific project :

The project is an experimental study of the resonant emission in coherently-driven single semiconductor quantum dots by optical spectroscopy and quantum optics experiments. Quantum dots are artificial nanostructures where the 3D-confinement of the electrons leads to an atom-like quantized energy spectrum. Semiconductor quantum dots are thus commonly considered as artificial atoms and this analogy has led to an important development of experiments in the field of cavity quantum electrodynamics with semiconductor systems. These nanostructures are indeed very promising for the realization of integrated single photon sources for quantum information applications. The simplest idea for realizing a single photon source is to use the resonant emission of a two-level quantum system (i.e. the fundamental interband excitonic transition in quantum dots). Thanks to an original orthogonal excitation-detection setup with a high spatial resolution (excitation guided through the structure and detection of the emission with a microscope objective in a confocal geometry), the quantum dots are addressed and coherently manipulated at resonance in order to minimize the residual excitation of their environment that acts as a fluctuating reservoir for spectral diffusion. The decoherence processes are then reduced and the emitted photons should show a maximum degree of indistinguishability. During this internship, the student will study the quantum properties of the resonant emission of a single quantum dot with quantum optics experiments. The student will also implement interferometric experiments in order to distinguish the coherent component of the resonant emission of a single quantum dot from the incoherent component.

The samples are fabricated at “Laboratoire de Photonique et de Nanostructures” (LPN) and this work is performed in close collaboration with “Institut des NanoSciences de Paris” (INSP) and the LPA theory group.

Techniques in use : Optical spectroscopy (photoluminescence, excitation of the photoluminescence, resonant emission spectroscopy) – High resolution Fourier transform spectroscopy – Time-resolved experiments (lifetime measurements) – Quantum optics (photon antibunching) – Lasers – Cryogeny.

Applicant skills : Quantum physics, physics of nanostructures. Skills in experimental optics.

Granted internship : yes (417 €/month)
C'nano IdF laboratory (France only) : yes
Possibility for a thesis : yes (type of grant : “Ecole Doctorale” grant)