Internship offered in M2
2017-2018

Responsible for internship

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Internship topic: Semiconductor quantum dots for integrated quantum technologies

Reliable single and indistinguishable photon sources are of great interest for applications in the emerging fields of quantum information processing, but also for fundamental quantum optics experiments. The simplest idea for realizing a single-photon source is to use the fluorescence of a two-level quantum system and for this purpose semiconductor quantum dots are very good candidates thanks to their discrete density of states and their easy integration into conventional semiconductor device structures. Semiconductor quantum dots are also promising candidates for the implementation of qubits in order to realize quantum logic gates.

The project aims to investigate the light-matter interaction at nanometer scale and realize an optimized source in order to integrate it in a photonic platform where a single dot is strongly coupled to the photons of an optical cavity. We will also address the problem of decoherence, which is an important issue specific to solid-state systems arising from the interaction between the dots and the solid matrix (phonon bath, charges, nuclear spins).

Single spins in quantum dots will be addressed and coherently manipulated with ultrafast optical pulses on resonance in order to minimize decoherence processes. Recently, we have proposed an electrically-tunable device with high emission rate and high degree of coherence that will be used in the future work. Spectroscopic and interferometric measurements will be performed at low temperature to determine characteristic properties of the system, like the resonance fluorescence spectrum, coherence time, radiative lifetime, indistinguishability of the emitted photons.

Coupled quantum dots, where carriers can tunnel coherently between the dots, have even greater potential: as storage units for spin qubits with long coherence times or as quantum gates needed for quantum computation.

The long term goal of the project is to study coupled quantum dots in order to implement stationary qubits that act as quantum memories and entangle them by flying qubits like photons, in order to realize logic gates for quantum computation within the solid-state.

Techniques involved : ultrafast spectroscopy, interferometric techniques

Type of internship: experimental
Paid internship: Yes
Can this internship be continued for a PhD? Yes
If yes, type of PhD funding envisaged is: Ecole Doctorale