Soutenance de thèse

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14 h, Amphithéâtre C2N

Giant polarisation rotation with a quantum dot-based spin-photon interface

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Abstract :

The development of an interface between stationary qubits and messenger qubits offers many possibilities for quantum communications, via the exchange of information between qubits, and for quantum computation, via the realisation of logic gates and/or complex, multi-entangled quantum states. In this context, we study a semiconductor quantum dot system embedded in a micropillar optical cavity. Such a system allows the trapping of an electron whose spin can interact with an incident photon: the polarisation of the reflected photon is then modified according to the spin state of the electron. The objective of such an interface is to obtain a perfect mapping between the spin state and the polarisation state of the photon after interaction with the quantum dot. This results in a giant polarisation rotation of the photons reflected by the studied system, the direction of which is spin-dependent. We have therefore developed an expertise in the generation of specific polarisation states, as well as in the measurement of arbitrary polarisation states, in order to analyse the polarisation response of the quantum dot-micropillar device. We then demonstrate the possibility of reaching a giant polarisation rotation that depends on the spin state of the electron. The measurement of this rotation is enabled by a full polarisation tomography. Finally, we study the efficiency of the spin state projection induced by the detection of a photon reflected by the system, in order to characterise the performance of our spin-photon interface. This work opens up possibilities towards the realisation of efficient spin-photon interfaces, based on charged quantum dot-cavity devices.

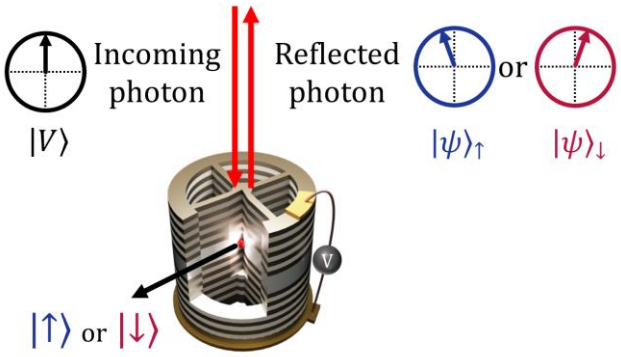

Figure: Scheme of an electrically contacted pillar microcavity coupled to a charged quantum dot. The polarisation of reflected photons is rotated through the interaction with the embedded spin qubit.