

## **EUROPHOTONICS-POESII MASTER COURSE**

## PROPOSAL FOR A MASTER THESIS

Dates: April 1<sup>st</sup>, 2016 – September 30<sup>th</sup>, 2016

Laboratory : Quantum Photonics Group, ICFO City, Country :Castelldefels

Title of the master thesis : High efficiency and long lived solid state quantum memory

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## Summary of the subject (maximum 1 page) :

This project is within the framework of experimental quantum information science, whose goal is to control quantum coherence effects in matter and light to enable new information processing capabilities. Quantum memories (QM) for light, which allow a coherent and reversible transfer of quantum information between light and long lived matter quantum bits, are crucial devices in quantum information science. In particular, they enable to interface stationary quantum bits (encoded in atom like systems) and flying qubits (encoded in photons). QMs are, for example, needed for the implementation of ultra-long distance quantum communication using quantum repeater architectures.

In our group, we are developing QMs in a solid state environment, using cryogenically cooled rare-earth doped crystals. Important requirement for quantum storage include efficient interaction between photon and matter, allowing high storage and retrieval efficiency of photonic qubits, as well as long storage times. Solid state spin-wave QMs demonstrated so far suffer from a low efficiency. The goal of this master project is to design and experimentally demonstrate a setup enabling high efficiency solid state QM. Several options will be considered, including inserting the memory into an impedance-matched optical cavity. Another possible project is to overcome the dephasing in the spin states.

## Keywords : Solid state Quantum Memory, Light-matter interaction, Decoherence, Additional information :

\* Required skills : Interest for experimental physics

\* Miscellaneous :