Spécialité de Master « Optique, Matière, Plasmas »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 16/10/2014

Responsable du stage / *internship supervisor*:

Nom / *name*:	Chanelière	Prénom/ *first name* :	Thierry
Tél :	01 69 35 21 41	Fax :	01 69 41 01 56
Courriel / *mail*:	thierry.chaneliere@u-psud.fr		

Nom du Laboratoire / *laboratory name*: Laboratoire Aimé Cotton

Code d'identification :UPR 3321 Organisme :CNRS

Site Internet / *web site*: http://www.lac.u-psud.fr/

Adresse / *address:* Campus d'Orsay, Bât. 505, 91405 ORSAY Cedex

Lieu du stage / *internship place*: Laboratoire Aimé Cotton

Titre du stage / *internship title*: Efficient quantum memory in the telecommunication wavelength range

Résumé / *summary*

Rare-earth ion doped crystals (REIDC) have useful properties that can be exploited in the context of quantum information. Optical and spin ion transitions have long coherence times at low temperature so they can make "good" atomic qubits. In solids, the luminescent centers are highly concentrated so the absorption is significant over a large bandwidth making theses materials well suited for broadband processing. This is crucial for the realization of optical quantum memories. We are currently working with an erbium doped Y_2SiO_5 crystal (Er^{3+}:Y_2SiO_5) for which we have demonstrated a large efficiency in the C-band of the telecommunication wavelength range [Optics Letters,39,2711(2014)].

1- We have identified a limiting factor for the extension of the memory bandwidth toward the GHz range [arxiv:1409.5544]. This latter is indeed limited by the intrinsic coupling between erbium ions (magnetic or electric dipoles). This issue can be avoided by an original material development. By adjusting the concentration and the orientation, an optimal sample can be fabricated. It will be the core of a large capacity memory compatible with quantum light sources that are currently developed in collaboration with the specialists of single photon generation.

2- One can also take the opposing viewpoint and actually benefit from the ions coupling. In that case, the coupled ions define a set of interacting qubits used to perform rudimentary quantum computing tasks. It is the case for example with an erbium ion and neighboring yttrium ions in Er^{3+}:Y_2SiO_5. A good understanding of the nearest neighbor interaction is required to turn this apparently detrimental effect into a useful quantum resource.

For an optimal light storage (1) or to define appropriate interacting qubits (2), an accurate perception of the Er ion coupled to its environment is critical for the development of quantum information in the telecommunication wavelength range. Theses two directions can be considered for the continuation of the internship into a PhD program.

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : YES**

Si oui, financement de thèse envisagé/ *financial support for the PhD***:École doctorale**

Lasers, Optique, Matière	**X**	Lumière, Matière, Interactions	**X**
Plasmas : de l'espace au laboratoire			