Spécialité de Master « Optique, Matière, Paris »

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

Proposition de stage

Date de la proposition : 16/10/2015

Responsable du stage / *internship supervisor*:

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

Code d'identification :UMR 9188 Organisme :CNRS / Univ. Paris-Sud / ENS Cachan

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

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

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

Titre du stage / *internship title*: Erbium doped materials for quantum optical processing.

Résumé / *summary*

Rare-earth ion doped crystals 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 memory efficiency in the C-band of the telecommunication wavelength range [Optics Letters,39,2711(2014)].

This level of control allows to consider the storage of non-classical light. For this purpose, we propose to focus on the so-called continuous variable (CV) regime of quantum optics. The CV sources in the telecom band has been extensively developed and integrated lately. They are well adapted to erbium doped materials. Their bandwidth correspond to our recent storage demonstration. They are also potentially spectrally multimode thus covering the remarkably high number of frequency channels available in Er^{3+}:Y_2SiO_5. The adaptation of a CV source to erbium samples will be conducted with the best national experts in the field.

In parallel to this finalized project, we also propose to investigate the next generation of Er doped materials. It has been shown recently that a controlled level of disorder induced in the host Y_2SiO_5 matrix can be beneficial because it increases the inhomogeneous linewidth and thus the processing bandwidth while keeping a good coherence time even at larger dopant concentration. This surprising win-win situation is actually explained by a reduction of the erbium-erbium coupling because the disorder makes this interaction non-resonant (lifting the degeneracy caused by a disturbed environment). A new crystalline sample of Er^{3+}:Y_2SiO_5 has been fabricated by our collaborators with a small amount of scandium (Sc^{3+}). Preliminary measurements have confirmed the potential of this new generation materials for ultra-fast optical processing in the field of both quantum and classical .information.

Theses complementary 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**

Lumière, Matière, Interactions	**X**	Lasers, Optique, Matière	**X**