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 : 7 novembre 2013

Responsable du stage / *internship supervisor*:			
Nom / *name*:	Zaquine Diamanti	Prénom/ *first name* :	Isabelle Eleni
Tél :	+33 14581-7839/7114	Fax :	+33 1 45 81 37 94
Courriel / *mail*:	isabelle.zaquine@telecom-paristech.fr, eleni.diamanti@telecom-paristech.fr		
Nom du Laboratoire / *laboratory name*: Laboratoire Traitement et Communication de l'information			
Code d'identification : UMR 5141		Organisme : Télécom ParisTech	

Site Internet / *web site*: http://iq.telecom-paristech.fr/

Adresse / *address:* 46 rue Barrault 75013 Paris

Lieu du stage / *internship place*: 46 rue Barrault 75013 Paris

Titre du stage / *internship title*: **Generation of multiparty entangled photon states**

Résumé / *summary*

Future information and communication technologies will likely rely on quantum resources. Entanglement, the notion by which two or more particles may become correlated in a way that cannot be described using our intuitive 'classical' understanding of cause and effect, is situated at the heart of these resources. Entangled states are indeed the essential element of practically all protocols and phenomena from which the field of quantum information derives its power.

The generation of entangled states in photonic systems, which are ideally suited for quantum communications, is typically performed using the second order nonlinear effect of spontaneous parametric down conversion (SPDC). In the last years, tremendous research efforts have been devoted to the generation of two-party entangled states, with great success. The implementations employ a wealth of configurations, at visible or telecommunication wavelengths, with different types of crystals, producing photon pairs with various spectral widths or temporal regimes. The next step is the generation of multiparty entangled states. Such states are in fact required in several recently proposed quantum computation and cryptographic protocols [for instance, Pappa et al, Phys. Rev. Lett. 2012 from our team], whose practical realization will open the way to useful advanced applications within future quantum networks.

Our goal here will be to examine ways of generating different types of multiparty entangled photon states. The production of such states is challenging, often involving higher order nonlinear effects or complex interferometers. Significant results can only be obtained after long integration times, requiring very stable systems. We will investigate techniques based on fusion-type processes, double pair generation in SPDC, or hyperentanglement involving degrees of freedom other than polarization. Our tests will be based on polarization entangled photon sources developed in our lab at telecommunication wavelengths. These have been used recently for entanglement distribution in the context of existing network infrastructures, using off-the-shelf fibered telecom components [Ghalbouni et al, Opt. Lett. 2013]. The objective of our work will be to develop flexible and efficient devices with features compatible with specific quantum information protocols. Furthermore, we will examine suitable entanglement witnesses for characterization of the generated states, which is a non-trivial task for multiparty entangled states, based on theoretical work performed in our team.

The internship is primarily of experimental nature. The subject requires knowledge of classical and quantum, linear and nonlinear optics. It is important to emphasize the multi-disciplinarity of the domain of quantum information. This work will imply interactions with computer scientists, theoretical physicists and also classical telecommunication specialists.

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***: EDOM, EDITE, Institut Mines/Télécom, Université Paris-Saclay, Région lle-de-France, CNRS**

Lasers, Optique, Matière	x	Lumière, Matière : Mesures Extrêmes	x
Plasmas : de l'espace au laboratoire			

*Fiche à transmettre (fichier pdf **obligatoirement**) sur le site http://stages.master-omp.fr*