



Master in Photonics – “PHOTONICS BCN” Master ERASMUS Mundus “EuroPhotonics”

MASTER THESIS PROPOSAL

Starting full time from April 2024

Presentation at the end of July or beginning of September 2024

Laboratory: Optoelectronics Group

Institution: ICFO

City, Country: Barcelona, Spain

Title of the master thesis: Stabilization of phase and polarization in multiplexed entangled states through multi-channels optical fibre arrays.

Name of the master thesis supervisor and co-supervisor: Supervisor – Dr. Prof. Valerio Pruneri;
Co-supervisor – Evelyn A. Ortega

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Keywords: Entanglement, stabilization, multiplexing, multi-core fibers, spatial light modulation.

Summary of the subject:

In order to successfully implement secure entanglement-based quantum communications, it is essential to develop robust entanglement distribution (ED) techniques, that ensure stabilization over long enough time scales and distances. Phase and polarization are light degrees of freedom that usually play important roles in most of the ED implementations. However, they intrinsically experience big relative distortions between channels of a network. This issue is especially pronounced in separated optical fibres and in free-space orthogonal modes. Finding solutions for a set of ED implementations will pave the way for more universal solutions, representing a big impact in the quantum communications sector mainly.

The main objective of the project consists in the design of phase and polarization stabilization protocols, and their implementation in ED through a multi-core fibre (MCF) and multiple single-mode fibres (SMFs). In order to do it, the student will utilize spatial light modulation techniques, PID-assisted interferometry control, classical and quantum light sources as well as single-photon detectors and imagers. The selected candidate will have the opportunity to work within a sociable and multidisciplinary team of experts, to utilize cutting edge-technology, to be regularly supervised, to develop a proactive attitude and to improve his/her self-regulation skills. The successful results of this research could lead to a series of developments beyond the original scope of the project.



Objectives:

1. To design and model stabilization techniques under different implementations of entanglement distribution.
2. To acquire expertise in the manipulation of experimental equipment, by mounting and optimizing an opto-electronics and opto-mechanical setup.
3. To demonstrate a functional state stabilization system in entanglement distribution, through a MCF and multiple SMFs.

Additional information:

* Required skills:

- Medium programming experience in more than one language, including Python
- Knowledge in optics

* Optional skills (beneficial for the candidate to have):

- Knowledge in photonics and quantum optics
- Knowledge in machine learning, deep learning or neural network
- Knowledge in imaging and sensing