Master in Photonics – "PHOTONICS BCN"
Master ERASMUS Mundus "EuroPhotonics"

MASTER THESIS PROPOSAL

Full time from April 2026 (it can start part time from February 2026)
Presentation date to be chosen: end of July or beginning of September 2026

Note: The main Master Thesis supervisor has to be a professor of the Master in Photonics program. One co-supervisor (internal or external) can be defined. Main Supervisor is responsible for the subject of the proposal and has to give continuous support to the student (research development, Report writing and presentation preparation). For external proposals a co-supervisor from the Master program and a collaboration agreement with UPC are needed.
You can find all information about the Master Thesis process in our webpage.

Laboratory: Optoelectronics Group
Institution: ICFO – The Institute of Photonic Sciences
City, Country: Castelldefels, Spain

Title of the master thesis: Characterization of classical and quantum light over a deployed fiber link

Name and affiliation of the master thesis supervisor: Prof. Dr. Valerio Pruneri, ICFO
Name and affiliation of the co-supervisor (if any): Dra. Evelyn A. Ortega, Adrian Sanchez ICFO (for external proposals a co-supervisor chose among the Master Program professors and a collaboration agreement with UPC is needed)
Email address: evelyn.ortega@icfo.eu, Adrian.Sanchez@icfo.eu
Phone number:
Mail address:

Keywords: characterization, optical fibers, entanglement, polarization.

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

Advances in quantum secure communications have increased drastically in the last decades, mainly motivated by the potential development of powerful quantum computers, capable of breaking classical cryptographic protocols. Within this field, entanglement-based quantum protocols offer one of the most secure alternatives against possible quantum attacks. Nowadays, the main challenges to overcome for the practical implementation of said protocols are the efficient generation and long-distance distribution of quantum entangled photons, which limit their real-world applicability.

One of the most widely used methods for generating entangled photon pairs is spontaneous parametric down-conversion (SPDC). This phenomenon can be used in multiple configurations to generate entanglement in several degrees of freedom, such as polarization, time-bin, or frequency-bin, among others.

Regarding efficient entanglement distribution, optical fibers have shown the best performance for terrestrial communication networks, providing low loss and better routing versatility. In addition, special types of fibers, such as multimode or multicore fibers, can be exploited to increase the maximum information transmission capacity of the link.

In this project, the student will work alongside a team of experts in the characterization of a deployed special fiber link, both with classical (laser) and quantum (SPDC) light. The characterization of the link in terms of polarization and phase stability is crucial for future quantum experiments conducted upon the link.

2. Objectives (maximum 1 page):

The project will be divided in two main sections. The first one consists in the characterization of the link employing classical light. The objectives of this section are:

- Characterizing parameters of the link, such as attenuation, chromatic dispersion, polarization-mode dispersion and crosstalk, among other useful metrics using classical light.
- Determining the temporal stability of polarization and phase in the link in different environmental conditions.

Upon successful completion of the previous objectives, the student will characterize the quality of quantum entanglement distributed through the link. The objectives of this section are:

- Aligning and in-lab characterizing a polarization-entangled photon source based on SPDC.
- Coupling polarization-entangled photons into the deployed fiber employing a custom-developed system.
- Analysing the quality of the distributed entanglement through the fiber link.

Additional information:
* Required skills:

- Basic knowledge in classical optics and optical fibers
- Basic knowledge in quantum physics, and especially quantum optics
- Programming in Python, Matlab and/or Labview at a basic level