



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

### **MASTER THESIS PROPOSAL**

**Starting full time from April 2025**

**Presentation at the end of July or beginning of September 2025**

**Laboratory:** Optoelectronics Group

**Institution:** ICFO

**City, Country:** Castelldefels, Spain

**Title of the master thesis:** Implementation and characterization of the building blocks of a bright polarization-entangled photon-pair source

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

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**Keywords:** Entanglement, Photon source, fiber

#### **Summary of the subject (maximum 1 page):**

Quantum communications (QC) is a promising branch of quantum technologies that offers unbreakable messaging security. This is possible because QC relies on the laws of nature rather than mathematical complexity. Although QC is well-established in control environments, it still requires extra effort to implement in deployed links. With the current technology, optimizing entangled photon pair sources (EPS) is a fundamental aspect to address.

This project consists of implementing and characterization of the building blocks of a bright polarization-based EPS using a Sagnac configuration. The characterization will focus on quantum state fidelity, two-photon visibility, and/or the Clauser-Horne-Shimony-Holt (CHSH) inequality. The source will ultimately be the building block of many QC experiments over a unique deployed optical link in Catalunya.

The student will join the ICFO optoelectronics group led by Prof. Valerio Pruneri, working closely with members of the quantum communication team to take advantage of the group's expertise in quantum optics.

#### **References:**

[1] A. Anwar, C. Perumangatt, F. Steinlechner, T. Jennewein, A. Ling, Entangled Photon-Pair Sources based on three-wave mixing in bulk crystals, Review of Scientific Instruments 92, 041101 (2021).



## Objectives:

1. Familiarization with optics laboratory equipment and components.
2. Design and model a bright polarization EPS.
3. Take part in the implementation and the characterization of the building components of a polarization EPS.

## Additional information (if needed):

### \* Required skills:

- Motivation to work and passion for quantum physics.
- Medium programming experience in more than one language, including Python.
- Knowledge in optics.