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The Institute  
of Photonic  
Sciences



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

### **MASTER THESIS PROPOSAL**

**Dates: April 2023 – July or September 2023**

**Laboratory:** Optoelectronics Group

**Institution:** ICFO – The Institute of Photonic Sciences

**City, Country:** Barcelona, Spain

**Title of the master thesis:** Active control of entangled photon states through machine learning assisted protocols

**Name of the master thesis supervisor and co-supervisor:**

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**Keywords:** Machine Learning; Entangled photon source; Smart quantum devices

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

Practical quantum technologies require robust architectures to be deployed in noise environments as it is with the classical counterparts. Quantum states however are usually very delicate against disturbances, requiring in situ adjustments to provide the expected result. This kind of control could be accomplished by PID loops, searching gradually for the parameters that offer the best adjustment. Machine learning protocols instead, can be trained in advance to recognize different kinds of noises (loss, dephasing, depolarizing, etc.), to then react immediately with the right adjustment parameters. This strategy allows for instance to develop smart quantum devices or links that prevent information leaking.

For the present project, the student will work with a multi-disciplinary team of experts of the Optoelectronics Group (Optogroup) at ICFO, aimed at developing a practical method for optimal entanglement generation and collection by implementing machine learning techniques through a feedback loop between quantum detection and optical/mechanical actuators.

The candidate will have to work extensively with software-hardware integration, which comprises active stabilization of EPS temperature, control of optical/mechanical actuators,



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extraction of data from scientific cameras or single-photon detectors, among other technologies.

**Objectives:**

- Synchronization and integration of electronic devices in EPSs.
- Optimization of fiber coupled entanglement through free-space beams control
- Documentation of the results in a written form (e.g. report, thesis, ...)

**Additional information:**

Required skills:

- Strong programming skills (e.g. Python, Matlab, Labview)
- Medium knowledge in quantum mechanics and photonics