



## **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: Instituto Universitario de Investigación en Óptica y Nanofísica**

**Institution: Universidad de Murcia**

**City, Country: Murcia, Spain**

**Title of the master thesis: Characterization and Manipulation of Photon Bunching for Biomedical Applications**

**Name of the master thesis supervisor and co-supervisor: Enrique Josua Fernandez and Crina Cojocaru**

(for external proposals a co-supervisor from the Master program and a collaboration agreement is needed)

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**Keywords: Pseudo-thermal light sources, bunching, intensity interferometry, non-linear microscopy**

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

The  $n^{\text{th}}$ -order or  $n^{\text{th}}$ -degree of coherence function provides information about the instantaneous intensity correlation across  $n$  spatial points at  $n$  temporal points. The thermal light sources present a second order coherence function with a maximum value of 2. This fact is also referred to as the Hanbury Brown-Twiss effect. A possible interpretation of this value is that photons arrive most likely in pairs to a given point and time within the coherence volume. Photon bunching -how photons are emitted, transmitted, and detected in terms of packing- is directly related to the coherence function. Certain experimental techniques allow the manipulation of the photon bunching, generating sources with thermal characteristics out of a laser source, or even augmenting the value of the bunching (superbunching).

By acting over the bunching of the illumination employed in non-linear microscopy it is expected a benefit in terms of efficiency in the technique.



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## Objectives:

Understand and implement a technique to characterize the bunching of light sources.

Use light sources of distinct bunching to measure and characterize the effects of this illumination in non-linear microscopy, with special emphasis on biological samples.

## Additional information (if needed):

\* Required skills:

\* Miscellaneous: