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

### **MASTER THESIS PROPOSAL**

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

**Laboratory: Department of Electronics and Biomedical Engineering**

**Institution: Universitat de Barcelona (UB)**

**City, Country: Barcelona, Spain**

**Title of the master thesis: Experimental characterization of interacting pairs of chip-integrated optomechanical cavities**

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

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**Keywords:** Cavity Optomechanics, silicon, optomechanical crystals

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

Cavity optomechanics, highlighted by the prestigious journal Nature as one of the latest milestones in photonics, studies the interaction between electromagnetic and mechanical modes in optical resonators. Among the different possible realisations of optomechanical cavities, optomechanical crystals (OMCs) are probably those with the strongest potential from the technological point of view since they can be straightforwardly integrated in photonic integrated circuit platforms. As a consequence of the periodic variation of both the dielectric and elastic properties, OMCs behave at the same time as photonic and phononic crystals, thus being able to display both photonic and phononic energy gaps of forbidden energies. By carefully introducing engineered defects within the periodical structure it is possible to create photonic/phononic cavities leading to the comparison of spatially colocalized photonic and phononic states within the gaps with enhanced light/matter interaction.

The master student will be integrated into an on-going national project dedicated to the implementation of OMCs in silicon chips that operate at room temperature in the near IR optical region, with applications in data processing or sensing, among others. In particular, the student will be in charge of the experimental characterization of coupled pairs of optomechanical oscillators.

References (<http://navarrourrios.com/Publications.html>):



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- D. Navarro-Urrios et al., “Nonlinear dynamics and chaos in an optomechanical beam”, Nature Communications, 8, 14965 doi:10.1038/ncomms14965 (2017).
- D. Navarro-Urrios et al., "Properties of Nanocrystalline Silicon Probed by Optomechanics", Nanophotonics, 9(16), 4819-4829 (2020)
- M. F. Colombano et al. "Synchronization of Optomechanical Nanobeams by Mechanical Interaction", Physical Review Letters 123 (1), 017402 (2019). Featured in Physics.aps.org, see Synopsis: Synchronizing Nanosized “Pendulums”

### Objectives:

- To perform a complete experimental characterization of the of the oscillating dynamics of two optomechanical cavities optically coupled by an integrated waveguide.
- To demonstrate the synchronization of their oscillating dynamics under specific optical driving conditions.

### Outcomes:

Getting prepared for a PhD project and/or position. The final master report can culminate in a publication.

### Additional information (if needed):

\* Required skills: Some knowledge of waveguide and fibre optic operation is recommended. The work will be primarily experimental, so good skills and interest in doing laboratory work is also recommended.