



# MASTER IN PHOTONICS – “PHOTONICS BCN” ERASMUS+ “EUROPHOTONICS”

## MASTER THESIS PROPOSAL

**Dates: April - September 2019**

**Laboratory :** Quantum Nano-Optoelectronics group of Prof. Frank Koppens (Website: Koppensgroupicfo.es)

**Institution:** ICFO

**City, Country :** Castelldefels, Spain

**Title of the master thesis:** Confining light below the size of an atom

**Name of the master thesis supervisor:** Frank Koppens

Email address : frank.koppens@icfo.eu

Phone number : +34 935534163

Mail address : Mediterranean Technology Park, Avinguda Carl Friedrich Gauss, 3, 08860 Castelldefels, Barcelona

**Keywords :** Plasmonics, Graphene, Near-field optics

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

One of the astounding aspects of graphene, is the strength of its interaction with light. Even a single monolayer is visible under the microscope, absorbing ~2.3% of visible light. In the infrared, the interaction of graphene with light is even more interesting. Monolayer graphene support joint oscillations of charge and EM radiation called plasmon polaritons with a wavelength that is orders of magnitude shorter than the vacuum wavelength. The plasmons are accordingly very strongly confined.

The ultimate limit to this confinement occurs when graphene is in close adjacency to a metallic surface. The extreme confinement of plasmons in that case, makes them enticingly powerful tool to study the basic quantum physics of graphene, as has been done in recent publications by our group (see M. Lundeberg et al., Science 2017 and D. Alcaraz Iranzo et al., Science 2018). But what happens if graphene is not just in close adjacency to a metal, but actually touching it?

The goal of this master project will be to answer this question. The student will combine structures of graphene and newly-available crystalline metal to create simple plasmon-supporting structures. The plasmons will be characterized using advanced measurement techniques of nearfield and/or farfield microscopy.

**Keywords :** graphene, plasmonics, nanofabrication



UNIVERSITAT POLITÈCNICA  
DE CATALUNYA  
BARCELONATECH

**UAB**  
Universitat Autònoma  
de Barcelona

 UNIVERSITAT DE  
BARCELONA

**ICFO**  
The Institute  
of Photonic  
Sciences

**Additional information :**

Required skills : Courses or hands-on experience in the following fields come in very useful:  
nanoscience, micro/nano fabrication, semiconductor physics, nanophotonics