

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: Single Molecule Biophotonics

Institution: ICFO – Institut de Ciències Fotòniques

City, Country: Barcelona, Spain

Title of the master thesis: Light-induced photo-oxidation of lipid membranes: mechanisms and effects.

Name of the master thesis supervisor and co-supervisor:

Supervisor: Prof. Dr. Maria Garcia Parajo; Co-Supervisor: Dr. Joaquim Torra

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Keywords: lipid oxidation, mechanobiology, reactive oxygen species, fluorescence microscopy, photophysics

Summary of the subject (maximum 1 page):

Lipid oxidation is a natural process in which oxidants attack and transform lipids altering the normal function of our cells and accelerating the onset of several inflammatory and neurodegenerative diseases. Understanding and controlling the initial steps of lipid oxidation, mechanisms and effects on membranes is crucial to unveil the physiopathology and to progress in the development of novel treatments.

Several tools and methods are now available to induce the oxidation of lipids and to study its effects on different types of lipid membranes. In particular, light-based tools capable of oxidizing lipid molecules are very attractive since light can be easily delivered or removed (switched on and off) and focused on specific regions, providing high spatiotemporal control on the *photo*-oxidation process.

The Single Molecule Biophotonics research group at ICFO, led by Prof. Dr. Maria Garcia-Parajo, is looking for a highly motivated graduate student who wish to enhance his/her scientific career in a friendly, international and stimulating environment within the glowing fields of Fluorescence Microscopy and Photo-MechanoBiology.

Specifically, the successful candidate will work in a new project that aims to study the effects of light-induced lipid photo-oxidation processes on the mechanical properties and organization of membranes.



Objectives:

The candidate will explore lipid membrane-binding molecules that, only when activated by light of a certain wavelength, can induce controlled lipid photo-oxidation in model structures. He/she will work with fluorescent sensors and lipids of different properties, combining photophysical methods and advanced fluorescence microscopy techniques, with particular emphasis on fluorescence lifetime imaging (FLIM).

The main objective is twofold: (1) study the mechanisms and species involved in the oxidation of lipids when using light-activatable molecules and (2) characterize its effects on the mechanical properties of the membranes and the reorganization of the lipid molecules.

Candidates with a background in physics/chemistry/biology are encouraged to apply. The student will work in an interdisciplinary group and will acquire wet lab skills, hands-on experience in fluorescent tools, spectroscopic and fluorescence microscopy techniques, photophysics of light-activatable molecules, preparation and study of lipid membranes and experience in writing and presenting the research results to a multidisciplinary audience.