Master in Photonics – "PHOTONICS BCN"
Master ERASMUS Mundus "EuroPhotonics"

MASTER THESIS PROPOSAL

Dates: April 2021 - September 2022

Laboratory: Single Molecule Biophotonics
Institution: ICFO-Institut de Ciencies Fotoniques
City, Country: Castelldefels, Barcelona, Spain

Title of the master thesis: Using fluorescence nanoscopy to study intracellular organization and membrane trafficking

Name of the master thesis supervisor and co-supervisor: Felix Campelo
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Keywords: Super-resolution Microscopy, Single Molecule Localization, Golgi complex, Protein Secretion

Summary of the subject (maximum 1 page):

The Golgi complex, made up of a stack of flattened membrane-bound cisternae, is the central cellular organelle where secretory proteins (such as insulin, collagens, or neurotransmitters) mature to their final fully-functional form. Eventually, these mature secretory cargo proteins are loaded into membrane-bound transport carriers for trafficking and secretion outside the cells. Despite its fundamental biological importance, the mechanisms that control that only fully matured proteins are secreted remain elusive.

Indirect evidence from several groups, including ours, suggests that the Golgi membranes need to be laterally compartmentalized into nanoscopic, highly-dynamic regions that present the optimal microenvironment for the timely organization of protein maturation and export. In particular, export domains set the grounds for transport carrier formation for secretion, whereas protein maturation occurs in enzymatic domains. However, due to their intrinsic dynamic character and small size (intra-Golgi transport carriers have sizes of 60-90 nm, and enzymatic

domains are probably even smaller), experimental accessibility to such functional membrane domains has been challenging.

The goal of this Master Project will thus be to apply advanced fluorescence nanoscopy techniques, such as single molecule localization microscopy (SMLM), stimulated emission depletion (STED) nanoscopy, and/or single particle tracking (SPT) to study intracellular compartmentalization and organization, with the ultimate goal of visualizing the entry of secretory proteins into export domains prior to the carrier formation with unprecedented spatial resolution. Altogether, the student will be able to actively participate in a joint effort that brings together molecular cell biologists, experimental and theoretical biophysicists, and advanced bionanophotonic tools to make ground-breaking discoveries in the field of membrane trafficking and intracellular organization and to push the frontiers of advanced optical instrumentation, data analysis algorithms and biophysical modelling.

Additional information (if needed):
* Required skills : No prior knowledge or experience in biology is required, but the candidates are expected to be keen on understanding cell biological processes and learning new techniques.

* Miscellaneous :