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

MASTER THESIS PROPOSAL

Dates: April 2021 - September 2022

Laboratory: **Molecular NanoPhotonics – Niek van Hulst group**
Institution: **ICFO**
City, Country : **Castelldefels - Barcelona**

Title of the master thesis:
"Tracking ultrafast energy flow on the nanoscale"

Name of the master thesis supervisor and co-supervisor:
(for external proposals a co-supervisor from the Master program in needed)
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Keywords :

- fs laser spectroscopy, nanoscale microscopy, transient spectroscopy, superresolution tracking, light-harvesting membranes, photocurrent detection, exciton transport, energy hopping, (de)coherence

Summary of the subject (maximum 1 page) :

The conversion of sunlight photons to electrons is the essence of the natural photosynthesis that powers life. Dedicated antennas funnel the sun's energy towards reaction centres. Amazingly, nature reaches almost perfect photon-to-electron conversion efficiency, while it regulates down at high light level for protection and survival.
How does nature dynamically re-organize the membrane architecture, its packing, order, diffusion, on light stress? Which pathways are taken to charge separation? What is the role of fluctuations, coherences, color and vibrations?
The ICFO group is active on the nanoscale tracking of photon and electron transport, to reveal efficiency, robustness and role of energy disorder in photosynthetic membranes, based on expertise in fs pulse control and nanoimaging. Specific objectives of the project:
Energy transport on the nanoscale: tracking spatiotemporal membrane transport by super-resolved transient optical microscopy and nanophotonic light localization: to reveal disorder and quantify diffusion.

Light to charge: photo-current detection of the energy flow: by ultrafast photo-thermoelectric graphene and/or photo-electrochemical detection to probe the charge separation of the reaction center directly, quantify rate and efficiency.
The project aim to gain insights on *nature's* energy strategies and is directly relevant for artificial photosynthesis and solar technology.

Additional information (if needed):
Required skills:
Exact Sciences or Physics or Engineering or Nanotechnology or Physical Chemistry.
Interest in experimental research, nanotechnology, sensitive imaging and detection.
Assertiveness and group spirit.

Training outcome:
- Skills: nanofabrication, nanocontrol, single particle detection, super-resolution, ultrafast detection, pulse lasers,
- Insight: advanced imaging, inferometric sensing, Fourier imaging, shot-noise limit of detection, single particle detection.....
- Getting prepared for a PhD project and position;
- Report of master project culminating in a publication.