MASTER IN PHOTONICS – "PHOTONICS BCN"
ERASMUS+ "EUROPHOTONICS-POESII"

MASTER THESIS PROPOSAL

Dates: spring-summer 2019, starting date can be discussed

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

Title of the master thesis:

"Single-shot 3D holographic fluorescence imaging"

Name of the master thesis supervisor:
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Keywords :

- Single particle detection
- Digital holography
- Interferometric imaging
- Super-resolution

Summary of the subject (maximum 1 page) :

Digital holography, with its ability to extract the phase from the recorded electromagnetic intensity at a detector, is revolutionizing imaging across the electromagnetic spectrum by combining traditional optics with our ever-expanding computational resources. At the same time fluorescence microscopy is the method of choice in biology due to its sensitivity, specificity and super-resolution capabilities. Combining both is hindered by the intrinsic low coherence of fluoresced light, and no workable single-shot holographic system for fluorescence microscopy has thus far been demonstrated. Here, we propose to this shortcoming by shearing interferometer capable of determining the full electric field of fluorescent light with sensitivities down to the single-molecule limit. This approach should enable computational focusing, providing a sharp image at any depth of focus of the imaging optics. Application of single-shot holography to fluorescence live-cell imaging, will allow parallel tracking of the 3D motion of internalized nanoparticles in cells.

Additional information :

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.

Related recent literature of the group:
Matz Liebel, James Hugall, Niek F. van Hulst, *NanoLetters*, 17 (2), 1277-1281 (2017).
Matz Liebel, Jaime Ortega Arroyo, Vanesa Sanz Beltrán, Johann Osmond, Romain Quidant, Niek F. van Hulst, “Single-Shot 3D Holographic Fluorescence Imaging”, *Nature BioTechnology*, in revision (sep 2018)