

INTERNSHIP PROPOSAL

Laboratory name: Institut Langevin
CNRS identification code:
Internship director's surname: Emmanuel Fort
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Web page: <https://www.institut-langevin.espci.fr/>
Internship location: Institut Langevin, 1 rue Jussieu, 75005 Paris

Thesis possibility after internship: YES
Funding: YE If YES, which type of funding: ANR or other

Dynamic Illumination Microscopy for Quantum Nano-Imaging

Scientific context

Fluorescence lifetime is a powerful observable to probe local biochemical or electromagnetic environments. It carries information about molecular interactions (FRET, tension, pH...) but also about the local density of optical states (LDOS), a fundamental quantity in nanophotonics and quantum electrodynamics that governs spontaneous emission.

Super-resolution microscopy (Nobel Prize 2014) enabled the localization of single emitters with nanometric precision, yet lifetime information is still mainly acquired using cameras or confocal TCSPC, at the cost of speed, photon loss and limited multiplexing.

We are developing a new approach of dynamic illumination microscopy, where position, lifetime and spectral information of single emitters are time-encoded in the illumination rather than in the emission image.

Objective of the project

The intern will contribute to the development of a new generation of dynamic illumination FLIM microscopy, applicable to:

- Nanophotonics and quantum optics: measuring LDOS fluctuations near plasmonic antennas, photonic crystals or disordered media;
- Quantum emitters: exploiting single-photon emission and antibunching to retrieve orientation, lifetime and LDOS of quantum dots, NV centers, or other solid-state emitters.
- Bio-imaging at the nanoscale: mapping chemical and mechanical cues in living cells (tension, pH, FRET);

The goal of the internship is to build and test an instrument capable of: generating time-modulated structured illumination and retrieving simultaneously the nanometric position (x,y,z) and the fluorescence lifetime τ of a unique single-photon emitter.

Perspective:

This internship is part of a broader research program and may be continued as a PhD thesis, depending on the motivation and performance of the candidate.

Contact: emmanuel.fort@espci.fr

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics:	YES	Soft Matter and Biological Physics:	YES
Quantum Physics:	YES	Theoretical Physics:	NO