Postdoctoral position

Subject: Dynamic Illumination Microscopy for Fluorescence Lifetime and Quantum Nano-Imaging

Laboratory: Institut Langevin / ESPCI Paris – PSL, 1 rue Jussieu, Paris (France)
Superviser: Pr. Emmanuel Fort

Project keywords: Dynamic illumination microscopy • Single-photon emitters • Fluorescence lifetime (FLIM) • Local Density of Optical States (LDOS) • Bio-imaging • Nanophotonics • Quantum emitters (antibunching)

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 postdoctoral project

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

- **Bio-imaging at the nanoscale:** mapping chemical and mechanical cues in living cells (tension, pH, FRET);
- **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.

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

Profile of the candidate

- PhD in physics, optics, photonics, or a related field.
- Skills: Optical microscopy or ultrafast optics, TCSPC / FLIM / photon statistics, Quantum emitters (quantum dots, NV centers, etc.), MATLAB / Python for data reconstruction.

- Mainly experimentalist
- Curiosity for bio-imaging *and/or* nanophotonics and quantum optics.

Environment

The postdoc will join the Langevin Institute (ESPCI Paris – CNRS), in a multidisciplinary environment bridging advanced microscopy, time-varying optics and wave physics and biological collaborations and nanofabrication.

Practical information

- Duration: 12 to 24 months (renewable)
- Start date: Flexible (2025–2026)
- Location: ESPCI Paris – Institut Langevin (1 rue Jussieu, Paris 5)

Application: CV + motivation letter + reference(s) to: *emmanuel.fort@espci.fr*