# PostDoc Proposal 2023

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| School - Location: Ecole Centrale Marseille | |
| Laboratory: Institut Fresnel | Web site: www.jeromewenger.com |
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| Title: Fiber-integrated plasmonic nanotweezers to manipulate single proteins |
| Scientific field (one among the list- remove other choices):<br>Natural & Life sciences: Physics & Astronomy |
| Free Key words: optical tweezers, photonics, plasmonics |

Details for the subject:

The Institut Fresnel is a research state laboratory based in Marseille / France, devoted to research and higher education in all areas of optical and photonic sciences. Institut Fresnel is seeking to recruit talented, enthusiastic young scientists who are highly motivated to boost their research career in the areas of nano-optics and/or biophotonics.

Optical tweezers offer a versatile approach to manipulate living cells and other micron-sized objects with minimal invasiveness. However, due to the diffraction limit, objects with sizes below 100 nm are nearly impossible to trap using conventional microscopes. To overcome this limitation, nanophotonics allows to concentrate light well below the diffraction limit. The nano-optical tweezers enable efficient trapping of nanoscale objects that would otherwise be too small or too transparent to be manipulated using conventional optical tweezers. Although nanotweezers have achieved impressive results, several major challenges remain open, notably (i) trapping of single proteins, (ii) monitoring the trap influence on the protein conformation and (iii) integrating nano-optical tweezers on optical fibers to ease their implementation with confocal microscopes.

The goal of this project is to advance the applicability of nano-optical tweezers towards single protein manipulation. Our aim is to develop fiber-integrated plasmonic nanodevices allowing to take maximum advantage of optical and thermal forces at the nanoscale in order to trap single proteins. Resonant plasmonic nanoantennas will be integrated at the end of an elongated fiber tip, allowing for the key advantages of (i) full 3D manipulation of the nanotrap and (ii) easy integration into any optical microscope system without requiring complex compensation for chromatic aberrations or highly specific multiband spectral filters. We will combine the fiber-based nano-optical tweezers with a dual-color microscope used for single molecule Förster resonance energy transfer (smFRET). smFRET is the best approach to investigate the protein conformational dynamics thanks to its sub-nanometer sensitivity to donor-

acceptor dye distance. This innovative approach will enable the exploration of a brand new territory of optical tweezers down to the single molecule level. The outcomes of this project will further advance the fields of nano-optical trapping, nanophotonics and single-molecule biophysics.

Recent relevant publications:


• Q. Jiang, P. Roy, J.-B. Claude, J. Wenger, Single Photon Source from a Nanoantenna-Trapped Single Quantum Dot, Nano Lett. 21, 7030 – 7036 (2021). ArXiv 2108.06508

• Q. Jiang, J.-B. Claude, J. Wenger, Plasmonic nano-optical trap stiffness measurements and design optimization, Nanoscale 13, 4188-4194 (2021). ArXiv 2102.05381

• Q. Jiang, B. Rogez, J.-B. Claude, G. Baffou, and J. Wenger, Quantifying the Role of the Surfactant and the Thermophoretic Force in Plasmonic Nano-optical Trapping, Nano Lett. 20, 8811–8817 (2020). ArXiv 2011.10263

• Q. Jiang, B. Rogez, J.-B. Claude, G. Baffou, J. Wenger, Temperature Measurement in Plasmonic Nanoapertures Used for Optical Trapping, ACS Photonics 6, 1763-1773 (2019). ArXiv 1906.01947.


Contacts


**Supervisor Dr Jerome Wenger**

**Google Scholar Jerome Wenger https://scholar.google.fr/citations?user=K3ujBLwAAAAJ&hl=fr**


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