

PhD fellowship
*Optical nanoantennas to enhance
single molecule fluorescence detection*



The Institut Fresnel is a research state laboratory based in Marseille / France, devoted to research and higher education. Institut Fresnel is seeking to recruit talented, enthusiastic young scientists who are highly motivated to boost their research career in the areas of in nanophotonics, biophotonics and related technologies.

Motivation

The successful candidate will be part of an emerging project carried out at the Institut Fresnel under the supervision of Jérôme Wenger with the funding of an ERC Consolidator Grant. Jerome Wenger's group has acquired a wide expertise in the nanoscale control of light fields in plasmonic nanostructures and its application to enhance fluorescence spectroscopy applications including FCS and FRET [1-6].

Our next project aims at efficiently monitoring single proteins using their fluorescence enhanced by optical nanoantennas. The plasmonic optical nanoantennas enable single protein analysis at the physiologically relevant micromolar concentrations thanks to the localization and enhancement of light-matter interactions at the nanoscale.

Research program

Nanophotonic elements to manipulate energy at the nanoscale and go significantly beyond the conventional diffraction-limited microscopes. The objective of this project is to extend the applicability of conventional optical microscopes using optical nanoantennas to enhance single molecule fluorescence detection. This breakthrough will enable improving the biosensing sensitivity and reach for the first time single molecule resolution at the biologically-relevant micromolar concentration.

This project will explore the interfaces between nanophotonics, biophysics and fluorescence spectroscopy. This synergy will enable groundbreaking applications on single proteins detection and analysis, watching a single molecule at work. The project outcomes will benefit many applications in structural biology, drug discovery and energy conversion at the nanoscale.

Required qualifications – Eligibility

To apply for a PhD fellowship, candidates must hold an internationally-recognized Master-equivalent degree in physics, nanosciences or engineering.

Experience in experimental and/or theoretical research on nano-optics and/or biophotonics will be highly appreciated, but is not mandatory.

No restrictions of citizenship apply to the PhD fellowship.

Terms of employment – PhD fellowship

The position is intended as full-time (38 hrs / week, 12 months / year) appointment under CNRS contract. The fellowships are offered for periods up to three years.

The selected PhD student will work under close supervision of Jerome Wenger and benefit from direct mentorship. PhD students at Institut Fresnel also benefit from several courses specially developed throughout the doctorate programme.

A PhD degree from Aix Marseille University will be granted after successful completion of the PhD research.

Application procedure

Suitable candidates are requested to submit:

- a Curriculum Vitae, including a fully referenced list of publications
- a presentation letter with declaration of interests and a description of your past achievements (max. 1 page)
- contact email of three potential references

In addition, candidates to a PhD fellowship are requested to submit:

- a scanned copy of your university academic transcripts in English
- a scanned copy of the Master degree, if available at the time of application
- a scanned copy of standardized English test results (TOEFL, TOEIC,...) if available

Applications should be submitted by email to jerome.wenger@fresnel.fr.

Selection is based on merit and potential, measured in terms of the academic record and personal achievements. Proactivity, participation in community activities, and capacity for team-work are also taken into account.

The call will remain open until positions are filled.

Web Links

www.jeromewenger.com

www.fresnel.fr/mosaic

References

Selection of recent publications from the group:

1. P. M. Winkler, R. Regmi, V. Flauraud, J. Brugger, H. Rigneault, J. Wenger, M. F. García-Parajo, *Transient Nanoscopic Phase Separation in Biological Lipid Membranes Resolved by Planar Plasmonic Antennas*, ACS Nano **11**, 7241-7250 (2017).
2. V. Flauraud, R. Regmi, P. M. Winkler, D. T. L. Alexander, H. Rigneault, N. F. van Hulst, M. F. Garcia-Parajo, J. Wenger, J. Brugger, *In-Plane Plasmonic Antenna Arrays with Surface Nanogaps for Giant Fluorescence Enhancement*, Nano Lett. **17**, 1703-1710 (2017).
3. J. de Torres, M. Mivelle, S. B. Moparthy, H. Rigneault, N. F. Van Hulst, M. F. García-Parajó, E. Margeat, J. Wenger, *Plasmonic Nanoantennas Enable Forbidden Förster Dipole-Dipole Energy Transfer and Enhance the FRET Efficiency*, Nano Lett. **16**, 6222-6230 (2016).
4. P. Ghenuche, M. Mivelle, J. de Torres, S. B. Moparthy, H. Rigneault, N. F. Van Hulst, M. F. García-Parajó, J. Wenger, *Matching Nanoantenna Field Confinement to FRET Distances Enhances Förster Energy Transfer Rates*, Nano Lett **15**, 6193-6201 (2015).
5. P. Ghenuche, J. de Torres, S. B. Moparthy, V. Grigoriev, J. Wenger, *Nanophotonic Enhancement of the Förster Resonance Energy-Transfer Rate with Single Nanoapertures*, Nano Lett **14**, 4707-4714 (2014).
6. D. Punj, M. Mivelle, S. B. Moparthy, T. van Zanten, H. Rigneault, N. F. van Hulst, M. F. Garcia-Parajo, J. Wenger, *A plasmonic 'antenna-in-box' platform for enhanced single-molecule analysis at micromolar concentrations*, Nature Nanotech. **8**, 512-516 (2013).