

## *PhD position in Bio-Photonics at IES CNRS*

### **Optical tweezers for biology-health application based on a structured light photonic source in interaction with nanocrystals**

**3-years doctoral fellowship at Univ Montpellier (FR) – Deadline 9 may 2022**

The Photonics & THz group (PHOTERA) and Materials, Micro et Nano-Systems group (M2A) at the *Institute of Electronics & Systems* (IES CNRS), University Montpellier in France, offers a *3-years doctoral fellowship* in the area of Photonics, laser physics & nanotechnology, and Bio-photonics.

#### **Research Project**

Recent progress in bio-photonics, optical instrumentation and dedicated nanotechnology overcome the limits of knowledge and for applications in biology, of interest to health and medicine. A new concept of optical tweezers makes it possible to manipulate, control and measure biological objects at the nanometric scale in a non-destructive way, by exploiting the various photonic forces of a laser. Nano-photonics has great potential to control, structure and multiplex the 3D spatial wave functions of the laser field [1-5]. We propose to overcome the limitations of optical tweezers in “Photonic Force Microscope” mode for bio-photonics, by developing a new instrument coupling a photonic source and innovative nano-tips for the study of nano-motors and biological tissues [6]. The first objective is the development of a new laser component based on III-V semiconductor nanotechnology emitting 2D structured and multiplexed light. The second objective is to study the interaction with a PhFM nanotip based on an innovative nano-crystal technology for 3D mechanical manipulation and measurement. We then propose to integrate this innovative system into an optical tweezers microscope, in order to test the analysis and control of the position and mechanical moment of biological nano-objects and the imaging of soft tissues.

The fellow will work with three senior scientists, PhDs, Postdocs. The fellow will join a dynamic center of optoelectronics research with a good publication record and strong research links in other countries. Facilities include clean room, laser/optics labs, multi-physic simulation software and good access to the scientific literature.

#### **Candidate**

Applications are invited from applicants holding a Master in physics, electronics, optics, laser or a related area. Applicants should have a strong interest in semiconductor physics and nanotechnology, laser physics and optics, instrumentations, biophotonics, and good practical skills. Initiative, ability to work in a team.

### **Partners**

Research will mainly occur at the Institute of Electronics and Systems, UMR CNRS 5214, in collaboration with French C2N-CNRS Renatech clean room facility, for III-V nanotechnology based semiconductor device fabrication, CBS CNRS Univ. Montpellier for bio-photonic instrumentation, INPHYNI-CNRS Valbonne for fundamental laser investigations, LP2N for metasurface based device design. In terms of possible intellectual property outcomes, this project will be followed by SATT AxLR and Innoptics industrial partners.

### **Funding**

This student will be funded by the Doctoral school of Univ. Montpellier (F), and experiments will be financially supported by ANR BLASON (*Light Bullets in Semiconductor lasers*), ANR HIREPFM and ANR SPATIOTERA (SPATial divisiOn mutliplexing for TERAbit/s terahertz communications).

### **Link to position offer at I2S doctoral school**

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### **References**

- [1] N. Vigne et al., États originaux de la lumière par structuration 3D de l'émission D'un laser à Métasurface », Photoniques, July 2021, DOI: 10.1051/photon/202110946
- [2] M. S. Seghilani et al. Scientific Reports, (6) 38156, Dec 2016
- [3] S. Blin et al. IEEE Journal of Selected Topics in Quantum Electronics, 23(4):1–11, July 2017
- [4] A. Garnache et al. "Laser device with a beam carrying controlled orbital angular momentum", WO 2016096893 A1 (2016)
- [5] A. Bartolo et al. Opt. Lett., 46(5):1109–1112, Mar 2021
- [6] R.Desgarceaux, Z.Santybayeva, E.Battistella, A.L.Nord, C.Braun-Breton, M.Abkarian, O.M.Maragò, B.Charlot, F.Pedaci, "High-Resolution Photonic Force Microscopy Based on Sharp Nanofabricated Tips", Nano Letters, (2020). doi : 10.1021/acs.nanolett.0c00729