INTERNSHIP PROPOSAL

Laboratory name: Laboratoire de Physique de l'ENS
CNRS identification code: UMR 8023
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Internship location: LPENS, 24 rue Lhomond, 75005 Paris cedex
Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: MSCA Fellowship

Photonic Crystal Cavities for Terahertz Biosensing

THz waves, typically between 0.1 THz and 10 THz, have great potential for a wide range of biomedical diagnostic applications, as well as for the fundamental study of a variety of biomolecules. Indeed, many biomolecules and biomolecular complexes exhibit relevant intramolecular and intermolecular resonances in this frequency range, paving the way for a wide range of biomedical and diagnostic applications. THz biosensing is therefore a fast-growing field of research. An extraordinary advantage of THz spectroscopy for biological applications is that it enables direct, label-free probing of the interaction of biomolecules with THz radiation.

The aim of this internship is to develop original THz photonic crystal cavities offering a high THz electric field concentration with an ultra-high quality factor, and thus optimized for high-sensitivity THz biosensing. Òur group has recently realized THz cavities providing high electric field confinement with a quality factor of a few tens but limited by the use of metals with ohmic losses [1,2]. To overcome these limitations, the candidate will realize dielectrically patterned, metal-free, THz photonic crystal cavities that will be further implemented into THz biosensors, to come closer to today's state-of-the-art bioanalytical tools. The candidate will design the THz photonic crystal cavities using simulations based on finite element method, participate to their fabrication and investigate their optical properties using THz spectroscopy systems.

This internship may be pursued by a thesis. Further developments in the PhD project will aim to develop THz biosensors based on the photonic crystal cavities and demonstrate their potential for detecting minute volumes of biological material such as molecules and vesicles. The thesis project is part of a European project on THz biosensors. During the PhD, the candidate will visit the partner laboratories involved in the project and carry out experiments in their laboratories.

[1] S. Messelot et al. ACS Photonics, 7, 2906 (2020)
[2] S. Messelot et al. Photon. Res. 11, 1203 (2023)

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