PhD: Enhancing THz Light-Matter Interaction for Probing Protein Structure

Fully funded (~26 000 €/year gross salary) PhD by an ERC consolidator grant

Context and objectives: The TeraHertz range (Thz), located between optics and electronics, is one of the last frontier of the electromagnetic research, with many potential fundamental and industrial applications. The Institute of Electronics, Microelectronics, and Nanotechnologies (IEMN) is conducting research the THz, proposing for instance sources detectors, lasers and telecommunication systems.

Recently, the team developed devices and methodology to enable the probe of subwavelength samples by TeraHertz-time-domain spectrometry (THz-TDS). The aim of this PhD thesis is to capitalize on these to enable THz wave investigation of biological molecules such as proteins and DNA to unravel their structure.

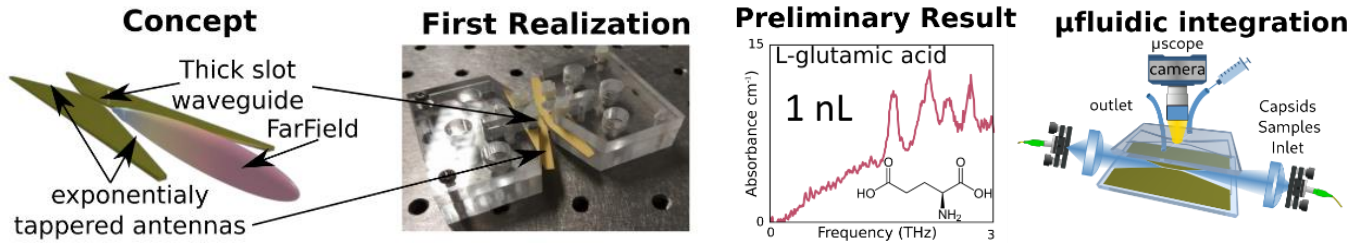

Figure 1: left, schematic of the butterfly device, and first realization, record spectrum of amino acids and future improvements.

TeraHertz spectroscopy is a promising tool for analyzing mater at the nanometer scale because vibration in this frequency range spread at the nanoscale. However, the small size of many samples limits the use of conventional techniques for their analysis. In the PhD you will design, simulate fabricate and use novel THz devices to overcome this limitation. Within a prestigious ERC Consolidator Grant, we have at disposal all the means to bring this research to the next level and develop new techniques for analyzing macromolecules like proteins in the THz range.

Missions: Your main mission will be to design and optimize the performance of the state-of-the-art device using advanced numerical methods, such as FDTD. You will then utilize our cutting-edge micro and nano fabrication facilities for device fabrication using the latest generation equipment. Once fabricated, you will validate the electromagnetic performances of the device in terms of field localization and coupling. Finally, you will operate the device for broadband THz spectroscopy with various macromolecular samples under different conditions, ranging from cryogenic temperatures in a specialized cryostat to microfluidic environments. Your ultimate goal will be to incorporate a cavity to enhance the light mater interaction even more and bring the sample towards new physics.

Environment: Our team of experienced researchers at IEMN Laboratory in Lille, France, offers a vibrant environment for conducting cutting-edge research in the TeraHertz range. As part of our THz-Photonics group, you will have access to our state-of-the-art nano fabrication facilities in our 1500m^2 clean room, as well as fully equipped experimental facilities. With our long-standing expertise in THz optoelectronic device design and realization, you will work alongside our team to design and conduct innovative THz biophotonics experiments.

We are seeking a physics or engineering master graduate, or equivalent, with expertise in experimental optics, spectroscopy, electromagnetism, or Python coding. The exact tasks will be tailored to your capacities and interests, and we encourage you to contact us today to learn more about this exciting opportunity!

Keywords: *TeraHertz, spectroscopy, antenna, wave propagation, Microfluidics*

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