A 36 months duration PhD will start at « Institut FOTON », at the DOP team/Rennes location, on the design, realization and characterization of a laser-based instrument for the submillimeter spectroscopy of the metabolism of microorganisms, and tests on ecological situations.

**Starting date:** between September 1st 2019 and November 1st 2019  
**Supervisor:** François Bondu  
**Research team:** laser Dynamics, micrOwave photonics, Polarimetry, terahertz, imaging (DOP), at Rennes (Beaulieu campus)  
**Keywords:** lasers, laser frequency and amplitude noises, submillimeter wave photonic synthesis, spectroscopy, metabolism, microorganism, ecology

**Project description**

The contribution of the metabolic activity of microorganisms (bacteria, archaea ...) to the ecological equilibrium is crucial, but its detailed composition is still a black box. The detection of the metabolome of microorganisms with submillimeter spectroscopy would contribute to the revolutions happening in microbiology. Indeed, in the 100 GHz - 1 THz range, the molecular linewidths at reduced pressure are some hundreds of kHz, so that each molecule has a unique signature and is quantifiable. With respect to other measurement technologies of the metabolome, spectroscopy would give access to large size molecules (>100 a.m.u), with detection threshold in the ppb range. A spectroscopy system with a compact source, easily tunable and with a low linewidth is not available today.  

The work will consist in the realization of a millimeter / submillimeter instrument of spectroscopy where the source and the detection system are based on optical frequency synthesis. The source will be realized from commercial optical fibered components, based on our earlier works (IEEE TMTT 63(4), p. 1367, 2017). The synchronous detection will also be based on optics. A first cell for spectroscopy will be realized. The instrument will be automated and its performances evaluated on ecological situations (about 10⁶ to 10⁹ microorganisms par gram of soil).

**Qualifications**

The candidate would ideally have firm competences in electronics and/or laser system optics. He will need to gain mastership in instrumentation, linear systems, servo systems, analog electronics at low and high frequencies, signal processing, modulation and demodulation, phase and amplitude noise of optical waves and microwaves, fiber optics. The candidate will have enough dynamism to acquire eventually lacking
knowledge. The candidate will be either engineer or will have a master in electronics, or optics, or physics. Good communication skills in English are required.

**Partnership**

The Institut FOTON is involved in a collaborative project with academic laboratories IEMN (Lille) and ECOBIO (Rennes).

**About the Institut FOTON (CNRS, UMR6082)**

The Institut FOTON is a research unit of the French National Centre for Scientific Research (CNRS) associated to University of Rennes 1 and the National Institute for Applied Sciences (INSA) of Rennes. FOTON is composed of three research teams: the “Optoelectronics, Heteroepitaxy and Materials” team, the “laser Dynamics, microwave photonics, Polarimetry, terahertz, imaging” team located in Rennes, and the “Photonic Systems” team located in Lannion. The two cities are located approximately 170 km apart, in the province of Brittany, Western France. Photonic Systems team is involved in research on laser physics, and in particular on the experimental demonstration of new functionalities that could potentially contribute to overcoming the challenges related to sensors sensitivity, telecom capacity. The group has an established reputation in the area of laser physics.

The successful candidate will carry out research in Lannion.

More information about FOTON can be found at: [http://foton.cnrs.fr](http://foton.cnrs.fr).

**Further information-Contact**

Further information may be obtained from Dr. François Bondu at:

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**Application procedure**

Please submit your application at your earliest convenience by e-mail to:

[francois.bondu@univ-rennes1.fr](mailto:francois.bondu@univ-rennes1.fr)

Your application should include:

- Cover letter
- Detailed CV
- Copy of M.Sc. degree or equivalent
- Grade transcripts
- List of publications, if applicable
- Contact details of two references

All qualified candidates are invited to apply.