

Ph.D. Position

Integrated optoelectronic oscillators

The Institut FOTON is offering a 36-month Ph.D. scholarship in the area of optoelectronic oscillators, microwave photonics, and integrated photonics.

Starting date: October 2024 (the starting date can be advanced or delayed if needed)

Supervisor: Marco Romanelli

Co-supervisors: Mehdi Alouini

Funding: PEPR Electronique (https://www.pepr-electronique.fr/projet_cible_oror/)

Research team: DOP (Dynamique des lasers, Optique-hyperfréquence, Polarimétrie), at Rennes (Beaulieu campus)

Keywords: Optoelectronic oscillators (OEO), microwave photonics, Photonic Integrated Circuits (PIC)

Project description

The generation of **microwave signals with high spectral purity** is essential for many applications, such as radar remote sensing and telecommunications. Institut FOTON's DOP team has been studying optical microwave generation methods such as **optoelectronic oscillators (OEOs)** for several years^{1,2}. Their use in systems today requires integration into photonic chips of just a few cm². In this context, we are exploring **OEO architectures featuring miniaturized photonic devices** realized on silicon chips.

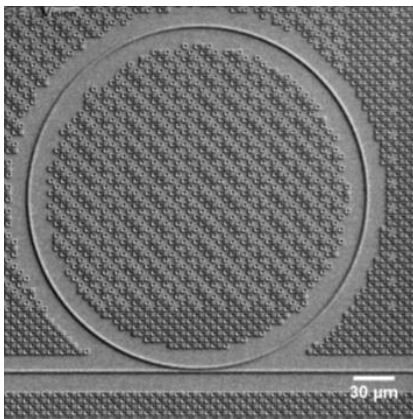


Image au microscope électronique à balayage d'un résonateur en anneau

As part of PEPR Electronique's OROR project (*Opto-RF pour la cOnvergence électRonique photonique*), we will have access to photonic chips produced at CEA-Leti, containing the building blocks needed to set up an OEO (delay lines, resonators).

The **aim of the thesis is to build OEOs using these chips** and to study, theoretically and experimentally, their performance, particularly in terms of **phase noise, oscillation frequency, long-term stability, and tunability**, with the perspective of developing a photonic integrated circuit (PIC) comprising a fully miniaturized OEO on chip. Different architectures will be implemented, tested and compared with similar

¹ B. Sinquin, « Oscillateur optoélectronique à modulation directe. Génération de signaux micro-ondes et d'impulsions optiques courtes. », <https://theses.hal.science/tel-04461814v1>.

² A. Thorette, « Dynamiques de synchronisation de lasers bifréquence à état solide et DFB soumis à une réinjection décalée en fréquence : applications en photonique micro-onde », <https://theses.hal.science/tel-02062296v1>.

architectures using non-integrated, off-the-shelf components available in the laboratory. These studies will benefit from the laboratory's laser and instrumental facilities, as well as the DOP team's expertise in laser oscillators and optical and microwave metrology. The research described in the subject will be carried out in the DOP team's laboratory. Short stays in CEA-Leti in Grenoble may also be required during the thesis.

Qualifications

Candidates must hold a master's degree in physics or photonics, or an engineering diploma. Good knowledge of optoelectronics, lasers and nonlinear optics will be particularly appreciated. The proposed subject requires both an interest in experimental work and in theoretical and numerical modeling. A good level of English is also essential.

About Institut FOTON (CNRS, UMR 6082)

Located in Brittany, Institut Foton is a joint research unit supervised by the University of Rennes, CNRS and INSA-Rennes. The institute is made up of three teams: two are located in Rennes (the DOP and OHM teams) and the third in Lannion (the SP team). The research described in the subject will be carried out in the DOP team's laboratory. This team's work focuses on laser dynamics, microwave and THz photonics, interferometric sensors, advanced imaging and integrated photonics. Further information on the Institut FOTON can be found at: <https://www.institut-foton.eu/>.

Further information-Contact

Further information may be obtained from Marco Romanelli at: marco.romanelli@univ-rennes.fr

Application procedure

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

marco.romanelli@univ-rennes.fr

Your application should include:

- Cover letter
- Detailed CV
- Copy of M.Sc. degree or equivalent
- Grade transcripts
- List of publications, if applicable
- Two letters of recommendation or names of two academic contacts who can recommend the candidate