Microwave photonics

This scientific activity aims at generating and stabilizing microwave signals on optical carriers. High-stability frequency references generation in the microwave range can indeed lead to applications such as optical distribution of clocks or analogic signals for all-optical radar processing. In parallel, the theoretic and experimental study of microwave photonics links - as the one inserted in most recent radar architectures - is another field of research. Lastly, this research field aims at designing new architectures for highly tunable opto-electronic oscillators.

The studies conducted in this domain are closely related to other research fields investigated by the team, such as **Laser dynamics**, **TeraHertz and metrology**, but also to some of our developments in **Advanced imaging**.

Programmable optical generation of radiofrequency & microwave signals

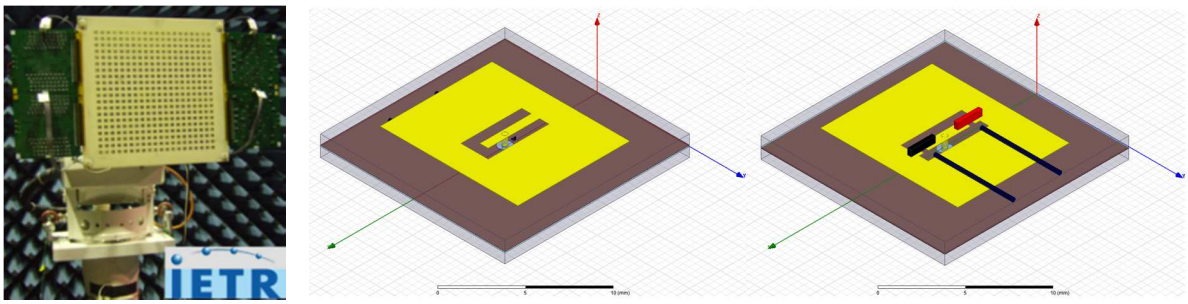
Microwave photonics links modeling

Performances of microwave photonics links for analogic signals transmission

Hybrid oscillators with opto-electronic feedback semi-conductors bi-lasers

Optical control of antennas

This activity is conducted in close collaboration with the Institute of Electronics and Telecommunications of Rennes (IETR). The mid-term ambition is to introduce optical control on large antennas networks developed at IETR. The current stage is to develop elementary control cells that can be addressed optically. Each elementary cell comprises semiconductors photocommutators which dephase the microwave by 180° when enlightened. This research activity mixes semi-conductor physics, photonics, microwave propagation and fast electronics.



(a) (b)

Fig 5: (a) Example of antennas developed by IETR on which optical control is currently being addressed (photograph IETR). (b) Structure of an optically reconfigurable elementary cell.

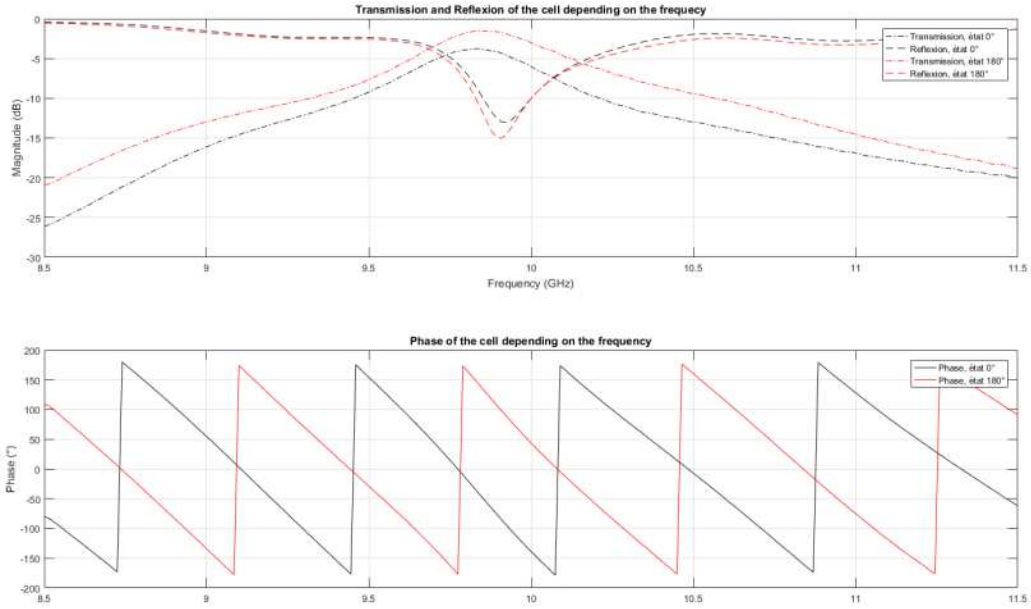


Fig 6: Transmission and reflection of an elementary cell along its two phase states.

Optical amplification

PhD theses (past / ongoing):

Antoine Rolland, « Oscillateurs ultrastables millimétrique et teraHertz par boucle à verrouillage de phase optoélectronique », 2013

Gwennaël Danion, « Oscillateur micro-onde à teraHertz ultra-stable », 2015

Lucien Pouget, « Contribution à l'augmentation des performances de liaisons optiques-hyperfréquences : non-linéarités et bruit »

Gael Kervella, « Circuits intégrés photoniques in InP pour la génération de signaux hyperfréquences », 2015

Thong Tien Pham, *« Étude et conception d'antennes réseaux transmetteurs millimétriques à reconfiguration par voie optique »*

Aurélien Thorette, *«Structures de polarisation dans les lasers et réinjection : application à la génération de faisceaux opto-hyper »*

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III-V Lab (Palaiseau)
Thales Research and Technology (Palaiseau)
Thales Systèmes Aéroportés
Thales Air Defense
Drexel University, (USA)
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