# TeraHertz and metrology

The objective of this research activity is to develop optical means to generate frequency references with high spectral purity in the teraHertz range, with record frequency stability. The applications of such references are high-resolution teraHertz spectroscopy, teraHertz metrology, and heterodyn detection of THz signals at room temperature.

The scientific activities in this domain are closely related to the research carried out in **Laser dynamics**, and correspond to an extrapolation of our work in **Microwave photonics** to the teraHertz range.

**Opto-electronic phase lock loop**

**Very low phase noise microwave/THz signal generation on optical carrier at 1.5µm**

**Design of a compact optical source of millimeter-wave radiation**

**Continuous THz source by photomixing at 800nm on Titane-Sapphire dual-frequency cavity**

## Time-domain teraHertz spectroscopy

The FOTON-DOP team is equipped with two time-domain teraHertz spectroscopy setups. The first one enables the characterization of the temporal response in the teraHertz domain of a material under pulsed excitation at 800 nm. We are currently adapting the system to allow continuous-wave operation under optical dual-frequency excitation in order to increase its spectral resolution of about 6 orders of magnitude. It is also used to characterize photo-induced transitions in the crystal materials studied in the Materials and Light departement in the IPR and in fluoride/chalcogenide glasses developed at the Institut des Sciences Chimiques de Rennes. The second setup operates under continuous-wave excitation at 1,5 µm.

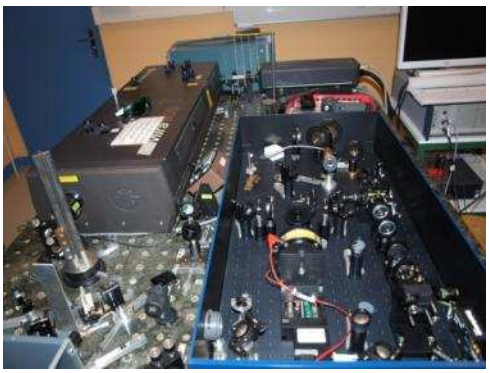

*Fig. 8 : Photograph of the 800 nm teraHertz time-domain spectroscopy setup.*

**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*

*Joachim Boerner, « Theoretical and experimental study of ultrastable solid-state laser delivering millimeter wave and teraHertz signals »*

Ayman Hallal, *« Laser impulsionnel à faible gigue »*

**Collaboration:**

Institut d'Electronique, de Microélectronique et Nanotechnologie – IEMN (Lille)

Laboratoire de Physique des Lasers, Atomes et Molécules – Phlam (Lille)

Thales Research and Technology (Palaiseau)

Observatoire de Nice-Côte d'Azur

Institut de Sciences Chimiques de Rennes

Resolution spectra systems

Menlo Systems

**Contacts:**


M. Alouini


F. Bondu


G. Loas


M. Romanelli


M.Vallet

**FOTON-DOP team**

Head of the team : François BONDU
Tel : +33 223 235 156
francois.bondu@univ-rennes1.fr

Website: http://foton.cnrs.fr/v2016/spip.php?rubrique111

Institut FOTON - Équipe DOP
Université de Rennes 1 – CNRS UMR 6082
Campus de Beaulieu – Bat 11B
263 avenue du Général Leclerc
F-35042 RENNES CEDEX
FRANCE