# PhD offer

*At the Institute of Electronics and Telecommunications of Rennes (IETR), France*

## LOW PROFILE AND BROADBAND ANTENNAS FOR HIGH SPEED WIRELESS AT 300 GHZ

### Project context

A more efficient use of available spectrum does not suffice to ***reach the ultra-large bandwidths*** (BWs) ***required by wireless systems beyond 5G***, and the use of frequencies in the Terahertz (THz) gap is the key to enable ultra-large BW wireless. The ***frequency range between 275 and 350 GHz*** is particularly convenient, owing to the following advantages: a) it has not yet been allocated; b) it presents atmospheric attenuation windows, which enable mid-range links and small cell deployment; c) the short wavelengths favor the design of on-chip antennas, integration and packaging; and d) THz links are less susceptible than optical wireless to air turbulence and humidity, fog, smoke, and rain.

One of the challenges in THz wireless communications consists in ***designing low-profile high-gain antennas efficiently coupled to continuous-wave THz sources at room temperature***, to compensate for the propagation loss. Moreover, ***appropriate radiation patterns must be tailored for the antennas in each THz wireless system***. For instance, directive pencil beams will suffice for point-to-point links, whereas small cells will demand a multi-beam system with broader angular coverage.

### Objectives of the PhD offer

This project will explore and compare ***two different antenna architectures***.

The first solution will consist of an array of one-dimensionally (1D) ***modulated metasurfaces (MTSs)***, fed by a quasi-optical beam-former in parallel-plate technology. The beam-former will provide a different phase profile for each MTS array. Thus, one may achieve multi-beam operation, while collimating the beam in the plane orthogonal to the 1D modulation.

Second, the candidate will study ***transmitarray (TA) antennas***. In this case, the multi-beam operation will be obtained by using an array in the focal plane of the TA. This solution avoids feed and strut blockage encountered in reflector antennas, while keeping a good overall efficiency.

Both architectures are amenable to reconfigurability and offer key advantages: MTS antennas lead to ultra-thin structures, but with a limited bandwidth (< 8%), whereas TAs provide broader bandwidths (20% and beyond) at the expense of using a more bulky solution (F/D ~0.5).

The tasks will include a thorough literature review, the design of the MTS/TA unit cells, the analysis and design of the modulated MTS, the TA lens, the quasi-optical beamformer and the TA focal plane. Last but not least, special attention must will be paid to ***finding the most appropriate materials and fabrication techniques***. By the end of the project, at least one prototype will be fabricated and measured at IETR´s World-class testing facilities.

### Candidate

*Required education level*: Master or equivalent degree. *Duration*: 36 months

*Required background*: antenna theory, microwave engineering, numerical modeling, periodic structures.

**Deadline to apply**: as soon as possible.

### Contact persons

To apply please send your motivation letter, CV, and the contact details of at least two references by email to:

***Prof. Ronan SAULEAU***, e-mail: ronan.sauleau@univ-rennes1.fr
***Dr. David GONZALEZ OVEJERO***, e-mail: david.gonzalez-ovejero@univ-rennes1.fr
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Due to the large number of received applications, we will contact only the short-listed candidates.