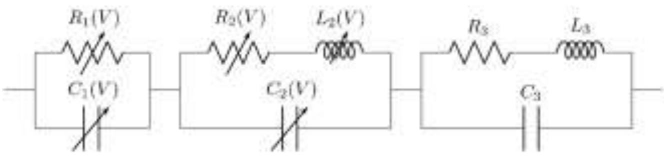
Internship proposal: **Optimization of Schottky diodes for rectifier and frequency doubler in the THz frequency range.**

There is a lot of interest in the Terahertz (THz) frequency range. Very high-frequency optoelectronic and nano-electronic components are exhibiting performance in progress and gradually bridge the gap between electronics and optics. Various applications are emerging in this frequency range such as telecommunications, spectroscopy (chemistry, physics and astronomy), medical imaging, and security or defense. Our team's research focuses on the design and optimization of new detectors and sources that would be compact, electrically tunable, low-power, low-cost, achievable, and the most effective possible.

For THz sources, we want to use frequency multipliers (i.e. a circuit allowing to obtain in output a multiple frequency of the input frequency), and for detectors we rely on rectifying circuits that provide a continuous response (or BF) to an HF or THz signal. These two types of circuits use Schottky diodes. The objective of internship work is to optimize Schottky GaAs diodes at THz frequencies for these two specific applications. Both circuit architectures require matching cells. A nonlinear electrical model of the Schottky diode is required for the harmonic balance method in the Keysight ADS environment.

The proposed work is a continuation of previous work lead in the team. A Monte Carlo code (1D physical modeling) allows to model the core of the diode by including all the important physical effects, a commercial software named Silvaco allow to access to the 2D or 3D parasitic elements, and an efficient nonlinear electrical model has been validated. Finally, simulations under Keysight ADS have already been undertaken for the two types of functions.



Intrinsic equivalent circuit of a Schottky diode in the THz frequency range

Six physical and geometric parameters of the diode largely control its operation at THz. These are the thicknesses and the doping levels of the so-called N and N+ zones, the diode area and the Schottky barrier height at the M/SC interface. With hypotheses and simplifications we will try to optimize the diode according to only 3 parameters: the thickness and doping level of the N zone (N_D, L_D) and the area (S) of the diode (which depends closely on the excitation power).

Organization of work
• Modeling Schottky diode parasitic resistors and capacitances with Silvaco numerical tools,
• Generation of the nonlinear model of these two parasitic elements,
• Refining of the Schottky Diode Impact Ionization Electrical Model,
• Optimization of the 3 parameters N_D, L_D and S for rectification application,
• Optimization of the 3 parameters N_D, L_D and S for the frequency doubler.

Depending on the student's training and affinity, the work will include varying doses of physics and HF/THz circuit design elements under Keysight ADS. This work can be continued in thesis.

Person to contact: Frédéric Aniel; Tel: 01 70 27 04 13, frederic.aniel@c2n.upsaclay.fr
C2N : UMR CNRS 9001–Université Paris Saclay, avenue Thomas Gobert 91120 Palaiseau