MASTER 2 — CONCEPTS FONDAMENTAUX DE LA PHYSIQUE

INTERNSHIP PROPOSAL · Academic year 2026–2027

Laboratory name	Laboratoire PhLAM, CNRS / Université de Lille
CNRS identification code	UMR 8523
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Internship location	PhLAM, Université de Lille, Villeneuve-d'Ascq, France
Thesis possibility after internship	YES — subject to doctoral funding
Funding	NO — internship stipend funding has to be secured

Title

Nonlinear Photoconductive Mixing in LTG-GaAs Devices for Coherent THz Detection and Frequency Combs

Summary

Terahertz (THz) photomixing in low-temperature-grown GaAs (LTG-GaAs) photoconductors is commonly described through a linear photoresponse. However, nonlinear current–voltage characteristics can generate additional mixing products and offer new approaches to coherent THz detection and frequency-comb generation and readout. This internship aims to understand and exploit these nonlinear mechanisms through a combination of theoretical modeling and experiments.

The student will extend an existing photoconduction model to account for nonlinear electrical transport under optical excitation, calculate the expected mixing signals and identify measurable signatures. Experiments will use LTG-GaAs photoconductive components previously developed in collaboration with IEMN (Lille). Electrical and optoelectronic characterization will be compared with simulations, followed by coherent THz detection tests. The generation and detection of THz frequency-comb signals will be explored according to experimental progress.

The work combines analytical and numerical modeling, optical photomixing, THz/RF measurements and signal analysis. Expected outcomes are a validated description of selected nonlinear mixing processes and an assessment of their metrological performance (sensitivity, selectivity and signal-to-noise ratio). A possible PhD continuation would extend this research to InGaAs-based photoconductors operating near 1.55 µm, with applications to frequency-referenced THz spectroscopy; doctoral funding is not yet secured.

Most appropriate specialities

Condensed Matter Physics: YES · Quantum Physics: YES

Soft Matter and Biological Physics: NO · Theoretical Physics: NO