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
Internship director	Florin Lucian Constantin
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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 to be secured

Title

Precision Molecular Spectroscopy with REFIMEVE Optical Frequency References for Fundamental Physics

Summary

Precision molecular spectroscopy can probe the stability of fundamental constants by comparing molecular transition frequencies with ultrastable optical references. The REFIMEVE network disseminates an optical frequency reference near 1542 nm over phase-stabilized fibre links, enabling precision measurements at distant laboratories. At PhLAM, this reference is used to interrogate an acetylene absorption transition and to study its spectroscopic and metrological performance.

The student will combine experimental spectroscopy with theoretical and numerical analysis. The work will include frequency calibration and line-shape modeling of acetylene absorption, characterization of frequency and intensity noise, and evaluation of the sensitivity to small frequency variations. Measurements will be compared with models incorporating Doppler and collisional broadening, and the role of the optical reference and detection chain in the uncertainty budget will be examined.

Depending on progress, the student may investigate improvements towards sub-Doppler spectroscopy or analyze the expected response to hypothetical oscillations of fundamental constants induced by ultralight dark matter. The primary outcome will be a quantitative assessment of an existing REFIMEVE-referenced molecular spectrometer. A possible PhD continuation could develop stabilized molecular frequency references and distributed comparisons for fundamental-physics searches; doctoral funding is not yet secured.

Most appropriate specialities

Quantum Physics: YES · Condensed Matter Physics: NO
Soft Matter and Biological Physics: NO · Theoretical Physics: NO