PhD student position in experimental ultra-high precision molecular spectroscopy

Institutes:
- Laboratoire de Physique des Lasers (LPL), CNRS-Université Paris 13, Villetaneuse
- Laboratoire d'Etudes du Rayonnement et de la Matière en Astrophysique et Atmosphères (LERMA), CNRS-Observatoire de Paris-Sorbonne Université, Paris

Teams:
- Metrology, Molecules et Fundamental Tests (MMFT, LPL)
- Molecular Spectroscopy and Laser Instrumentation for Environment (SMILE, LERMA)

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Widely tuneable ultra-stable mid-infrared laser sources for precise measurements in fundamental physics, and atmospheric and Earth sciences

Ultra-high resolution molecular spectroscopy is an interdisciplinary field with fascinating and far-reaching applications ranging from fundamental physics to Earth and planetary science, and to astrophysics and cosmology. The mid-infrared domain, the so-called *molecular fingerprint* region, is a crucial spectral window which hosts a considerable number of intense vibrational signatures of species of various interests.
This PhD project is a collaboration between LPL at Université Paris 13 and LERMA located at the Sorbonne Université Jussieu campus. It is funded in the frame of the 80|PRIME action on the occasion of the 80th birthday of CNRS. The thesis focuses on the development of new-generation QCL (quantum cascade laser) based spectrometers specifically designed for precision vibrational spectroscopy in the mid-infrared (8-11 µm). The proposed technology is at the forefront of time-frequency metrology and will be used to perform tests of fundamental physics and explore the limits of the standard model (measurements of variation of fundamental constants, tests of fundamental symmetries), as well as to carry out precise spectroscopic measurements dedicated to atmospheric physics and climate change research.
The successful applicant will actively participate in the development and operation of QCL based spectrometers which are frequency stabilised to optical frequency combs and calibrated to some of the world's best atomic clocks. In particular, the work will consist in making a crucial improvement to a very stable system already build by the MMFT team of LPL, which yet shows a limited frequency tuneability. The challenge is to make a system both ultra-stable and widely tuneable. Two complementary strategies will be explored. The applicant will be successively hosted by the two teams involved. After a first year of training at LPL, she/he will work with the LERMA team.

The PhD will be carried out in close relationship with national operations such as LabEx FIRST-TF and EquipEx REFIMEVE+, allowing the applicant to fully integrate with the time-frequency metrology community in France and beyond.
The PhD is meant to start with the University year, ideally on September 1st, 2019. We look for applicants motivated by experimental PhD work, interested in learning about time-frequency metrology, lasers, electronics and non-linear optics as well as molecular spectroscopy.

Keywords:
frequency metrology, Doppler-free methods, precision measurements, optical frequency comb lasers, quantum cascade lasers, molecular physics, quantum physics, optics and lasers, vacuum techniques, electronics, programming and simulation

Relevant publications:
Argence *et al*, Nature Photon. **9**, 456 (2015), arXiv:1412.2207
Santagata *et al*, Optica **6**, 411 (2019)
Minissale *et al*, J. Mol. Spectrosc. **384**, 103 (2018)

Requirements:
The applicant should possess good basic knowledge in physics and optics, show motivation, be an interactive team player, have good communication skills both orally and in writing, and have experience in scientific programming (Labview, python, C#,…).

Interested candidates should send to Christof Janssen or Benoît Darquié their motivation letter and an exhaustive CV along with the contact details of persons who are willing to send recommendation letters.