# Spécialité de Master « Optique, Matière, Plasmas »

*Stage de recherche (4 mois minimum, à partir de début mars)*

## Proposition de stage

*Date de la proposition : 24/10/14*


**Responsable du stage** / *internship supervisor*:

Nom / *name*: VENTRILLARD Prénom : Irène

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**Nom du Laboratoire** / *laboratory name*: **Laboratoire Interdisciplinaire de Physique (LIPhy)**

Code d'identification :UMR5588 Organisme :UJF/CNRS

Site Internet / *web site*: http://www-liphy.ujf-grenoble.fr/-Detection-de-traces-et-isotopes-

Adresse / *address:* 140 av de la Physique, BP87/38402 St Martin d'Hères

Lieu du stage / *internship place*: Grenoble

**Titre du stage** / *internship title*: Optical spectrometer based on a Quantum Cascade Laser (QCL) for trace detection of NO in breath analysis


Résumé / *summary*

The LAME group of the LIPhy is well known in France and abroad for being at the fore front in the development of ultrasensitive spectroscopic techniques for selective and quantitative measurements of molecules present in a gas mixing at very low concentration. Techniques rely on the coupling of a laser light to a high finesse optical cavity where the gas to be analysed is continuously flowing. In the framework of breath analysis, a spectrometer dedicated to NO detection has been developed based on a quantum cascade laser (QCL) operating in the mid infra-red region (MIR, at 5.26µm). The performance is already compatible with breath analysis with a sensitivity of 40 ppt for an acquisition time of 1s. Nevertheless further characterizations of this NO spectrometer will be performed as part of this internship in a detailed study of its accuracy. The objective is to study fundamental effects associated with the combination of QCLs with the original spectroscopic technique used. In particular, due to the strong absorption of the molecular lines in the MIR, the power broadening effect of intensity saturation has to be understood quantitatively. Another effect that will be studied is the impact of residual optical interference fringes on the spectrum normalization process. This effect is often more important in a QCL setup than in the traditional DFB setup, and it too requires a better characterization. These studies will involve both experiments and simulations.


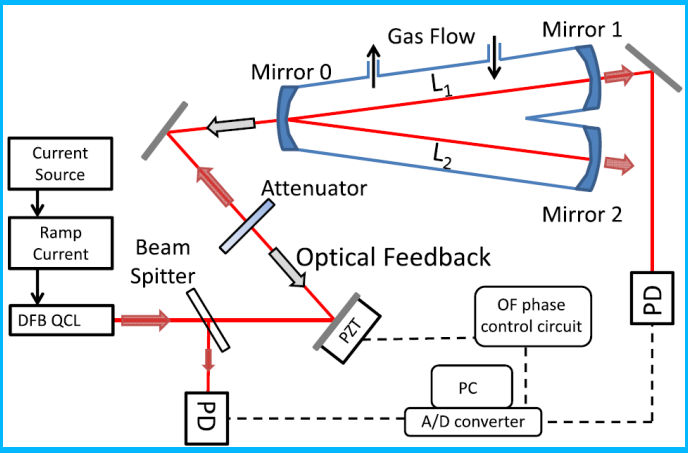


*Figure 1 : QCL-OF-CEAS experimental scheme: the laser beam is focused into the V-shape cavity made of three mirrors (M1 , M2 and M3). Two photodiodes monitor the incident laser power and light transmitted by the cavity. The OF-phase coming back to the QCL is actively and finely adjusted by a steering mirror mounted on a piezoelectric translator (PZT), while the QCL is mounted on a translation stage for rough cavity–laser distance adjustment. A variable attenuator allows adjusting the OF coupling.*


Gorrotxategi-Carbajo, P., Fasci, E., Ventrillard, I., Carras, M., Maisons, G., & Romanini, D. *Applied Physics B*, *110*(3), 309–314 (2003).


**Ce stage pourra-t-il se prolonger en thèse ?** *Possibility of a PhD* **? : YES**

**Si oui, financement de thèse envisagé/** *financial support for the PhD***: ANR, CIFRE ou bourse ministère selon le profil de l'étudiant et le résultat de l'ANR**

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|---|---|---|---|
| Lasers, Optique, Matière | **YES** | Lumière, Matière, Interactions | **YES** |
| Plasmas : de l'espace au laboratoire | | | |