Spécialité de Master « Optique, Matière, Paris »

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

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 21 septembre 2018

Responsable du stage / *internship supervisor*:

Nom / *name*: VENTRILLARD

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

Code d'identification : UMR 5588

Organisme : UGA/CNRS

Site Internet / *web site*: https://www-liphy.ujf-grenoble.fr/

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

Lieu du stage / *internship place*: GRENOBLE

Titre du stage / *internship title*: **Laser dynamics: laser line width broadening measurements**

Résumé / *summary*

Context: We propose an original method for the measurement of the Henry factor (α_H) coupling the refraction index and the gain of the amplification medium of a semiconductor laser. This factor was introduced to account for the laser linewidth broadening ($1+\alpha_H^2$) with respect to the fundamental limit [1] given by the spontaneous emission rate of the gain medium which perturbs the laser field maintained by stimulated emission (Schawlow-Townes equation). Even though the dynamics of diode lasers has been investigated during a few decades, for quantum cascade lasers (QCLs) investigations of their linewidth are not many and results are sometimes contradictory. We propose an original method of measurement which should allow a better understanding of the dynamics of these lasers.

Method: The technique which will be applied consists in the observation of the laser response to optical feedback, in a regime of weak feedback levels [2]. Optical feedback induces a change of the emission frequency and power. One can show that a measurement of both these parameters allows to deduce the α_H coefficient. The originality of this technique rests on the use of a resonant optical cavity in a V-shaped geometry (see picture below).

Objective: The goal is the determination of the Henry factor for different types of semiconductor lasers: Diode lasers in the near infrared (~2µm) to obtain results to be compared to previously published values; then in particular QCLs and ICLs (intra-band cascade lasers) in the mid infrared (around 5µm) which have become commercially available only these last few years.

Expected skills : The candidate will have good knowledge of laser optics and an interest in instrumental developments and modeling.

Master 1 or Master 2 internship: position available from February 2019, duration of 2 to 6 months. PhD continuation possible (well suited).

Supervisor: irene.ventrillard@univ-grenoble-alpes.fr

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[1] C. H. Henry, "Theory of the Linewidth of Semiconductor Lasers," *IEEE J. Quantum Electron.*, vol. 18, no. 2, pp. 259–264, 1982.

[2] C. Szwaj, E. Lacot, and O. Hugon, "Large linewidth-enhancement factor in a microchip laser," *Phys. Rev. A - At. Mol. Opt. Phys.*, vol. 70, no. 3, pp. 4–7, 2004.

[3] J. Morville, S. Kassi, M. Chenevier, and D. Romanini, "Fast, low-noise, mode-by-mode, cavity-enhanced absorption spectroscopy by diode-laser self-locking," *Appl. Phys. B*, vol. 80, no. 8, pp. 1027–1038, May 2005.

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***:**

Lumière, Matière, Interactions	**X**	Lasers, Optique, Matière	**X**