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Titre du stage / thèse

Frequency stabilization of a single frequency semiconductor laser to a molecular transition of Acetylene detected in saturated absorption

Stabilisation en fréquence d'un laser monofréquence sur une transition moléculaire d'Acétylène (C₂H₂) en absorption saturée

Internship description:

Context of the study:

The “Molecular Metrology and Fundamental Tests” group of the Laboratoire de Physique des lasers (LPL) is involved in several projects dealing with ultra-stable frequency references based on detection of molecular transitions. In this context, the master student will become part of a team involved in the development of compact ultra-stable optical frequency combs based on semiconductor mode-locked lasers. Such transportable devices could play an important role in generating and distributing low phase noise optical and microwave signals. This is essential for a number of scientific and technical applications such as clocks, gravimeters, sensors, synchronization at large-scale facilities, and radar systems.

One essential step of the project is to transfer stability and accuracy of a molecular transition to the comb. The chosen molecular reference is a transition of Acetylene ¹³C₂H₂ in a cell at 1.542μm which will be probed by a single-frequency semiconductor laser.

In order to increase the Signal to Noise ratio of the molecular signal, the gas-cell will be inserted into an optical resonator. In order to realize a compact system, we plan to test the metrological performances of a fiber based ring cavity. For this purpose we use an ultra-stable optical reference transmitted by the “Observatoire de Paris” (SYRTE) on an optical fiber.

Program of the internship:

- Detection and characterization of linear absorption of Acetylene
- Detection and characterization of the absorption in saturation spectroscopy (Doppler-free configuration)
- Signal/Noise improvement by inserting the cell into an optical resonator based on fiber components
- Laser frequency stabilization onto the molecular signal
- Metrological characterization (noise analysis, frequency accuracy and stability)

Duration of the internship:

- 4 months minimum

Key words :

Laser, optoelectronics, nonlinear spectroscopy, electronic servo loop, metrology.

Level required:

Master degree, Engineer degree.

PhD possibility ?

YES