Spécialité de Master « Optique, Matière, Plasmas »

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

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 31/10/2012

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Lieu du stage / *internship place*: LPA-ENS, 24 rue Lhomond, 75005 Paris

Titre du stage / *internship title*: ***Phase-Locking of Quantum Cascade Lasers***

Résumé / *summary*

The terahertz (THz) frequency range lies between the microwave and mid-infrared ranges and offers unique applications in various domains including security imaging, astronomy and detection of gases. THz techniques also allow investigations into fundamental physical properties of materials**.** Even with these possibilities, the THz range remains largely unexplored due to the high cost, limited performance and dimensions of the sources and detectors currently used. This is the "THz gap", referencing to the lack of semiconductor based technologies. In this context, a breakthrough in source technology was realised with the THz Quantum Cascade Laser (QCL). This III-V nanostructured device is very promising as a practical THz source as it is based on standard semiconductor materials, very powerful and extremely compact. We propose to bring together the technologies of THz-QCLs with optical ultra-fast techniques to create a hybrid source-detection system with very important benefits for spectroscopy applications. In this context, one of the most successful THz spectroscopy scheme is the time-domain spectroscopy (TDS) technique that uses ultra-fast lasers (eg 800nm fs Ti:Sa) for the THz generation and detection. In the current state of the art, THz-TDS mostly relies on the generation of low power (few µW level) THz pulses in photoconductive antennas using femtosecond optical pulses. The detection is performed via electro-optic sampling. The detection being coherent, the detection is ultra-sensitive to the phase-locked THz pulses but insensitive to any unsynchronized radiation source (eg thermal noise). Nevertheless, the main drawback of the technique is that the generation using photoconductive antennas is not efficient and limited to very low powers. Since QCLs are THz sources able to emit in the mW range, their use as a source for TDS is highly desirable. This requires to phase-lock the QCL emission to a fs laser, which is the core of the project. This will open up the possibility of combining QCLs with TDS, taking advantage of the power of the former and the sensitive coherent detection of the latter technique.

Toutes les rubriques ci-dessous doivent obligatoirement être remplies

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***: ED397**

Lasers et matière	**x**	Lumière, Matière : Mesures Extrêmes	**x**
Optique de la science à la technologie		Plasmas : de l'espace au laboratoire	

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