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 : 09/10/18

Responsable du stage / *internship supervisor*:			
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Nom du Laboratoire / *laboratory name*: LP2N (Laboratoire de photonique, numérique et nanosciences)			
Code d'identification :UMR5298		Organisme : Institut d'Optique	
Site Internet / *web site*: https://www.coldatomsbordeaux.org/aufrons			
Adresse / *address:* Rue Francois Mitterrand, 33400 Talence			
Lieu du stage / *internship place*: Talence - Bordeaux (33)			

Titre du stage / *internship title*: **Spectroscopy and locking of laser frequency on molecular gaz in hollow core fibers.**

Résumé / *summary*

The recent years have seen tremendous progress in the realization and the study of artificial quantum materials using ultracold atomic gases. By trapping fermionic or bosonic atoms in artificial crystals of light (so-called optical lattices), fundamental condensed matter phenomena traditionally only observed in solid-state materials have become accessible in a different and highly controlled environment. Experiments are now reaching up the level where these quantum gases start to be considered as true "quantum simulators" for tackling a broad range of open physics problems, including among others quantum magnetism and topological insulators.

The long-term objective of our project is to explore quantum transport in subwavelength lattices, and how it is influenced by lattice geometry, band structure topology, disorder or interactions. To this end, we are currently building a novel experimental apparatus specifically adapted to the production of ultracold bosonic and fermionic potassium gases with adjustable interactions. The fermionic species studied will be potassium 40 that presents a low field Feshbach resonance. The development of the laser system (767 nm) to cool potassium will be central in this intership. This laser system is developed in collaboration with two companies (Muquans, GLO photonics) which are both experts of frequency doubled telecom lasers for laser cooling of Rubidium (780 nm) and hollow core fiber fabrication respectively.

During its internship, the task of the student will be dual. At first, he will set-up, lock and characterize a laser (767 nm) that will serve as a frequency reference for the optical bench. For this, the student will realize the Doppler free spectroscopy of Potassium atoms on which the laser will be frequency locked. Secondly, the student will work on an innovative laser architecture that involves telecom lasers (1534 nm) which are frequency locked on molecular gases confined in a hollow core fiber and frequency doubled to generate 767 nm cooling light. The developed architectures is entirely fibered which guarantees robustness and compactness. In this part of the work, the student will frequency lock the laser on the saturation spectroscopy of the molecular gaz. The performance of this novel architecture will be characterized by comparing the frequency stability of the two lasers at 767 nm.

The master student will work in a team composed of 1 PhD, 1 PostDoc and 2 researchers.

The subject of the internship will allow the student to progress on theoretical (lasers, light-matter interaction, fermionic simulators) and experimental knowledge (non-linear and laser optics, mechanics, analog and digital (FPGA) locking electronics, programming, data analysis etc…).

Depending on the intern, this master thesis could lead to a PhD thesis (grant secured)**.** Such PhD thesis will be at the frontier between fundamental (quantum simulators) and applied (laser developments) science with strong interaction with the two partner companies (Muquans, GLOphotonics).

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

Si oui, financement de thèse envisagé/ *financial support for the PhD*: **CNES (en cours) / DGA (obtenu)**

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

Fiche à transmettre (fichier pdf ***obligatoirement****) sur le site http://stages.master-omp.fr*