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 : 21-09-2018

Responsable du stage / *internship supervisor*:

Nom / *name*:	Vernac	Prénom/ *first name* :	Laurent
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Nom du Laboratoire / *laboratory name*: Laboratoire de Physique des Lasers

Code d'identification :UMR7538 Organisme : Université Paris 13 - CNRS

Site Internet / *web site*: www-lpl.univ-paris13.fr

Adresse / *address:* 99 Avenue Jean Baptiste Clément, 93430 Villetaneuse

Lieu du stage / *internship place*: Laboratoire de Physique des Lasers

Titre du stage / *internship title*: A new laser system for quantum magnetism experiments

We propose an experimental internship dedicated to setting up a new laser system in a quantum gas experiment. This new laser will provide an important upgrade of the laser cooling stage (more power, better stability).

We work with chromium Bose Einstein Condensates (BECs). In such systems, the dipole-dipole interactions between the atoms provide long range and anisotropic couplings between spins, offering a natural platform to study quantum magnetism, either with bulk BECs [1], or with BECs loaded in 3D optical lattices [2].

The cooling laser at 425 nm (providing Zeeman Slower and MOT light) is obtained by frequency-doubling IR radiation (at 850 nm) in a Fabry-Perot cavity. Efficient frequency conversion is ensured by a non-linear crystal located inside the cavity, provided the IR light is resonant inside the cavity. The goal of the internship is to replace the present IR source (a Ti:Sa laser) by a compact and robust high power laser source, in which a low power master diode laser is amplified in a tapered amplifier.

The student will set-up the master laser, optimize the amplification process, and maximize frequency doubling in the cavity by tweaking the spatial mode of the amplified laser. Finally, frequency locking of the master diode will be performed. This work involves a number of modern optics experimental tasks (monomode fiber coupling, or mode-adaptation for a cavity), and electronics.

Building this new laser system will increase the stability of the experiment. This is an important feature for the studies we plan to implement, in order to demonstrate the growth of quantum correlations in lattice spin systems. In particular, it should allow measurements of the collective spin properties of the quantum gas at the quantum noise level.

We propose a PhD position starting in September 2019, with a grant from Ecole Doctorale Paris 13, and funding from ANR.

[1] Collective Spin Modes of a Trapped Quantum Ferrofluid - S. Lepoutre et al, Phys. Rev. Lett. 121, 013201 (2018) - https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.121.013201

[2] Quantum Thermalization in a spin-3 many-body dipolar lattice system - S. Lepoutre et al, arXiv:1803.02628 (2018) - https://arxiv.org/abs/1803.02628

Toutes les rubriques ci-dessous doivent obligatoirement être remplies

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*: **Financement garanti (bourse fléchée) de l'Ecole doctorale de Paris 13**

Lumière, Matière, Interactions	**oui**	Lasers, Optique, Matière	**oui**

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