Spécialité de Master « Optique, Matière, Paris »

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

Proposition de stage

Date de la proposition : 10th November 2016

Responsable du stage / *internship supervisor*:

Nom / *name*:	**Cheneau**	**Prénom/ *first name* :**	**Marc**
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Nom du Laboratoire / *laboratory name*: Laboratoire Charles Fabry

Code d'identification : UMR8501 **Organisme :Institut d'optique & CNRS**

Site Internet / *web site*: https://www.lcf.institutoptique.fr/Groupes-de-recherche/Optique-atomique

Adresse / *address:* 2, avenue Augustin Fresnel, 91127 Palaiseau

Lieu du stage / *internship place*: Institut d'optique

Titre du stage / *internship title*: **Setting up a quantum gas microscope experiment for Strontium atoms**

Résumé / *summary*

Statistical mechanics is one of the most powerful constructions of physics. It predicts that the equilibrium properties of any system composed of a large number of particles depend only on a handful of macroscopic parameters, no matter how the particles exactly interact with each other. But the question of how many-body systems relax towards such equilibrium states remains largely unsolved. This problem is especially acute for quantum systems, which evolve in a much larger mathematical space than the classical space-time and obey non-local equations of motion.

Despite the formidable complexity of quantum dynamics, recent theoretical advances have put forward a very simple picture: the dynamics of quantum many-body systems would be essentially local, meaning that it would take a finite time for correlations between two distant regions of space to reach their equilibrium value. This locality would be an emergent collective property, similar to spontaneous symmetry breaking, and have its origin in the propagation of quasiparticle excitations.

The fact is, however, that only few observations directly confirm this scenario. In particular, the role played by the dimensionality and the range of the interaction potential between the particles is largely unknown. The concept of our research is to take advantage of the great versatility offered by ultracold atom systems to investigate experimentally the relaxation dynamics in regimes well beyond the boundaries of our current knowledge. We are currently constructing a new-generation quantum gas microscope experiment for strontium gases. Amongst the innovative experimental techniques that we are implementing is the electronic state hybridisation with Rydberg states, called Rydberg dressing.

The aim of the internship is to set up the source of Strontium atoms, which will be used to feed the magneto-optical trap. The source will consist in three pieces: 1. An oven in which metallic strontium is heated to several hundred degrees; 2. A transverse collimation stage for reducing the divergence of the atomic jet coming out of the oven using resonant laser beams; 3. A Zeeman slower for decelerating the atoms in the jet from a few hundred meters per second to a few tens of centimeter per seconds.

A PhD thesis would be a natural continuation of the internship. The aim of the thesis would be to complete the construction of the experimental set-up and start investigating the relaxation dynamics of our quantum gas.
Funding for the PhD is already available.

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*: Funding already available

Lumière, Matière, Interactions	**Yes**	Lasers, Optique, Matière	**Yes**