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 :

Responsable du stage / *internship supervisor*:

Nom / *name*:	Bourdel	Prénom/ *first name* :	Thomas
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Nom du Laboratoire / *laboratory name*: Laboratoire Charles Fabry

Code d'identification :UMR9501 Organisme :Institut d'optique, Univ. P11, CNRS

Site Internet / *web site*: https://www.lcf.institutoptique.fr/lcf-en/Research-groups/Atom-optics/Experiments/Interaction-and-disorder

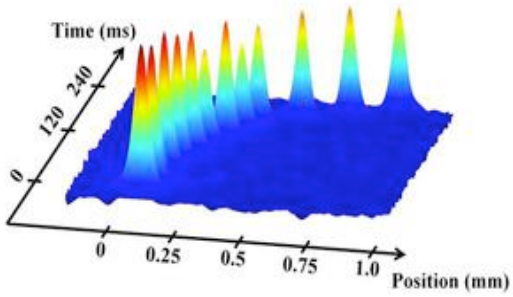
Adresse / *address:* 2 av. A. Fresnel, 91120 Palaiseau

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

Titre du stage / *internship title*: Bose-Einstein condensâtes with variable interactions

Résumé / *summary*

Our group is experienced in controlling interspecies interaction in potassium 39 condensates, in reduced dimensionality (1D and 2D) and in introducing disorder by laser speckle. We can thus probe the properties of a variety of interacting quantum systems. We are especially interested in systems where mean-field theory fails because of the important role of quantum fluctuations. A new science chamber is now operational for our ^{39}K cooling apparatus,. It allows for large condensates, fast magnetic field sweeps and an efficient imaging system.



Non-dispersive propagation of a 39K bright soliton.
S. Lepoutre et al., PRA 94, 053626 (2016)

We propose a **Master internship** on **Potassium condensates in different spin states**

The intern will work on **Radio-frequency fields to transfer the atoms in different spin states.** The goal will be to setup an agile Radio-frequency source and to characterize its performance. Techniques such as adiabatic transfers, π pulses or Radio-frequency dressing will be tested on ultra-cold atomic clouds. We then could detect the change of the interaction (scattering length) as a function of the spin state and as a function of the magnetic field. Interactions in spin mixtures are especially interesting.

The internship could continue with a **PhD thesis**. On this time scale, several projects are envisioned on one-dimensional gases with variable interactions in specific situations revealing complex beyond-mean field behaviors:

-The dynamics of bright solitons (1D condensates that remain bound because of attractive interaction) when colliding with thin barriers. Is it possible to create a Schrödinger cat useful for atom interferometry ?
-The study of dilute quantum liquid droplets, mixture of condensates that are self-bound because of dominant beyond mean-field effects. In one-dimension, they are expected to have very specific properties.
-Interaction quenches in bright solitons; the goal would be to observe the splitting of a bright soliton into two smaller ones (of different masses) after an interaction quench. This behavior is only captured in a full quantum mechanical description.

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***: Ecole doctorale, DGA, …**

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

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