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## Master internship + PhD

### Soliton dynamics in the 2D-1D crossover

#### Location

Laboratoire Kastler Brossel. Collège de France. Paris

#### Contacts

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#### Scientific context

Ultracold quantum gases are an ideal platform to investigate quantum phenomena with an unprecedented level of control. Using the flexibility in shaping the spatial profiles of the trapping lasers, the potential landscape and the dimensionality of atomic clouds can be shaped at will. The dynamical behavior of such strongly interacting quantum systems is extremely rich and challenging to explore.

The rubidium team of the Quantum Gases Group at Collège de France has a long-standing experience in the investigation of low-dimensional Bose gases. More specifically, we have developed in the last years new techniques to imprint arbitrary wave functions, spin textures, or to lattice potentials (see [1, 2] and Fig. 1). It has opened many new opportunities for the study of Bose gases. For example, we have recently explored the properties of superfluid state of matter [3–5], the non-linear dynamics and solitons physics in one and two dimensions [6–9] and few-body physics [10].

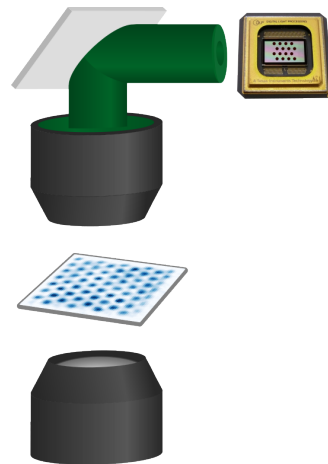
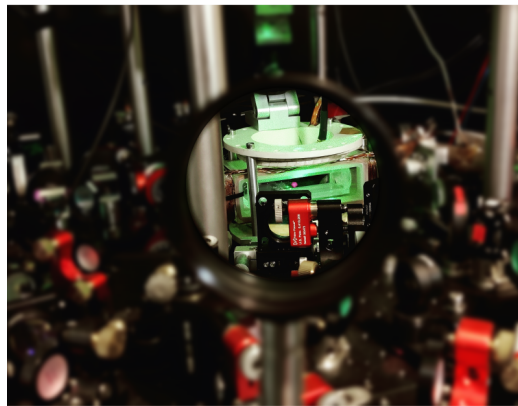


Figure 1. *Left, observation of Rb atoms in a magneto-optical trap. Right, sketch of the experiment: a 2D layer of atoms is spatially shaped to arbitrary patterns (here a triangular lattice) by projecting the image of a spatial modulator (DMD) onto the atoms through a microscope objective.*

#### The team

There are currently 3 PhD students in the team. Three permanent researchers are involved in the supervision of the students.

## PhD project

We are looking for a Master's student interested in pursuing an M2 research internship in our team, followed by a PhD. Funding for the PhD is secured. The PhD project will focus on the dynamics of solitons in low-dimensional Bose gases. In a first experiment, the student will generate solitons in an ensemble of identical 1D Bose gases and investigate their evolution upon introducing tunnel coupling between initially independent gases. In certain unstable regimes, we expect the formation of topological defects, such as Josephson vortices, which we will aim to observe experimentally. In the limit of uncoupled gases, we will also investigate the dynamics and collisions of multi-soliton states, with a particular focus on the role of quantum fluctuations in their evolution.

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