Postdoc Position

Rydberg Bose gases in low dimensions

Location
Laboratoire Kastler Brossel. Collège de France. Paris center
Quantum gases group (5 permanent researchers,
4 experiments and about 15 students/postdocs)

Contacts
Permanent staff : J. Beugnon, S. Nascimene, J. Dalibard
Contact: beugnon@lkb.ens.fr
Website: www.quantumgases-pariscdf.fr

Funding
24 months from September 2023 (ERC consolidator grant). Possible extension to a third year.

Profile
PhD with strong expertise in experimental and quantum physics, preferably with some experience in cold atom physics. The applicant will join the rubidium team and will have to supervise 3 PhD students working jointly on two running cold atom apparatus. Female candidates are strongly encouraged.

Scientific context

The rubidium team of the Quantum Gases Group at Collège de France has a long-standing experience in the investigation of two-dimensional Bose gases. More specifically, we have developed in the last years new techniques to imprint arbitrary wave functions or spin textures in such gases [1, 2] (see Fig. 1). It has opened many new opportunities for the study of planar Bose gases. For example, we have recently explored the thermodynamics of the superfluid (Kosterlitz-Thouless) transition [3, 4] and the non-linear dynamics of this scale invariant gas [5–7]. We have also studied magnetic interactions [8], measured the atom-dimer scattering length [9] and the superfluid fraction in a spatially modulated cloud [10].

In addition to the first generation experimental setup, we have developed a new generation experiment dedicated to the physics of mesoscopic ensembles and low-dimensional Bose gases (1D or 2D) and compatible with the excitation of the atoms to Rydberg states (see Fig. 1). Thanks to the strong dipole-dipole interaction between Rydberg-excited atoms, this new system will allow us to explore quantum many-body physics of strongly interacting gases.

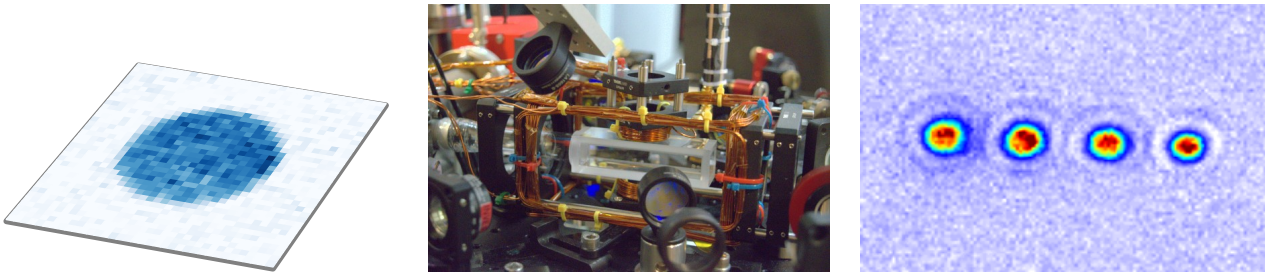

FIGURE 1. *Left, perspective view of a 2D homogeneous box-trapped rubidium gas. Center, picture of the current status of the new generation experiment. Right, absorption image of an array of 4 independent Bose-Einstein condensates realized in a time-averaged optical potential in the new generation setup.*

Postdoctoral project

The applicant is expected to contribute to both experiments. On the first generation setup, we will continue to explore the physics of low-dimensional quantum gases with a possible research direction towards the study of quantum dynamics of indivudual (and possibly coupled) 1D systems with a motivation to reach the strongly interacting (Tonks) regime. On the new generation experiment, the short term-goal is to explore Rydberg blockade and entanglement in a single and an array of super-atoms. On mid-term we will explore Rydberg dressing of low-dimensional bulk gases.

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