Stage de recherche

Proposition de stage			
Date de la proposition : 24/10/2024			
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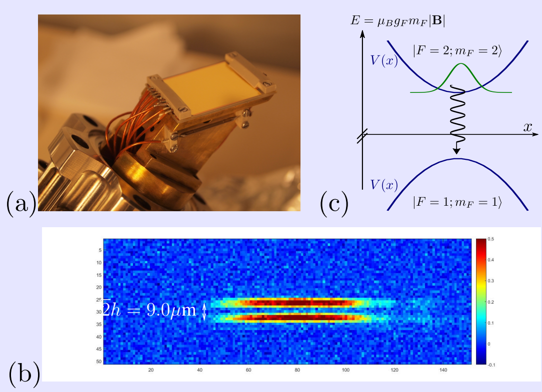
Lieu du stage : Institut d'Optique			

Titre du stage/title : Effect of controlled losses on a one-dimensional bose gas

In cold atom experiments, it is possible to realize reduced-dimensional gases by freezing out degrees of freedom. In particular, one-dimensional gases can be realized. Moreover, because of the very low energies of the atoms in these experiments, the interactions between atoms are well modeled by contact interactions. We thus realize the Lieb-Liniger model which describes 1D Bosons with contact interactions. This paradigmatic model of N-body physics belongs to the class of integrable models. This property implies that the system supports quasi-particles of infinite lifetime, labeled by their velocity called rapidity. Since quasiparticles have an infinite lifetime, the distribution of rapidities in the gas is constant over time. Thus, if the system is prepared with a non-thermal rapidity distribution, the system will never relax to a thermal state. Such a situation is specific to integrable systems. Indeed, an ergodic system always relaxes, with respect to local or small-body observables, towards a thermal state. Preparing an integrable system in a non-thermal state and characterizing the latter will be a major advance in the field of integrable systems.

We aim to achieve non-thermal states in the LCF atom chip experiment by implementing losses. Indeed, our previous theoretical studies have shown that losses are expected to produce a non-thermal state[1]. To simplify the modeling of the experiment and the analysis of the results, we will implement these losses on an atomic cloud confined in a box-shaped longitudinal potential. The characterization of the system will be done using the measurement protocol of the rapidity distribution recently implemented on our experiment[2].

During this internship, the student will participate in the implementation of this research project. In particular, it will install the device which allows losses to be achieved by microwave coupling to a non-trapped state.



(a) Rubidium atoms are confined in magnetic traps made by microwires deposited on a substrate, the "atom chip". Very strong transverse gradients enable to reach the 1D regime. (b) Absorption image of a one-dimensional gas. The two clouds correspond to the cloud and its reflection in the mirror covering the chip. (c) Losses will be made by microwave radiation that will couple the atoms to an untrapped state.

[1] L. Dubois et al., "Probing the Local Rapidity Distribution of a One-Dimensional Bose Gas", Phys. Rev.Lett. **133** 113402 (2024)

[2] I. Bouchoule and J. Dubail, "Breakdown of Tan's relation in lossy one-dimensional Bose gases", Phys. Rev.Lett. **126** 160603 (2021)

Ce stage pourra-t-il se prolonger en thèse ? Possibility of a PhD ? : NO			
Si oui, financement envisagé / financial support for the PhD:			
Laser, optique, matière :	×	Lumière, Matière, Interactions	×