INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: LPENS
CNRS identification code: UMR8023
Internship director'surname: Frédéric Chevy
e-mail:Frederic.chevy@phys.ens.fr Phone number:0144323256
Web page: https://www.lpens.ens.psl.eu/frederic-chevy/
Internship location: LPENS, 24 rue Lomond 75005 Paris

Thesis possibility after internship: YES
Funding: YES If YES, which type of funding:QuanTIP

Quasi-1D Fermi gases

Quantum physics in lower dimension is strikingly different from its 3D counterparts, and many paradigms governing three-dimensional phenomena fail when the dynamics of particles is confined in one or two dimensions. A celebrated example is the breakdown of Landau's Fermi liquid model in 1D: while thermodynamical and transport properties of 3D interacting fermionic systems can be captured by assuming that they behave as an ensemble of weakly interacting quasi-particles, the low-lying excitations of one-dimensional systems are governed by collective excitations where density and spin degrees of freedom are decoupled and are described by a so-called Luttinger-Tomonaga Liquid.
This project is devoted to the experimental study of strongly correlated ultracold Fermi gases trapped in an optical lattice confining the atoms in tubes where their dynamics is (quasi) one-dimensional when the confinement is strong enough (see figure below). The goal of the thesis will be to characterize the class of 1D theories describing these systems. Indeed, it can be shown that the interplay between strong confinement and strong correlations can lead to the emergence of few-body interactions involving three of more particles (See Orso & Chevy, Phys. Rev. A 107, 043317 (2023)).

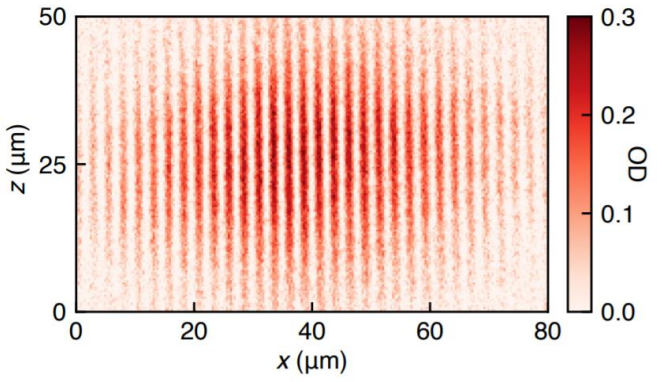

Figure 1: array of individual 1D tubes. The distance between two neighboring tubes is 2.5µm and each tube contains typically a hundred atoms. Figure from de Daniloff *et al.*, PRL **127**, 113602 (2021).

The project will be conducted in collaboration the theory team of Giuliano Orso at MPQ.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES Soft Matter and Biological Physics: NO
Quantum Physics: YES Theoretical Physics: YES