# *M1 INTERNSHIP PROPOSAL*

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**Energy-space sub-diffusion in driven disordered Bose gases**

Understanding the mechanisms at play when a system is driven out of equilibrium is a central challenge in modern science, lying at the intersection of quantum and statistical physics. Today, this problem can be advantageously studied in cold-atomic systems, where the high level of control makes fundamental concepts of non-equilibrium quantum physics accessible to experimental investigation.

In a recent experiment involving ultracold bosons subjected to both an external oscillating force and a spatially disordered optical potential [1], a novel mechanism of sub-diffusive transport in energy space has been observed. This phenomenon arises from the elastic redistribution of energy due to disorder scattering, combined with heating induced by the driving force. It has been recently explained using Boltzmann theory, assuming a specific type of disorder potential [2]. However, the sub-diffusion mechanism is expected to be sensitive to the statistical properties of the disorder, for which a comprehensive quantitative treatment has not yet been achieved.

In this context, the goal of this M1 internship will be to analytically derive an equation of motion for a driven disordered Bose gas, taking into account the details of the disorder correlation. Once this task is completed, both analytical and numerical solutions of the equation of motion will be carried out. The project will take place at the Laboratoire Kastler Brossel at Sorbonne Université, within the 'Quantum Theory, Atoms and Fields' group. It will involve both theoretical formalisms such as the Boltzmann equation and the Green's function technique, and finite-difference numerical simulations. This internship will generally be an opportunity to become familiar with the modern research fields of non-equilibrium quantum physics and ultracold Bose gases.

[1] G. Martirosyan et al., Phys. Rev. Lett. 132, 113401 (2024).
[2] E. Gliott, A. Rançon, N. Cherroret, arXiv 2405.15915 (2024).