Many Body Localization

Simona Scaffidi Abbate

Supervisors: Prof. Giovanni Modugno

Ultracold quantum gases offer an important opportunity of exploring challenging frontier problems thanks to the control of key properties such as dimensionality, temperature, density, interaction and disorder.
During my Phd, I want to study the Quantum phase slips and Many Body localization phenomenons by using Bose-Einstein Condensate.

Quantum phase slips are excitations in superfluids and superconductors at low temperatures. These excitations are particularly abundant in 1D systems because of the fragility of their phase coherence [1,2]. By studing the dissipative dynamics of 1D atomic superfluids, we have been able to detect for the first time the crossover from a regime of phase slips generated by thermal fluctuations to a regime where the phase slips are generated by purely quantum fluctuations. [3]

By using the 1D systems in disordered optical lattices we want to study the many-body localization. The phenomenon of Anderson localization [4], i.e. the localization of non-interacting particles in a disordered potential landscape, is very well known, at least from a theoretical point of view. The next question is how interactions among particles modify the picture of Anderson localization. There are theoretical results at zero temperature, but little in know about the behavior of a disordered interacting system at finite temperature[5,6]. The general expectation is that localization might survive for some range of temperature and interactions, giving rise to the so-called many-body localization [7,8]
We are currently exploring how the localization properties of a strongly correlated bosonic gas evolve from the low temperature Bose glass regime to the high temperature many-body localized regime. The hope is to identify a dynamical phase transition predicted by the theory and to achieve a quantitative confirmation of many-body localization in the regime of strong correlations.

References

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