Many-body physics of bosons in (quasi)disorder

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Anderson's localization was introduced more than fifty years ago in the context of single-particle physics: the eigenstates of the Shrödinger equation with a random potential may be localized in space leading to the absence of particle transport. It was realized quite recently that the localization idea is actually much more general and applies to a variety of situations. This program was put forward to solve the problem of electron lifetime in a quantum dot and lead to the discovery of the many-body localization physics (Anderson localization in the many-body Fock space). In the solid state context this approach has proven to be very useful to tackle the long-standing problem of the transport of interacting localized single-particle states in the absence of phonons. This gave rise to the demonstration of the energy threshold between the insulating and metallic regimes [1]. The physics of interacting bosons [2] is also very interesting particularly in connection with ongoing experiments on cold atomic gases. In this seminar I would like to show to you very recent results on the finite-temperature fluid-insulator transition of bosons in one dimension (1D). On the one hand I will present the case of the quasiperiodic potential (superposition of two incommensurate periodic potentials) and give predictions regarding the transport phase diagram including the unexpected freezing with heating behaviour [3]. On the other hand I will talk about the transport of strongly-interacting 1D bosons in the random potential and I will show the reentrance of the insulating state at strong interaction, hence completing the transport phase diagram of interacting disordered bosons at finite temperature [4].

References:

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[2] I. L. Aleiner, B. L. Altshuler, and G. V. Shlyapnikov, A finite-temperature phase transition for disordered weakly interacting bosons in one dimension, Nature Physics **6**, 900 (2010).

[3] V.P. Michal, B.L. Altshuler and G.V. Shlyapnikov, Delocalization of Weakly Interacting Bosons in a 1D Quasiperiodic Potential, Phys. Rev. Lett. **113**, 045304 (2014).

[4] V.P. Michal, I.L. Aleiner, B.L. Altshuler, G.V. Shlyapnikov, Finite-Temperature Fluid-Insulator Transition of Strongly Interacting 1D Disordered Bosons, arXiv:1502.00282.