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How Nonlinear Interactions Challenge the Anderson Transition

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Abstract:

When a quantum particle, for instance an atom, propagates in a 3D disordered environment, a spatial localization of its wave function occurs when the particle's energy is decreased below a critical value: this is the Anderson transition. Macroscopically, this peculiar effect manifests itself as a phase transition separating a regime where transport is diffusive and the system a "conductor" (above the critical point) from a regime where transport is completely suppressed and the system behaves as an "insulator" (below the critical point).
In cold atomic gases, interactions between particle complicate this picture. Ongoing research on 1D gases of disordered bosons already indicated that Anderson localization tends to be strongly altered by interactions. Their effect on the Anderson transition that occurs in 3D is, on the other hand, presently unknown. In this presentation I will discuss recent theoretical predictions partially elucidating this question. In particular I will show that even weak interactions deeply alter the nature of the Anderson transition: While there still exists a critical point in the system, below that point a novel phase appears, displaying a new critical exponent, subdiffusive transport and a breakdown of the one-parameter scaling description of Anderson localization[1].

1 N. Cherroret, B. Vermersch, J. C. Garreau and D. Delande, arXiv:1401.1038