

Interacting electrons in disordered quantum wires: Dephasing and low-T transport.

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Understanding the interplay between disorder and interaction is an extremely challenging problem. Most of our physical intuition on that problem in dimensions $d=2$ and $d=3$ has been gained by starting from the noninteracting case, where disorder leads to Anderson localization, and then looking at the effects of small interactions. Interactions lead then to inelastic scattering cutting the effects of localization.

In one dimension because the interactions themselves are crucial and lead to a non-fermi liquid behavior (Luttinger liquid), it is very convenient to include them from the start, for example using bosonization. In this framework the effect of disorder can then be viewed essentially as the pinning of a charge density wave and tackled by methods such as renormalization group. These methods have proven instrumental in getting the phase diagram and various physical quantities and showing that attractive interactions can lead to a delocalization transition. For strong interactions and weak disorder, using these methods one could also get the transport properties in an intermediate temperature or frequency range. However getting the low temperature dc transport was still an open question, since this regime is beyond the reach of the RG. In addition linking the approach using bosonization with the more conventional analysis in terms of fermions was still largely open for d.c. transport, even if recently this link could be done for the system in presence of a bath, giving back Mott's variable range hopping.

In their paper, Gornyi, Mirlin and Polyakov look at the transport of a one dimensional disordered system (in the absence of a bath) very close to the non-interacting point. They follow an analysis essentially similar to that of Altshuler-Aronov in higher dimensions, but adapted to the one dimensional case. The interactions provide the inelastic scattering necessary to cut the localization effects. They find at low temperature a transport quite different from the standard Mott's variable range hopping law (because of the absence of an external bath). Even if various questions remain, such an analysis is clearly interesting since it is a step forward in understanding how dephasing can occur in one dimension, as well as linking the standard image of an interaction induced dephasing in a disordered system, with the rather complementary image of the bosonized system where interactions are absorbed from the start.