Effects of interactions on transport in disordered many-body systems

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Abstract:

The influence of disorder on interacting many-body systems plays a prominent role in modern condensed matter physics. Not only is the presence of disorder often unavoidable in the complex materials used in experiment, disorder leads to fascinating phenomena in their own right.
Generally speaking, disorder tends to slow down the motion of particles and even very weak disorder may be sufficient to completely localize them.
The addition of interactions to the problem leads to a plethora of new phenomena. In this talk, I will discuss two selected examples that illustrate the rich physics of interacting disordered systems at low temperatures: In experiment, one often observes that disordered films on the verge of becoming superconducting develop a pronounced resistance maximum. I will explain our theoretical understanding of this surprising effect. Next, I intend to compare charge and heat transport in the disordered electron liquid. A principle difficulty for the description of thermal transport is that temperature is an internal parameter, and a temperature gradient does not correspond to an external ³mechanical² force like the one originating from an electric potential. The use of Luttinger[1]s gravitational potentials allows us to develop a comprehensive theory of thermal transport at low temperatures and to draw conclusions about the validity of the Wiedemann-Franz law.