Transport through normal conducting nano structures: Effect of electron-electron interaction

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The interplay of disorder and interaction is one of the most challenging problems of solid state physics. In this work we study low temperature properties of one dimensional systems, where the effects of interaction and disorder are both strongly enhanced. Interaction can drive a clean Fermi system to a variety of very different quantum states, like Luttinger liquid, charge density waves, Wigner crystals, etc.

For non-interacting systems in 1D disorder always leads to Anderson localization. However, interaction can lead to metallic states even in the presence of disorder. In addition, if a system is localized in the thermodynamic limit, it may remain metallic as long as the system size is smaller than the localization length.

We use the DMRG method to study strict and quasi one-dimensional systems including interaction and defects/disorder. The DMRG enables us to get accurate results for systems much larger than compared to exact diagonalization even for strongly interacting systems in the presence of impurites.