Electronic transport in one-dimensional wires

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I will try to give a pedagogical, theoretical review on electronic transport in one-dimensional interacting electron systems, i.e., Tomonaga-Luttinger liquids. In one spatial dimension electron-electron interactions cannot be treated perturbatively and, in fact, change low-energy properties of an electron system completely. The universality class of the resulting strongly-interacting electron system is called a Tomonaga-Luttinger liquid (unless interactions induce an excitation gap). The Tomonaga-Luttinger liquids are characterized by (i) power-law correlations at zero temperature and (ii) spin-charge separation. An example of (i) that is important to our discussion is that the tunneling density of states into a Tomonaga-Luttinger liquid has a power-law energy dependence. This leads to various anomalous transport properties such as a power-law temperature dependence of linear conductance. Topics to be discussed include the conductance of one-dimensional wires with 0, 1 or 2 impurities.

If I still have time after talking about the Tomonaga-Luttinger liquids, I will also give a short review on random-matrix approach to transport in quasi-one-dimensional non-interacting electron systems. Fokker-Planck equations that govern statistical properties of transmission probabilities are introduced and their applications are discussed.