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Dephasing and weak localization in an interacting 1D system[1]

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We study the transport properties of interacting electrons in a disordered quantum wire (e.g. carbon nanotube) within the framework of the Luttinger liquid model. The conductivity at finite temperature is nonzero only because of inelastic electron-electron (e-e) scattering. We demonstrate that the notion of weak localization (WL) is applicable to the strongly correlated one-dimensional electron system and calculate the WL correction to the conductivity at not too low temperatures. The relevant dephasing rate is governed, for spinless electrons, by the interplay of e-e interaction and disorder. This WL dephasing rate is parametrically different from the dephasing rate of Aharonov-Bohm oscillations in a ring. Our approach, combining bosonization with fermionic treatment of the problem, provides a framework for systematically studying the mesoscopic phenomena in strongly correlated 1D electron systems. In the end, the fate of dephasing at lower temperatures (in the strong-localization regime) is briefly discussed.

[1]in collaboration with I.V.Gornyi and D.G.Polyakov