Luttinger liquid behavior in weakly disordered quantum wires

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We have measured the temperature dependence of the conductance in long V-groove quantum wires (QWRs) fabricated in GaAs/AlGaAs heterostructures. Our data is consistent with recent theories developed within the framework of the Luttinger liquid model, in the limit of weakly disordered wires. We show that for the relatively low level of disorder in our QWRs, the value of the interaction parameter g is $g \approx 0.66$, which is the expected value for GaAs. However, samples with a higher level of disorder show conductance with stronger temperature dependence, which does not allow their treatment in the framework of perturbation theory. Fitting such data with perturbation-theory models leads inevitably to wrong (lower) values of g.

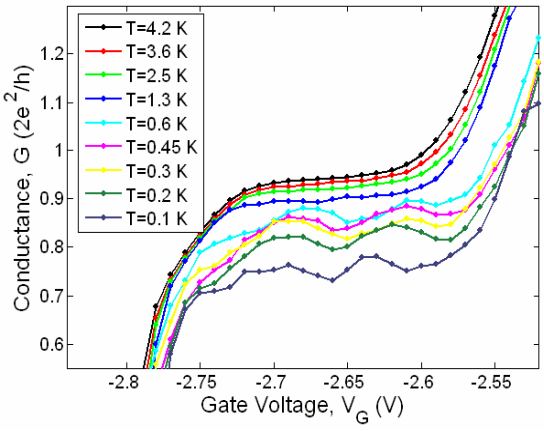

FIG. 1. Conductance versus gate voltage for 0.5 μm gate width at various temperatures. The variation of the first plateau value is approximately 20% over the wide temperature range.

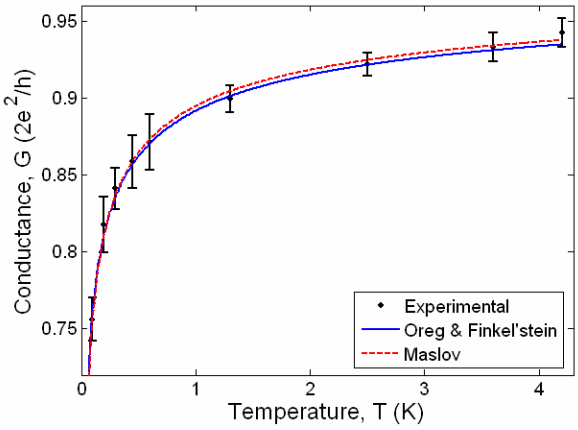

FIG. 2. Conductance values of the first plateau versus temperature in the wire shown on Fig. 1 (points with error bars). The theoretical curves (blue and red – see Ref. [1] and [2] respectively) are plotted for the same interaction parameter, g = 0.64.

1. Y. Oreg and A. M. Finkel'stein, *Phys. Rev. B* **54**, R14265 (1996).
2. D. L. Maslov, *Phys. Rev. B* **52**, R14368 (1995).