Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Conductance reduction without shot noise in quantum wires

MARKUS KINDERMANN, PIET W. BROUWER, Cornell University — Shot noise can only be avoided in conductors without backscattering of conduction electrons. Such conductors without backscattering and a twofold spin-degeneracy have a minimal (nonzero) conductance of 2 e^2/h in the case of weak interactions. In recent experiments, however, also conductors with a reduced conductance of 1.4 e^2/h have shown a clear tendency of noise suppression in zero magnetic field. It has been argued, that these experiments point to a lifted spin-degeneracy in these wires, spin-polarizing their conductance electrons. In this talk I will describe a model of an interacting quantum wire that is able to reproduce the transport behavior observed in these experiments qualitatively: that of the "Coulomb Tonks gas" of impenetrable electrons. It can be realized in ultra-thin wires, such as carbon nanotubes. We have studied transport through a finite-length Coulomb Tonks gas connected to bulk leads in various exactly solvable limits, both in and out of equilibrium. While we find a reduction of the conductance of such a wire to e^2/h in all cases, the current in the wire does not exhibit any fluctuations at zero temperature. Most importantly, our model demonstrates that such noise suppression does not require a spin-polarization.

Markus Kindermann
Cornell University

Date submitted: 02 Dec 2005

Electronic form version 1.4