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Spin properties of strongly interacting quantum wires

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A number of recent experiments on quantum wires report deviations from perfect conductance quantization at low densities. These conductance anomalies manifest themselves as quasi-plateaus in the conductance as a function of gate voltage at about 0.5 to 0.7 of the conductance quantum $G_0 = 2e^2/h$, depending on the device. Most commonly the experimental findings are attributed to non-trivial spin properties of quantum wires. In particular, spontaneous spin polarization of the ground state has been proposed as a possible origin of the conductance anomalies. The issue has generated a lot of interest in the community as this interpretation is in apparent contradiction with the Lieb-Mattis theorem, which forbids spontaneous spin polarization in one dimension. However, the spin properties may change dramatically when the system becomes quasi-one-dimensional. We show [1] that sufficiently strong interactions between electrons induce deviations from the strictly one-dimensional geometry and indeed give rise to a ferromagnetic ground state in a certain range of electron densities. A novel phase with more complicated spin interactions generated by four-particle ring exchanges is identified at higher densities.

[1] A.D. Klironomos, J.S. Meyer, and K.A. Matveev, Europhys. Lett. **74**, 679 (2006).