Sequential tunneling in InAs nanowires

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We have studied the electronic transport in InAs one-dimensional (1D) quantum wires. We have observed that in sufficiently disordered wires the electronic transport is dominated by so called Coulomb blockade regime, where the conductivity can be well described by the tunneling through the dot embedded between 1D Luttinger liquids, see Fig. 1(a). However, the conductance peaks weaken at low temperature, in contrast to the Coulomb blockade peaks reported so far in all the experiments in other material systems. This phenomenon was predicted theoretically [1] for materials with a Luttinger interaction parameter $g < 1/2$, where the conductance peak is given by:

$$G = AG_0 \frac{\gamma(T)}{T} \cosh\left(\frac{\varepsilon_\gamma}{2kT}\right)^{-1} \left|\Gamma\left(\frac{1}{2g} + i\frac{\varepsilon_\gamma}{2\pi kT}\right)\right|^2 ,$$

where $\gamma(T) \sim T^{(1/g-1)}$. By fitting our data to the theory, we found that in InAs wires the value of $g \approx 0.4$.

In the presentation, I will suggest a few possible explanations why the effective Luttinger parameter g in the InAs wires is smaller than the one observed in other 1D systems, like carbon nanotubes, or GaAs quantum wires.

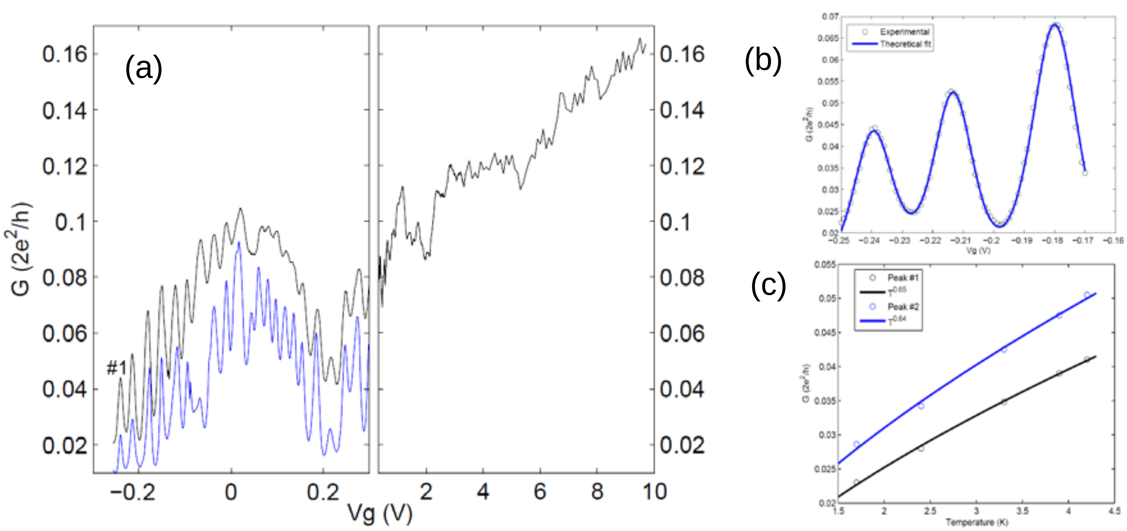

Fig. 1. (a) Conductance of InAs nanowire *vs.* gate voltage at *T* = 4.2 K (black) and 1.7 K (blue), the first conductance peak is marked (nanowire diameter = 50 nm, length = 650 nm); (b) experimental data for the first three peaks and theoretical fit (solid curve) at *T* = 4.2 K; conductance maxima *vs. T* and power law fits (first peak – solid black curve; second peak – solid blue curve).

1. A. Furusaki, *Phys. Rev. B* **57**, 7141 (1998).