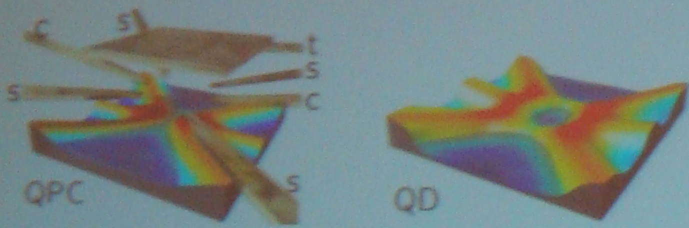
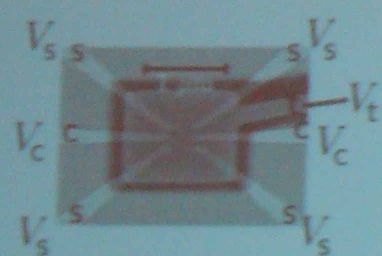
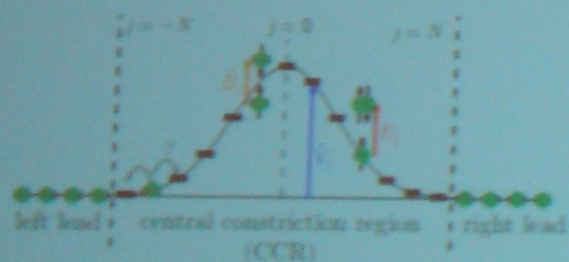
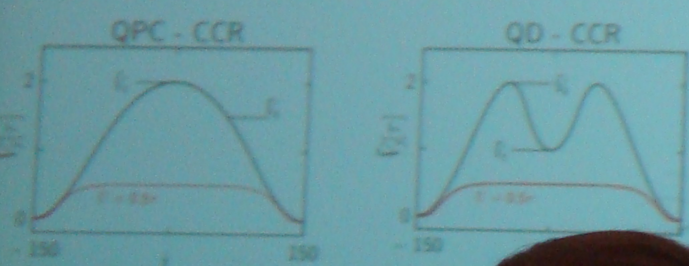
Sample, model & method









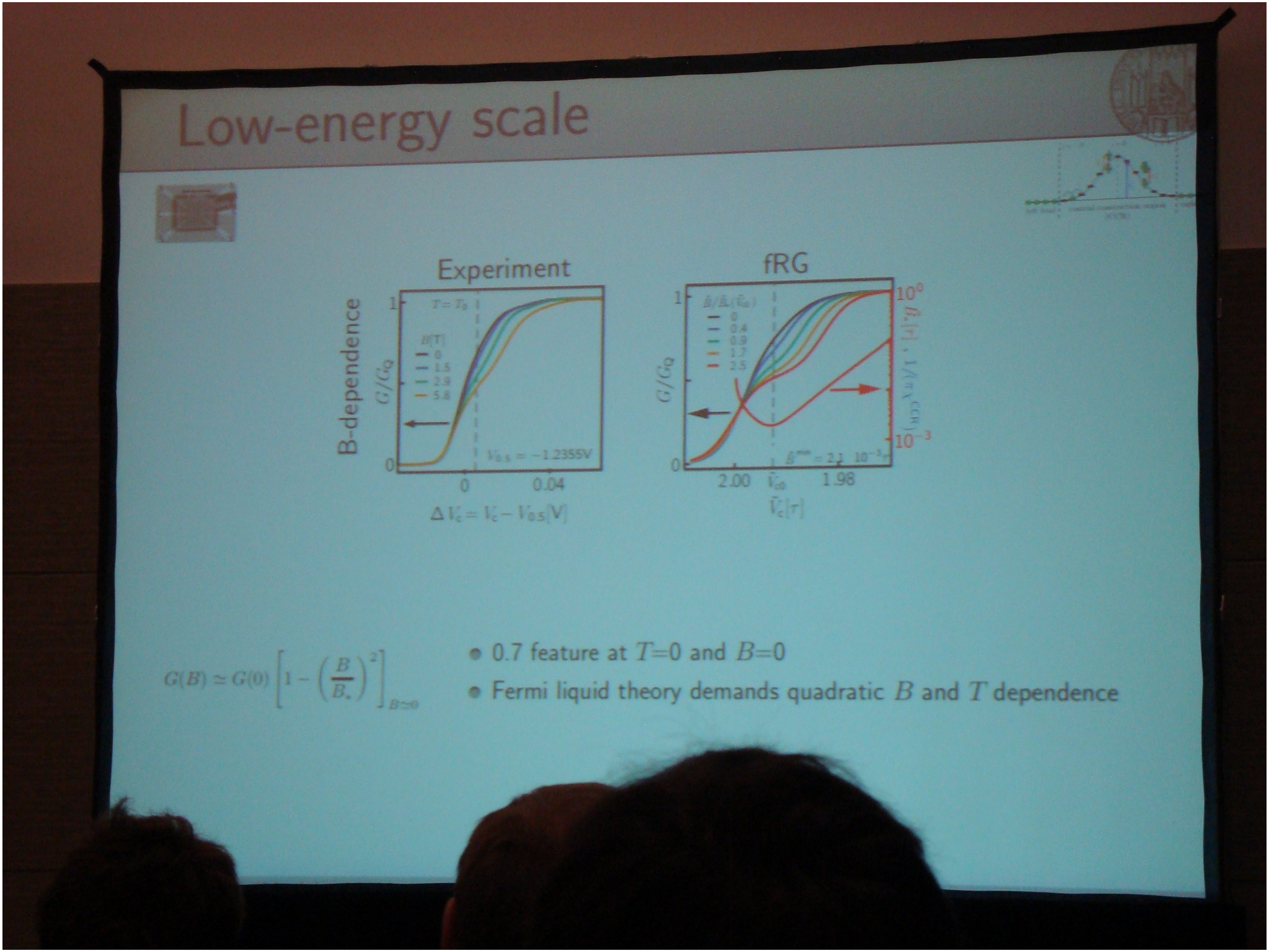
- Experiment:
  - control over length (V_s) and width (V_t) of QPC
  - possibility to tune into the QD region
    (Data not shown in this presentation)
- Model:
  - one-dimensional tight binding chain

$$H = \sum_{j\sigma} \left[\tilde{V}_{j\sigma} \hat{n}_{j\sigma} - \tau (d^\dagger_{j+1\,\sigma} d_{j\sigma} + \mathrm{h.c.}) \right] + \sum_j U_j n_{j\uparrow} n_{j\downarrow}$$

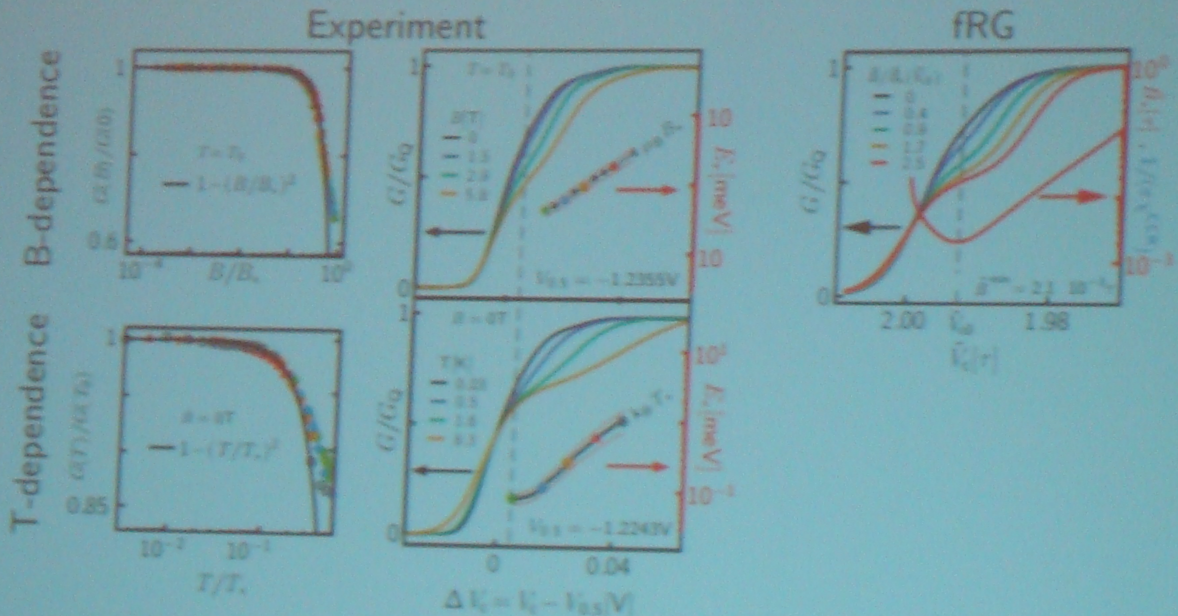
  - control over length (Ω_x) and width (U) of QPC

$$\tilde{V}_{j\sigma} = \tilde{V}_c - \frac{\Omega_x^2}{4\tau} j^2 - \frac{\tilde{B}\sigma}{2}$$

  - possibility to tune into QD region
- Method: functional Renormalization Group
  - RG-enhanced perturbation theory in the interaction (assuming no symmetry breaking)
  - Summation of Parquet-like diagrams, i.e. coupled RPA-approximation
  - only for T=0 (frequency independent self- … d vertex)


Low-energy scale
Experiment
fRG
B-dependence
G/G_Q
$T = T_0$
B[T]
0
1.5
2.9
5.8
$V_{0.5} = -1.2355$V
$\Delta V_c = V_c - V_{0.5}$[V]
0
0.04
$\tilde{B}/\tilde{B}_*(\tilde{V}_{c0})$
0
0.4
0.9
1.7
2.5
10^0
10^{-3}
2.00
$\tilde{V}_{c0}$
1.98
$\tilde{V}_c[\tau]$
$G(B) \simeq G(0)\left[1 - \left(\frac{B}{B_*}\right)^2\right]_{B\simeq 0}$
0.7 feature at T=0 and B=0
Fermi liquid theory demands quadratic B and T dependence

Low-energy scale

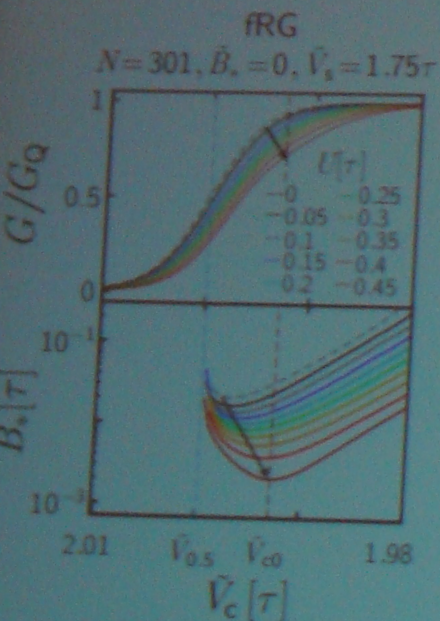


$$G(B) \simeq G(0)\left[1-\left(\frac{B}{B_*}\right)^2\right]_{B\simeq 0}$$

$$G(T) \simeq G(0)\left[1-\left(\frac{T}{T_*}\right)^2\right]_{T\simeq 0}$$

- 0.7 feature at T=0 and B=0
- Fermi liquid theory demands quadratic B and T dependence
- Low energy scale B_* depends exponentially on gate voltage

The role of interaction & geometry



$$T(\omega) \simeq \frac{1}{e^{2\pi(\tilde{V}_c - \tilde{V}_{0.5} - \omega)/\Omega_x} + 1}$$

Büttiker M **1990** *Phys. Rev. B* **41** 7906

$$\tilde{B}_*^0\left(\tilde{V}_c\right) \simeq \frac{\sqrt{2}}{\pi}\Omega_x e^{\pi\frac{\tilde{V}_{0.5}-\tilde{V}_c}{\Omega_x}}$$

- leading exponential dependence of the low energy scale
  - does not depend on interaction
  - can be analytically derived for the noninteracting case
  - is a consequence of geometry, and depends only on Ω_x

- Both Kondo-effect and 0.7 anomaly show Fermi liquid behavior
- Low-energy scale of the 0.7 anomaly is a result of geometry
- Todo for 0.7 anomaly: Fermi liquid description, i.e. effective Hamiltonian for low energies that describes QPC in terms of phase shifts