

Extracting net current from an upstream neutral mode in the fractional quantum Hall regime

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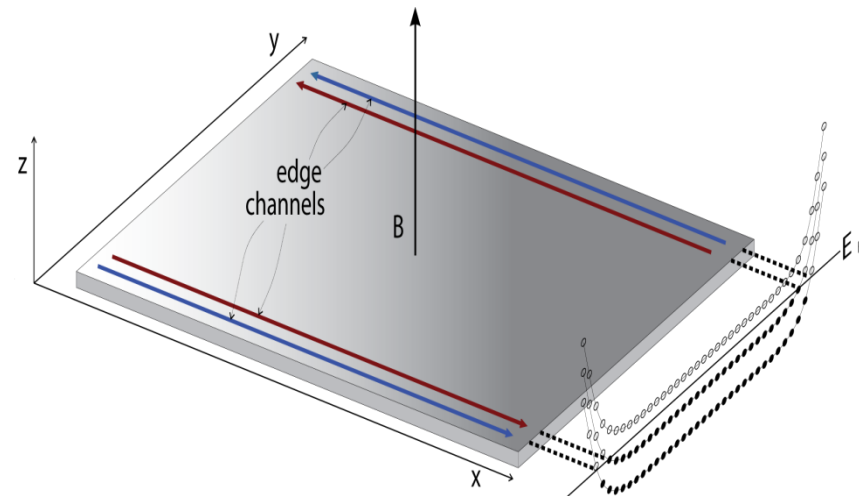
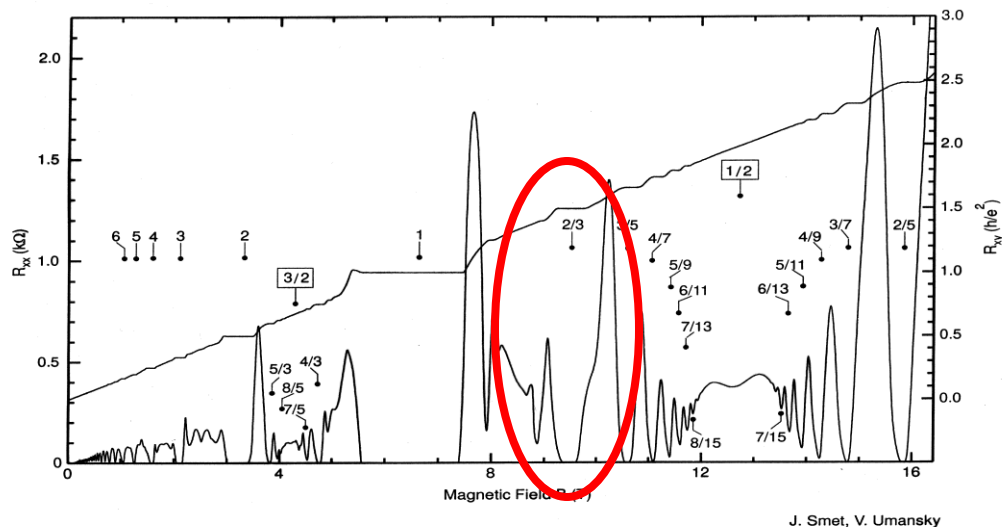
Diana Mahalu

EP2DS, Wroclaw, Poland, 2013

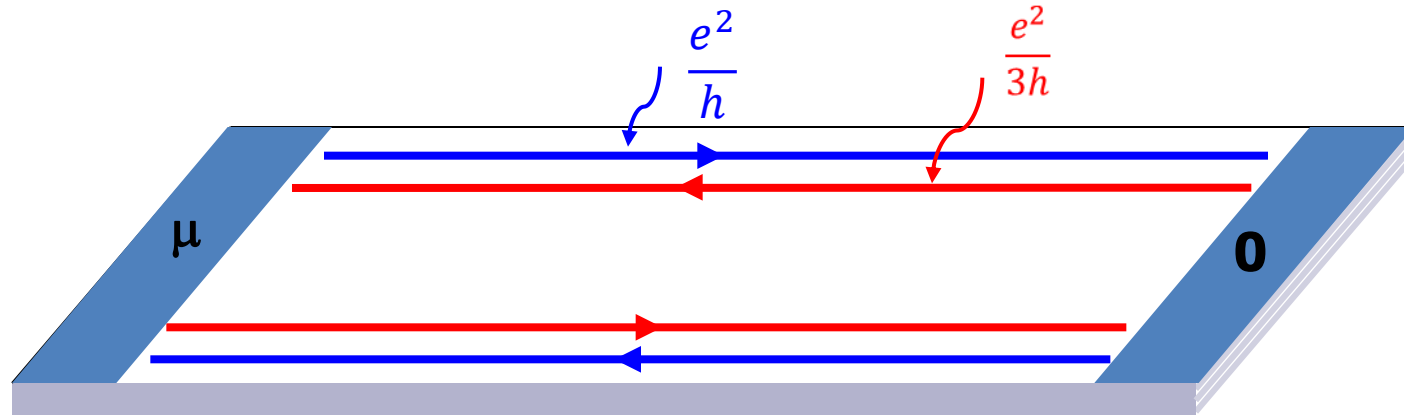


Quantum Hall Effect – the essentials

- bulk is insulating ($R_{xx}=0$)
- R_{xy} is quantized ($\frac{h}{e^2\nu}$)
- current runs along the edges in a chiral fashion
- edges can have fractional conductance



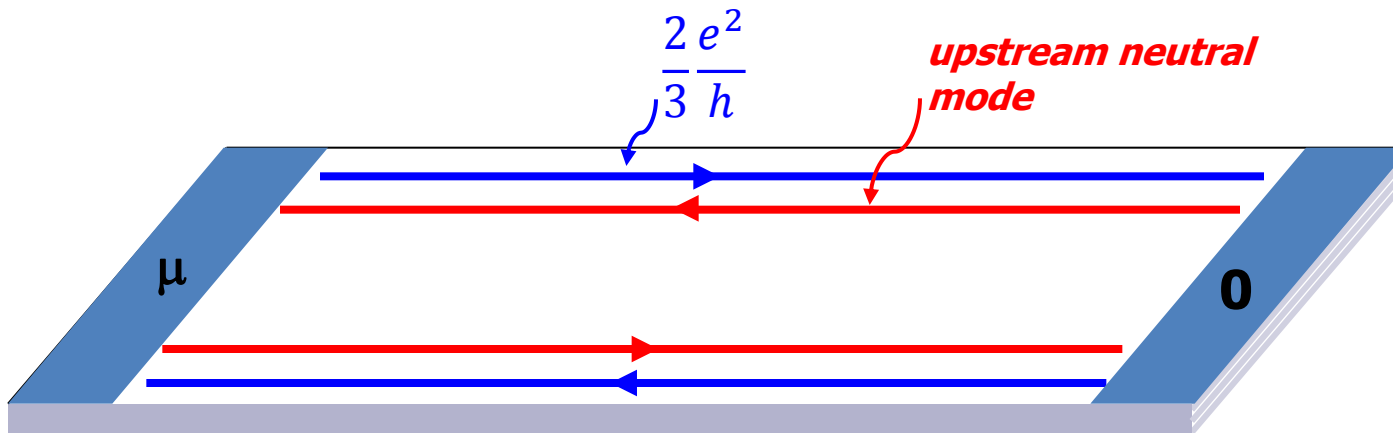
Edge structure in $\nu=2/3$



$$\sigma_{2P} = \frac{4e^2}{3h}$$

MacDonald, PRL **64**, 220-223 (1990)

disorder and interactions

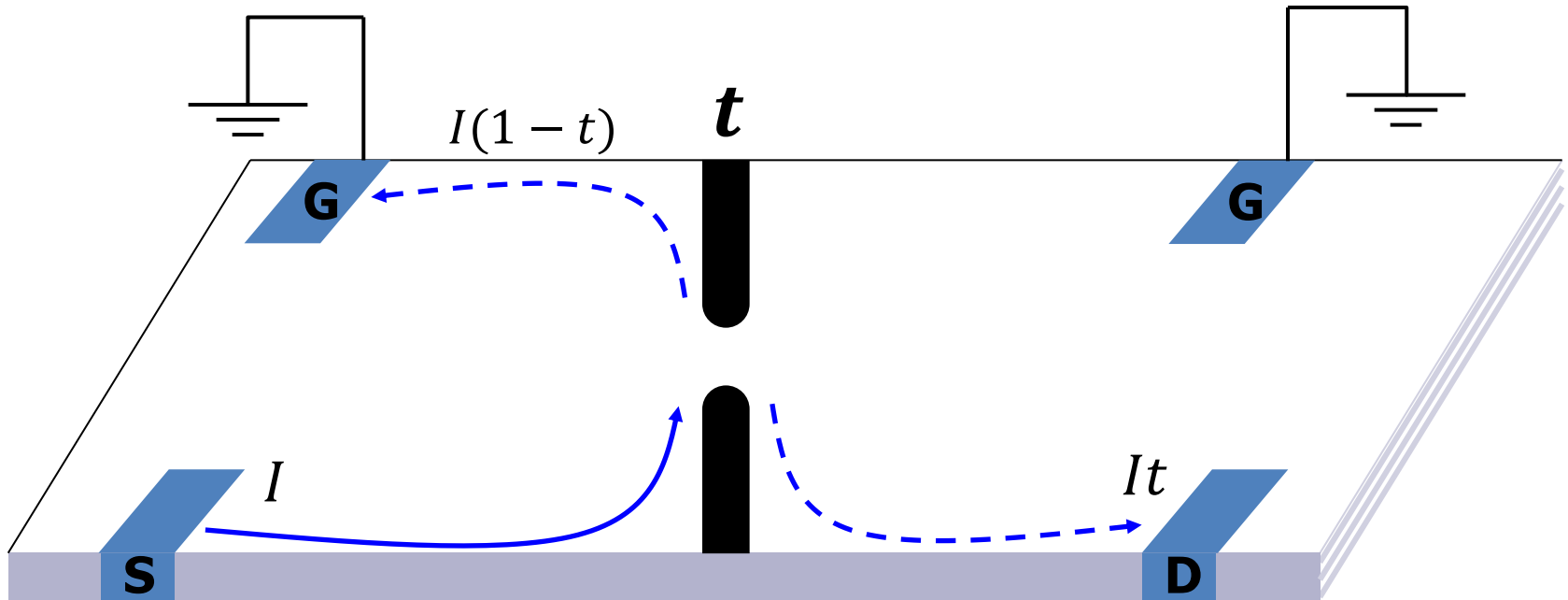


$$\sigma_{2P} = \frac{2e^2}{3h}$$

Kane, Fisher & Polchinski, PRL **72**, 4129-4132 (1994)

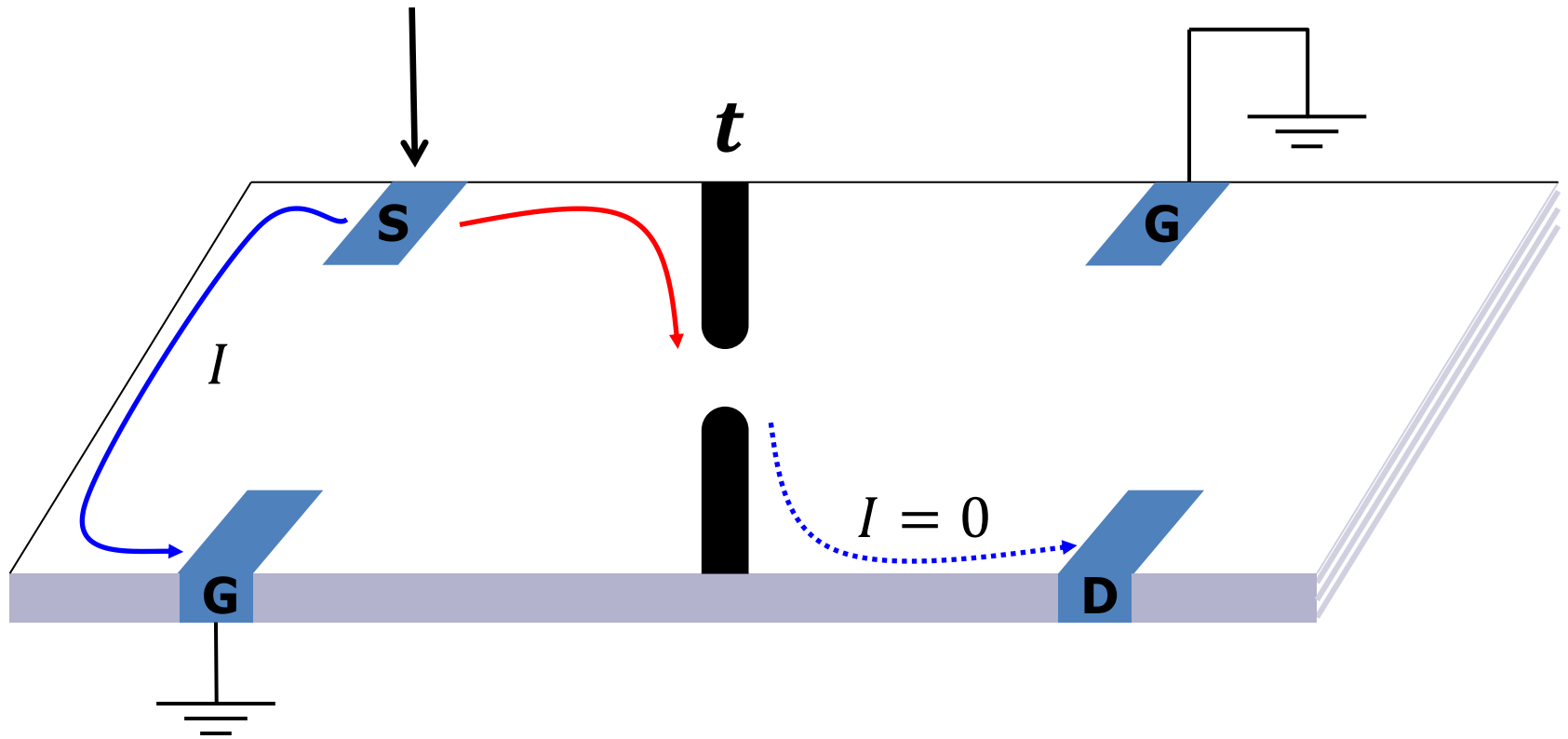
How can you
measure
neutral modes ?

QPC – an electronic beam splitter



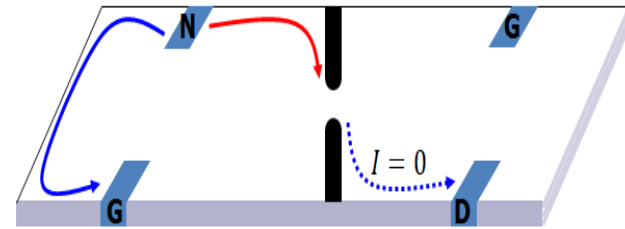
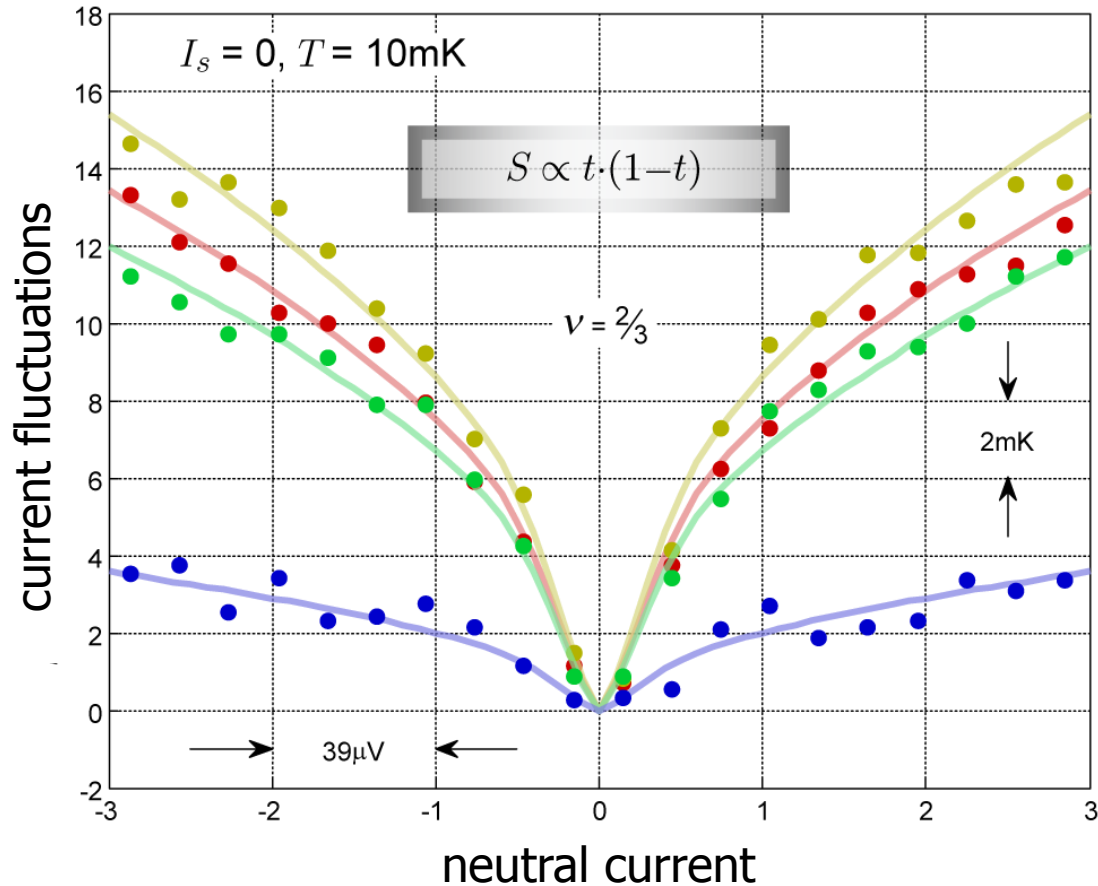
$$\text{shot noise} = 2e^*It(1 - t)$$

Detection of neutral modes via noise



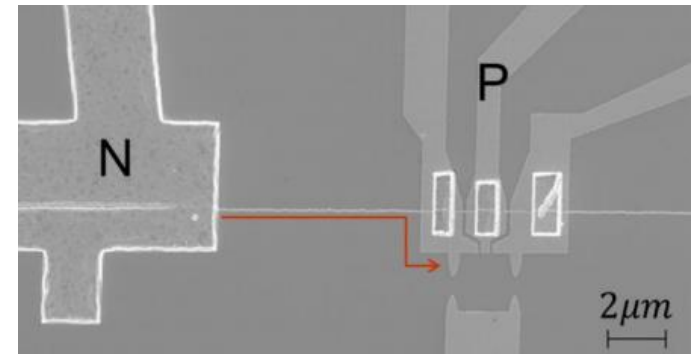
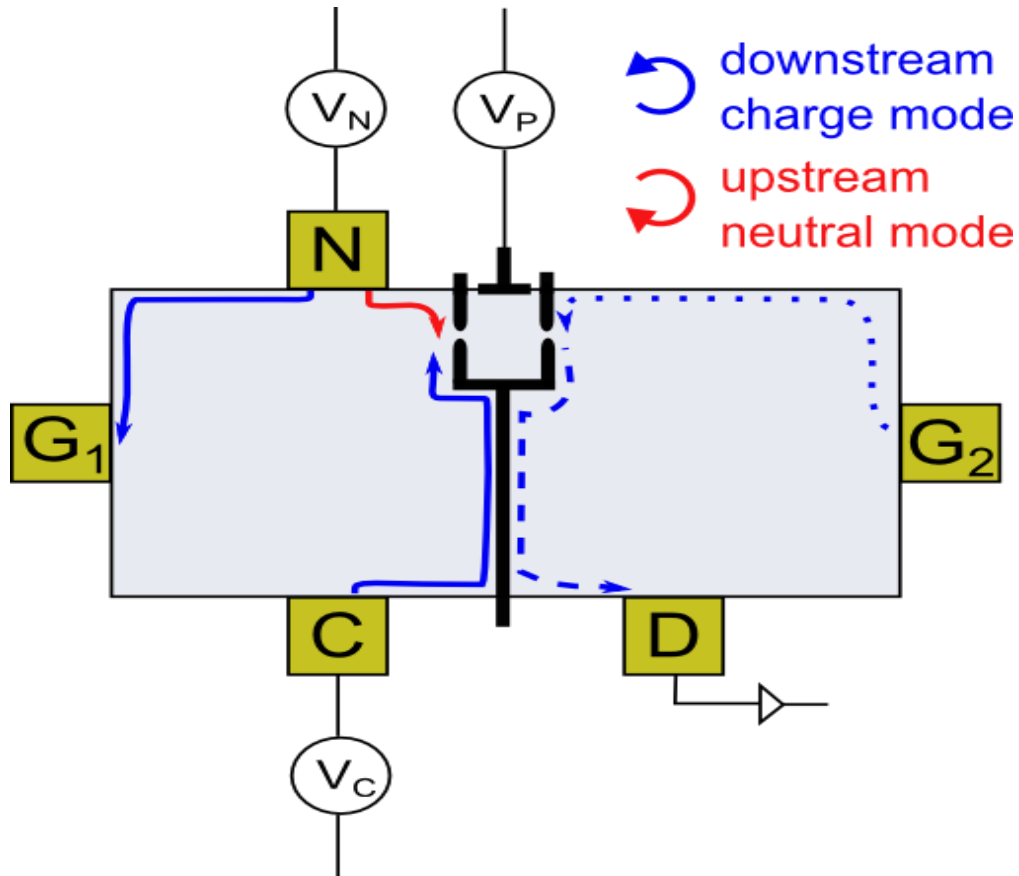
zero net current
but what about current fluctuations?

Detection of neutral modes via noise

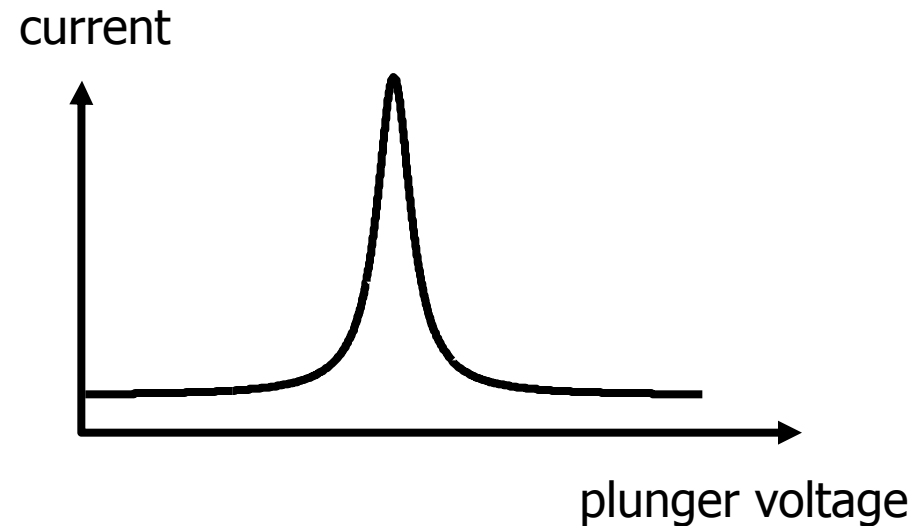
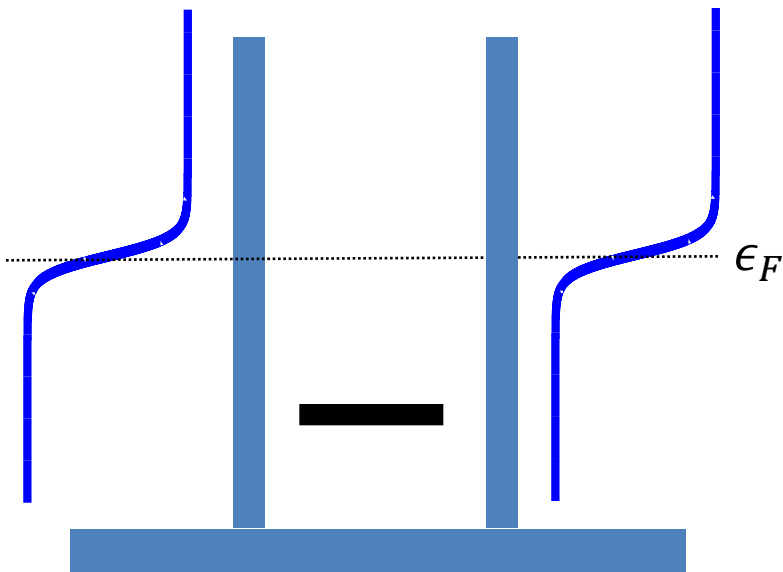
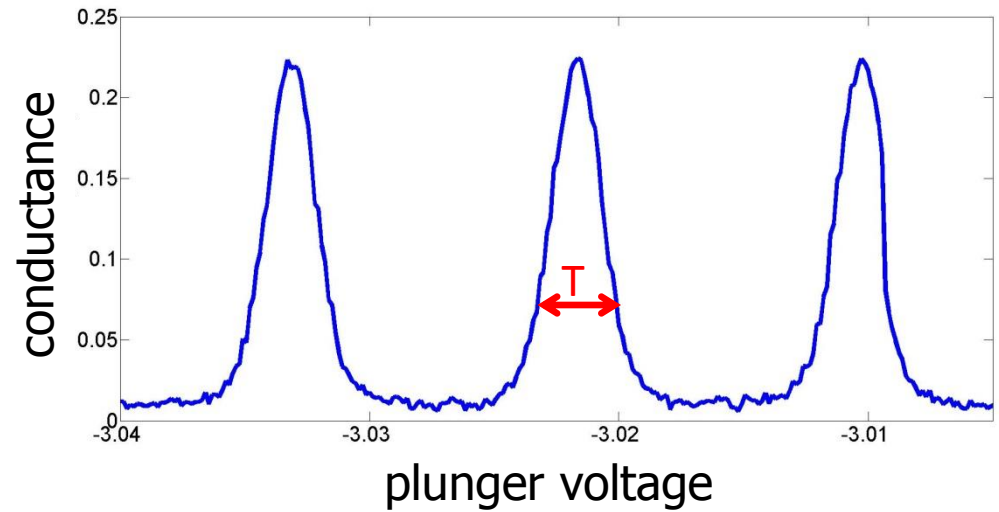
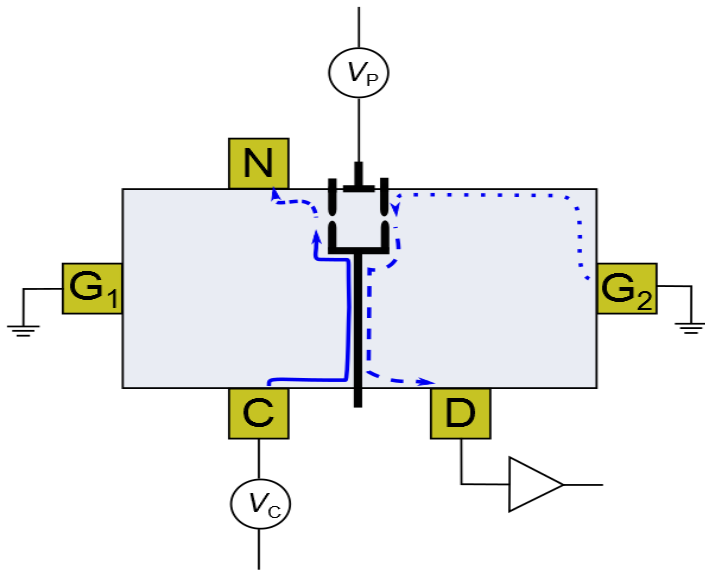


observable current fluctuations with zero net current

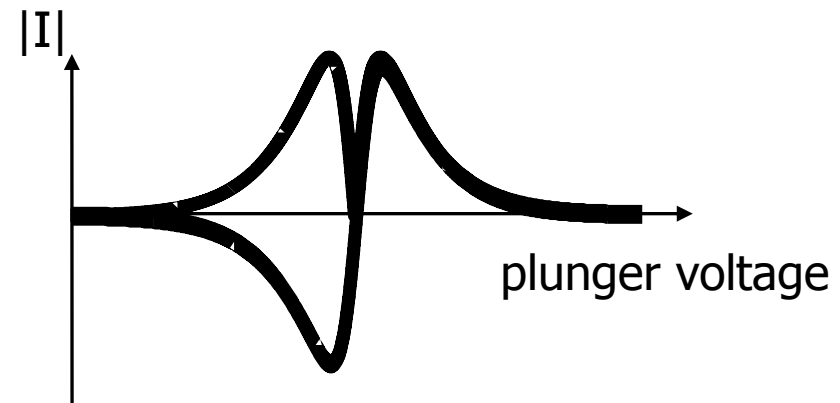
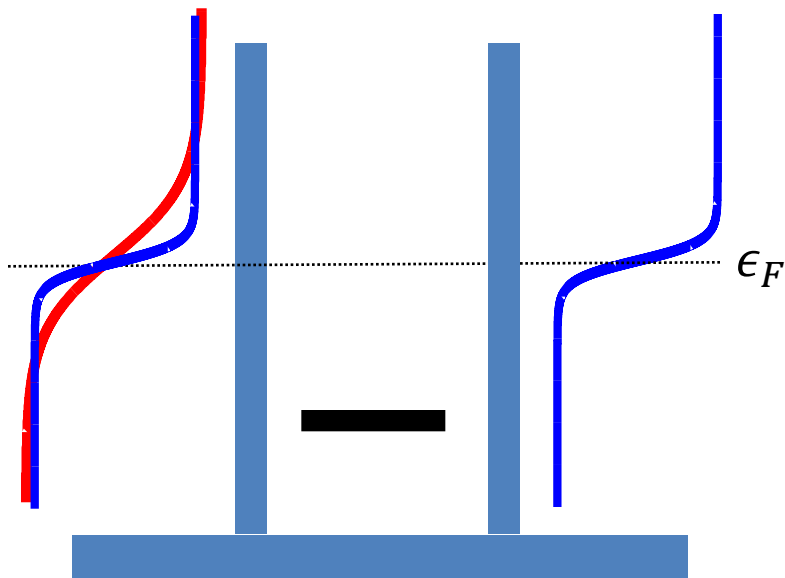
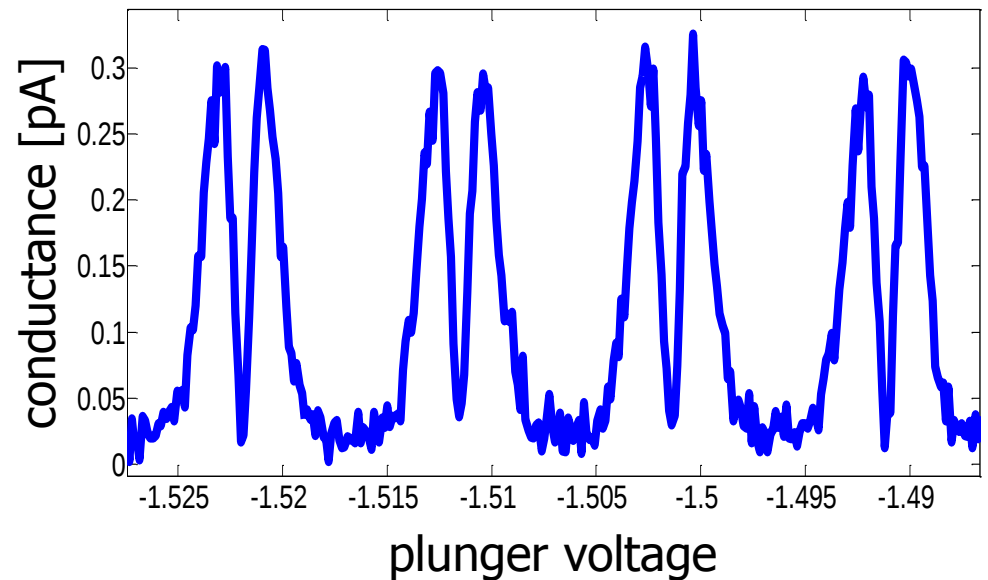
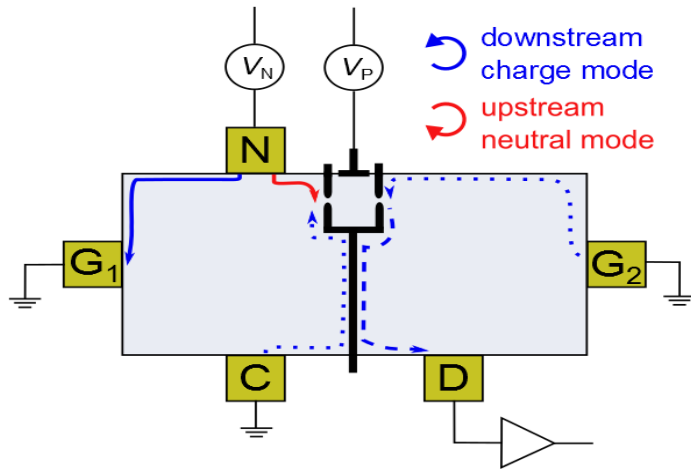
Moving from QPC to QD



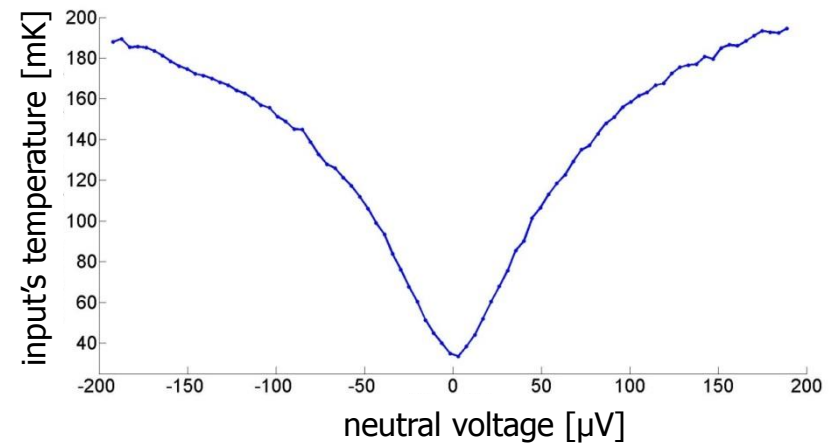
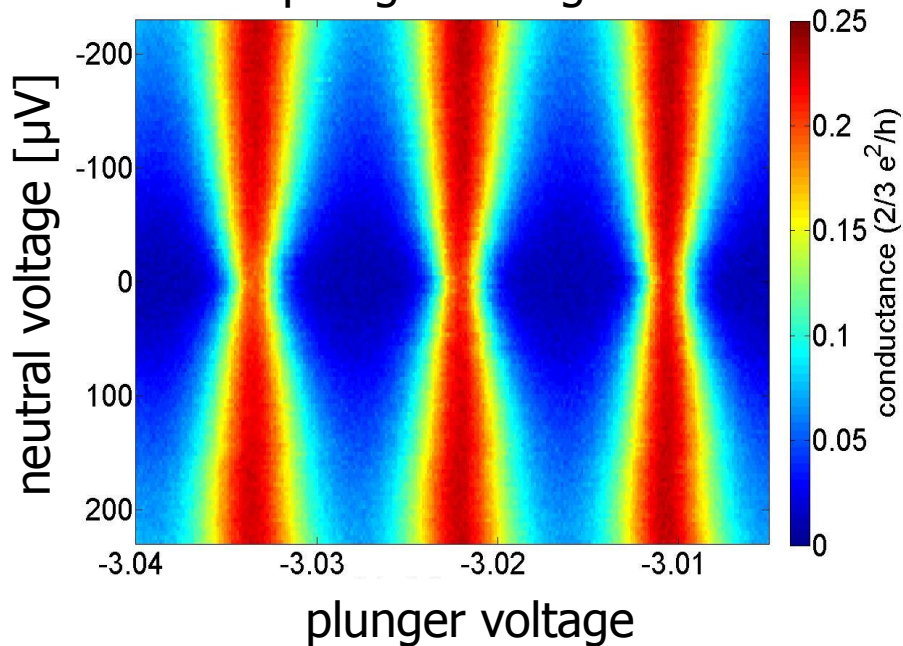
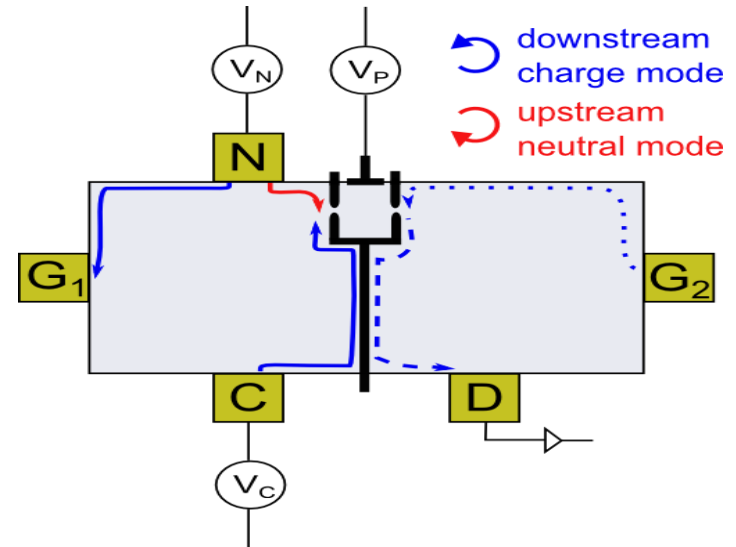
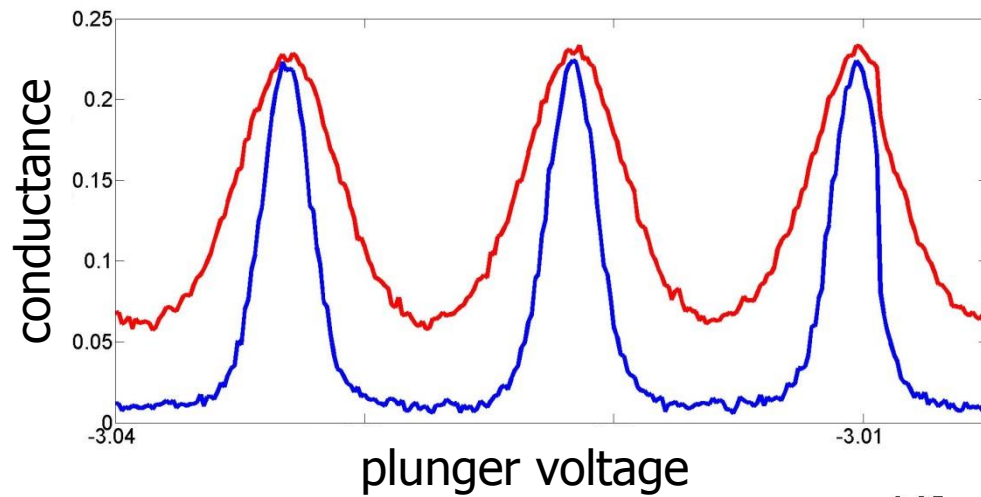
Coulomb Blockade



The Neutral Mode Heats the QD

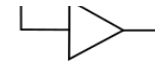
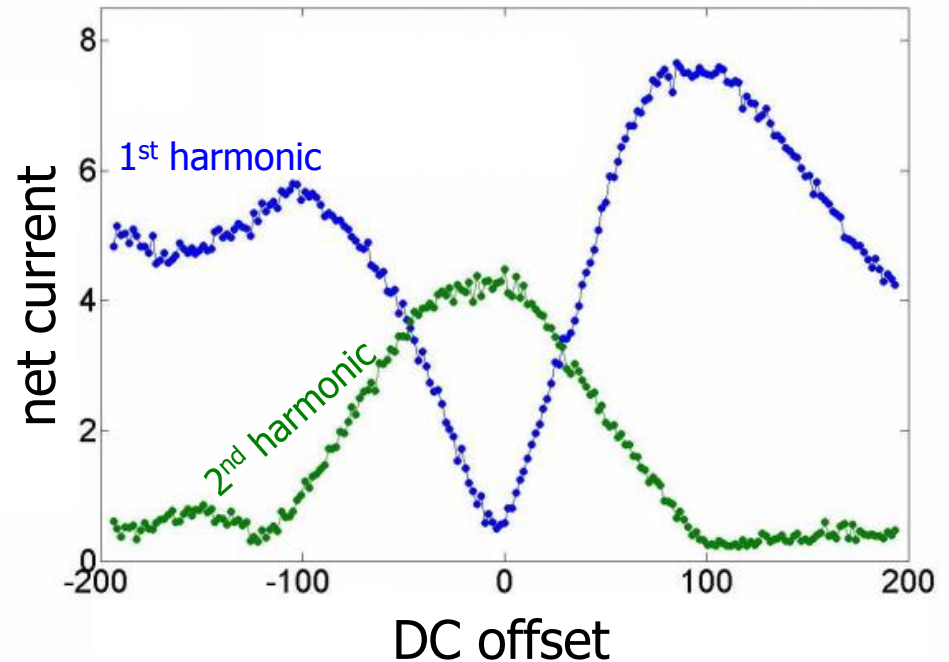
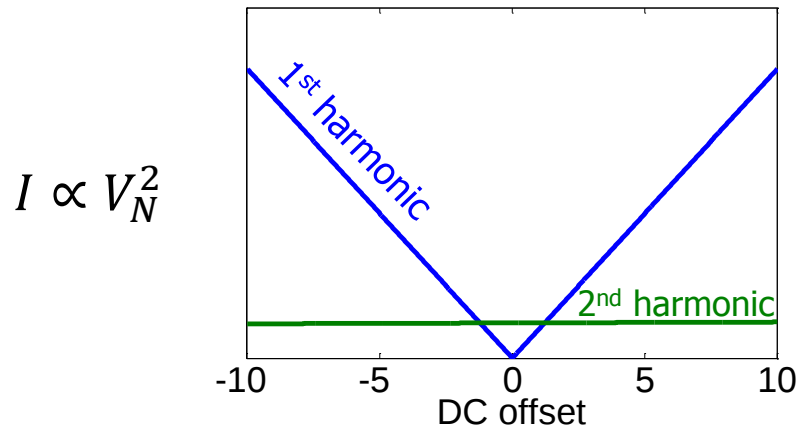
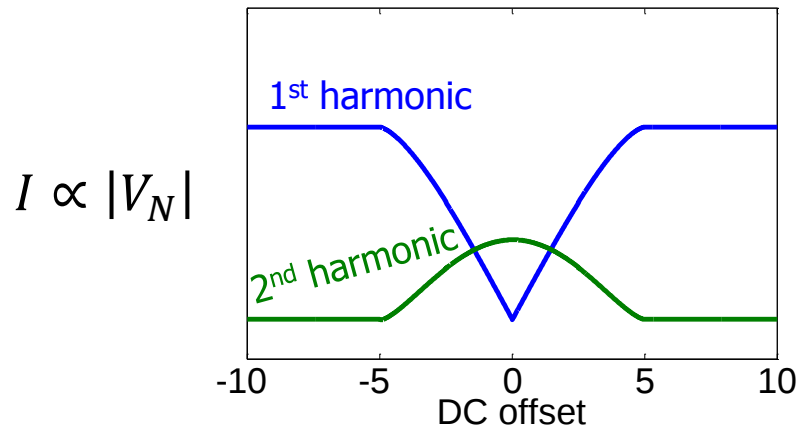


Neutral modes broaden the CB



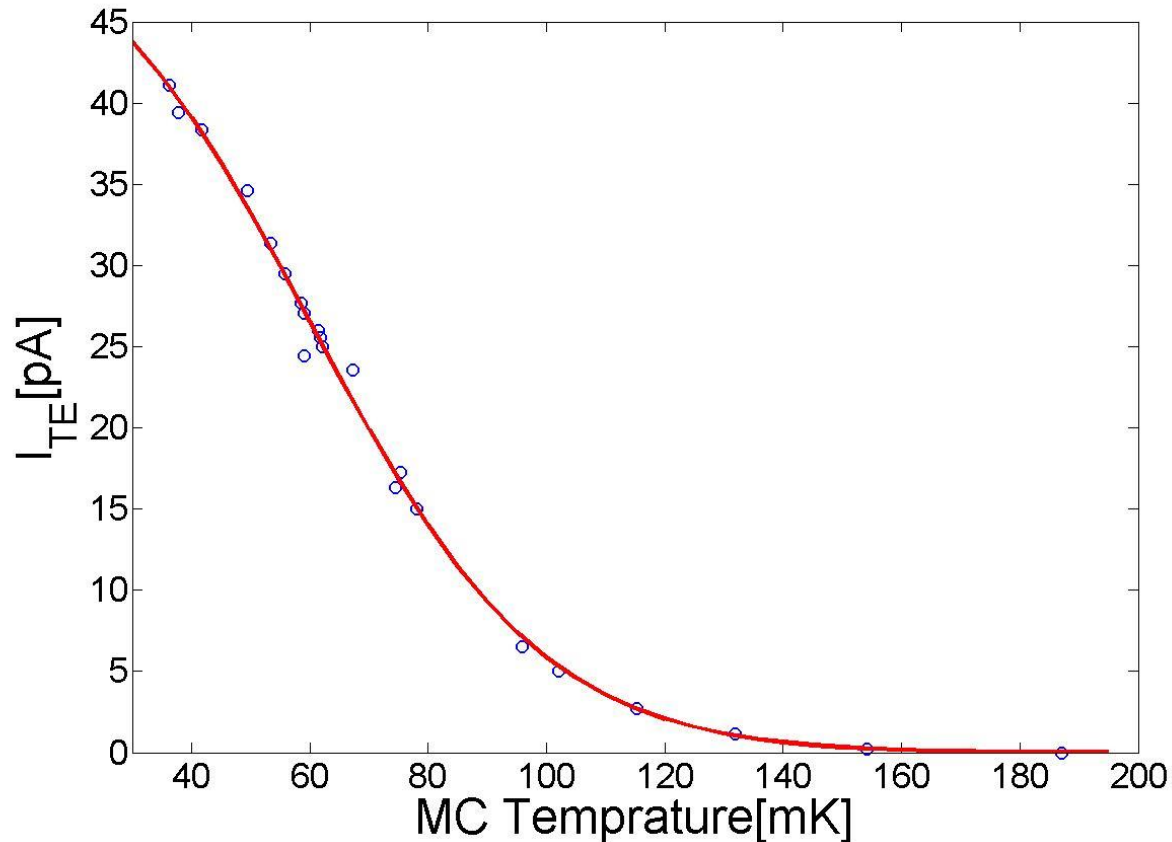
Linear dependence on Neutral voltage

$$V_N = V_{N,DC} + V_{N,AC} \cos(\omega t)$$



$$I \propto |V_N|$$

Neutral modes decay with temperature



$$T_{\text{in}} = T_{\text{MC}} + \alpha e^{-\left(\frac{T_{\text{MC}}}{T_0}\right)^2}$$

Summary

- quantum dots are good neutral mode detectors
- impinging neutral modes on a QD heats its input → thermo-electric current is created
- theoretical predictions were verified via thermo-electric current
- further work - $\nu = 5/2$
 - observation of unique energy levels

THANKS

