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Two path transport measurements on a triple quantum dot

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arXiv: 0702.2058v2
• substrate: GaAs / AlGaAs heterostructure

• 3 dots (A, B, C) arranged in a triangular geometry
  each dot is connected to one separate lead (Source, Drain 1 & 2)

• 4 gates (G1 to G4)

• 1 QPC (can be also used as G5)

  all dots are coupled with each other
dot fabrication

- oxide lines define geometry of the design of the triple dot
  => local anodic oxidation by atomic force microscope (AFM)

Principle of local anodic oxidation (LAO):
setup and measurement

• He3/He4 dilution refrigerator
  \[ T = 15 \text{ mK} \]

• transport measurements of path 1 & 2 at Drain 1 & 2

• charge sensing with the QPC
QPC measurements

- **green circle**: resonance of dot A & B
- **yellow circle**: resonance of dot A & C
- **red circle**: resonance of dot B & C
- **black circle**: resonance of all three dots
Transport measurement of path 1 & 2 measured at Drain 1 & 2

$V_{G4} = -100 \text{mV}$

- **dot A & B**
- **dot A & C**
- **dot A**
- **dot C**
- **dot B**
VG4 = -100mV
VG2 = changes stepwise

Drain 1 & Drain 2 are measured in one diagram

Resonance A & B (blue) is splitted by resonance A & C (red) due to strong interdot coupling of dot A & C

dot A & C

dot A & B

VG4 = -100mV
VG2 = changes stepwise
valid for large tunnel coupling
Goal / Motivation

Use the dot as spin entangler:

1\textsuperscript{st} step:  
form a spin singlet in dot A  

2\textsuperscript{nd} step:  
entangled spins are separated and transported separately on path 1 and path 2  

Trap of electrons:  
Electrons are transported if they go into the dot via dot B & C and transport through dot A blockaded.