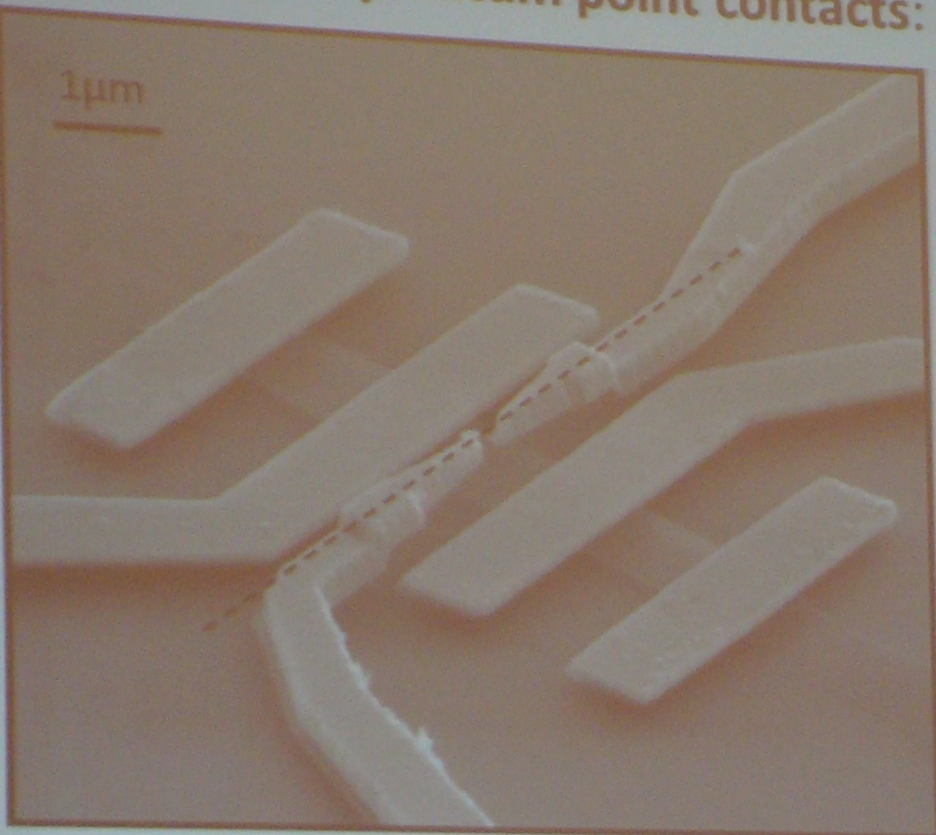
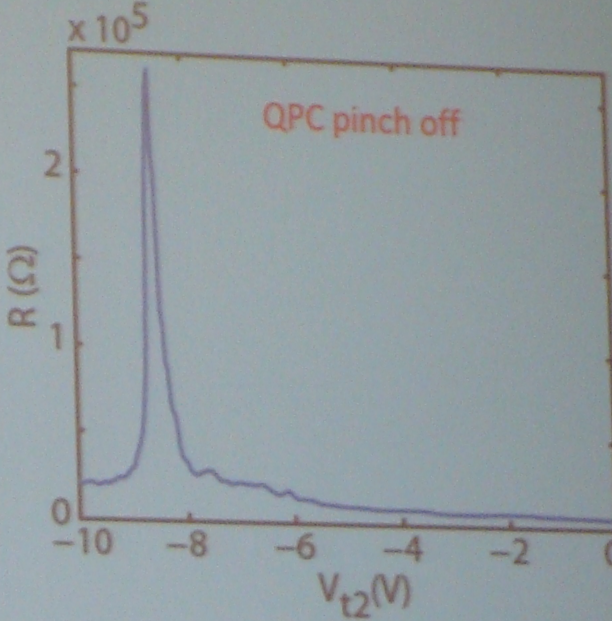
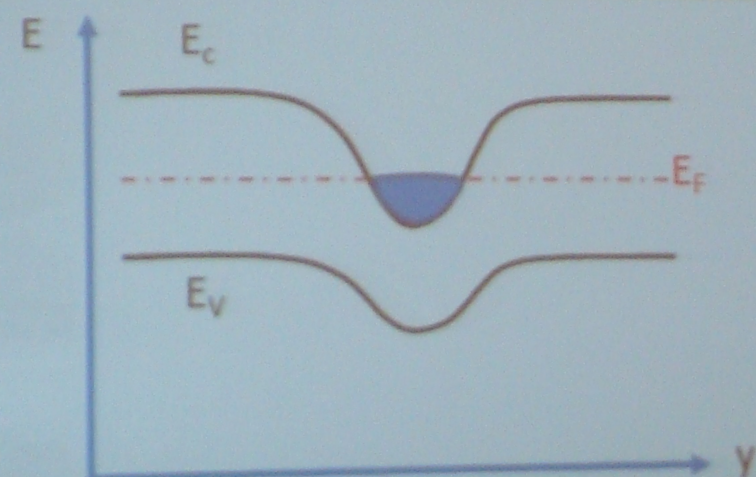
Gate defined quantum point contacts: confinement via bandstructure







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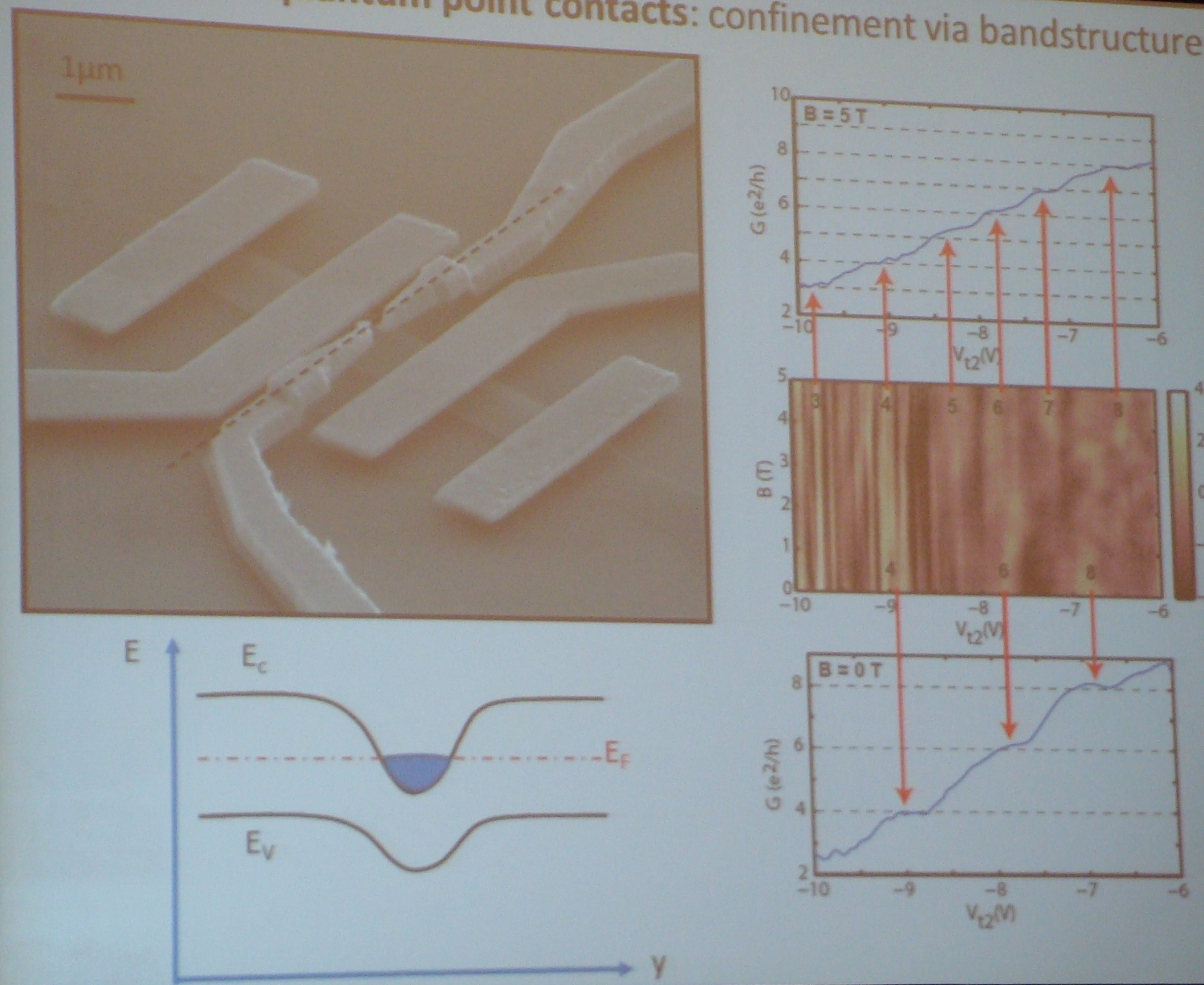
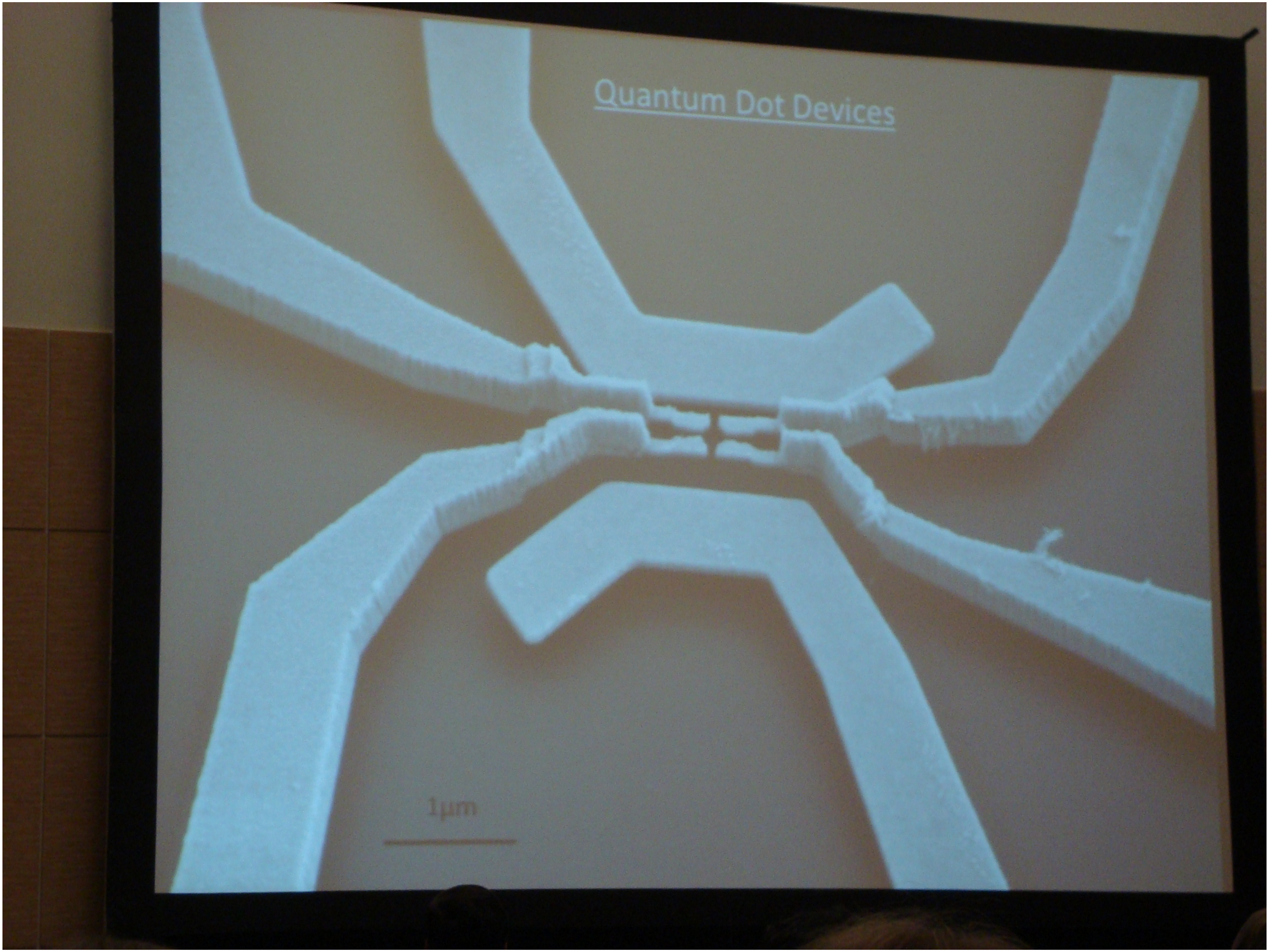
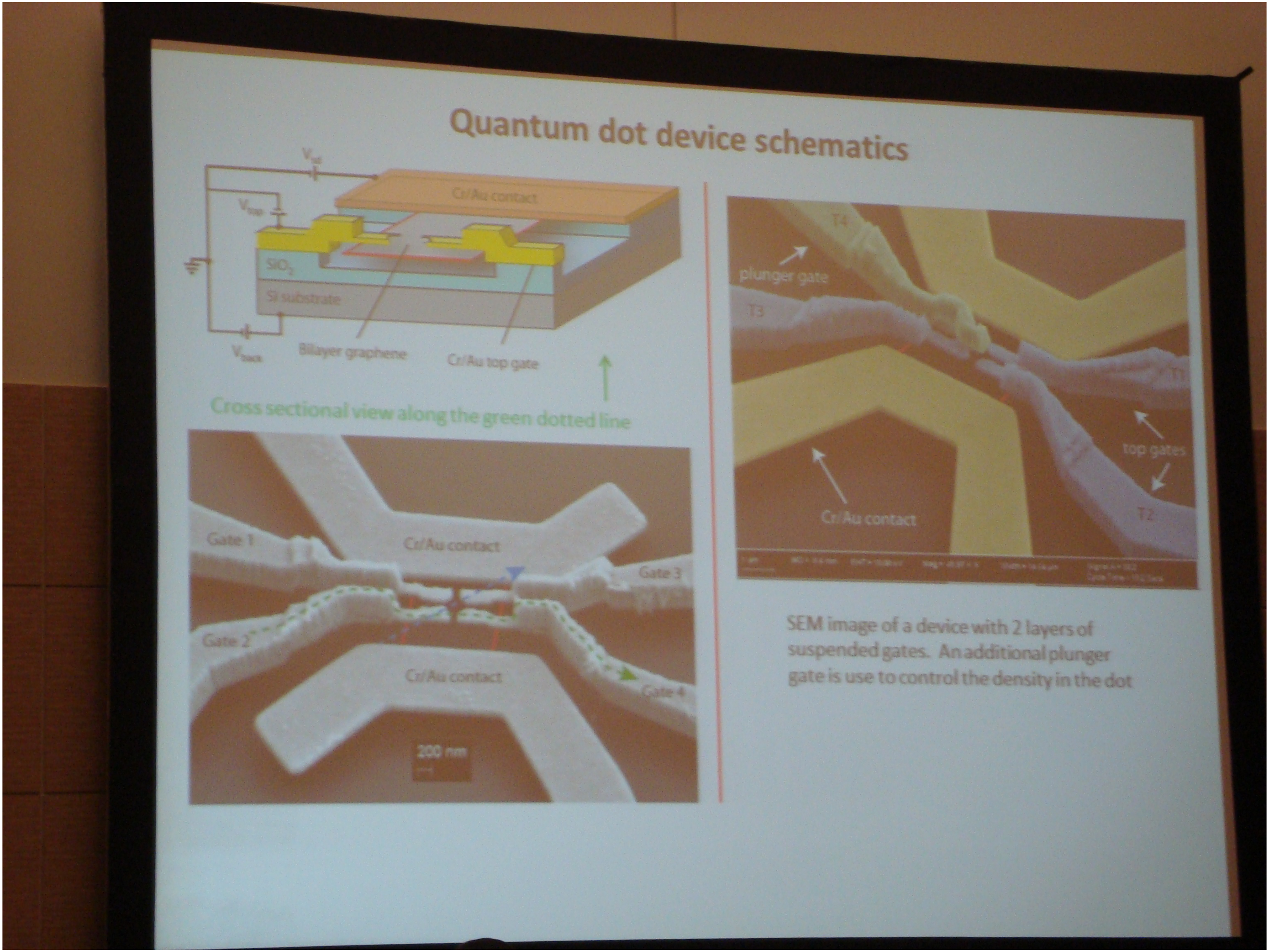
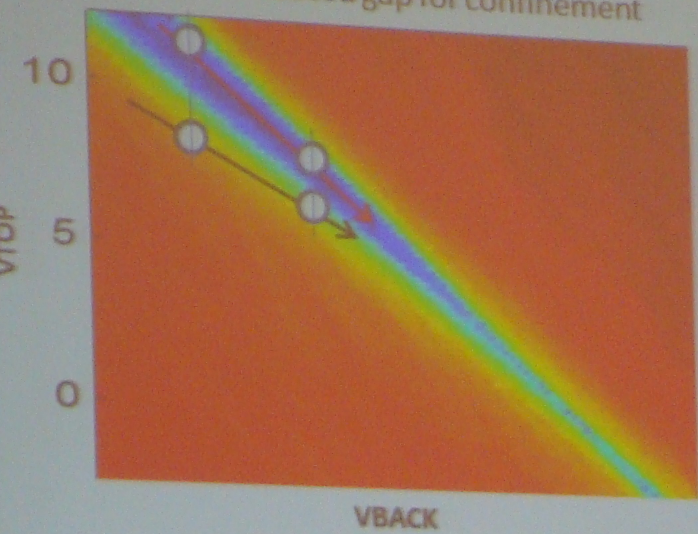



Quantum Dot Devices
1µm

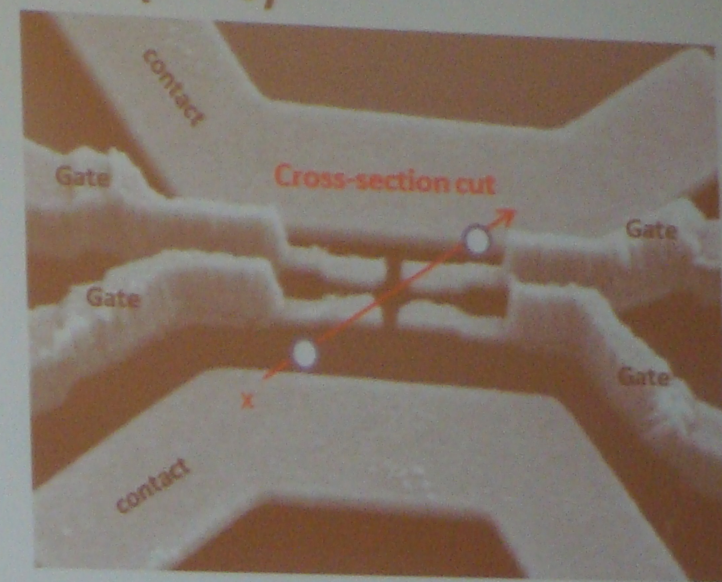

Quantum dot device schematics
V_sd
V_top
V_back
Cr/Au contact
SiO2
Si substrate
Bilayer graphene
Cr/Au top gate
Cross sectional view along the green dotted line
Gate 1
Gate 2
Gate 3
Gate 4
Cr/Au contact
Cr/Au contact
200 nm
T4
plunger gate
T3
T1
top gates
T2
Cr/Au contact
SEM image of a device with 2 layers of
suspended gates. An additional plunger
gate is use to control the density in the dot

Schematic of gate-defined quantum dots (B = 0)

Use electric field induced gap for confinement



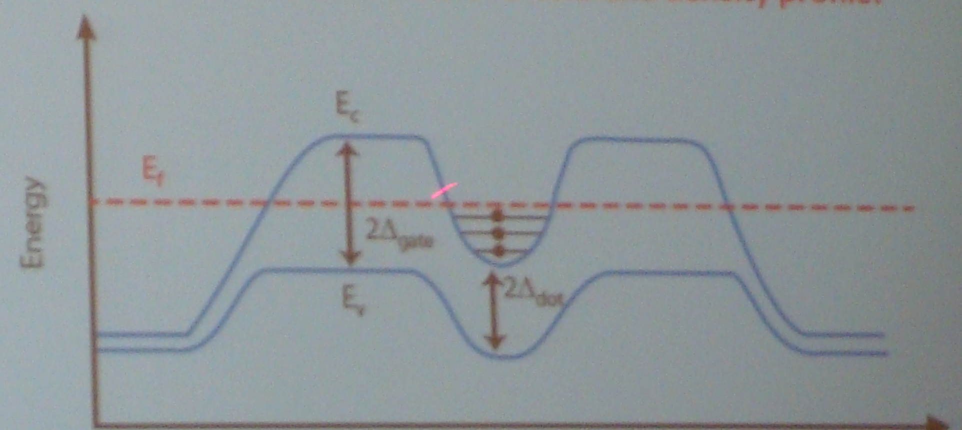
In reality, central region is partially coupled to split gates (indicated by black arrow above)

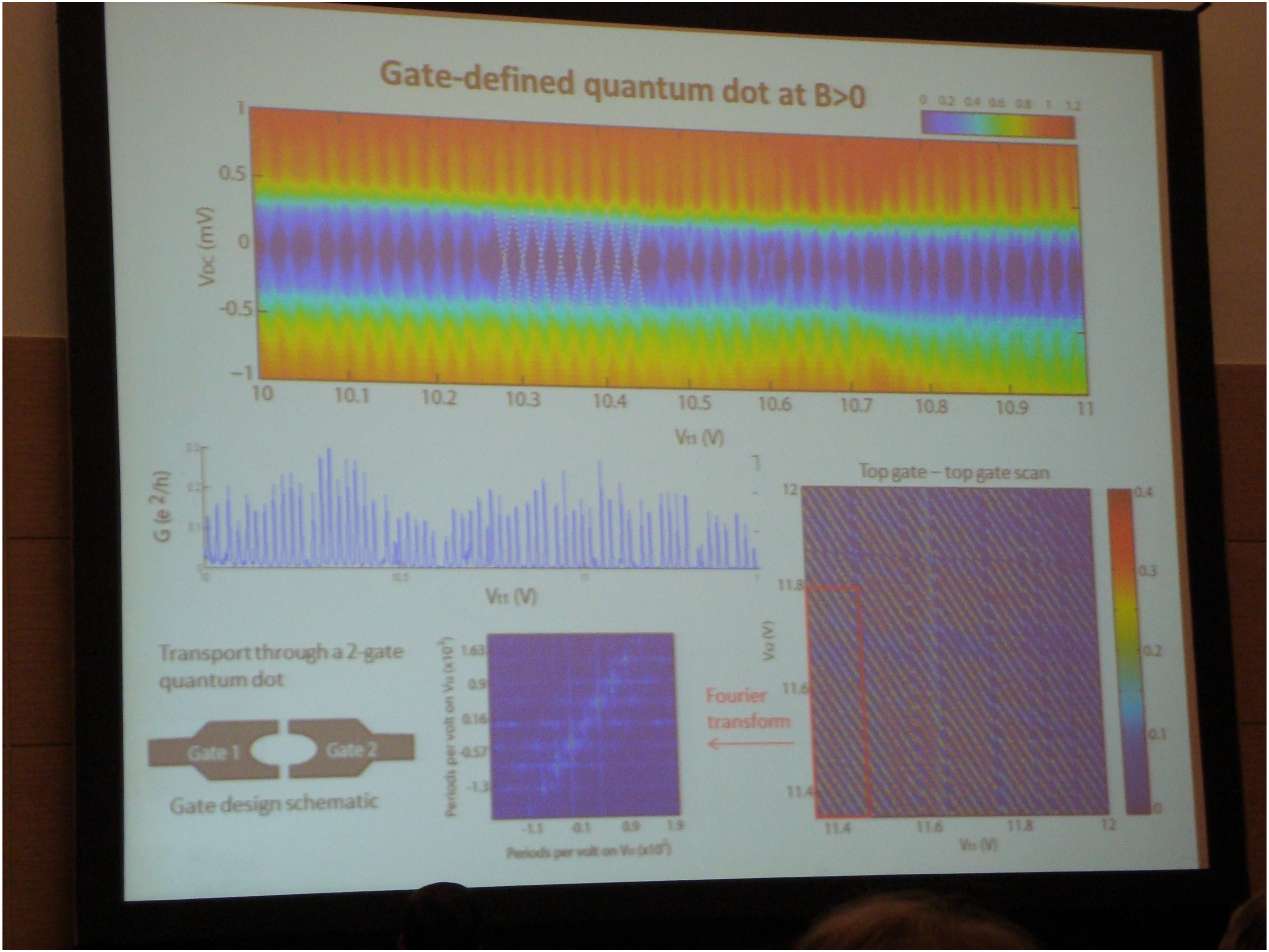


-Beneath the local top gates, we induce a bandgap by applying a perpendicular E field, meanwhile fixing VTOP and VBACK at a ratio that maintains zero carrier density

-In non top-gated regions, there is charge accumulation due to an uncompensated voltage from the back gate

Cross-sectional view of E field and density profile:





Gate-defined quantum dot at B>0
V_DC (mV)
V_T1 (V)
G (e 2/h)
V_T1 (V)
Top gate – top gate scan
V_T2 (V)
V_T1 (V)
Fourier transform
Periods per volt on V_T2 (x10^3)
Periods per volt on V_T1 (x10^3)
Transport through a 2-gate quantum dot
Gate 1
Gate 2
Gate design schematic