

Remote capacitive sensing in two dimension quantum dot arrays

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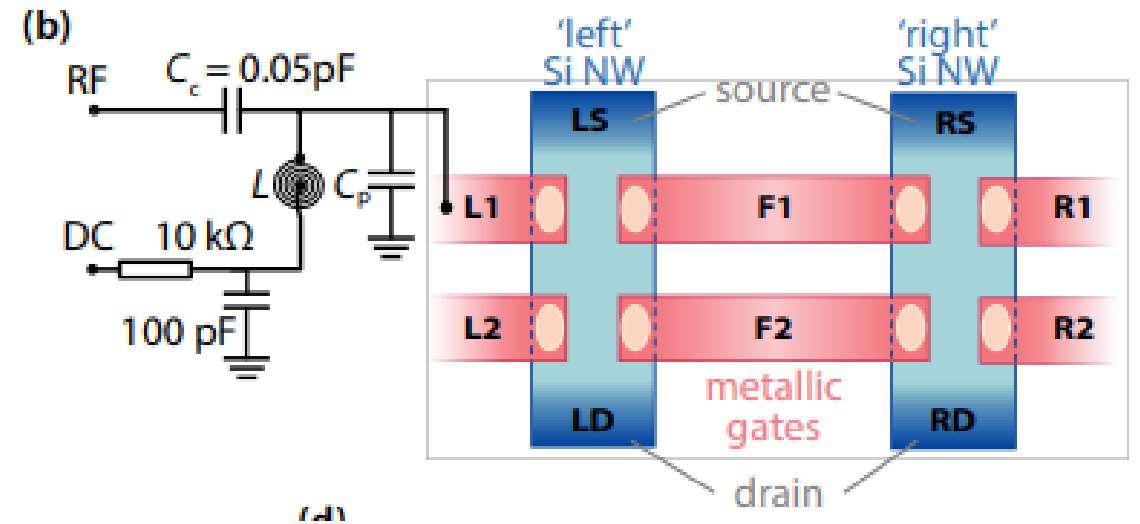
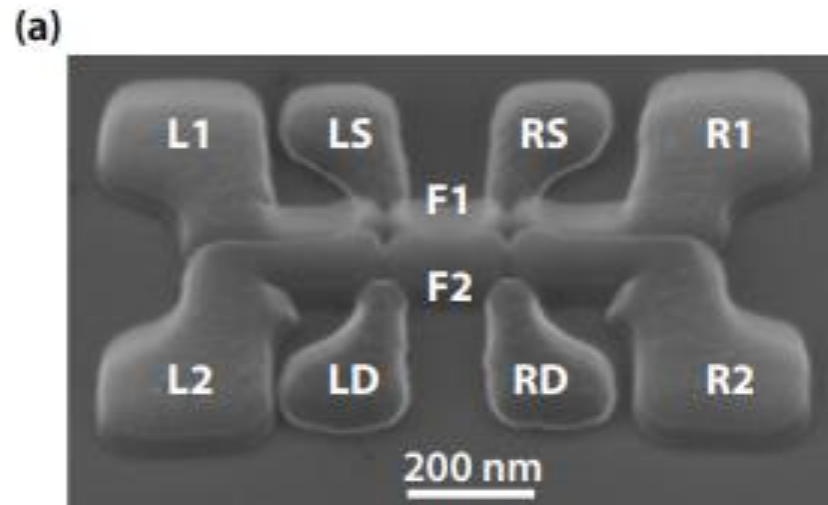
By Mathieu de Kruijf

Overview

- Device design
- Proof of concept
- Remote sensing
- Capacitive coupling

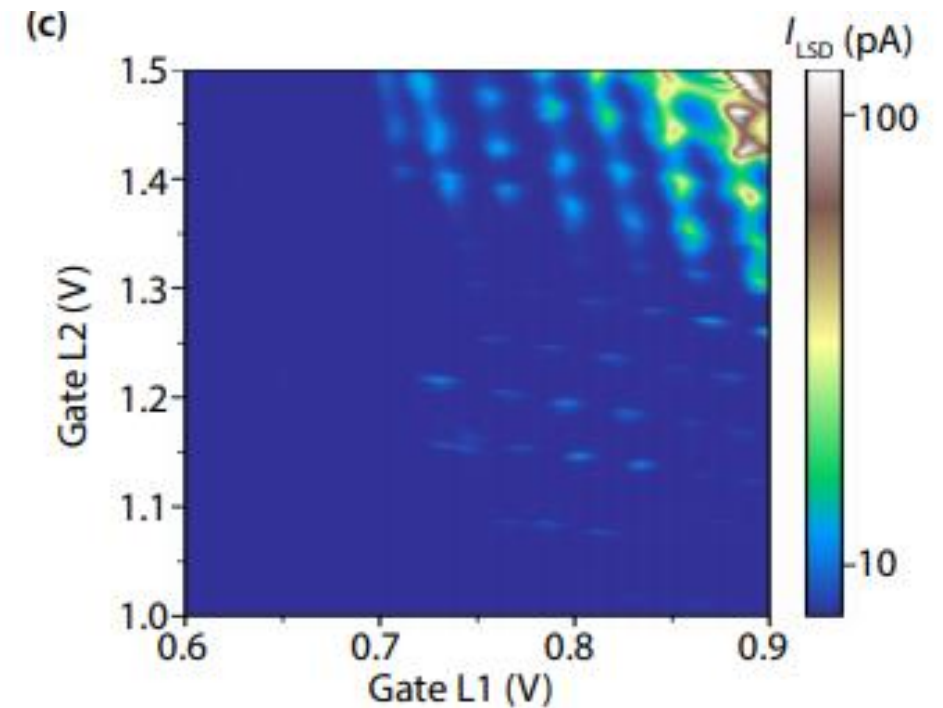
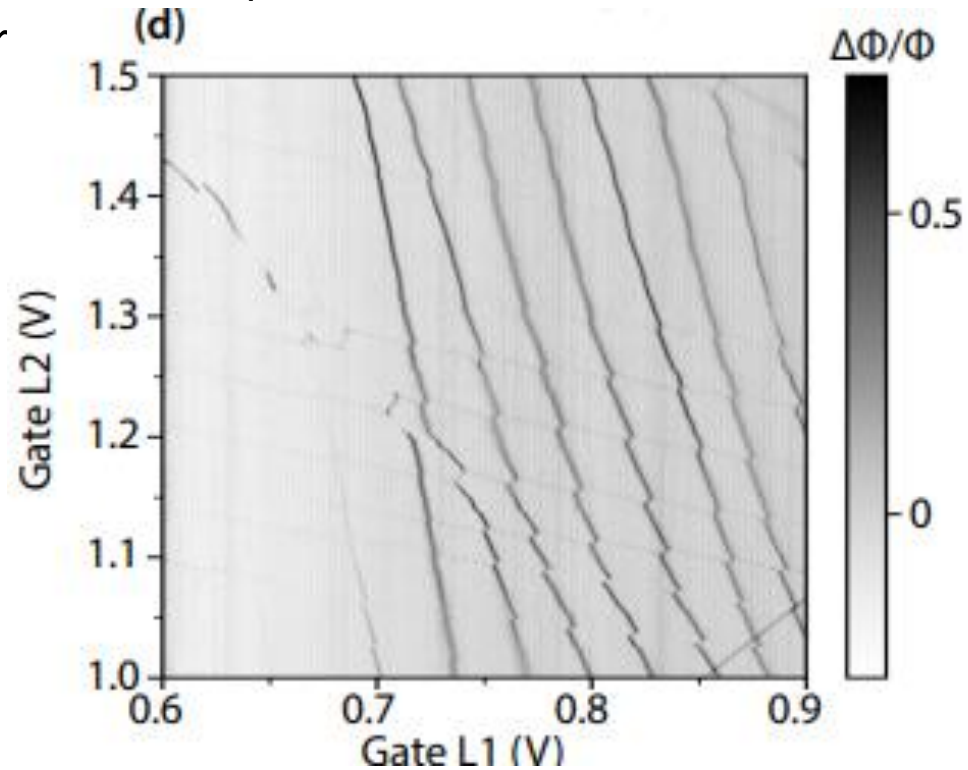
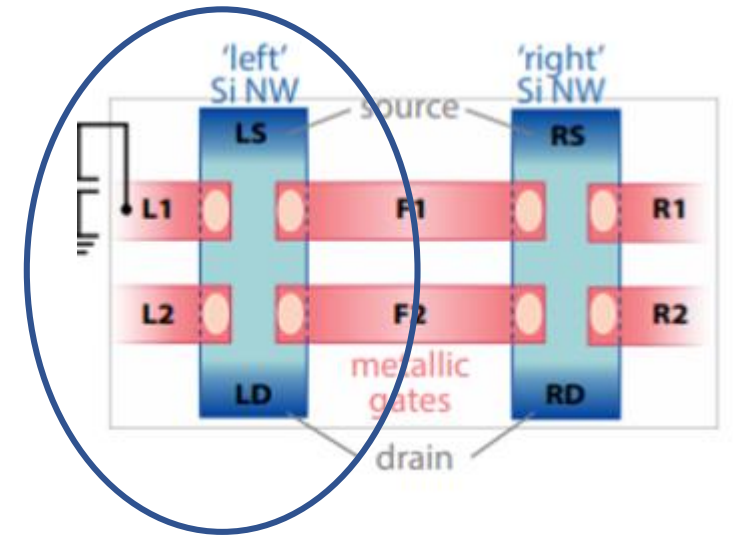
Device design

- 2 parallel nanowires
- 4 independent traditional gates
- 2 floating gates
- Top gate
- Gate reflectometry setup on gate L1



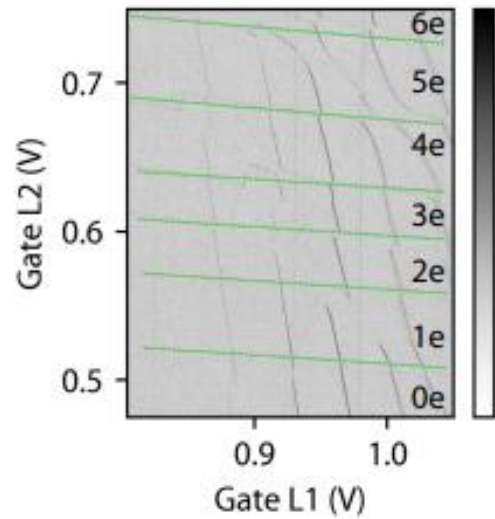
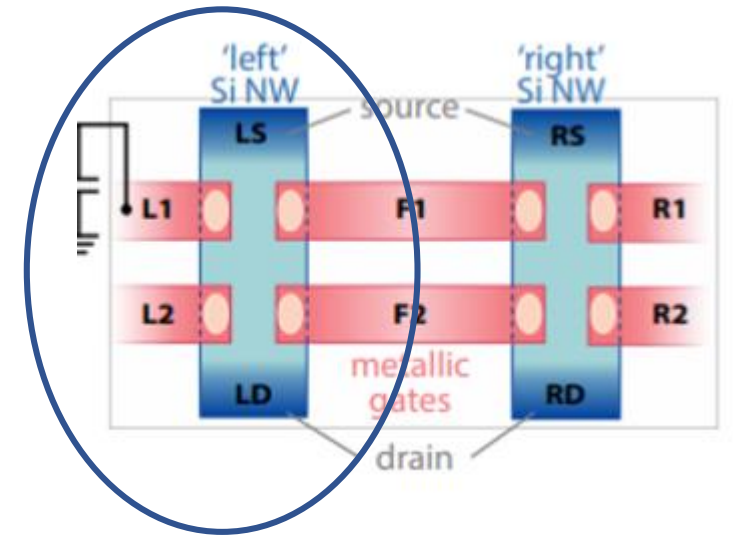
Proof of concept

- Single NW set-up
- DQD like stability diagram
- In transport hard to count occupancy
- Transition up to last electron visible in r

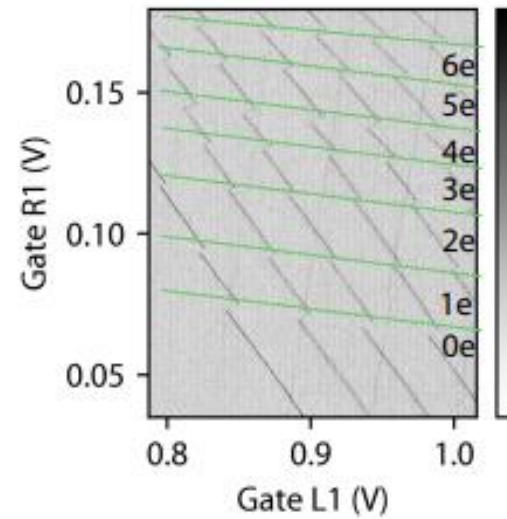


Depleting all dots

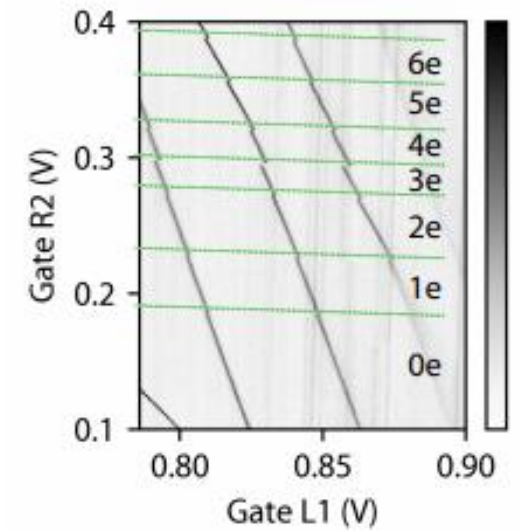
- Single NW setup
- Ion donor visible



D_L2



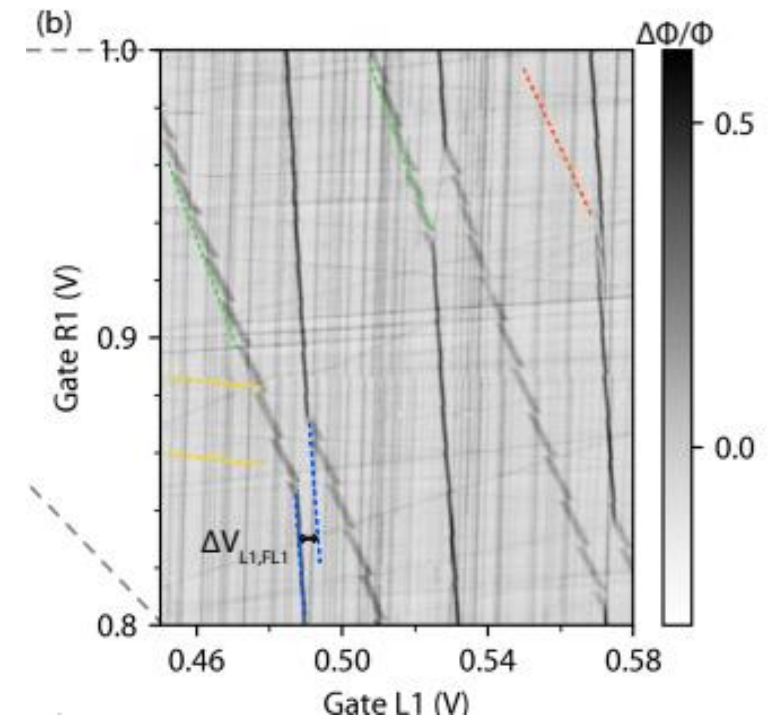
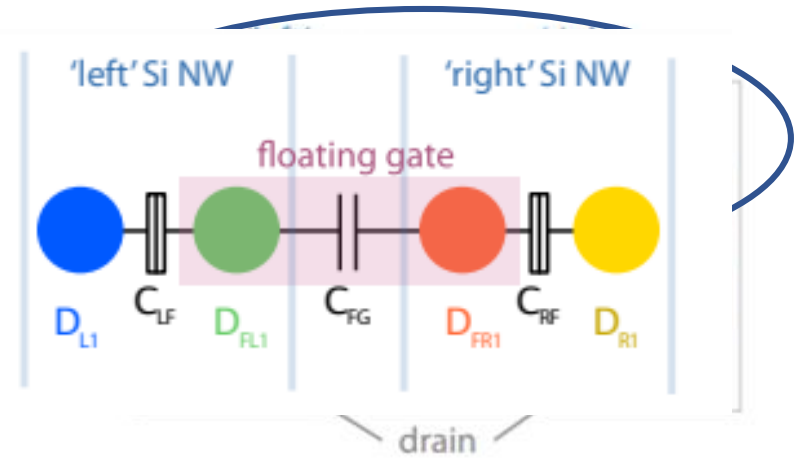
D_R1



D_R2

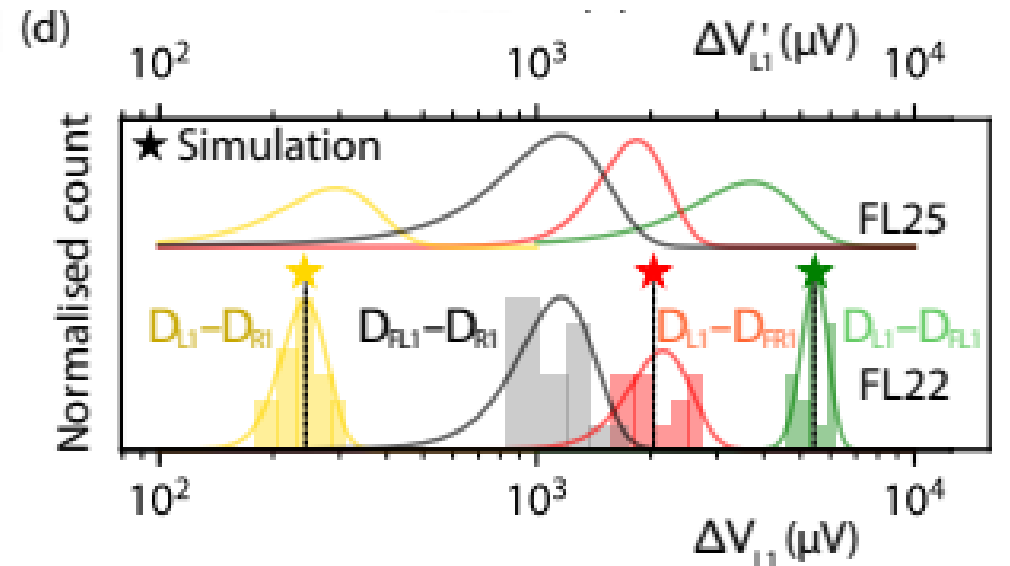
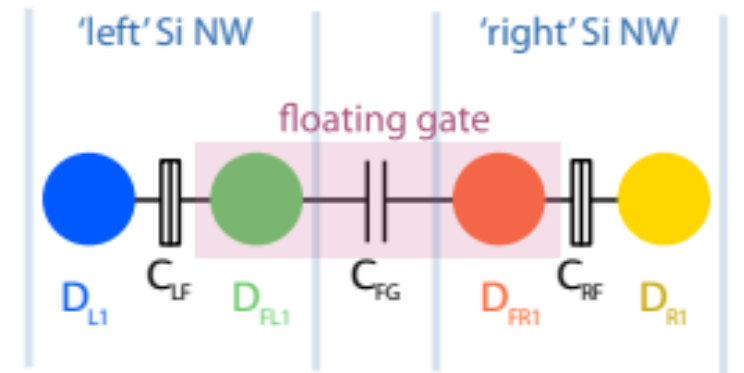
Remote sensing

- Using top gate to assist floating gate
- Sensing dot contains ~ 10 electrons
- Gate capacitances and magnitude of capacitive shift used to identify dots



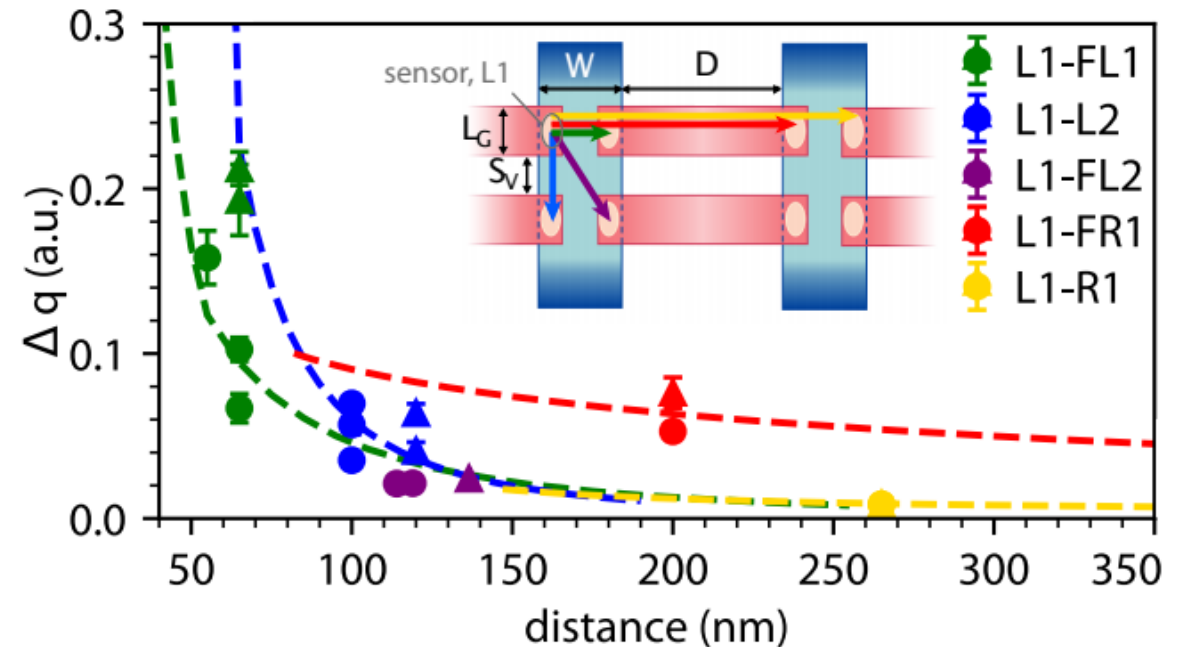
Remote sensing

- Quantified magnitude of RF shift
- Two tested devices show good agreement
- Simulated results align with data



Capacitive coupling

- Define $\Delta q = \Delta V_{(L1,i)} / V_{C_{l1}}$
- For same nanowire rapid drop with separation
- Other nanowire second order effects -> slower decay



Outlook

- Apply this technique to achieve spin read-out
- Ability to couple qubits over longer distances
- More extensive networks of QDs/qubits