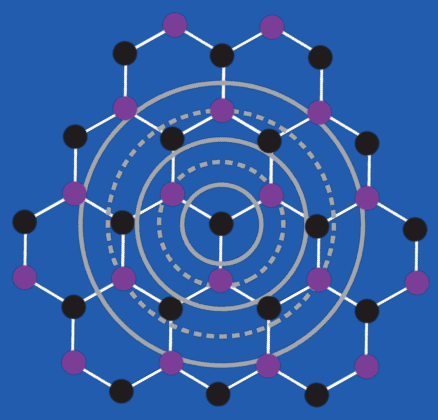
ETH zürich

Quantum Center
General Meeting 2024

QUANTUM CENTER

Electron-Phonon Coupling in Bilayer Graphene Quantum Dots



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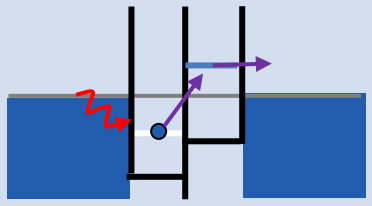
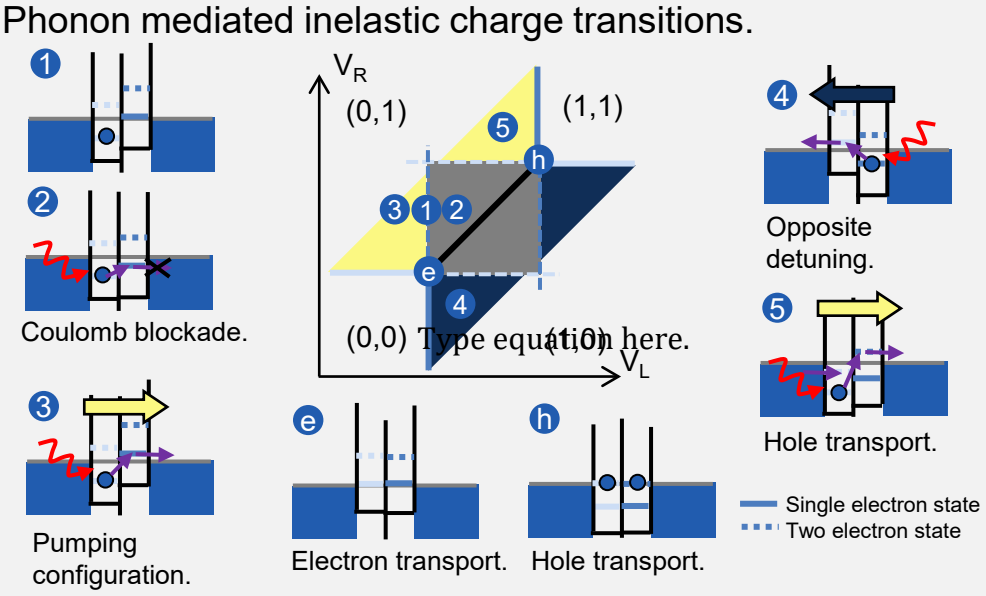
Phonon as Source of Relaxation and Decoherence

- Phonons limit qubit relaxation and coherence times [1]
- 2D, high energy phonons in graphene

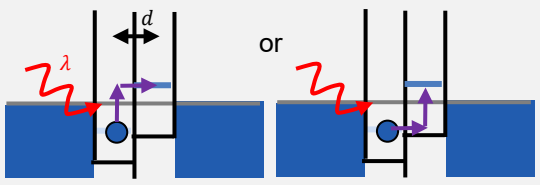


1 Phonon Interaction with QD

Phonon mediated inelastic charge transitions.



Interference effect.



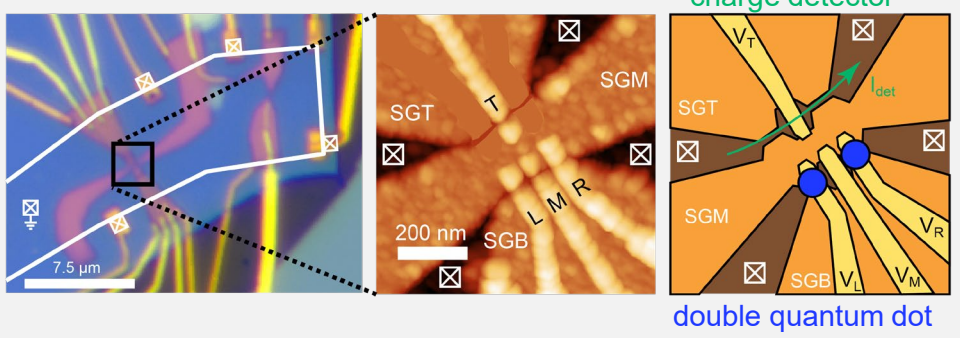
Oscillation between metastable state and ground state.

$$\left(n+\frac{1}{2}\right)=\frac{d}{\lambda}$$

[1]

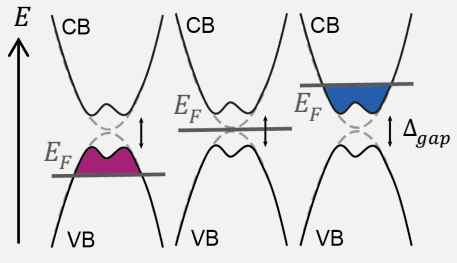
2 DQD in Graphene

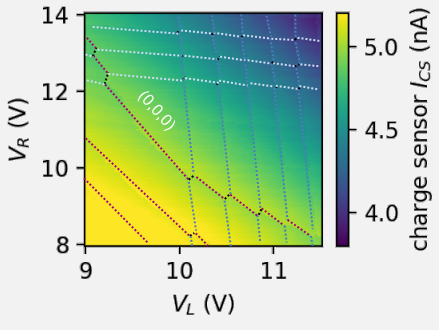
The device. [2]



Electron-hole symmetry in BLG.

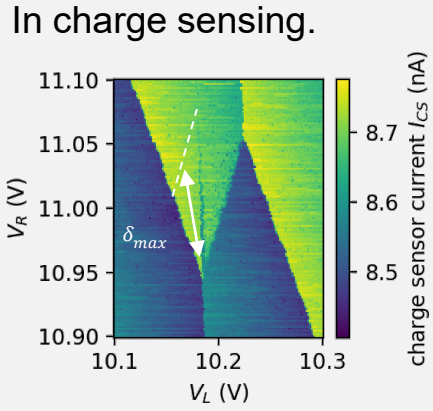
[3] p-type neutral n-type



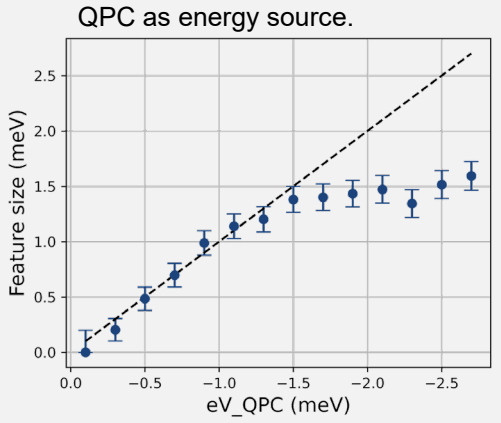


3 First Measurements of the Pumping Effect

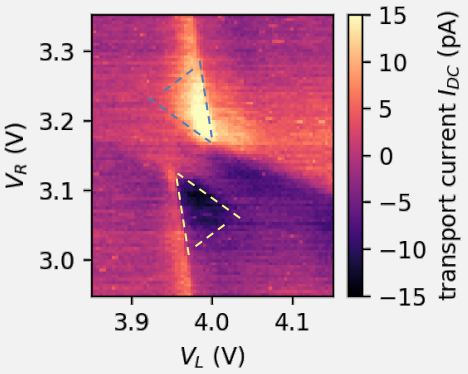
In charge sensing.



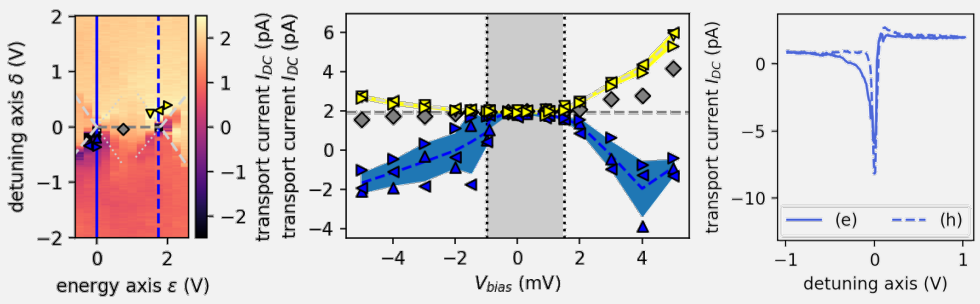
QPC as energy source.



In transport.



- Enhanced current in transport
- Current direction only depends on DQD detuning
- Current strength scales linear with QPC bias after low power onset
- Asymmetric driving

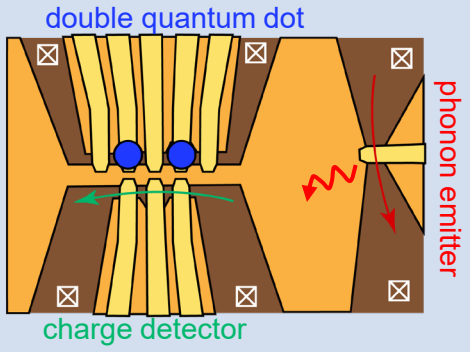


Conclusion and Outlook

QPC acts as energy source that drives inelastic transition. However, multiple mechanism can cause that: Coulomb back action, plasmons, photons.

Future design should incorporate:

- Separate circuits
- Reduction of capacitive coupling (Coulomb back action)
- Tuneable distance between double dot



References

1. Granger et al., Quantum Interference and phonon-mediated back-action in lateral quantum-dot circuits, nat. phys. (2012)
2. Adam et al., …., in preparation
3. Tong, Spin and valleys in coupled bilayer graphene quantum dots, phd thesis, ETH publications

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