Coherent Manipulation of Coupled Electron Spins in Semiconductor Quantum Dots

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M. D. Lukin,[1] C. M. Marcus,[1] M. P. Hanson,[3] A. C. Gossard[3]
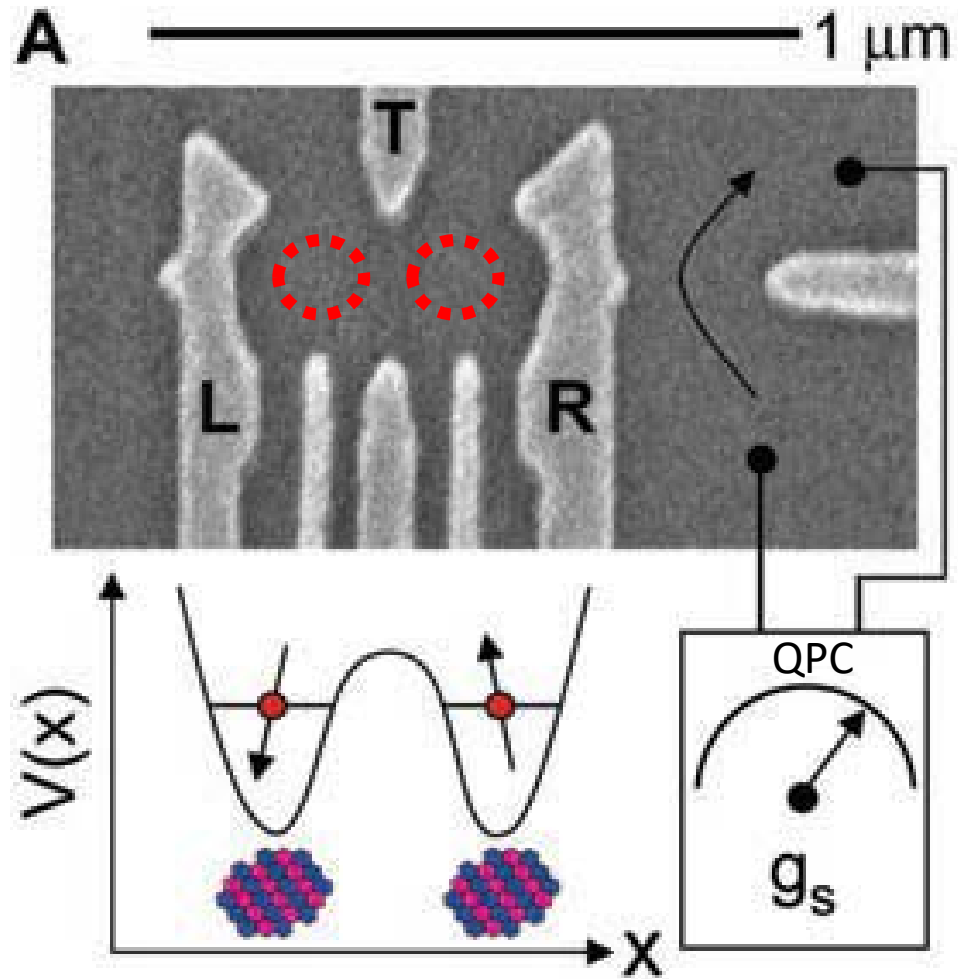
Pierre Chevalier Kwon
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Motivation

- quantum computation
- good qubit: high T1, T2, …
- qubit with 2 QDs

Outline

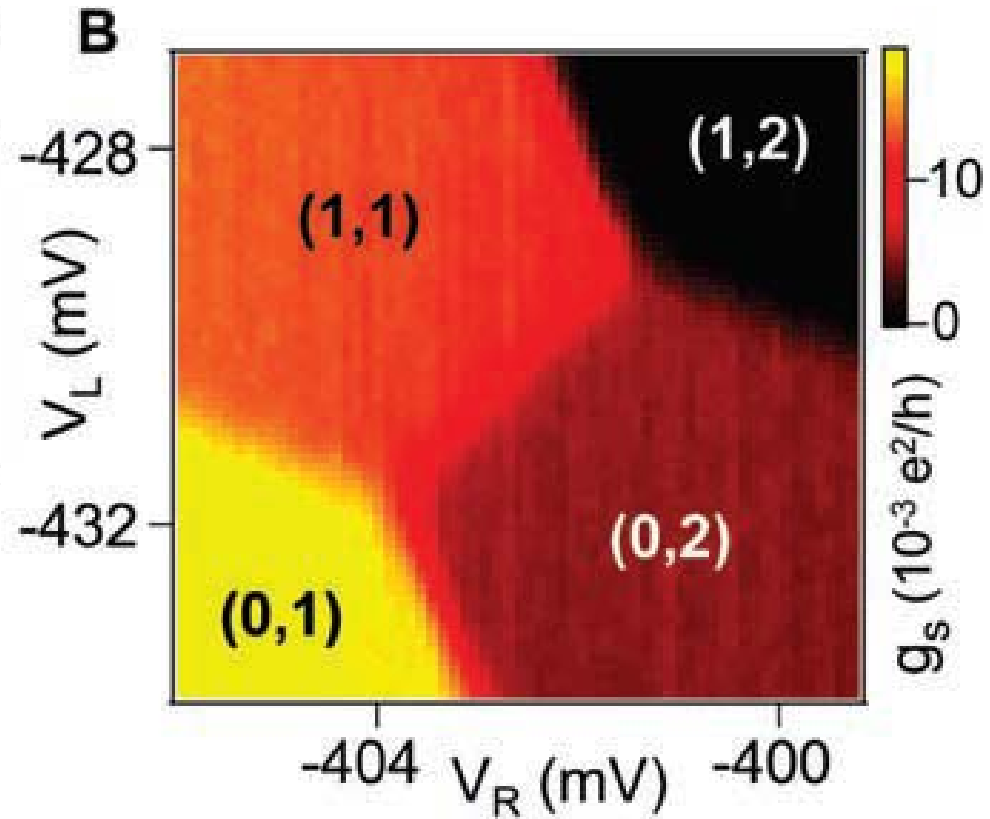- Coherently manipulated a 2 level system made with 2 QDs
- T2* ~ 10 ns
- SWAP time down to ~ 350 ps
- T2 > 1,2 µs

Device architecture

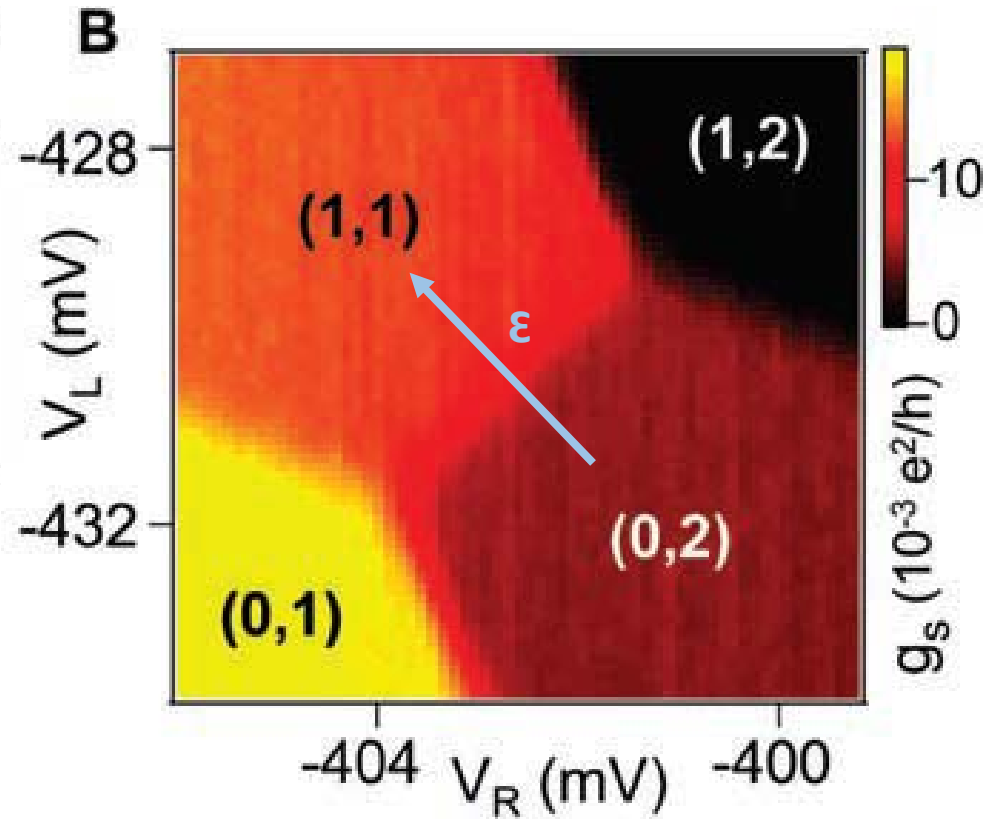- GaAs/AlGaAs heterostructure
- 2 quantum dots (using a 2DEG)
- QPC charge sensor
- Te = 135 mK
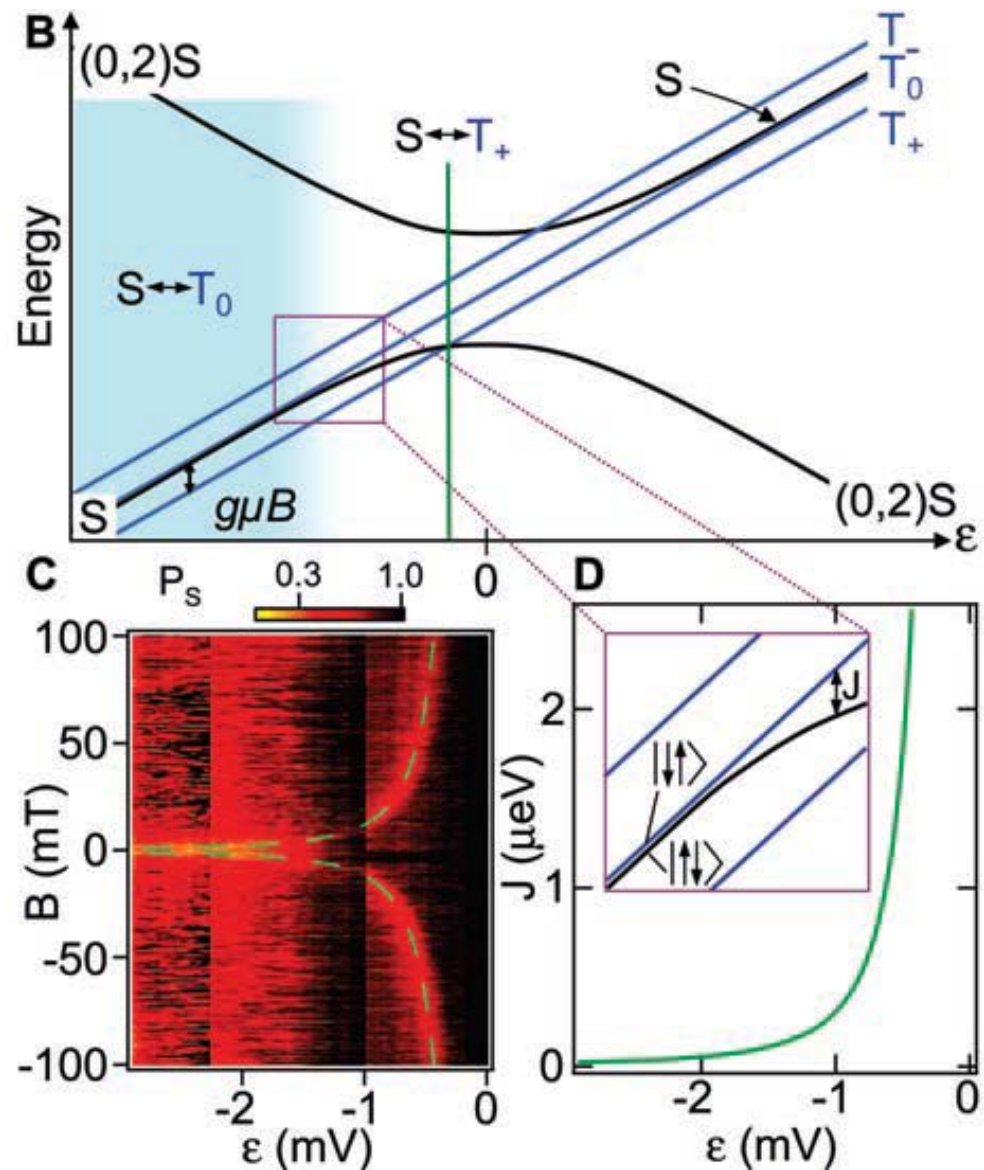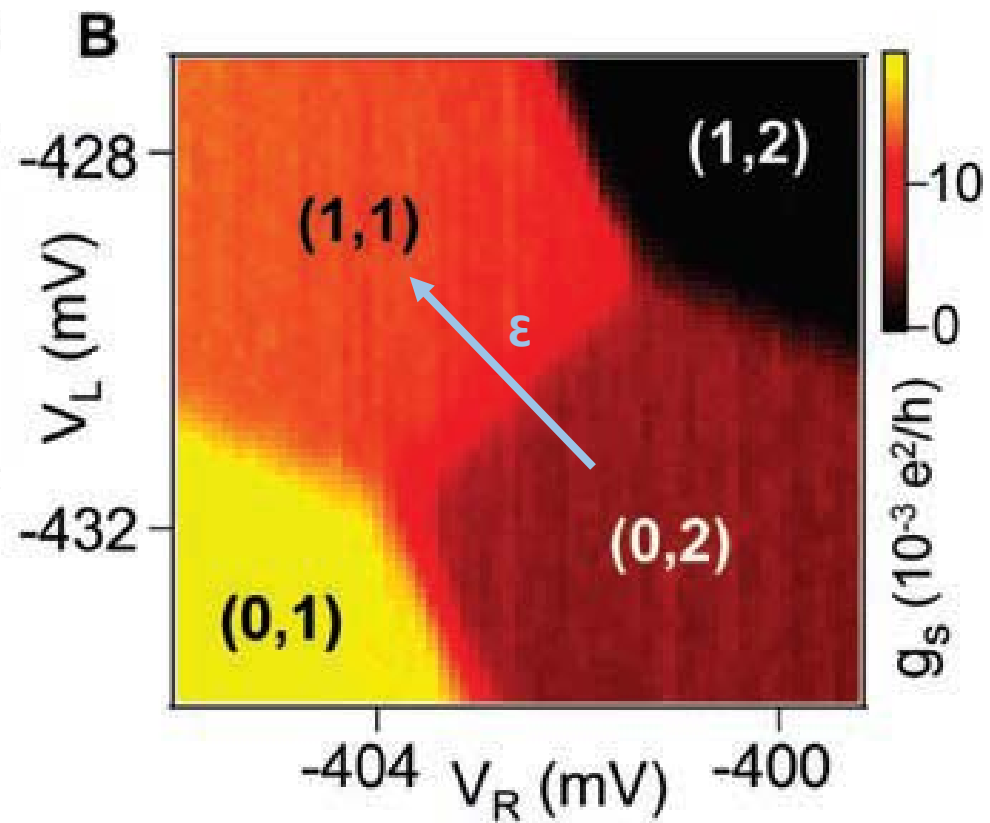- B || z

Double-dot charge stability diagram

- Conductance of QPC $f(V_L, V_R)$ give the charge stability diagram
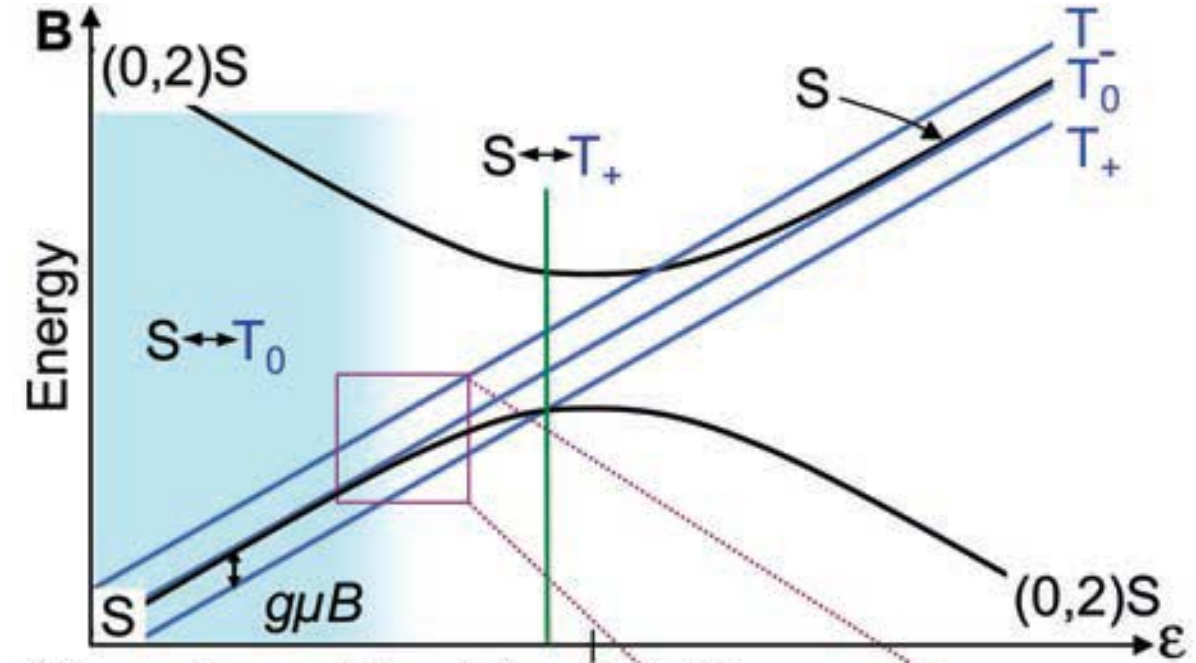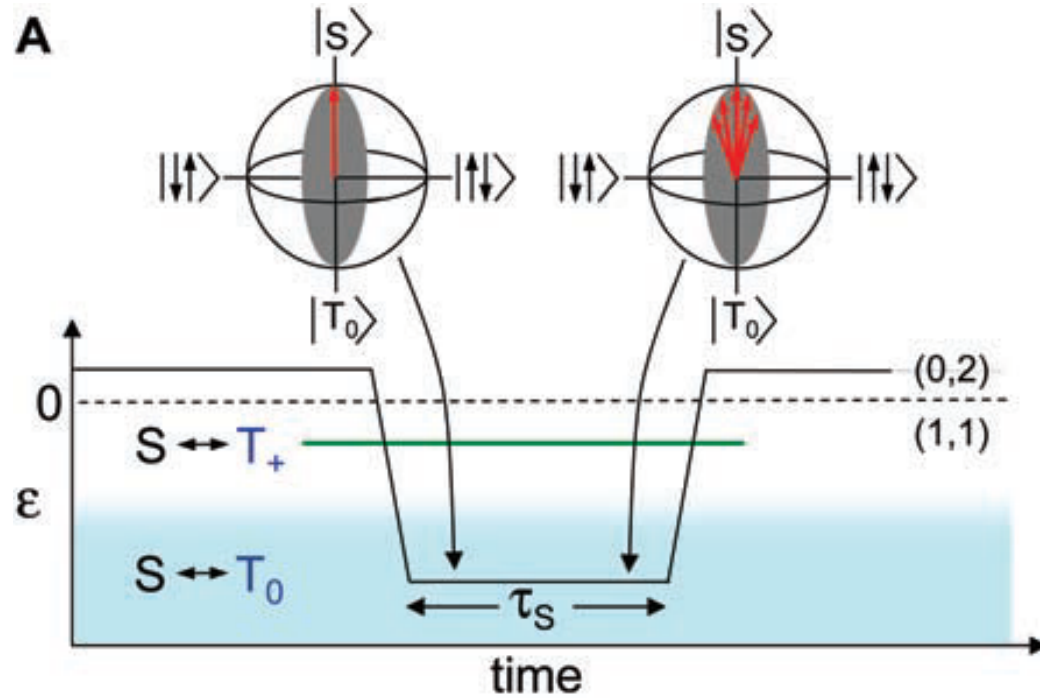
Double-dot charge stability diagram

- Conductance of QPC $f(V_L, V_R)$ give the charge stability diagram
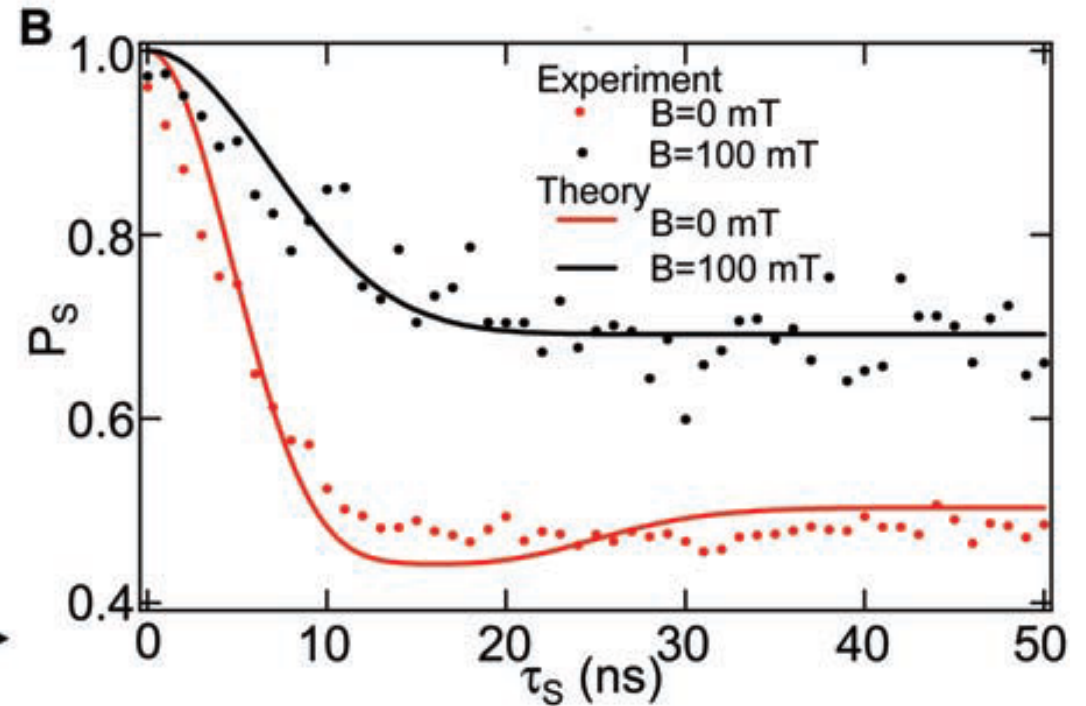
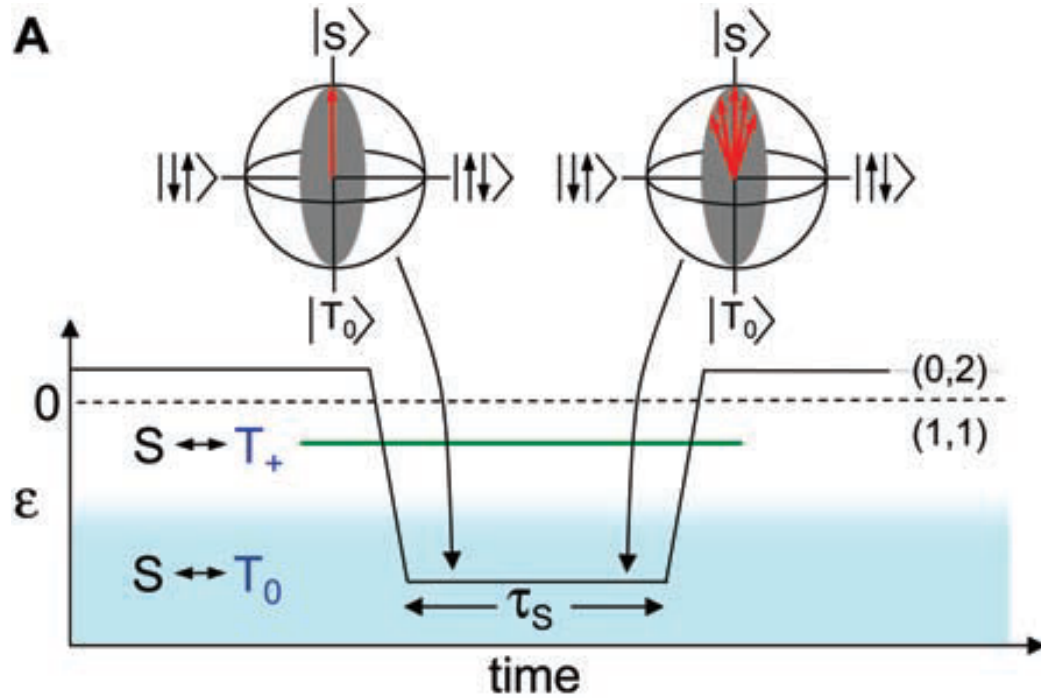- We can define the detuning ε

Double-dot charge stability diagram

How long the electrons can be spatially separated before losing phase coherence? i.e. T2*= ?

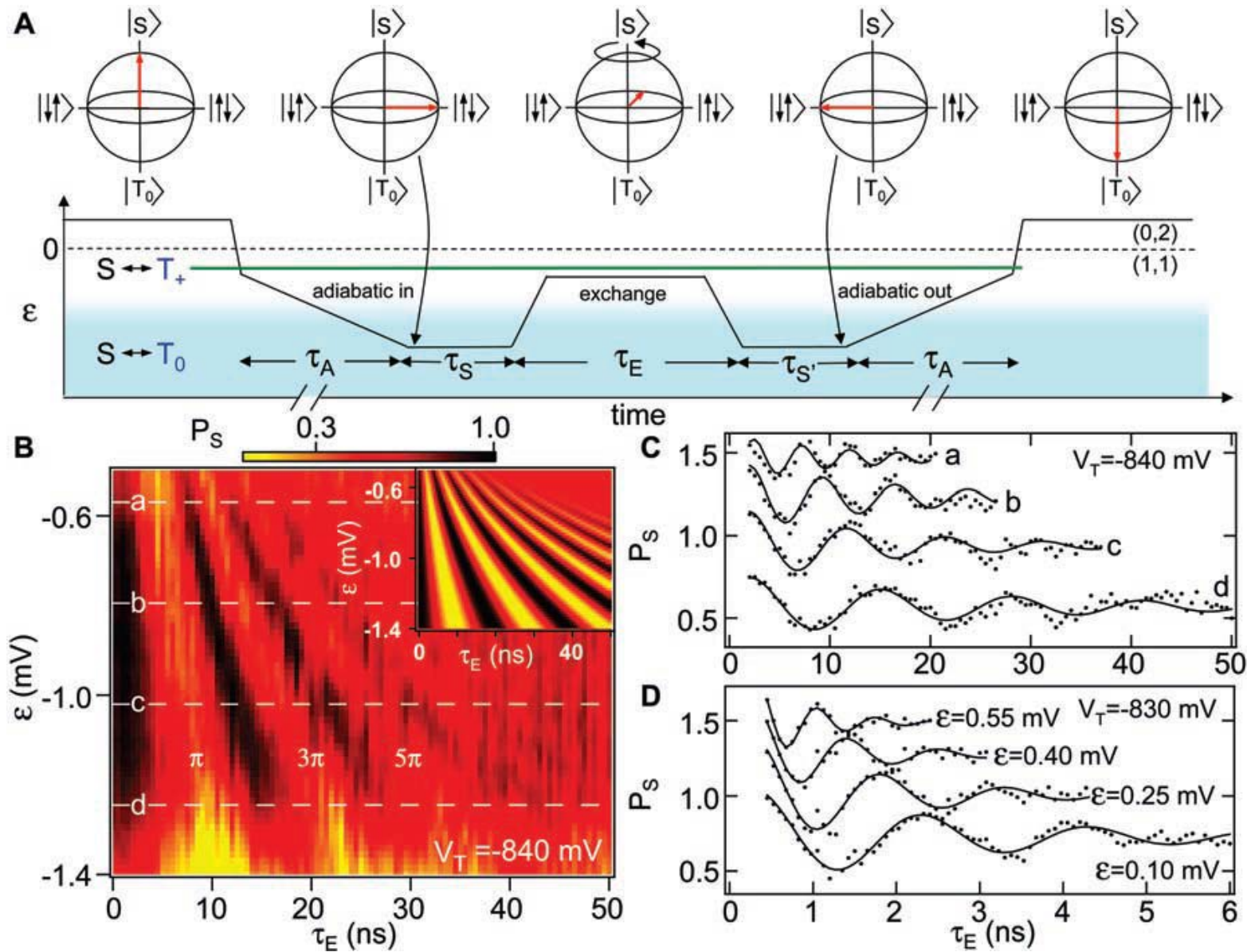## How long the electrons can be spatially separated before losing phase coherence? i.e. T2*= ?

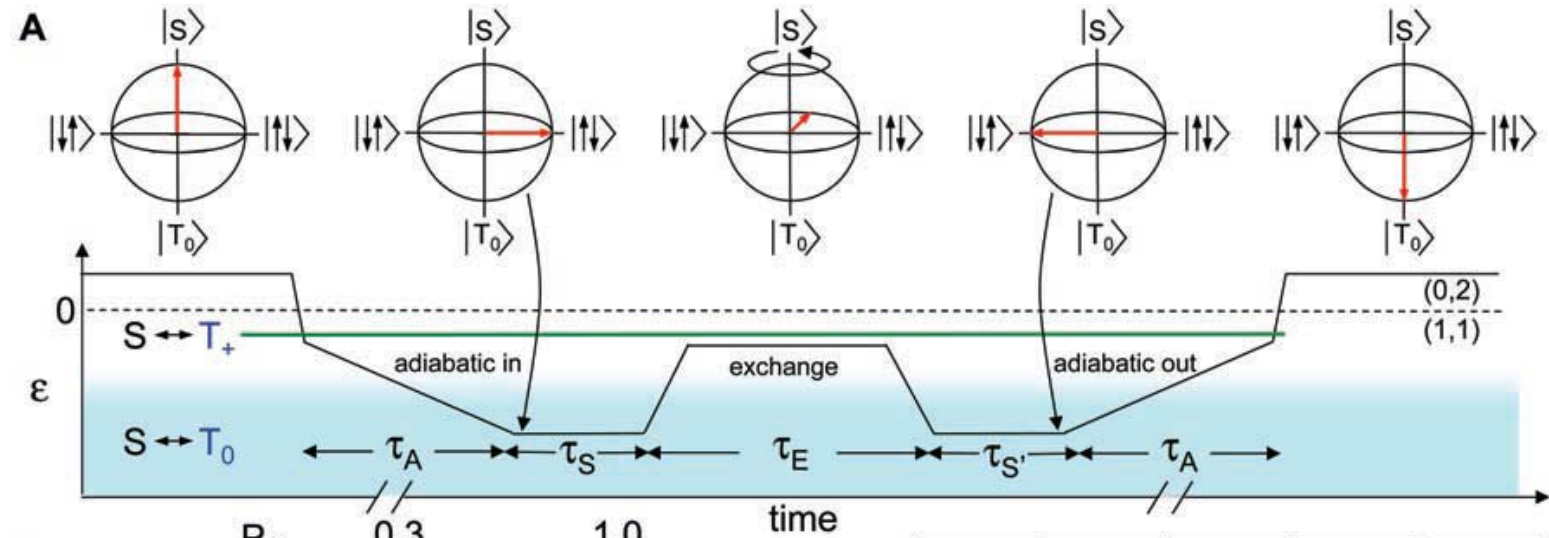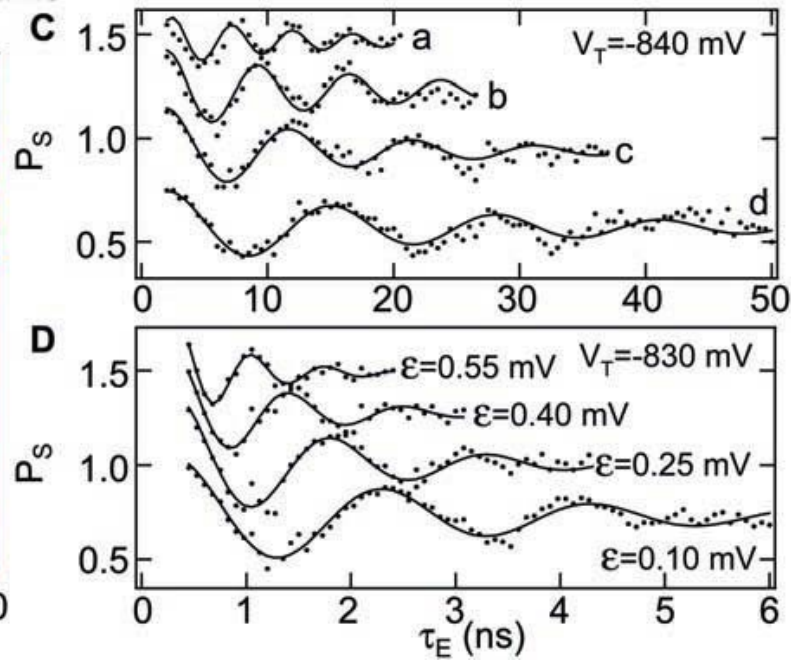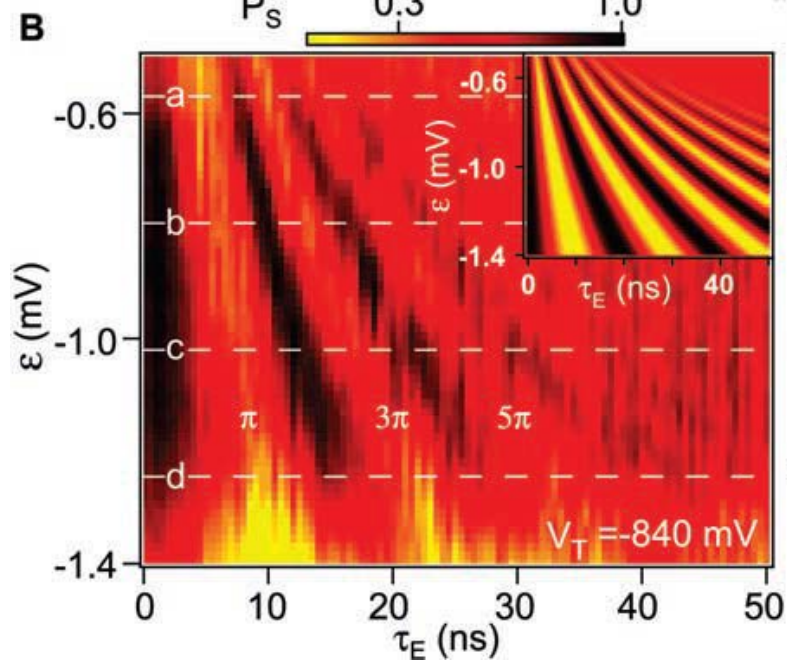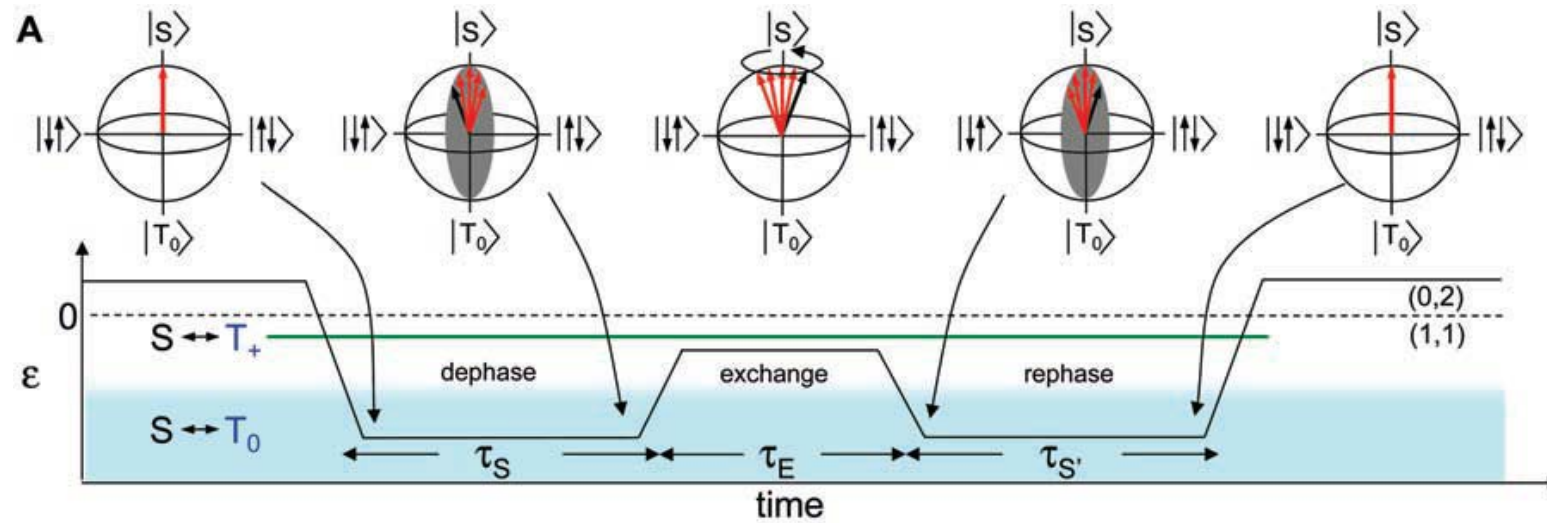T2* ~ 10 ns
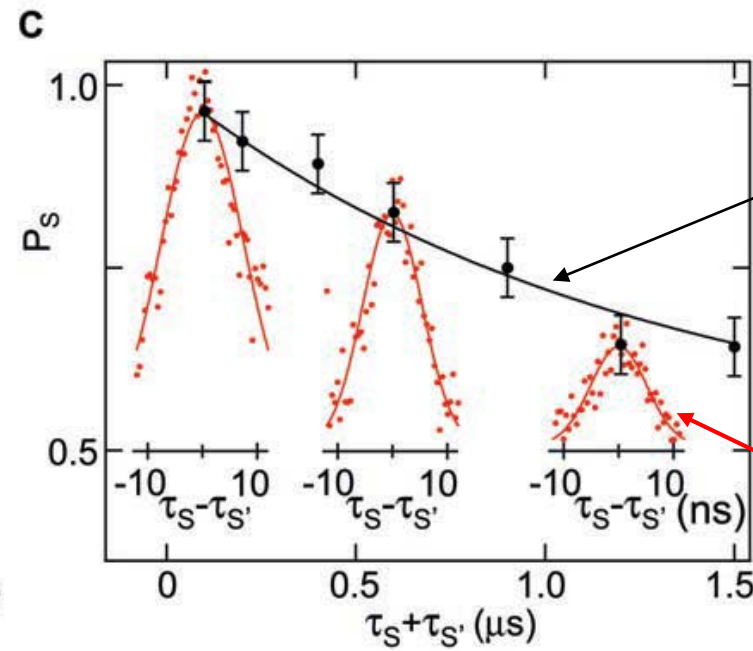
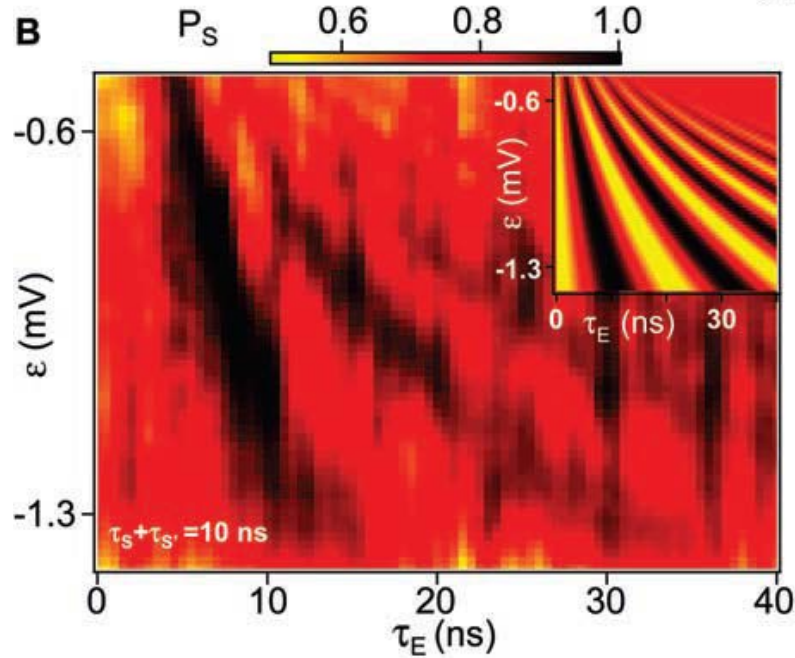# Spin SWAP and Rabi oscillations

Spin SWAP and Rabi oscillations

- Spin SWAP down to ~350 ps

Singlet-triplet spin-echo

- T2 > 1,2 µs

Shape related to T2 (black curve)

Shape related to T2*(red curve)