Conditional Dynamics of Interacting Quantum Dots

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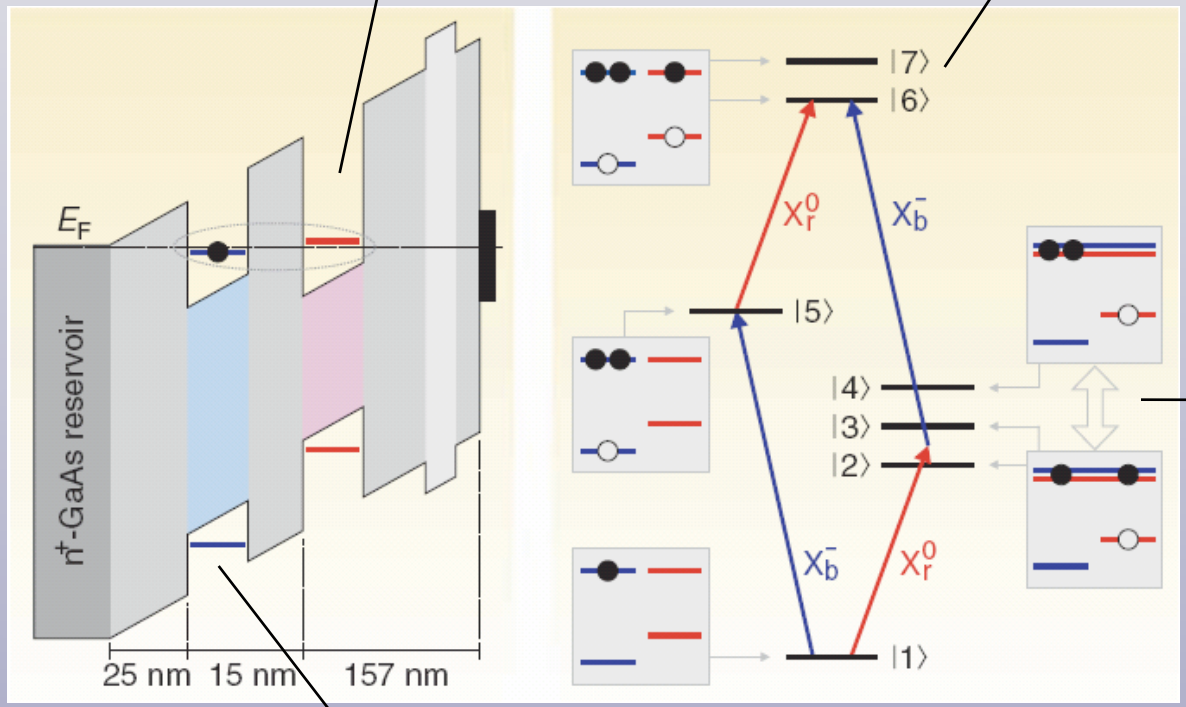
Abstract

- Two vertically coupled Quantum Dots (1 single-charged, 1 neutral)
- Transition probability controlled by excitation in neighboring QD
- Interaction mediated by tunnel coupling
- Gated by laser field

Motivation -> realization of optical controlled phase gate between two solid state qubits

Theory

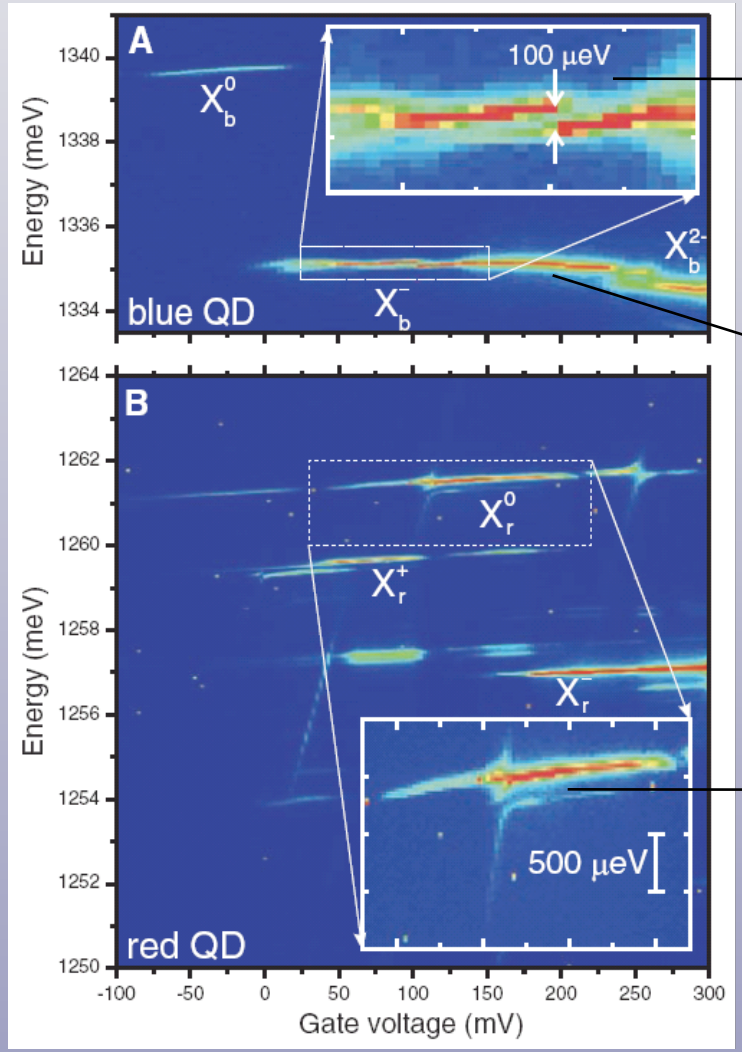


Exciton $X^{\text{n charge carriers}}_{\text{QD}}$

-> shift in reds excitation energy -> conditional

Experimental implementation

Photoluminescence (PL) measurement



charge change in red QD

linear stark shift

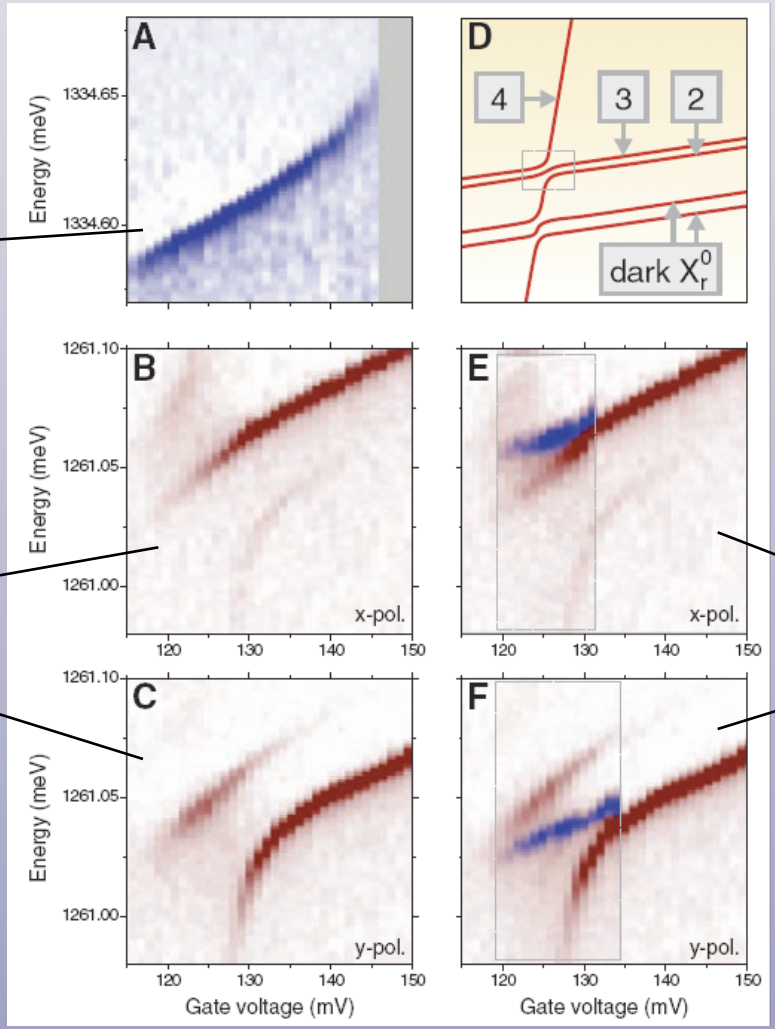
anticrossing with interdot and intradot

-> tunnel coupling

Differnetial transmission

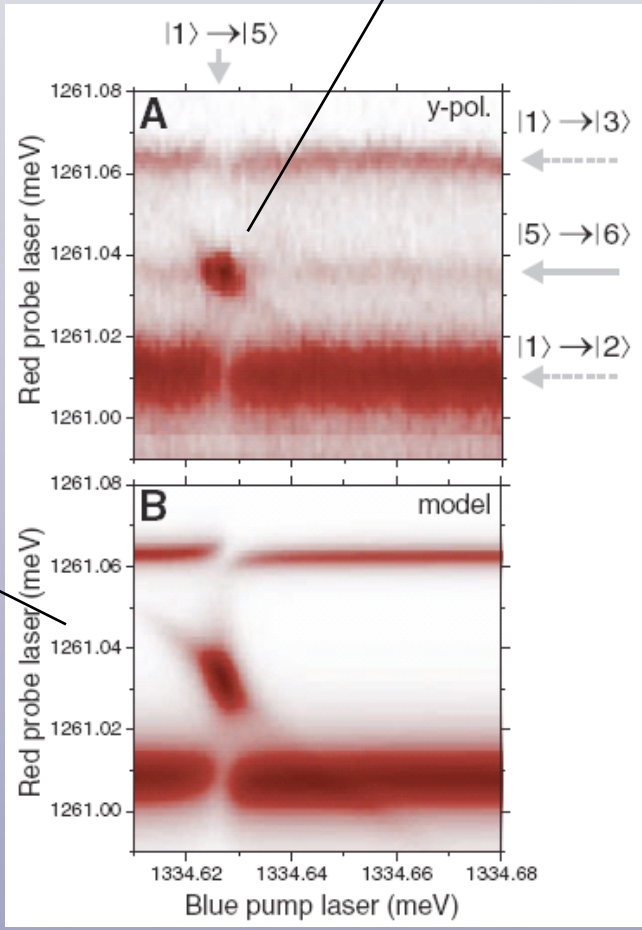
linear
-> no tunnel
coupling in X_b^-

absorption
of X_r^0
polarized
lasers



B and C
with X_b^-
laser present

conditional shift in red
if blue laser in resonance



density matrix
approach

gate voltage at 130 mV

Advantages

- Large shift in energy
- Tuning through gate voltage
- Gating in sub-picosecond timescales