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

hole exchange splitting into $X_{r,y}^0$ and $X_{r,x}^0$

mixing of resonant States -> shift

smaller, ‘blue‘ QD

Exciton $X_{QD}^n$ charge carriers

-> 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
Differential transmission

linear
-> no tunnel coupling in $X_b$

absorption of $X_r^0$

polarized lasers

B and C with $X_b$ laser present
density matrix approach

conditional shift in red if blue laser in resonance

gate voltage at 130 mV
Advantages

• Large shift in energy

• Tuning through gate voltage

• Gating in sub-picosecond timescales