Spintronics/Electronics in Quantum Dots

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1. Motivation

Realistic simulation of exchange

- interaction in coupled QD devices
- Interplay between device parameters
- and many-body physics in coupled QD
- Computational support for

4. Coupled Lateral QDs

Layout & Stability Diagram (Kouwenhoven, Marcus)





5. Triple LCVQDs

Split Gate Structure (Austing)



interpretation of experimental data

2. Model

High resolution grid **•** Full 3D multiscale simulation with local spin density approximation (LSDA) of the (500,000-700,000 density-functional theory (DFT) for dot(s) region and semiclassical description of charge in Cylindrical grid the outside regions



mesh pts)

Self-consistent solution of Kohn-Sham and Poisson equations on parallel platform € 0.3-

-1.8 -1.6 -1.4 -1.2 V (V)

• Finite element method (FEM) Rectangular grid with trilinear polynomials

> Exact diagonalization of the many-particle Schrodinger equation with realistic 3D confinement potentials

3. Flowchart

Kohn-Sham Equation







*****T^T-T^S *****Δ_{SAS}, 2D ED

⊖∆_{SAS}, 3D DF1

∗v^s-v[⊤]



Potential Profile: Simulation







Singlet – Triplet Energy Separation as a Function of Magnetic Field

-1.4 -1.2 V (V)

-1.6



Electron Charging Diagram (Upper/Bottom Gates)

Electron Charging Diagram (Side Gates)

