# Spintronics/Electronics in Quantum Dots 

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## 1. Motivation

mealistic simulation of exchange interaction in coupled QD devices - Interplay between device parameters and many-body physics in coupled QD

- Computational support for
interpretation of experimental data


## 2. Model

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


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

Rectangular grid

- Finite element method (FEM) with trilinear polynomials
- Exact diagonalization of the many-particle Schrodinger equation with realistic 3D confinement potentials

3. Flowchart

4. Goupled Lateral Q.Ds

Layout \& Stability Diagram
(Kouwenhoven, Marcus)


5. Triple LCVQDs

Split Gate Structure (Austing)


Singlet - Triplet Energy Separation
as a Function of Lefi/Right Gate Bias

$\frac{\text { Experimental }}{\text { Structure }}$


Singlet - Triplet Energy


Separation as a Function of Magnetic Field


Expansion of the two-particle wave-function into the product of the SP states

> Electron Dendate Elities


> Behavior of Jin B-field is determined by: Mixing of SP states with different angular momenta

> OR/AND
> - Decrease in the overlap between left and
> right dot wave-functions (HL).

Electron Charging Diagram
(Upper/Bottom Gates)

## Electron Charging

 Diagram (Side Gates)

Ground-State Electron Densities

