Quantum Many-Body Simulations of Double Dot System

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Introduction

Quantum-Dot

- Small semiconductor nanostructures
- 2-10 nanometers with $10-50$ particles

Quantum-Dot Model

- Schrödinger equation
  - $\mathscr{H}\left|\psi\right\rangle = E\left|\psi\right\rangle$

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- Born-Oppenheimer Approximation
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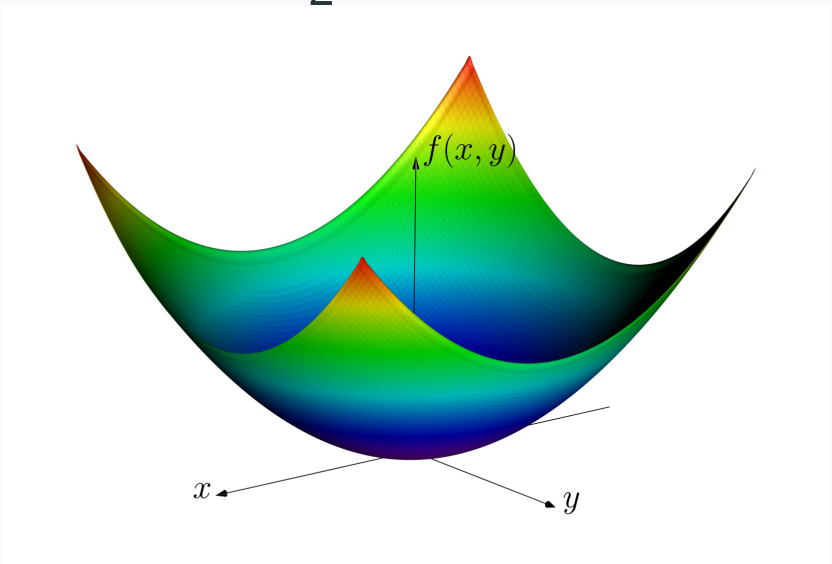
Quantum-Dot Model

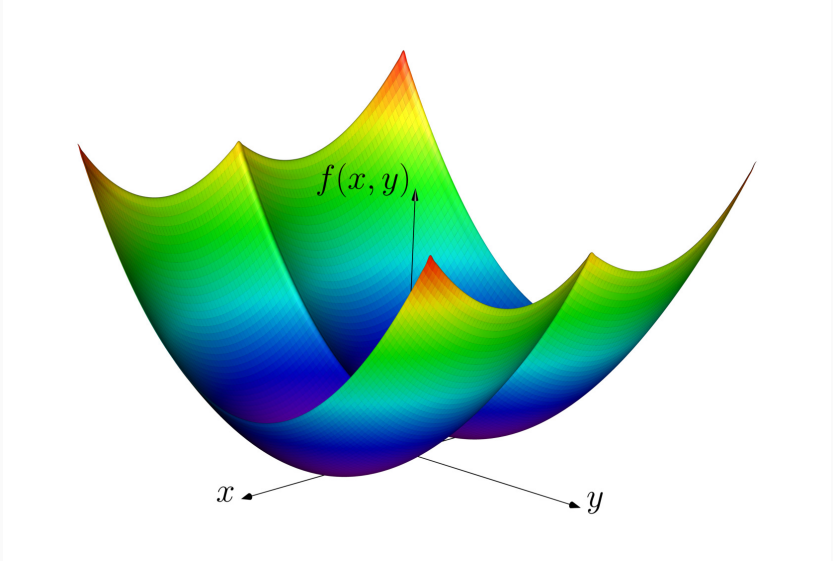
- Interaction
  - $f\left(r_i, r_j\right) = \frac{1}{|r_i - r_j|}$

Quantum-Dot Model

- Interaction: Coulomb repulsion
  - $f(r_i, r_j) = \frac{1}{|r_i - r_j|}$
- Confinement: Harmonic Oscillator[1], Double-Well[2]

$$V(r) = \frac{1}{2}\omega m r^2 \qquad V(R, r) = \frac{1}{2} m\omega^2 \left(r^2 - \delta R|x| + R^2\right)$$





[1] S. Kvaal. "Harmonic Oscillator Eigenfunction Expansions, Quantum dots, and Effective Interactions". In: *Phys. Rev. B* 80 (4 2009), p. 045321.

[2] M. J. A. Schuetz et al. "Nuclear Spin Dynamics in Double Quantum Dots: Multistability, Dynamical Polarization, Criticality, and Entanglement". In: *Phys. Rev. B* 89 (19 2014), p. 195310.

Quantum-Dot Model

#NucleiHaveFeelingsTo

Methods

Methods

- Hartree-Fock(HF)
- Variational Monte-Carlo(VMC)

Implementation

Summary and Conclusion

Questions?

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