1. : A B A

single-particle electronic

(A)

1 3 A

(k = 0) A

1 6 free-standing fit

A accommo-

date predicts . semiconductor-embedded ,

A / A , 26 .

(A) 7 , (,

) ~10^3 10 ( )

A A

many-body description

( ) (10^3 10)

A 8 ,

( ) 9

multi-band coupling (A),

arbitrary shapes and materials, realistic surface

(multiplet) 10^3 10^5 atoms ( ).

2.

2.1 A: The single-particle problem

1. The shape, size and composition of the dot are accepted as "input",

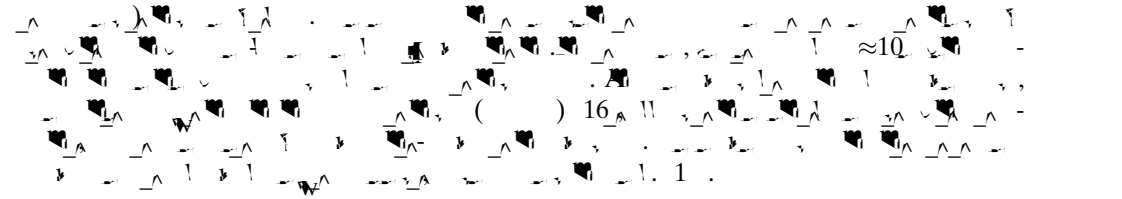
2. Atoms are relaxed to their strain-minimizing positions

3. The single-particle screened pseudopotential is fit to bulk solids:

$$V_{\quad} + V_{\quad} = \sum_{n,\alpha} V_\alpha(r - R_{n,\alpha}) . \qquad (1)$$

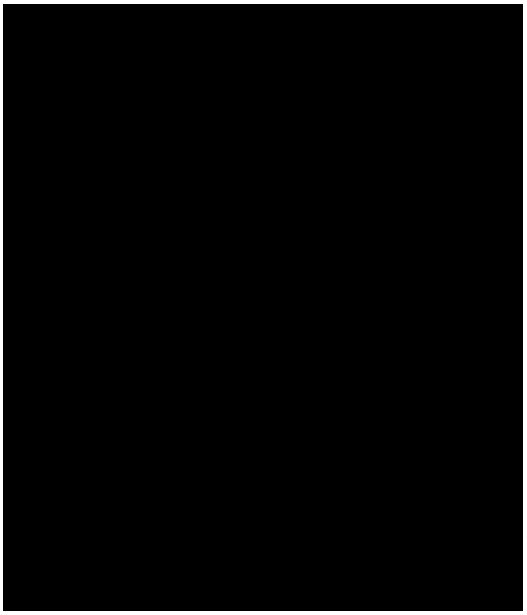
4. The wavefunctions are expanded in plane-waves,

5. The pseudopotential-plane wave Hamiltonian is diagonalized incredibly rapidly



2.2. B: The many-body problem

1. Inter-electronic integrals are computed numerically: ψ_i J_{ij} K_{ij} 9, 17 ,



3. Established an energy-level model for the "semiconductor embedded" self-assembled InAs/GaAs dots [23–29].

3.2 The main accomplishments to-date for the "intermediate-energy problems"

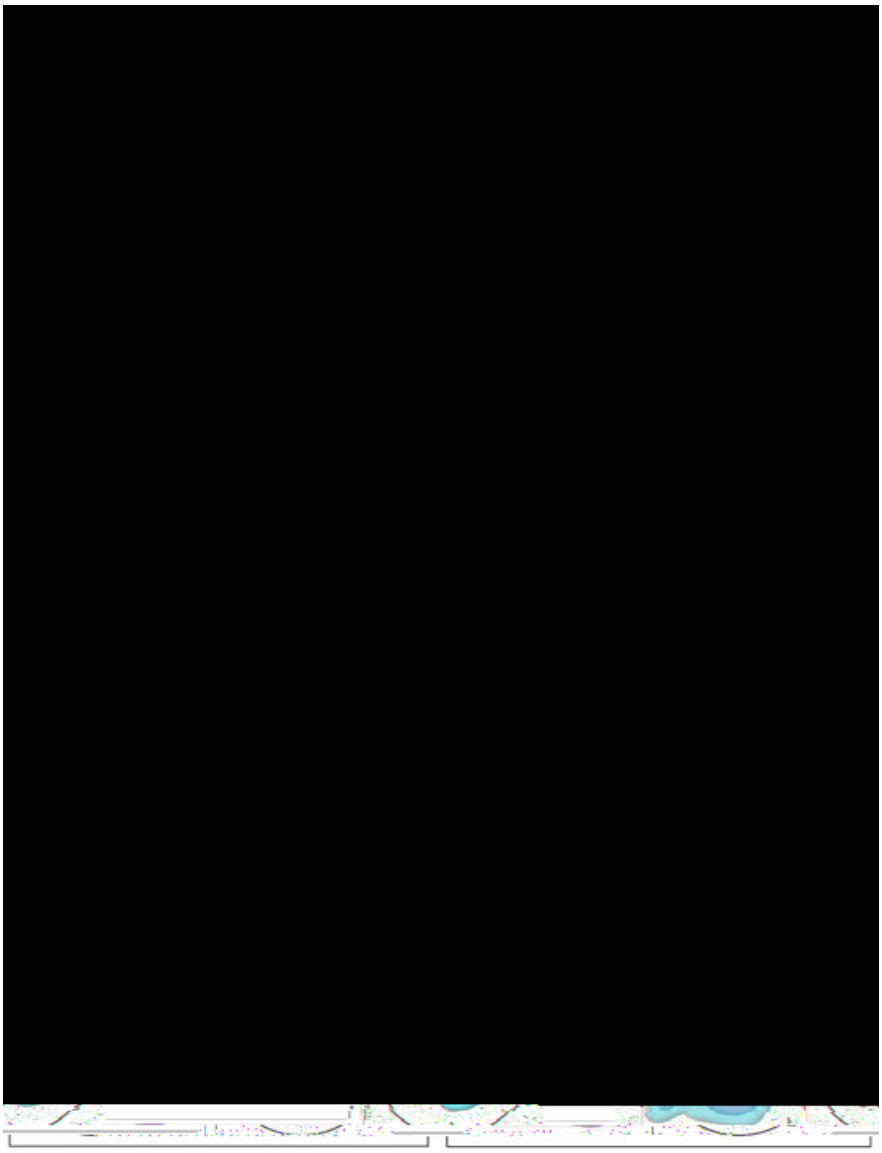
1. Predicted the electron-addition energies in freestanding InAs [30, 31] and CdSe [32] dots,

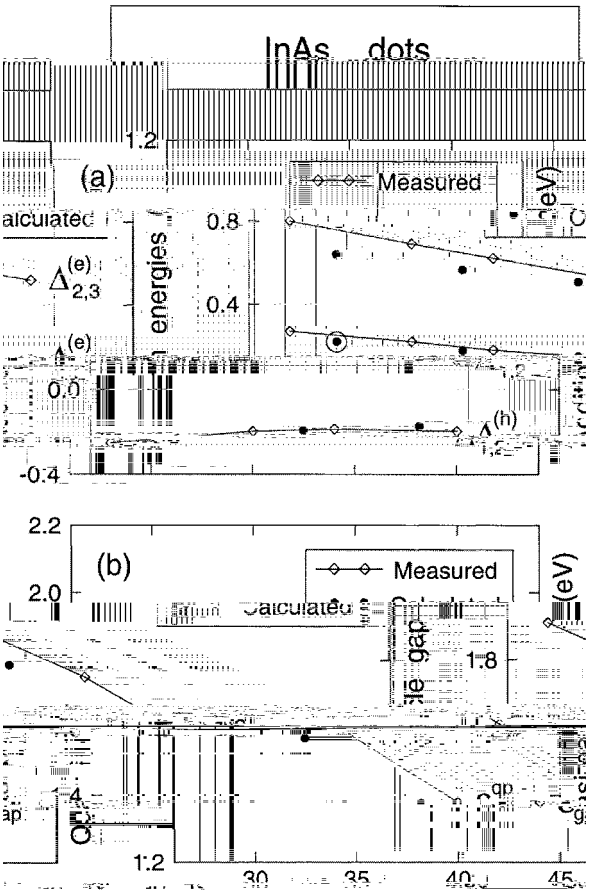
2. Established deviations from Hund's rule as well as "spin-blockade" [32].

3.3 The main accomplishments to-date, for the "low-energy problems"

Established theory of electron–hole exchange in dots [, 9, 17].

$\Delta_x \sim R^{-3}$.





4.

predictive

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