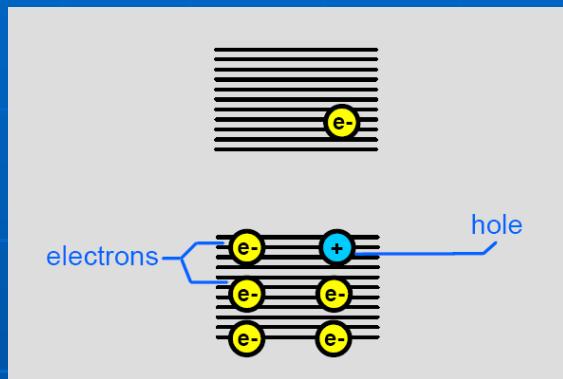


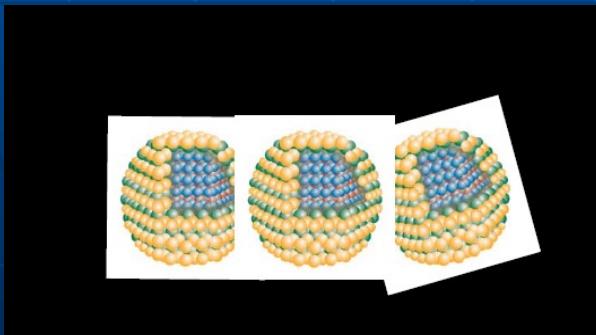
EXCITONS AND EXCITON ASSOCIATED QUASIPARTICLES IN QUANTUM DOT

Que Huong Nguyen

Semiconductors



Quantum Dot



Quantum Confinement in Nanostructures

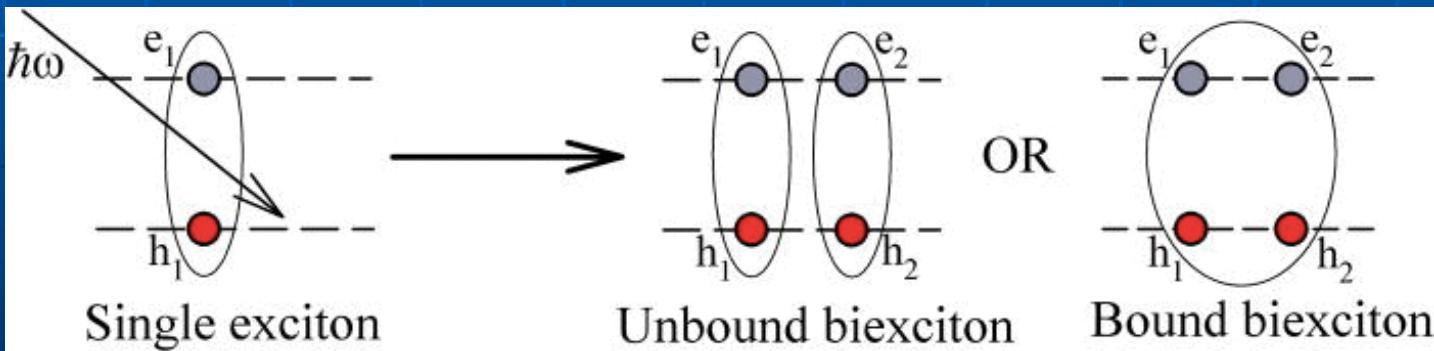
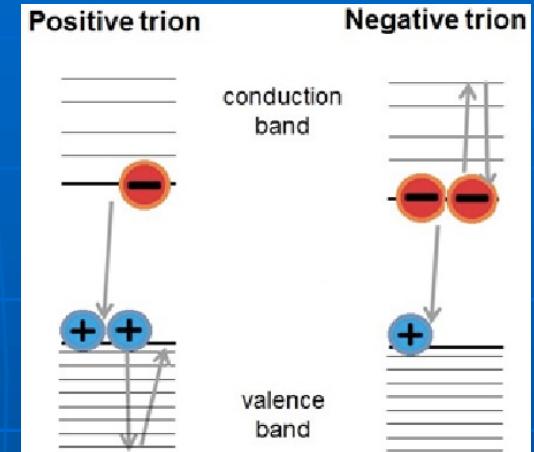
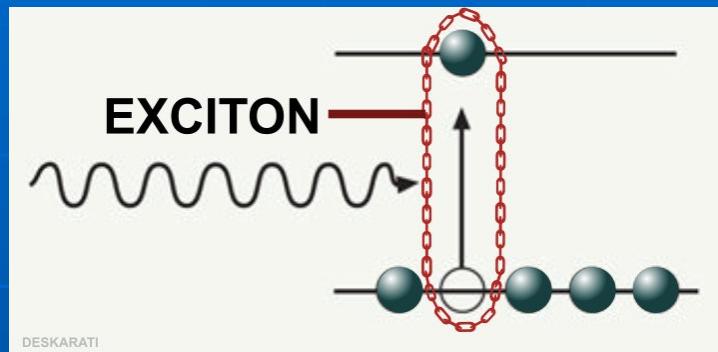
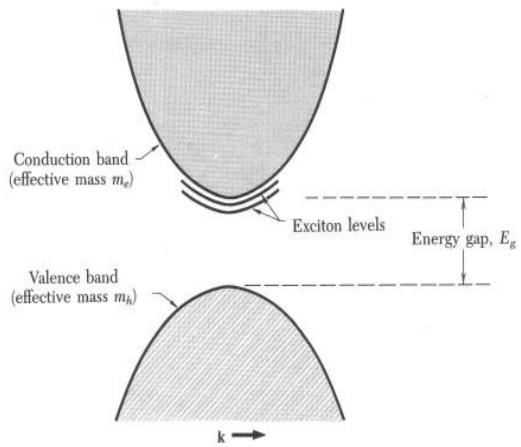
Confined in:

- 1 Direction:** Quantum well (thin film)
Two-dimensional electrons
- 2 Directions:** Quantum wire
One-dimensional electrons
- 3 Directions:** Quantum dot
Zero-dimensional electrons

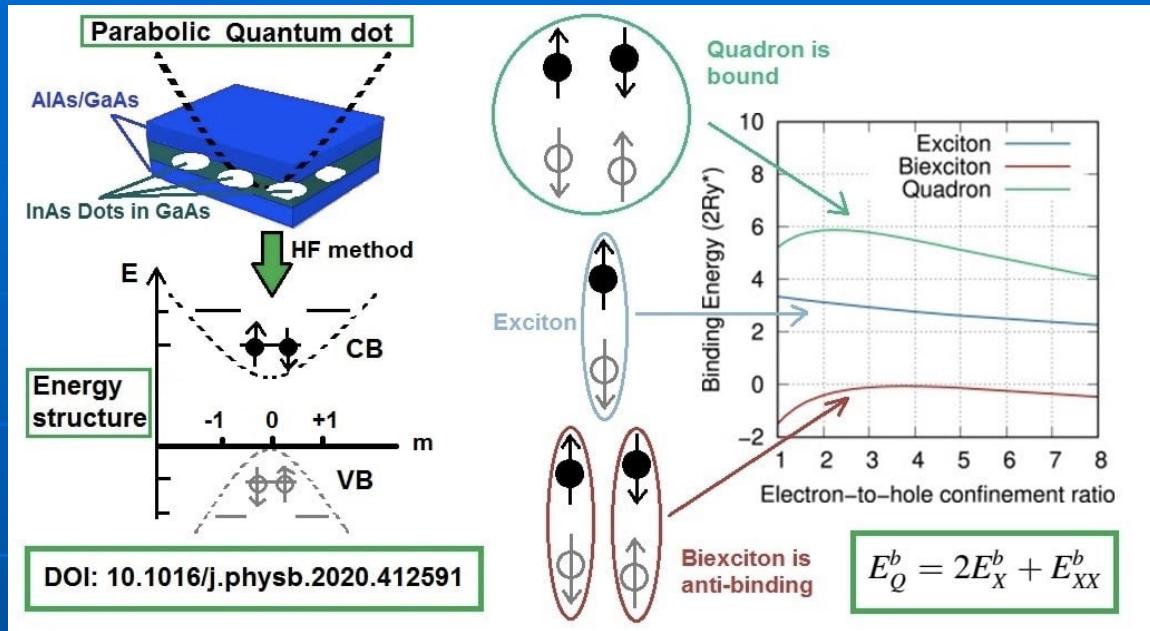
Each confinement direction converts a continuous k in a discrete quantum number n .

The right side of the slide features three diagrams illustrating quantum confinement. The top diagram shows a thick gray slab representing a quantum well, with arrows indicating confinement in the vertical k_y and k_x directions, and a vertical axis labeled n_z . The middle diagram shows a thinner gray slab representing a quantum wire, with arrows indicating confinement in the k_x and k_z directions, and a vertical axis labeled n_y . The bottom diagram shows a very thin gray slab representing a quantum dot, with arrows indicating confinement in all three dimensions k_x , k_y , and k_z , and axes labeled n_x , n_y , and n_z .

Excitons, Biexcitons and Trions



Strongly confined 2D parabolic quantum dot: Biexciton or quadron?



$$\begin{aligned}
 H = & \sum_p \{ \omega^{ex}(p) a_p^+ a_p + \omega^\gamma(p) b_p^+ b_p + \Gamma_p (a_p^+ b_p + b_p^+ a_p) \\
 & + \Omega^c(p) C_p^+ C_p + \sum_q S(p-q) a_p^+ a_q (C_{(p-q)} + C_{-(p-q)}^+) + c.c] \}
 \end{aligned}$$