Intraexcitonic Energy Transition in GaAs Quantum Wells

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Abstract

Intraexcitonic energy transitions are calculated for hydrogenic exciton states in GaAs quantum wells within a variational scheme in the effective-mass approximation and using an infinite-confinement potential model. In the first part we present the binding energies of the heavy and light-hole exciton ground and excited states with wave functions taken as products of the electron and hole wave functions in the quantum well and the three-dimensional nonseparable hydrogenic wave function. For very small values of width, our results reproduce the exact two-dimensional hydrogenic limit and conversely, for wide wells, we recover the exact three-dimensional results. The binding energy is calculated for the exciton states 1s, 2s, $2p_x$, $2p_z$, 3s, $3p_x$, and $3p_z$. The allowed transitions for these excitonic states obey the selection rules for an hydrogenic atom. In addition, we study the expectation values for the electron-hole distance in the direction of the well and in the transverse direction.

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