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Zeeman splitting, Zeeman transitions and optical absorption of an electron confined in spherical quantum dots under the magnetic field

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ABSTRACT

In this study, we present a detailed theoretical investigation of the effect of an externally applied magnetic field on the energy states 1*s*, 1*p*, 1*d* and 1*f* in the spherical quantum dot with finite and infinite confinement potentials. For both finite and infinite spherical quantum dot, the first four electron energies, Zeeman transition energies between these electronic states and optical absorption coefficients between the related states with and without magnetic field are investigated. The results show that the confinement potential, magnetic field and dot radius have a strong effect on energy states, Zeeman transition energies and absorption coefficients especially in the large dot radii. In the small dot radii, energy levels are relatively insensitive to the magnetic field because the spatial confinement of the electron prevails over the magnetic confinement. As Δm changes from -1 to $+1$, the peak positions of the optical absorptions shift to higher energy values (blue shift). The absorption peaks for the infinite quantum dot are localised in higher photon energies those that of the finite quantum dot. The magnetic field causes that the degeneration of energies to be removed and the peak positions of transitions corresponding to $\Delta m = +1$ shift towards to blue in contrast to the cases of $\Delta m = -1$ and $\Delta m = 0$.

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1. Introduction

Recent advances in semiconductor technology have enabled the production of low-dimensional heterostructures such as quantum wells [1–3], quantum wires [4–6] and quantum dots (QDs) [7–9]. Among these low-dimensional structures, QDs have received great attention due to their potential applications in microelectronics and optoelectronic devices. QDs are artificially fabricated atoms where charge carriers are confined in three dimensions just like electrons

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