Ain Shams University,
Faculty of science, Department of Physics.

Study of the Electronic Properties of Quantum Dots.

Thesis

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By

Hazem Mohamed Abdelhamid Abdelsalam

Researcher Assistant, Theoretical Physics Department, National Research Center.

Supervisors

Professor: **Mohamed Hassan Talaat.**

Prof of Physics, Faculty of Science, Ain Shams University.

Professor:**Nagwa Ahmed El-meshad.**

Prof. of Physics, National Research Center.

Professor: **Igor Lukyanchuk.**

Prof. of Physics, University of Picardie Jules Verne.

Date

Ain Shams University,
Faculty of science, Department of Physics.

Title Sheet

Student Name : Hazem Mohamed Abdelhamid Abdelsalam.
Degree: Dr. of Philosophy in Physics.
Department: Physics.
Faculty: Science.
University: Ain Shams.
Graduation Date: 2004.
PhD Awarding Date: 20

Ain Shams University,
Faculty of science, Department of Physics.

Approval Sheet

Student Name: Hazem Mohamed Abdelhamid Abdelsalam.

Thesis Title: Study of the Electronic Properties of Quantum Dots.

Degree: Dr. of Philosophy in Physics.

Supervisors Committee

Professor: **Mohamed Hassan Talaat.**

Prof of Physics, Faculty of Science, Ain Shams University

Professor:**Nagwa Ahmed El-meshad.**

Prof. of Physics, National Research Center.

Professor: **Igor Lukyanchuk.**

Prof. of Physics, University of Picardie Jules Verne.

Higher Studies

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Abstract

Abstract Hazem Mohamed Abdelhamid Abdelsalam. Study of the Electronic Properties of Quantum Dots. Ain Shams University, University of Picardie Jules Verne, and National Research Center .

Quantum dots (QDs) have captured the substantial attention of nanotechnology due to their unique optical and magnetic properties. The new element here is the physical confinement which creates localized electronic states and tunable energy gap in these systems. Through this thesis electronic properties of different types of quantum dots are discussed. In chapter 1, we introduce a literature survey about these QDs. In chapter 2, we study the electronic properties of semiconductor GaAs quantum dot (QD) under the effect of constant magnetic field with two types of quantum confinement potentials: parabolic and inverse parabolic confinement potential. As a function of magnetic field we observed Anti crossing between the ground state energy and the first excited state energy. Within the tight binding model, electronic energy levels of graphene quantum dots of circular, hexagonal, and triangular shapes are studied. In general two types of edge states, located nearby the Dirac point can be discerned, the zero energy states (ZES) that are degenerate and located exactly at $\epsilon = 0$ and the dispersed edge states (DES) that fill the low-energy domain within the gap and are symmetrically distributed with respect to $\epsilon = 0$. As a comparison between the two types of the QDs we calculated the transition energy inside each QD, we obtained this energy in the infrared light range.

In chapter 3, we calculate the electronic density of states and orbital magnetic susceptibility of graphene and multilayer graphene quantum dots (MGQDs). In case of single layer graphene QD, ZES observed in triangular GQDs do not contribute to magnetic susceptibility since they don't move from their location at $\epsilon = 0$ when magnetic field is applied. In contrast, the localized edge states in hexagonal GQDs are mostly distributed nearby ϵ=0 which give a considerable contribution to the orbital diamagnetism. The properties of MGQD depend