بسم الله الرحمن الرحيم

شبكة المعلومـــــات الجامعية

التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكروفيلم

﴿ قـــســـم ﴾

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأفلام قد اعدت دون آية تغيرات

يجب أن

تحفظ هذه الأفلام بعيداً عن الغبار

في درجة حرارة من 15 – 20 مئوية ورطوبة نسبية من 20-40 %

To be kept away from dust in dry cool place of
15 – 25c and relative humidity 20-40 %

بعض الوثائق الأصلية تالفة

بالرسالة صفحات

لم ترد بالأصـــل

Ain-Shams University
Faculty of Engineering

INVESTIGATION OF THE QUANTUM CONDUCTANCE CHARACTERISTICS OF SOME MESOSCOPIC DEVICES

A Thesis

Submitted in Partial Fulfillment

For the award of the M.Sc. Degree in Engineering Physics

By

Walid Abd El-Monem Zein

B.Sc. Ain-Shams University, 1997

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Subject : Investigation of the Quantum Conductance Characteristics of Some Mesoscopic Devices.
Degree : M.Sc. thesis Ain Shams University, Faculty of Engineering, Engineering Physics and Math.Dept.,2001.

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ABSTRACT

Name : Walid Abd El-Monem Zein.

Subject: Investigation of the quantum conductance characteristics of some mesoscopic devices.

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In the present thesis the quantum transport characteristics of mesoscopic system under the effect of magnetic field and in the Coulomb blockade regime are studied. Such mesoscopic system is modeled as two semiconductor quantum dots coupled to superconducting leads via two quantum point contacts.

The conductance of such mesoscopic junction has been obtained in terms of the Andreev reflection tunneling probability by using the Landauer-Büttiker equation. This Andreev reflection tunneling probability was deduced by solving the Bogoliubov-deGennes (BdG) equation, describing the electron transport through the junction. Numerical calculation has been performed, treating the electron transport as a stochastic process.

The obtained results show that the electron transport through such mesoscopic device has a coherent property, so as the devices size is less than the mean free path of electrons and the corresponding coherence length of Cooper pair. An important result was obtained which shows the deviation of the periodic oscillation of the dependence of the conductance on the magnetic field from the conventional quantum flux. However, it should be modified by a parameter, which is very sensitive to the quantum dot size. The periodic oscillation of the conductance with the

gate voltage gives an evidence of the role of discrete states and their coexistence with coulomb charging energy in our mesoscopic device.

The second part of the thesis was devoted for computing the quantum noise spectrum and its dependence on the magnetic field and quantum dot size. This quantum noise spectrum has been deduced in terms of the current driven by an AC-voltage. The transimpedance of the equivalent mesoscopic device has been also obtained and computed at different frequencies. The frequency dependence of the quantum noise spectrum at different temperatures, magnetic field and quantum dot size show a stochastic resonance trend which is characterized for nonlinear quantum systems.

In general the present results found a good concordant with those in the literature. Such investigations on mesoscopic system in the present thesis might be valuable for nanotechnology of nanoelectronic devices. The thesis contains four chapters. The first one reviewed the historical works on quantum dots. The second chapter treats the theory of the considered mesoscopic junction. The numerical calculations and results are given in chapter three. Chapter four summarizes the main conclusions.

Key Words. Mesoscopic device-Quantum dot-Andreev reflection-Superconductor (S)- semiconductor (Sm) interface-Coulomb blockade-Quantum noise spectrum.