

Quantum Transport

Introduction to Nanoscience

Yuli V. Nazarov
and **Yaroslav M. Blanter**

CAMBRIDGE

Quantum Transport Introduction To Nanoscience

Yuli V. Nazarov, Yaroslav M. Blanter



Quantum Transport Introduction To Nanoscience:

Quantum Transport Yuli V. Nazarov, Yaroslav M. Blanter, 2009-05-28 Quantum transport is a diverse field sometimes combining seemingly contradicting concepts quantum and classical conduction and insulating within a single nanodevice Quantum transport is an essential and challenging part of nanoscience and understanding its concepts and methods is vital to the successful fabrication of devices at the nanoscale This textbook is a comprehensive introduction to the rapidly developing field of quantum transport The authors present the comprehensive theoretical background and explore the groundbreaking experiments that laid the foundations of the field Ideal for graduate students each section contains control questions and exercises to check readers understanding of the topics covered Its broad scope and in depth analysis of selected topics will appeal to researchers and professionals working in nanoscience Quantum Transport Juli V. Nazarov, Yaroslav M. Blanter, 2009 *Theory of Quantum Transport at Nanoscale* Dmitry Ryndyk, 2015-12-08 This book is an introduction to a rapidly developing field of modern theoretical physics the theory of quantum transport at nanoscale The theoretical methods considered in the book are in the basis of our understanding of charge spin and heat transport in nanostructures and nanostructured materials and are widely used in nanoelectronics molecular electronics spin dependent electronics spintronics and bio electronics The book is based on lectures for graduate and post graduate students at the University of Regensburg and the Technische Universität Dresden TU Dresden The first part is devoted to the basic concepts of quantum transport Landauer B ttiker method and matrix Green function formalism for coherent transport Tunneling Transfer Hamiltonian and master equation methods for tunneling Coulomb blockade vibrons and polarons The results in this part are obtained as possible without sophisticated techniques such as nonequilibrium Green functions which are considered in detail in the second part A general introduction into the nonequilibrium Green function theory is given The approach based on the equation of motion technique as well as more sophisticated one based on the Dyson Keldysh diagrammatic technique are presented The main attention is paid to the theoretical methods able to describe the nonequilibrium at finite voltage electron transport through interacting nanosystems specifically the correlation effects due to electron electron and electron vibron interactions Nanostructures and Nanotechnology Douglas Natelson, 2015-06-18 A carefully developed textbook focusing on the fundamental principles of nanoscale science and nanotechnology *Nanoelectronics* Khurshed Ahmad Shah, 2025-10-21 The book covers the latest advancements in the field of nanoelectronics interaction of light with matter optical properties surface plasmons nanophotonic and plasmonic applications nanomaterials engineering in nanoelectronics fabrication techniques and applications It presents the structure properties and device applications of carbon nanotubes graphene and silicene The book further includes topics on perovskites and applications quantum dots for optoelectronic sensing devices computing applications and advanced applications in diagnostic and therapeutic tools This book Introduces topics on quantum phenomenon in nanoelectronics transistors in modern computing spintronic devices flexible and wearable

electronics and case studies and includes topics on development of hybrid material of one dimensional 1D and 2D carbon in nanomedicine computed tomography ultrasound and stapled peptides drug Presents physical and electrical properties of nanoscale materials applications of carbon nanotubes such as batteries supercapacitors biosensors photodetectors and field emission sources and topics on the surface plasmon resonance nanolasers nanoantennas photonic crystals and luminescent materials Discusses quantum dots quantum electronic devices nanosensors quantum computing device applications of perovskite materials spintronics drug delivery and gene therapy applications and the scaling laws in nanoelectronics materials for nano FET high speed computing and advanced nanoscale FET architectures Highlights recent developments in the field of nanoscale devices based on graphene and silicene such as biosensing and gas sensing thermoelectric devices and optoelectronic applications Explains the basic quantum theory pizelectricity in zinc oxide quantum dots and nanosensing includes the topics on data storage and quantum logic gates It is primarily written for senior undergraduates graduate students and academic researchers in the fields including physics computers nanoelectronics electrical engineering electronics and communications engineering nanoscience and nanotechnology

Quench Dynamics in Interacting and Superconducting Nanojunctions Rubén Seoane Souto, 2020-02-05 Effects of many body interactions and superconducting correlations have become central questions in the quantum transport community While most previous works investigating current fluctuations in nanodevices have been restricted to the stationary regime Seoane s thesis extends these studies to the time domain It provides relevant information about the time onset of electronic correlations mediated by interactions and superconductivity This knowledge is essential for the development of fast electronic devices as well as novel applications requiring fast manipulations such as quantum information processing In addition the thesis establishes contact with issues of broad current interest such as non equilibrium quantum phase transitions

Modern Theories of Many-Particle Systems in Condensed Matter Physics Daniel C. Cabra, Andreas Honecker, Pierre Pujol, 2012-01-05 Condensed matter systems where interactions are strong are inherently difficult to analyze theoretically The situation is particularly interesting in low dimensional systems where quantum fluctuations play a crucial role Here the development of non perturbative methods and the study of integrable field theory have facilitated the understanding of the behavior of many quasi one and two dimensional strongly correlated systems In view of the same rapid development that has taken place for both experimental and numerical techniques as well as the emergence of novel testing grounds such as cold atoms or graphene the current understanding of strongly correlated condensed matter systems differs quite considerably from standard textbook presentations The present volume of lecture notes aims to fill this gap in the literature by providing a collection of authoritative tutorial reviews covering such topics as quantum phase transitions of antiferromagnets and cuprate based high temperature superconductors electronic liquid crystal phases graphene physics dynamical mean field theory applied to strongly correlated systems transport through quantum dots quantum information perspectives on many body physics frustrated magnetism statistical

mechanics of classical and quantum computational complexity and integrable methods in statistical field theory As both graduate level text and authoritative reference on this topic this book will benefit newcomers and more experienced researchers in this field alike *Introduction to Graphene-Based Nanomaterials* Luis E. F. Foa Torres,Stephan Roche,Jean-Christophe Charlier,2014-01-23 Beginning with an introduction to carbon based nanomaterials their electronic properties and general concepts in quantum transport this detailed primer describes the most effective theoretical and computational methods and tools for simulating the electronic structure and transport properties of graphene based systems Transport concepts are clearly presented through simple models enabling comparison with analytical treatments and multiscale quantum transport methodologies are introduced and developed in a straightforward way demonstrating a range of methods for tackling the modelling of defects and impurities in more complex graphene based materials The authors also discuss the practical applications of this revolutionary nanomaterial contemporary challenges in theory and simulation and long term perspectives Containing numerous problems for solution real life examples of current research and accompanied online by further exercises solutions and computational codes this is the perfect introductory resource for graduate students and researchers in nanoscience and nanotechnology condensed matter physics materials science and nanoelectronics

Nonequilibrium Quantum Transport Physics in Nanosystems Felix A. Buot,2009 This book presents the first comprehensive treatment of discrete phase space quantum mechanics and the lattice Weyl Wigner formulation of energy band dynamics by the originator of these theoretical techniques The author s quantum superfield theoretical formulation of nonequilibrium quantum physics is given in real time without the awkward use of artificial time contour employed in previous formulations These two main quantum theoretical techniques combine to yield general including quasiparticle pairing dynamics and exact quantum transport equations in phase space appropriate for nanodevices The derivation of transport formulas in mesoscopic physics from the general quantum transport equations is also treated Pioneering nanodevices are discussed in the light of the quantum transport physics equations and an in depth treatment of the physics of resonant tunneling devices is given Operator Hilbert space methods and quantum tomography are discussed Discrete phase space quantum mechanics on finite fields is treated for completeness and by virtue of its relevance to quantum computing The phenomenological treatment of evolution superoperator and measurements is given to help clarify the general quantum transport theory Quantum computing and information theory is covered to demonstrate the foundational aspects of discrete quantum dynamics particularly in deriving a complete set of multiparticle entangled basis states **An Introduction to Quantum Transport in Semiconductors** David K. Ferry,2017-12-14 Throughout their college career most engineering students have done problems and studies that are basically situated in the classical world Some may have taken quantum mechanics as their chosen field of study This book moves beyond the basics to highlight the full quantum mechanical nature of the transport of carriers through nanoelectronic structures The book is unique in that addresses quantum transport only in

the materials that are of interest to microelectronics semiconductors with their variable densities and effective masses The author develops Green s functions starting from equilibrium Green s functions and going through modern time dependent approaches to non equilibrium Green s functions introduces relativistic bands for graphene and topological insulators and discusses the quantum transport changes that these bands induce and discusses applications such as weak localization and phase breaking processes resonant tunneling diodes single electron tunneling and entanglement Furthermore he also explains modern ensemble Monte Carlo approaches to simulation of various approaches to quantum transport and the hydrodynamic approaches to quantum transport All in all the book describes all approaches to quantum transport in semiconductors thus becoming an essential textbook for advanced graduate students in electrical engineering or physics

Quantum Transport in Nanostructures and Molecules LAMBERT,2021-03-23 *Proceedings of the International Conference on Quantum Transport and Quantum Coherence (Localisation 2002)* Yoshiyuki Ono,2003 *Introduction to Nanoscience* Gabor L. Hornyak,2008-05-15 Tomorrow s nanoscientist will have a truly interdisciplinary and nano centric education rather than for example a degree in chemistry with a specialization in nanoscience For this to happen the field needs a truly focused and dedicated textbook This full color masterwork is such a textbook It introduces the nanoscale along with the societal impacts of nanoscience then presents an overview of characterization and fabrication methods The authors systematically discuss the chemistry physics and biology aspects of nanoscience providing a complete picture of the challenges opportunities and inspirations posed by each facet before giving a brief glimpse at nanoscience in action nanotechnology This book is written to provide a companion volume to Fundamentals of Nanotechnology The two companion volumes are also available bound together in the single volume Introduction to Nanoscience and Nanotechnology Qualifying instructors who purchase either of these volumes or the combined set are given online access to a wealth of instructional materials These include detailed lecture notes review summaries slides exercises and more The authors provide enough material for both one and two semester courses American Journal of Physics ,2009 **Journal of Computational and Theoretical Nanoscience** ,2005 **2002 International Conference on Computational Nanoscience and Nanotechnology** Matthew Laudon,2002 The worlds most comprehensive and up to date collection of Nanotechnology and Nanoscience technical papers Technical Proceedings of the Nanotech 2002 and the International Conference on Computational Nanoscience and Nanotechnology Nanotech Vol 1 Sequence and Biological Structure Computer Aided Drug Design Biological Conduction Processes Biotechnology Micro and Nano Fluidic Systems Soft Condensed Matter Extended Scale Atomistics Quantum Effects Quantum Devices Spintronics Mechanical Properties at the Nanoscale Molecular and Nano Electronics Condensed Matter Phenomena Process Modeling Nanotechnology Materials and Nanostructures Studies Nano Particles and Molecules Papers taken from the 2002 Nanotechnology Conference and Trade Show San Juan Puerto Rico April 2002 Quantum Transport in Submicron Devices Wim Magnus,Wim Schoenmaker,2002-06-12 The aim of this book is to

resolve the problem of electron and hole transport with a coherent and consistent theory that is relevant to the understanding of transport phenomena in submicron devices Along the road readers encounter landmarks in theoretical physics as the authors guide them through the strong and weak aspects of various hypotheses Introduction to Nanoscience and Nanotechnology Gabor L. Hornyak,2009 PerspectivesIntroductionNanoscience and Nanotechnology The DistinctionHistorical PerspectivesAdvanced MaterialsTools of NanoNature s Take on Nano and the Advent of Molecular BiologyThe Nano PerspectiveSocietal Implications of NanoIntroduction to Societal IssuesEthical ImplicationsLegal ImplicationsEnvironmental ImplicationsPublic PerceptionFuture of Nanotechnology NanotoolsCharacterization MethodsCharacterization of NanomaterialsElectron Probe MethodsScanning Probe Microscopy MethodsSpectroscopic MethodsNonradiative and Nonelectron Characterization MethodsFabrication MethodsFabrication of Nano *Nanoscience and Technology* Chunli Bai,Sishen Xie,Xing Zhu,2007 Nanotechnology has been a priority research field in many countries because new discoveries in this field have the potential power to unravel new phenomena and new principles of materials use This collection of knowledge concerning frontier issues in nanotechnology will aid the further promotion of the integration of nanotechnology and industry **The British National Bibliography** Arthur James Wells,2009

Unveiling the Energy of Verbal Beauty: An Psychological Sojourn through **Quantum Transport Introduction To Nanoscience**

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