Quantum Transport Introduction To Nanoscience

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Quantum Teleportation Is Real, Here's How It Works

Quantum Transport, Lecture 1: IntroductionQuantum Transport, Lecture 5: Ballistic Transport

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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 ...

Quantum Transport

This book provides an introduction to the electrical and transport properties of graphene and other two ... the analytical connection between the quantum Hall wave function and the flatness of bands ...

Introduction to Graphene-Based Nanomaterials

With a view to future applications in electronics and quantum technology, researchers are focusing ... in the research group of Professor Christian Schönenberger at the Swiss Nanoscience Institute and ...

Ultrathin semiconductors electrically connected to superconductors for the first time

Since their introduction in the 1990s ... yet short distances for carrier collection/transport from the semiconductor interface within the nanowire (that is, light absorption and charge transfer ...

Nanowire photonics

1 Institute for Quantum Information and State Key Laboratory of High Performance Computing, College of Computer Science and Technology, National University of Defense Technology, 410073 Changsha, ...

Implementing graph-theoretic quantum algorithms on a silicon photonic quantum walk processor

Transport in nano-pores: Depinning transitions for and ratcheting of driven interacting colloidal particles in heterogeneous nano-pores [63]. Dewetting of polymer mixtures: Coupling of decomposition ...

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Thus, there is an urgent and critical need to reformulate these bioactive agents using nanoscience and nanotechnology as alternative strategies. This article overviews current design and ...

Engineering Nanomedicines for Improved Melanoma Therapy: Progress and Promises

Advancing to the nanoscale is not just a step toward miniaturization, but requires the introduction ... by quantum physics and they exhibit unique behavior. Fundamental scientific advances are ...

Chapter 1: Toward the Nanoscale

To coincide with this year's Reith Lectures, entitled the Triumph of Technology, You and Yours asked what has been the most significant technological innovation since 1800. From the hundreds of ...

The Triumph of Technology

The Linneqs environment is lead by a coordinator, Per Delsing, together with four project coordinators for the four different research areas, Vitaly Shumeiko (Qubits), Dag Winkler (Quantum Transport .

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Graduate Certificates

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Degree accreditation

The Electrical and Computer Engineering Department offers major programs leading to the bachelor of science in electrical engineering or the bachelor of science in electrical and computer engineering, ...

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.

A comprehensive introduction to the rapidly developing field of quantum transport for graduate students, researchers and professionals working in nanoscience.

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.

This book presents the conceptual framework underlying the atomistic theory of matter, emphasizing those aspects that relate to current flow. This includes some of the most advanced concepts of non-equilibrium quantum statistical mechanics. No prior acquaintance with quantum mechanics is assumed. Chapter 1 provides a description of quantum transport in elementary terms accessible to a beginner. The book then works its way from hydrogen to nanostructures, with extensive coverage of current flow. The final chapter summarizes the equations for quantum transport with illustrative examples showing how conductors evolve from the atomic to the ohmic regime as they get larger. Many numerical examples are used to provide concrete illustrations and the corresponding Matlab codes can be downloaded from the web. Videostreamed lectures, keyed to specific sections of the book, are also available through the web. This book is primarily aimed at senior and graduate students.

Graphene is one of the most intensively studied materials, and has unusual electrical, mechanical and thermal properties, which provide almost unlimited potential applications. This book provides an introduction to the electrical and transport properties of graphene and other two dimensional nanomaterials, covering ab-initio to multiscale methods. Updated from the first edition, the authors have added chapters on other two dimensional materials, spin related phenomena, and an improved overview of Berry phase effects. Other topics include powerful order N electronic structure, transport calculations, ac transport and multiscale transport methodologies. Chapters are complemented with concrete examples and case studies, questions and exercises, detailed appendices and computational codes. It is a valuable resource for graduate students and researchers working in physics, materials science or engineering who are interested in the field of graphene-based nanomaterials.

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-Büttiker 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.

An accessible introduction to advanced quantum theory, this textbook focuses on its practical applications and is ideal for graduate students in physics.

As electric devices become smaller and smaller, transport simulations based on the quantum mechanics become more and more important. There are currently numerous textbooks on the basic concepts of quantum transport, but few present calculation methods in detail. This book provides various quantum transport simulation methods and shows applications for transport properties of nanometer-scale systems. It starts with a short review of quantum transport, followed by various calculation methods based on scattering approaches, non-equilibrium Green's function (NEGF), master equation, and time-dependent wave-packet diffusion (TD-WPD). With these tools, transport properties of various nanosystems are then explored.

Linear current-voltage pattern, has been and continues to be the basis for characterizing, evaluating performance, and designing integrated circuits, but is shown not to hold its supremacy as channel lengths are being scaled down. In a nanoscale circuit with reduced dimensionality in one or more of the three Cartesian directions, quantum effects transform the carrier statistics. In the high electric field, the collision free ballistic transform is predicted, while in low electric field the transport remains predominantly scattering-limited. In a micro/nano-circuit, even a low logic voltage of 1 V is above the critical voltage triggering nonohmic behavior that results in ballistic current saturation. A quantum emission may lower this ballistic velocity.