

Fedir T. Vasko • Oleg E. Raichev

Quantum Kinetic Theory and Applications

Electrons, Photons, Phonons



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Quantum Kinetic Theory And Applications

Electrons

Photons Phonons

Vladimir I. Gavrilenko



Quantum Kinetic Theory And Applications Electrons Photons Phonons:

Quantum Kinetic Theory and Applications Fedir T. Vasko, Oleg E. Raichev, 2005-08-16 This lecture style monograph is addressed to several categories of readers First it will be useful for graduate students studying theory Second the topics covered should be interesting for postgraduate students of various specializations Third the researchers who want to understand the background of modern theoretical issues in more detail can find a number of useful results here The phenomena covered involve kinetics of electron phonon and photon systems in solids The dynamical properties and interactions of electrons phonons and photons are briefly described in Chapter 1 Further in Chapters 2-8 the authors present the main theoretical methods linear response theory various kinetic equations for the quasiparticles under consideration and diagram technique The presentation of the key approaches is always accompanied by solutions of concrete problems to illustrate ways to apply the theory The remaining chapters are devoted to various manifestations of quantum transport in solids The choice of particular topics is determined by their scientific importance and methodological value The 267 supplementary problems presented in the ends of chapters are offered to guide the reader in self study Focusing attention on the methodological aspects and discussing a great diversity of kinetic phenomena in keeping with the guiding principle a method is more important than a result the authors minimize both detailed discussion of physical mechanisms of the phenomena considered and comparison of theoretical results to experimental data

Quantum Kinetic Theory and Applications Fedir T. Vasko, Oleg E. Raichev, 2006-06-08 Physical kinetics is the natural section of the course of theoretical physics in its standard presentation It stays at the boundary between general theories and their applications solid state theory theory of gases plasma and so on because the treatment of kinetic phenomena always depends on specific structural features of materials On the other hand the physical kinetics as a part of the quantum theory of macroscopic systems is far from being complete A number of its fundamental issues such as the problem of irreversibility and mechanisms of chaotic responses are now attracting considerable attention Other important sections for example kinetic phenomena in disordered and/or strongly non equilibrium systems and in particular phase transitions in these systems are currently under investigation The quantum theory of measurements and quantum information processing actively developing in the last decade are based on the quantum kinetic theory Because a deductive theoretical exposition of the subject is not convenient the authors restrict themselves to a lecture style presentation Now the physical kinetics seems to be at the stage of development when according to Newton studying examples is more instructive than learning rules In view of these circumstances the methods of the kinetic theory are presented here not in a general form but as applications for description of specific systems and treatment of particular kinetic phenomena The quantum features of kinetic phenomena can arise for several reasons

Kinetic Theory and Transport Phenomena Rodrigo Soto, 2016-10-20 One of the questions about which humanity has often wondered is the arrow of time Why does temporal evolution seem irreversible That is we often see objects break into pieces but we never see them

reconstitute spontaneously This observation was first put into scientific terms by the so called second law of thermodynamics entropy never decreases However this law does not explain the origin of irreversibility it only quantifies it Kinetic theory gives a consistent explanation of irreversibility based on a statistical description of the motion of electrons atoms and molecules The concepts of kinetic theory have been applied to innumerable situations including electronics the production of particles in the early universe the dynamics of astrophysical plasmas quantum gases or the motion of small microorganisms in water with excellent quantitative agreement This book presents the fundamentals of kinetic theory considering classical paradigmatic examples as well as modern applications It covers the most important systems where kinetic theory is applied explaining their major features The text is balanced between exploring the fundamental concepts of kinetic theory irreversibility transport processes separation of time scales conservations coarse graining distribution functions etc and the results and predictions of the theory where the relevant properties of different systems are computed

Optics of Nanomaterials Vladimir I. Gavrilenko, 2019-11-08 Nanomaterials are mainly categorized into three groups fundamental building blocks dispersions or composites of building blocks in randomly ordered matrices and spatially resolved ordered nanostructures Today nanomaterials that offer some unique optical properties may find application as pure materials or may be integrated into larger structures This book presents examples of both pure and composite materials that include organic inorganic nanocomposites and quantum dots embedded into different matrices for various applications in modern nanotechnology This edition has been thoroughly revised and updated with the most recent developments in the field The newly added introductory paragraphs will help students and young researchers in better understanding the chapters The new sections on frequently used physical constants and units conversions as well as the updated bibliography add to the book's utility This textbook is unique compared with its counterparts in the market in respect of its scope as it contains introductory sections to the important topics on nanomaterial optics This feature broadens its readership from engineers and researchers working in the field of materials science and optics to lecturers graduate students and beginners who want to deepen their knowledge in nanomaterial optics

Handbook of Spin Transport and Magnetism Evgeny Y. Tsymbal, Igor Zutic, 2011-08-25 In the past several decades the research on spin transport and magnetism has led to remarkable scientific and technological breakthroughs including Albert Fert and Peter Gruber's Nobel Prize winning discovery of giant magnetoresistance GMR in magnetic metallic multilayers Handbook of Spin Transport and Magnetism provides a comprehensive balanced account of the state of the art in the field known as spin electronics or spintronics It reveals how key phenomena first discovered in one class of materials such as spin injection in metals have been revisited decades later in other materials systems including silicon organic semiconductors carbon nanotubes graphene and carefully engineered nanostructures The first section of the book offers a historical and personal perspective of the field written by Nobel Prize laureate Albert Fert The second section addresses physical phenomena such as GMR in hybrid structures of ferromagnetic

and normal metals The third section discusses recent developments in spin dependent tunneling including magnetic tunnel junctions with ferroelectric barriers In the fourth section the contributors look at how to control spin and magnetism in semiconductors In the fifth section they examine phenomena typically found in nanostructures made from metals superconductors molecular magnets carbon nanotubes quantum dots and graphene The final section covers novel spin based applications including advanced magnetic sensors nonvolatile magnetoresistive random access memory and semiconductor spin lasers The techniques and materials of spintronics have rapidly evolved in recent years leading to vast improvements in hard drive storage and magnetic sensing With extensive cross references between chapters this seminal handbook provides a complete guide to spin transport and magnetism across various classes of materials and structures **Electron and**

Nuclear Spin Dynamics in Semiconductor Nanostructures M. M. Glazov, 2018 This book focuses on the main aspects of electron and nuclear spin dynamics in semiconductor nanostructures It summarizes main results of theoretical and experimental studies of interactions in spin systems effects of ultrafast spin manipulation by light phenomena of spin losses and the physics of the omnipresent spin noise *Labs on Chip* Eugenio Iannone, 2018-09-03 *Labs on Chip Principles Design and Technology* provides a complete reference for the complex field of labs on chip in biotechnology Merging three main areas fluid dynamics monolithic micro and nanotechnology and out of equilibrium biochemistry this text integrates coverage of technology issues with strong theoretical explanations of design techniques Analyzing each subject from basic principles to relevant applications this book Describes the biochemical elements required to work on labs on chip Discusses fabrication microfluidic and electronic and optical detection techniques Addresses planar technologies polymer microfabrication and process scalability to huge volumes Presents a global view of current lab on chip research and development Devotes an entire chapter to labs on chip for genetics Summarizing in one source the different technical competencies required *Labs on Chip Principles Design and Technology* offers valuable guidance for the lab on chip design decision making process while exploring essential elements of labs on chip useful both to the professional who wants to approach a new field and to the specialist who wants to gain a broader perspective **American Journal of Physics**, 2005 **Fundamentals Of Solid**

State Electronics Chih Tang Sah, 1991-10-30 This is perhaps the most comprehensive undergraduate textbook on the fundamental aspects of solid state electronics It presents basic and state of the art topics on materials physics device physics and basic circuit building blocks not covered by existing textbooks on the subject Each topic is introduced with a historical background and motivations of device invention and circuit evolution Fundamental physics is rigorously discussed with minimum need of tedious algebra and advanced mathematics Another special feature is a systematic classification of fundamental mechanisms not found even in advanced texts It bridges the gap between solid state device physics covered here with what students have learnt in their first two years of study Used very successfully in a one semester introductory core course for electrical and other engineering materials science and physics junior students the second part of each

chapter is also used in an advanced undergraduate course on solid state devices The inclusion of previously unavailable analyses of the basic transistor digital circuit building blocks and cells makes this an excellent reference for engineers to look up fundamental concepts and data design formulae and latest devices such as the GeSi heterostructure bipolar transistors

Quantum Kinetics in Transport and Optics of Semiconductors Hartmut Haug,Antti-Pekka Jauho,2007-12-10 Nanoscale miniaturization and femtosecond laser pulse spectroscopy require a quantum mechanical description of the carrier kinetics that goes beyond the conventional Boltzmann theory On these extremely short length and time scales the electrons behave as do partially coherent waves This monograph deals with quantum kinetics for transport in low dimensional microstructures and for ultra short laser pulse spectroscopy The nonequilibrium Green function theory is described and used for the derivation of the quantum kinetic equations Numerical methods for the solution of the retarded quantum kinetic equations are discussed and results are presented for high field transport and for mesoscopic transport phenomena Quantum beats polarization decay and non Markovian behaviour are treated for femtosecond spectroscopy on a microscopic basis Since the publishing of the first edition in 1996 the nonequilibrium Green function technique has been applied to a large number of new research topics and the revised edition introduces the reader to many of these areas such as molecular electronics noise calculations build up of screening and polaron correlations and non Markovian relaxation among others Connection to recent experiments is made and it is emphasized how the quantum kinetic theory is essential in their interpretation Microscale

and Nanoscale Heat Transfer C.B. Sobhan,G.P. Peterson,2008-06-12 Through analyses experimental results and worked out numerical examples *Microscale and Nanoscale Heat Transfer Fundamentals and Engineering Applications* explores the methods and observations of thermophysical phenomena in size affected domains Compiling the most relevant findings from the literature along with results from their own re *College of Engineering* University of Michigan. College of Engineering,1987 *Technical Abstract Bulletin* ,1967 **Semiconductor Optics 2** Heinz Kalt,Claus F.

Klingshirn,2024-03-16 This book provides an introduction to and an overview of the multifaceted area of dynamics and nonlinearities related to optical excitations in semiconductors It is a revised and significantly extended edition of the well established book by C Klingshirn split into two volumes and restructured to make it more concise Inserts on important experimental techniques reference to topical research and novel materials as well as consideration of photonic applications support research oriented teaching and learning This book reviews nonlinear optical properties and many body phenomena evoked by high densities of quasi particles in semiconductors Coherent dynamics and relaxation of optical excitations carriers excitons electron hole plasmas etc as well as condensation phenomena are elucidated in these materials A broad overview is provided of seminal research results augmented by detailed descriptions of the relevant experimental techniques e g ultrafast spectroscopy four wave mixing and the Hanbury Brown and Twiss experiment Offering a comprehensive introduction to hot topics in current research polariton condensates valley coherence and single photons to name a few it

also discusses applications of the described physical concepts in topical areas such as quantum information photonics spintronics and optoelectronics Covering subjects ranging from physics to materials science and optoelectronics the book provides a lively and comprehensive introduction to semiconductor optics beyond the linear regime With many problems chapter introductions schematic depictions of physical phenomena as well as boxed inserts and a detailed index it is suitable for use in graduate courses in physics and neighboring sciences like material science and optical communication It is also a valuable reference resource for doctoral and advanced researchers

University of Michigan Official Publication University of Michigan, 1988 Each number is the catalogue of a specific school or college of the University

Heat Transport in Micro- and Nanoscale Thin Films Bekir Sami Yilbas, Saad Bin Mansoor, Haider Ali, 2017-08-23 Heat Transport in Micro and Nanoscale Thin Films presents aspects and applications of the principle methods of heat transport in relation to nanoscale films Small scale parts and thin films are widely used in the electronics industry However the drastic change in the thermal conductivity with reducing device size and film thickness modifies the energy transport by heat carrying phonons in the film Energy transfer in small sized devices and thin films deviate from the classical diffusion to radiative transport This book deals with micro nano scale heat transfer in small scale devices and the thin films including interface properties of cross plane transport The book fills the gap between applications of the physical fundamentals and energy transport at the micro and nano scale which will be valuable for academics researchers and students in the fields of materials science and energy transport Offers a specialist focus on nanoscale thin films allowing the reader to create more efficient heat transfer systems Includes in depth coverage of the formulation of transient energy transport for short durations of heating which is valuable those working in electronics Focuses on applications and real life case studies to clearly illustrate how the theories explained in the book can be used in industry

The University of Virginia Record University of Virginia, 2007

Handbook of Nanoscience, Engineering, and Technology William A. Goddard III, Donald Brenner, Sergey Edward Lyshevski, Gerald J Iafrate, 2018-09-03 In his 1959 address There is Plenty of Room at the Bottom Richard P Feynman speculated about manipulating materials atom by atom and challenged the technical community to find ways of manipulating and controlling things on a small scale This visionary challenge has now become a reality with recent advances enabling atomistic level tailoring and control of materials Exemplifying Feynman s vision Handbook of Nanoscience Engineering and Technology Third Edition continues to explore innovative nanoscience engineering and technology areas Along with updating all chapters this third edition extends the coverage of emerging nano areas even further Two entirely new sections on energy and biology cover nanomaterials for energy storage devices photovoltaics DNA devices and assembly digital microfluidic lab on a chip and much more This edition also includes new chapters on nanomagnet logic quantum transport at the nanoscale terahertz emission from Bloch oscillator systems molecular logic electronic optics in graphene and electromagnetic metamaterials With contributions from top scientists and researchers from around the globe this color handbook presents a unified up to date

account of the most promising technologies and developments in the nano field It sets the stage for the next revolution of nanoscale manufacturing where scalable technologies are used to manufacture large numbers of devices with complex functionalities *Joyce in the Belly of the Big Truck; Workbook* Joyce A. Cascio, 2005-05 **Collected Readings in**

Inorganic Chemistry George Willard Watt, William Franklin Kieffer, 1962

Whispering the Strategies of Language: An Emotional Quest through **Quantum Kinetic Theory And Applications Electrons Photons Phonons**

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