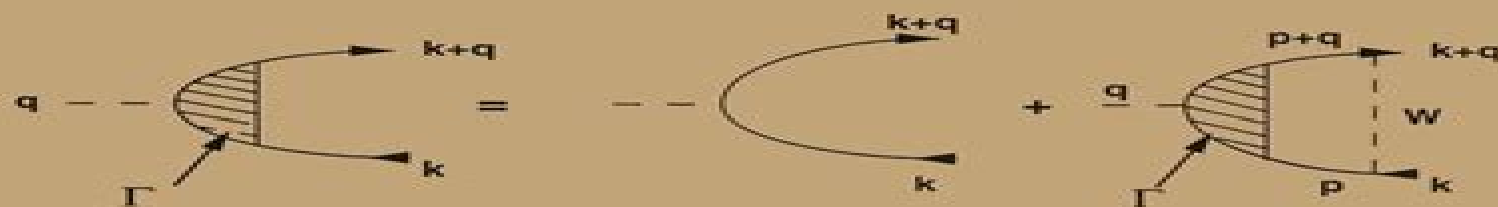


Many-Particle Physics

THIRD EDITION



Gerald D. Mahan

Many Particle Physics Physics Of Solids And Liquids

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Many Particle Physics Physics Of Solids And Liquids:

Many-Particle Physics Gerald D. Mahan, 2012-12-06 This textbook is for a course in advanced solid state theory It is aimed at graduate students in their third or fourth year of study who wish to learn the advanced techniques of solid state theoretical physics The method of Green s functions is introduced at the beginning and used throughout Indeed it could be considered a book on practical applications of Green s functions although I prefer to call it a book on physics The method of Green s functions has been used by many theorists to derive equations which when solved provide an accurate numerical description of many processes in solids and quantum fluids In this book I attempt to summarize many of these theories in order to show how Green s functions are used to solve real problems My goal in writing each section is to describe calculations which can be compared with experiments and to provide these comparisons whenever available The student is expected to have a background in quantum mechanics at the level acquired from a graduate course using the textbook by either L I Schiff A S Davydov or I Landau and E M Lifshitz Similarly a prior course in solid state physics is expected since the reader is assumed to know concepts such as Brillouin zones and energy band theory Each chapter has problems which are an important part of the lesson the problems often provide physical insights which are not in the text Sometimes the answers to the problems are provided but usually not

Modern Many-particle Physics: Atomic Gases, Quantum Dots And Quantum Fluids Enrico Lipparini, 2003-09-26 An important part of this book is devoted to the description of homogenous systems such as electron gas in different dimensions the quantum well in an intense magnetic field liquid helium and nuclear matter However the most relevant part is dedicated to the study of finite systems metallic clusters quantum dots the condensate of cold and diluted atoms in magnetic traps helium drops and nuclei The book focuses on methods of getting good numerical approximations to energies and linear response based on approximations to first principles Hamiltonians These methods are illustrated and applied to Bose and Fermi systems at zero and finite temperature Modern Many Particle Physics is directed towards students who have taken a conventional course in quantum mechanics and possess a basic understanding of condensed matter phenomena

Many-particle Physics G.D. Mahan, 2000 Solid State Theory, Volume 2 Gerd Czycholl, 2023-08-29 The present volume 2 covers advanced topics in theoretical solid state physics and thus ties in directly with the fundamentals Solids in external fields or more generally in non equilibrium and deviations from the ideal 3 dimensional crystal structure surfaces impurities low dimensional structures quantum dots etc are treated The consideration of collective phenomena such as superconductivity and magnetism complete the presentation The reader is assumed to have the contents of Volume 1 electrons and phonons in ideal crystals Bloch theorem population number representation or 2nd quantization electron electron and electron phonon interaction as well as the basic knowledge of general theoretical physics mechanics electrodynamics quantum mechanics and statistical physics usually available after a bachelor s degree in physics Volume 2 is thus ideally suited for students in the master s program in physics who wish to specialize in experimental or

theoretical solid state physics Addressing current topics e g Kondo effect fractional quantum Hall effect 2 dimensional crystals such as graphene giant magnetoresistance effect and others provides an optimal transition to modern research The new edition has been completely revised expanded with numerous exercises and existing redesigned with the associated solutions now included in the book Advanced Physics of Electron Transport in Semiconductors and Nanostructures Massimo V. Fischetti, William G. Vandenberghe, 2016-05-20 This textbook is aimed at second year graduate students in Physics Electrical Engineering or Materials Science It presents a rigorous introduction to electronic transport in solids especially at the nanometer scale Understanding electronic transport in solids requires some basic knowledge of Hamiltonian Classical Mechanics Quantum Mechanics Condensed Matter Theory and Statistical Mechanics Hence this book discusses those sub topics which are required to deal with electronic transport in a single self contained course This will be useful for students who intend to work in academia or the nano micro electronics industry Further topics covered include the theory of energy bands in crystals of second quantization and elementary excitations in solids of the dielectric properties of semiconductors with an emphasis on dielectric screening and coupled interfacial modes of electron scattering with phonons plasmons electrons and photons of the derivation of transport equations in semiconductors and semiconductor nanostructures somewhat at the quantum level but mainly at the semi classical level The text presents examples relevant to current research thus not only about Si but also about III V compound semiconductors nanowires graphene and graphene nanoribbons In particular the text gives major emphasis to plane wave methods applied to the electronic structure of solids both DFT and empirical pseudopotentials always paying attention to their effects on electronic transport and its numerical treatment The core of the text is electronic transport with ample discussions of the transport equations derived both in the quantum picture the Liouville von Neumann equation and semi classically the Boltzmann transport equation BTE An advanced chapter Chapter 18 is strictly related to the tricky transition from the time reversible Liouville von Neumann equation to the time irreversible Green s functions to the density matrix formalism and classically to the Boltzmann transport equation Finally several methods for solving the BTE are also reviewed including the method of moments iterative methods direct matrix inversion Cellular Automata and Monte Carlo Four appendices complete the text *Conceptual Foundations of Materials*, 2006-09-20 The goal of this Volume Conceptual Foundations of Materials A standard model for ground and excited state properties is to present the fundamentals of electronic structure theory that are central to the understanding and prediction of materials phenomena and properties The emphasis is on foundations and concepts The Sections are designed to offer a broad and comprehensive perspective of the field They cover the basic aspects of modern electronic structure approaches and highlight their applications to the structural ground state vibrational dynamic and thermodynamic etc and electronic spectroscopic dielectric magnetic transport etc properties of real materials including solids clusters liquids and nanostructure materials This framework also forms a basis for studies of emergent properties arising from low energy

electron correlations and interactions such as the quantum Hall effects superconductivity and other cooperative phenomena. Although some of the basics and models for solids were developed in the early part of the last century by figures such as Bloch, Pauli, Fermi, and Slater, the field of electronic structure theory went through a phenomenal growth during the past two decades, leading to new concepts, understandings, and predictive capabilities for determining the ground and excited state properties of real complex materials from first principles. For example, theory can now be used to predict the existence and properties of materials not previously realized in nature or in the laboratory. Computer experiments can be performed to examine the behavior of individual atoms in a particular process to analyze the importance of different mechanisms or just to see what happens if one varies the interactions and parameters in the simulation. Also, with *ab initio* calculations, one can determine from first principles important interaction parameters which are needed in model studies of complex processes or highly correlated systems. Each time a new material or a novel form of a material is discovered, electronic structure theory inevitably plays a fundamental role in unraveling its properties. Provides the foundations of the field of condensed matter physics. An excellent supplementary text for classes on condensed matter physics, solid state physics. Volume covers current work at the forefront. Presentations are accessible to nonspecialists with focus on underlying fundamentals.

Quantum Field Theory Lukong Cornelius Fai, 2019-06-20. Choice Recommended Title February 2020. This book explores quantum field theory using the Feynman functional and diagrammatic techniques as foundations to apply Quantum Field Theory to a broad range of topics in physics. This book will be of interest not only to condensed matter physicists but physicists in a range of disciplines as the techniques explored apply to high energy as well as soft matter physics. Features Comprehensive and rigorous yet presents an easy to understand approach. Applicable to a wide range of disciplines. Accessible to those with little or basic mathematical understanding.

Nanoelectronics: A Molecular View Avik Ghosh, 2016-09-29. This is one of the best available graduate level textbooks on electronic transport at the nanoscale. Its unique feature is providing a thorough and completely self-contained treatment of several theoretical formalisms for treating the transport problem. As such, the book is useful not only for the graduate students working in the field of nanoscale electrical transport but also for the researchers who wish to expand their knowledge of various fundamental issues associated with this rapidly developing field. Of particular note are deep physical insights accompanying the rigorous mathematical derivations in each of the chapters as well as the clear statement of all the approximations involved in a particular theoretical formalism. This winning combination makes the book very accessible to a reader with basic knowledge of quantum mechanics, solid state theory, and thermodynamics, statistical mechanics. I give this book the highest recommendation. Read Full Review. Serfei A. Egorov, University of Virginia, USA. This book is aimed at senior undergraduates, graduate students, and researchers interested in quantitative understanding and modeling of nanomaterial and device physics. With the rapid slow down of semiconductor scaling that drove information technology for decades, there is a pressing need to understand and model electron flow at its

fundamental molecular limits The purpose of this book is to enable such a deconstruction needed to design the next generation memory logic sensor and communication elements Through numerous case studies and topical examples relating to emerging technology this book connects top down classical device physics taught in electrical engineering classes with bottom up quantum and many body transport physics taught in physics and chemistry The book assumes no more than a nodding acquaintance with quantum mechanics in addition to knowledge of freshman level mathematics Segments of this book are useful as a textbook for a course in nano electronics

The Non-Equilibrium Green's Function Method for Nanoscale Device Simulation Mahdi Pourfath, 2014-07-05 For modeling the transport of carriers in nanoscale devices a Green function formalism is the most accurate approach Due to the complexity of the formalism one should have a deep understanding of the underlying principles and use smart approximations and numerical methods for solving the kinetic equations at a reasonable computational time In this book the required concepts from quantum and statistical mechanics and numerical methods for calculating Green functions are presented The Green function is studied in detail for systems both under equilibrium and under nonequilibrium conditions Because the formalism enables rigorous modeling of different scattering mechanisms in terms of self energies but an exact evaluation of self energies for realistic systems is not possible their approximation and inclusion in the quantum kinetic equations of the Green functions are elaborated All the elements of the kinetic equations which are the device Hamiltonian contact self energies and scattering self energies are examined and efficient methods for their evaluation are explained Finally the application of these methods to study novel electronic devices such as nanotubes graphene Si nanowires and low dimensional thermoelectric devices and photodetectors are discussed

Comprehensive Semiconductor Science and Technology, 2011-01-28 Semiconductors are at the heart of modern living Almost everything we do be it work travel communication or entertainment all depend on some feature of semiconductor technology Comprehensive Semiconductor Science and Technology Six Volume Set captures the breadth of this important field and presents it in a single source to the large audience who study make and exploit semiconductors Previous attempts at this achievement have been abbreviated and have omitted important topics Written and Edited by a truly international team of experts this work delivers an objective yet cohesive global review of the semiconductor world The work is divided into three sections The first section is concerned with the fundamental physics of semiconductors showing how the electronic features and the lattice dynamics change drastically when systems vary from bulk to a low dimensional structure and further to a nanometer size Throughout this section there is an emphasis on the full understanding of the underlying physics The second section deals largely with the transformation of the conceptual framework of solid state physics into devices and systems which require the growth of extremely high purity nearly defect free bulk and epitaxial materials The last section is devoted to exploitation of the knowledge described in the previous sections to highlight the spectrum of devices we see all around us Provides a comprehensive global picture of the semiconductor world Each of the

work s three sections presents a complete description of one aspect of the whole Written and Edited by a truly international team of experts

Dynamics of Classical and Quantum Fields Girish S. Setlur,2013-12-05 Dynamics of Classical and Quantum Fields An Introduction focuses on dynamical fields in non relativistic physics Written by a physicist for physicists the book is designed to help readers develop analytical skills related to classical and quantum fields at the non relativistic level and think about the concepts and theory through numerous probl

Cold Chemistry Olivier Dulieu,Andreas Osterwalder,2017-12-12 Explores the theoretical and experimental aspects of cold and ultracold molecular collisions for students and researchers in theoretical chemistry and chemical reaction molecular dynamics

Nanostructured Semiconductors Konstantinos Termentzidis,2017-09-01 The book is devoted to nanostructures and nanostructured materials containing both amorphous and crystalline phases with a particular focus on their thermal properties It is the first time that theoreticians and experimentalists from different domains gathered to treat this subject It contains two distinct parts the first combines theory and simulations methods with specific examples while the second part discusses methods to fabricate nanomaterials with crystalline and amorphous phases and experimental techniques to measure the thermal conductivity of such materials Physical insights are given in the first part of the book related with the existing theoretical models and the state of art simulations methods molecular dynamics ab initio simulations kinetic theory of gases In the second part engineering advances in the nanofabrication of crystalline amorphous heterostructures heavy ion irradiation electrochemical etching aging recrystallization ball milling PVD laser crystallization and magnetron sputtering and adequate experimental measurement methods are analyzed Scanning Thermal Microscopy Raman thermal wave methods and x rays neutrons spectroscopy

Polymers, Liquid Crystals, and Low-Dimensional Solids Norman H. March,Mario P. Tosi,2012-12-06 This book deals with three related areas having both fundamental and technological interest In the first part the objective is to provide a bird s eye view on structure in polymeric solids This is then complemented by a chapter directly technological in its emphasis dealing with the influence of processing on polymeric materials In spite of the technological interest this leads to some of the current fundamental theory Part II concerned with liquid crystals starts with a discussion of the physics of the various types of material and concludes with a treatment of optical applications Again aspects of the theory are stressed though this part is basically phenomenological in character In Part III an account is given first of the use of chemical bonding arguments in understanding the electronic structure of low dimensional solids followed by a comprehensive treatment of the influence of dimen sionality on phase transitions A brief summary of dielectric screening in low dimensional solids follows Space charge layers are then treated including semiconductor inversion layers Effects of limited dimensionality on superconductivity are also emphasized Part IV concludes the volume with two specialized topics electronic structure of biopolymers and topological defects and disordered systems The Editors wish to acknowledge that this book had its origins in the material presented at a course organized by the International Centre for Theoretical Physics

Trieste *Nonlinear Dynamics and Quantum Chaos* Sandro Wimberger, 2014-05-13 The field of nonlinear dynamics and chaos has grown very much over the last few decades and is becoming more and more relevant in different disciplines This book presents a clear and concise introduction to the field of nonlinear dynamics and chaos suitable for graduate students in mathematics physics chemistry engineering and in natural sciences in general It provides a thorough and modern introduction to the concepts of Hamiltonian dynamical systems theory combining in a comprehensive way classical and quantum mechanical description It covers a wide range of topics usually not found in similar books Motivations of the respective subjects and a clear presentation eases the understanding The book is based on lectures on classical and quantum chaos held by the author at Heidelberg University It contains exercises and worked examples which makes it ideal for an introductory course for students as well as for researchers starting to work in the field Spectroscopy of Complex Oxide Interfaces Claudia Cancellieri, Vladimir N. Strocov, 2018-04-09 This book summarizes the most recent and compelling experimental results for complex oxide interfaces The results of this book were obtained with the cutting edge photoemission technique at highest energy resolution Due to their fascinating properties for new generation electronic devices and the challenge of investigating buried regions the book chiefly focuses on complex oxide interfaces The crucial feature of exploring buried interfaces is the use of soft X ray angle resolved photoemission spectroscopy ARPES operating on the energy range of a few hundred eV to increase the photoelectron mean free path enabling the photons to penetrate through the top layers in contrast to conventional ultraviolet UV ARPES techniques The results presented here achieved by different research groups around the world are summarized in a clearly structured way and discussed in comparison with other photoemission spectroscopy techniques and other oxide materials They are complemented and supported by the most recent theoretical calculations as well as results of complementary experimental techniques including electron transport and inelastic resonant X ray scattering **Quantum Transport in Semiconductors** David K. Ferry, Carlo Jacoboni, 2013-06-29 The majority of the chapters in this volume represent a series of lectures that were given at a workshop on quantum transport in ultrasmall electron devices held at San Miniato Italy in March 1987 These have of course been extended and updated during the period that has elapsed since the workshop was held and have been supplemented with additional chapters devoted to the tunneling process in semiconductor quantum well structures The aim of this work is to review and present the current understanding in nonequilibrium quantum transport appropriate to semiconductors Generally the field of interest can be categorized as that appropriate to inhomogeneous transport in strong applied fields These fields are most likely to be strongly varying in both space and time Most of the literature on quantum transport in semiconductors or in metallic systems for that matter is restricted to the equilibrium approach in which spectral densities are maintained as semiclassical energy conserving delta functions or perhaps incorporating some form of collision broadening through a Lorentzian shape and the distribution functions are kept in the equilibrium Fermi Dirac form The most familiar field of

nonequilibrium transport at least for the semiconductor world is that of hot carriers in semiconductors

Crystalline Semiconducting Materials and Devices Paul N. Butcher, Norman H. March, Mario P. Tosi, 2013-11-11 This book is concerned primarily with the fundamental theory underlying the physical and chemical properties of crystalline semiconductors After basic introductory material on chemical bonding electronic band structure phonons and electronic transport some emphasis is placed on surface and interfacial properties as well as effects of doping with a variety of impurities Against this background the use of such materials in device physics is examined and aspects of materials preparation are discussed briefly The level of presentation is suitable for postgraduate students and research workers in solid state physics and chemistry materials science and electrical and electronic engineering Finally it may be of interest to note that this book originated in a College organized at the International Centre for Theoretical Physics Trieste in Spring 1984 P N Butcher N H March M P Tosi vii Contents 1 Bonds and Bands in Semiconductors 1 E Mooser 1 1 Introduction 1 2 The Semiconducting Bond 2 1 3 Bond Approach Versus Band Model 6 1 4 Construction of the Localized X by Linear Combination of n Atomic Orbitals 13 1 5 The General Octet Rule 23 1 6 The Aufbau Principle of the Crystal Structure of Semiconductors 26 1 7 A Building Principle for Polyanionic Structures 29 I H Structural Sorting 39 1 9 Chemical Bonds and Semiconductivity in Transition Element Compounds 46 1 10 Conclusion 53 References 54 2 Electronic Band Structure 55 G Grosso 2 1 Two Different Strategies for Band Structure Calculations 55 2 2 The Tight Binding Method

Introduction to Cluster Dynamics Paul-Gerhard Reinhard, Eric Suraud, 2003-12-19 Cluster als mesoskopische Teilchen bilden das Bindeglied zwischen der Atom und Molekülphysik auf der einen und der Physik der kondensierten Materie auf der anderen Seite Die technische Entwicklung hin zu immer kleineren Dimensionen erfordert eine umfassende Kenntnis von Systemen die aus nur wenigen Teilchen bestehen Als Einführung in das Gebiet der Cluster Physik mit Ausrichtung auf die Clusterdynamik schließt das Buch eine Lücke in der vorhandenen Literatur Die Beschreibung der Clusterdynamik berücksichtigt sowohl aktuelle Entwicklungen in der Femtosekunden Spektroskopie als auch im Bereich der zeitabhängigen Dichtefunktionaltheorie

Modern Many-particle Physics: Atomic Gases, Nanostructures And Quantum Liquids (2nd Edition) Enrico Lipparini, 2008-02-01 This book is devoted to the description of Bosonic and Fermionic systems metallic clusters quantum dots wires rings and molecules trapped Fermi and Bose atoms liquid drops of Helium electron gas in different dimensions and geometries with and without magnetic fields Extensively updated with 200 extra pages the new edition of this successful book includes the field's cutting edge areas spin orbit coupling in heterostructures and spintronics the conductivity problem conductivity of quantum wires magnetoconductivity of nanostructures spin Hall conductivity atomic Fermi gases in traps non collinear local spin density approximation calculations and Brueckner Hartree Fock in finite size systems

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