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# *Introduction to the Theory of the Integer Quantum Hall Effect*



*Edited by János Hajdu*



# Introduction To The Theory Of The Integer Quantum Hall Effect

**Peter YU, Manuel Cardona**



## **Introduction To The Theory Of The Integer Quantum Hall Effect:**

**Introduction To The Theory To The Integer Quantum Hall Effect** O. Janßen, [Introduction to the Theory of the Integer Quantum Hall Effect](#) Martin Janßen, 1994-08-09 This book has been conceived as a multipurpose introduction and comprises three parts that can be viewed as independent units The reader can start at any level The first part chapters 2 3 A is intended to convey physical insight into the subject The next part chapters 4 8 presents linear response theory as a basic tool and gives various applications of the theory The final part chapters 9 12 develops modern aspects such as localization transition as a critical phenomenon and the methods of finite size scaling and multifractal analysis Experimental and theoretical physicists graduate students as well as experts in transport theory will discover new aspects and interesting perspectives on magneto transport

**The Quantum Hall Effect** Benoît Douçot, Vincent Pasquier, Vincent Rivasseau, 2006-01-20 The Poincar Seminar is held twice a year at the Institut Henri Poincar in Paris The goal of this seminar is to provide up to date information about general topics of great interest in physics Both the theoretical and experimental results are covered with some historical background Particular care is devoted to the pedagogical nature of the presentation This volume is devoted to the quantum Hall effect After a historical and general presentation by Nobel prize winner Klaus von Klitzing discoverer of this effect the volume proceeds with reviews on the mathematics and physics of both the integer and fractional case It includes up to date presentations of the tunneling and metrology experiments related to the quantum Hall effect It will serve the community of physicists and mathematicians at professional or graduate student level

**Perspectives in Quantum Hall Effects** Sankar Das Sarma, Aron Pinczuk, 2008-07-11 The discovery of the quantized and fractional Quantum Hall Effect phenomena is among the most important physics findings in the latter half of this century The precise quantization of the electrical resistance involved in the quantized Hall effect phenomena has led to the new definition of the resistance standard and has metrologically affected all of science and technology This resource consists of contributions from the top researchers in the field who present recent experimental and theoretical developments Each chapter is self contained and includes its own set of references guiding readers to original papers and further reading on the topic

**Fundamentals of Semiconductor** Peter YU, Manuel Cardona, 2013-11-11 Fundamentals of Semiconductors attempts to fill the gap between a general solid state physics textbook and research articles by providing detailed explanations of the electronic vibrational transport and optical properties of semiconductors The approach is physical and intuitive rather than formal and pedantic Theories are presented to explain experimental results This textbook has been written with both students and researchers in mind Its emphasis is on understanding the physical properties of Si and similar tetrahedrally coordinated semiconductors The explanations are based on physical insights Each chapter is enriched by an extensive collection of tables of material parameters figures and problems Many of these problems lead the student by the hand to arrive at the results

*Quantum Transport in Semiconductor Submicron Structures* B. Kramer, 2012-12-06 The

articles in this book have been selected from the lectures of a NATO Advanced Study Institute held at Bad Lauterberg Germany in August 1995 Internationally well known researchers in the field of mesoscopic quantum physics provide insight into the fundamental physics underlying the mesoscopic transport phenomena in structured semiconductor inversion layers In addition some of the most recent achievements are reported in contributed papers The aim of the volume is not to give an overview over the field Instead emphasis is on interaction and correlation phenomena that turn out to be of increasing importance for the understanding of the phenomena in the quantum Hall regime and in the transport through quantum dots The present status of the quantum Hall experiments and theory is reviewed As a key example for non Fermi liquid behavior the Luttinger liquid is introduced including some of the most recent developments It is not only of importance for the fractional quantum Hall effect but also for the understanding of transport in quantum wires Furthermore the chaotic and the correlation aspects of the transport in quantum dot systems are described The status of the experimental work in the area of persistent currents in semiconductor systems is outlined The construction of one of the first single electron transistors is reported The theoretical approach to mesoscopic transport presently a most active area is treated and some aspects of time dependent transport phenomena are also discussed     Quantum Metrology Ernst O. Goebel,Uwe Siegner,2015-06-10 The International System of Units SI is the world s most widely used system of measurement used every day in commerce and science and is the modern form of the metric system It currently comprises the meter m the kilogram kg the second s the ampere A the kelvin K the candela cd and the mole mol The system is changing though units and unit definitions are modified through international agreements as the technology of measurement progresses and as the precision of measurements improves The SI is now being redefined based on constants of nature and their realization by quantum standards Therefore the underlying physics and technologies will receive increasing interest and not only in the metrology community but in all fields of science This book introduces and explains the applications of modern physics concepts to metrology the science and the applications of measurements A special focus is made on the use of quantum standards for the realization of the forthcoming new SI the international system of units The basic physical phenomena are introduced on a level which provides comprehensive information for the experienced reader but also provides a guide for a more intense study of these phenomena for students     Group Theoretical Methods in Physics G.S Pogosyan,L.E Vincent,K.B Wolf,2005-05-01 Symmetry is permeating our understanding of nature Group theoretical methods of intrinsic interest to mathematics have expanded their applications from physics to chemistry and biology The ICGTMP Colloquia maintain the communication among the many branches into which this endeavor has bloomed Lie group and representation theory special functions foundations of quantum mechanics and elementary particle nuclear atomic and molecular physics are among the traditional subjects More recent areas include supersymmetry superstrings and quantum gravity integrability nonlinear systems and quantum chaos semigroups time asymmetry and resonances condensed matter and statistical physics Topics such as linear and nonlinear

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The New International System of Units (SI) Ernst O. Göbel, Uwe Siegner, 2019-05-29 The International System of Units the SI provides the foundation for all measurements in science engineering economics and society The SI has been fundamentally revised in 2019 The new SI is a universal and highly stable unit system based on invariable constants of nature Its implementation rests on quantum metrology and quantum standards which base measurements on the manipulation and counting of single quantum objects such as electrons photons ions and flux quanta This book explains and illustrates the new SI its impact on measurements and the quantum metrology and quantum technology behind it The book is based on the book Quantum Metrology Foundation of Units and Measurements by the same authors From the contents Measurement The SI Syst me International d Unit s Realization of the SI Second Thermal Beam Cs Clock Laser Cooling and the Cs Fountain Clock Flux Quanta Josephson Effect and the SI Volt Quantum Hall Effect the SI Ohm and the SI Farad Single Charge Transfer Devices and the SI Ampere The SI Kilogram the Mole and the Planck constant The SI Kelvin and the Boltzmann Constant Beyond the present SI Optical Clocks and Quantum Radiometry Outlook

**Gravitation and Cosmology: From the**

**Hubble Radius to the Planck Scale** Richard L. Amoroso, G. Hunter, Menas Kafatos, J.P. Vigiér, 2006-04-11 Jean Pierre Vigiér continually labeled one of les heretiques de la science l eternel resistant et le patriarche is yet a pillar of modern physics and mathematics with one leg firmly planted in theory and the other in empiricism spanning a career of nearly 60 years with a publication vitae quickly approaching 400 He wrote of his mentor Louis de Broglie Great physicists fight great battles which perhaps applies even more so to 1 Jean Pierre Vigiér himself If fortune allows a visit to Paris reported to be the city of love and certainly one of the most beautiful and interesting cities in the world one has been treated to a visual and cultural feast For example a leisurely stroll from the Musee du Louvre along the Champs Elysees to the Arc de Triomphe would instill even the least creative soul with the entelechies of a poets muse It is perhaps open to theoretical interpretation but if causal conditions have allowed one to be a physicist visiting Paris one may have taken opportunity to visit the portion of the old Latin quarter in place Jussieu where Pierre et Marie Curie Universite reported to be the best university in France is stationed

*Fundamentals of Semiconductors* Peter YU, Manuel Cardona, 2007-05-08 This third updated edition of Fundamentals of Semiconductors attempts to fill the gap between a general solid state physics textbook and research articles by providing detailed explanations of the electronic vibrational transport and optical properties of semiconductors The approach is physical and intuitive rather than formal and pedantic Theories are presented to explain experimental results This textbook has been written with both students and researchers in mind Its emphasis is on understanding the physical properties of Si and similar tetrahedrally coordinated semiconductors The explanations are based on physical insights Each chapter is

enriched by an extensive collection of tables of material parameters figures and problems Many of these problems lead the student by the hand to arrive at the results

**Physics of Zero- and One-Dimensional Nanoscopic Systems** Sachindra Nath Karmakar, Santanu Kumar Maiti, Chowdhury Jayeeta, 2007-09-04 In recent years submicron and nanoscale systems have featured strongly on the research agenda due to the technological progress and new physics that have emerged from studies of ultra small systems A fundamental understanding of basic physical phenomena on the mesoscopic and nanoscopic scales is required to exploit the technological potential offered by these exotic materials The present book contains review like chapters by some of the leading experts in the field covering topics such as the Kondo effect electron transport disorder and quantum coherence with electron electron interaction persistent current thermoelectric phenomena etc in quantum dots quantum wires carbon nanotubes and more This book will be valuable to researchers and students in condensed matter physics

**The Physics of the Two-Dimensional Electron Gas** J.T. Devreese, F.M. Peeters, 2012-12-06 The 1986

Advanced Study Institute on The Physics of the two Dimensional Electron Gas took place at the Conference Centre liTer Helme close to Oostende Belgium from June 2 till 16 1986 We were motivated to organize this Advanced Study Institute in view of the recent experimental and theoretical progress in the study of the two dimensional electron gas An additional motivation was our own theoretical interest in cyclotron resonance in two dimensional electron systems at our institute It is my pleasure to thank several instances and people who made this Advanced Study Institute possible First of all the sponsor of the Advanced Study Institute the NATO Scientific Committee Furthermore the co sponsors Agfa Gevaert Bell Telephone Mfg Co N V Burroughs Belgium Control Data Digital Equipment Corporation Esso Belgium European Research Office USA Kredietbank National Science Foundation USA Special thanks are due to the members of the Program Committee and the members of the Organizing Committee I would also like to thank Mrs H Evans for typing assistance

*The Quantum Hall Effects* Tapash Chakraborty, Pekka Pietiläinen, 1995-07-12 The Fractional Quantum Hall Effect presents a general survey of most of the theoretical work on the subject and briefly reviews the experimental results on the excitation gap Several new topics like anyons radiative recombinations in the fractional regime experimental work on the spin reversed quasi particles etc are added to render the monographic treatment up to date To complete the picture this second edition includes three chapters on the integral quantum Hall effect

**Composite Fermions, A Unified View Of The Quantum Hall Regime**

Olle G Heinonen, 1998-10-15 One of the most exciting recent developments to have emerged from the quantum Hall effect is the subject of composite fermions This important volume gives a self contained comprehensive description of the subject including fundamentals more advanced theoretical work and results from experimental observations of composite fermions

*Metrology and Fundamental Constants* International School of Physics "Enrico Fermi", 2007-10-26 This volume can be justified by the following three facts the need to provide from time to time a coordinated set of lectures which present the relevant progress in Metrology the increasing intertwining between Fundamental Physics and the practice of Metrological

Measurements and third the flurry of new and unexpected discoveries in this field with a correlated series of Nobel Prizes bestowed to individuals working in Fundamental Constants research and novel experimental methods One of the most fascinating and exciting characteristics of metrology is its intimate relationship between fundamental physics and the leading edge of technology which is needed to perform advanced and challenging experiments and measurements as well as the determination of the values and interrelations between the Fundamental Constants In some cases such as the caesium fountains clocks or the optical frequency standards the definition of the value of a quantity is in the laboratory in the region of  $10^{-16}$  and experiments are under way to reach  $10^{-18}$  Many of these results and the avenues leading to further advances are discussed in this volume along a major step in metrology expected in the near future which could change the old definition of the kilogram still based on a mechanical artefact toward a new definition resting on a fixed value of a fundamental constant

Basic Semiconductor Physics Chihiro Hamaguchi, 2017-11-27 The new edition of this textbook presents a detailed description of basic semiconductor physics The text covers a wide range of important phenomena in semiconductors from the simple to the advanced Four different methods of energy band calculations in the full band region are explained local empirical pseudopotential non local pseudopotential KP perturbation and tight binding methods The effective mass approximation and electron motion in a periodic potential Boltzmann transport equation and deformation potentials used for analysis of transport properties are discussed Further the book examines experiments and theoretical analyses of cyclotron resonance in detail Optical and transport properties magneto transport two dimensional electron gas transport HEMT and MOSFET and quantum transport are reviewed while optical transition electron phonon interaction and electron mobility are also addressed Energy and electronic structure of a quantum dot artificial atom are explained with the help of Slater determinants The physics of semiconductor lasers is also described including Einstein coefficients stimulated emission spontaneous emission laser gain double heterostructures blue lasers optical confinement laser modes and strained quantum well lasers offering insights into the physics of various kinds of semiconductor lasers In this third edition energy band calculations in full band zone with spin orbit interaction are presented showing all the matrix elements and equipping the reader to prepare computer programs of energy band calculations The Luttinger Hamiltonian is discussed and used to analyze the valence band structure Numerical calculations of scattering rate relaxation time and mobility are presented for typical semiconductors which are very helpful for understanding of transport Energy band structures and effective masses of nitrides such as GaN InN AlN and their ternary alloys are discussed because they are very important materials for the blue light emission and high power devices with and high frequency Learning and teaching with this textbook is supported by problems and solutions in the end of the chapters The book is written for bachelor and upper undergraduate students of physics and engineering

**Symmetries in Science XI** Bruno Gruber, Giuseppe Marmo, Naotaka Yoshinaga, 2005-12-27 This book is a collection of reviews and essays about the recent developments in the area of Symmetries and applications of Group

Theory Contributions have been written mostly at the graduate level but some are accessible to advanced undergraduates. The book is of interest to a wide audience and covers a broad range of topics with a strong degree of thematical unity. The book is part of a Series of books on Symmetries in Science and may be compared to the published Proceedings of the Colloquia on Group Theoretical Methods in Physics. Here however prevails a distinguished character for presenting extended reviews on present applications to Science not restricted to Theoretical Physics.

Statistical Field Theories Andrea Cappelletti, Giuseppe Mussardo, 2012-12-06 Recent developments in theoretical physics include new instances of the unification of quite different phenomena. The theoretical community is challenged by the growing interactions between high energy physics, statistical physics and condensed matter physics. The common language though is exact solutions of two dimensional and conformable field theories. This volume is a faithful representation of this interdisciplinary domain. Conformable and integrable field theories have been active research topics for several decades. The main recent developments concern the boundary effects and applications to disordered systems. The number of applications of the exact methods to condensed matter problems has been growing over the years. Nowadays it is widely recognized that strongly interacting systems in low dimensions can be successfully described by integrable and conformable theories. This volume is an indispensable aid to those seeking to find their way in this domain.

*Recent Progress In Many-body Theories - Proceedings Of The 12th International Conference* Joseph Carlson, Gerardo Ortiz, 2006-07-25 Quantum many body theory has greatly expanded its scope and depth over the past few years treating more deeply long standing issues like phase transitions and strongly correlated systems and simultaneously expanding into new areas such as cold atom physics and quantum information. This collection of contributions highlights recent advances in all these areas by leaders in their respective fields. Also included are some historic perspectives by L P Gor'kov and S T Belyaev. Feenberg Medal Recipients at this conference and Nobel Laureate P W Anderson gives his unique outlook on the future of physics. The volume covers the key topics in many body theory tied together through advances in theoretical tools and computational techniques and a unifying theme of fundamental approaches to quantum many body physics.



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## **Table of Contents Introduction To The Theory Of The Integer Quantum Hall Effect**

1. Understanding the eBook Introduction To The Theory Of The Integer Quantum Hall Effect
  - The Rise of Digital Reading Introduction To The Theory Of The Integer Quantum Hall Effect
  - Advantages of eBooks Over Traditional Books
2. Identifying Introduction To The Theory Of The Integer Quantum Hall Effect
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Introduction To The Theory Of The Integer Quantum Hall Effect
  - User-Friendly Interface
4. Exploring eBook Recommendations from Introduction To The Theory Of The Integer Quantum Hall Effect
  - Personalized Recommendations
  - Introduction To The Theory Of The Integer Quantum Hall Effect User Reviews and Ratings
  - Introduction To The Theory Of The Integer Quantum Hall Effect and Bestseller Lists
5. Accessing Introduction To The Theory Of The Integer Quantum Hall Effect Free and Paid eBooks
  - Introduction To The Theory Of The Integer Quantum Hall Effect Public Domain eBooks
  - Introduction To The Theory Of The Integer Quantum Hall Effect eBook Subscription Services
  - Introduction To The Theory Of The Integer Quantum Hall Effect Budget-Friendly Options

6. Navigating Introduction To The Theory Of The Integer Quantum Hall Effect eBook Formats
  - ePub, PDF, MOBI, and More
  - Introduction To The Theory Of The Integer Quantum Hall Effect Compatibility with Devices
  - Introduction To The Theory Of The Integer Quantum Hall Effect Enhanced eBook Features
7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Introduction To The Theory Of The Integer Quantum Hall Effect
  - Highlighting and Note-Taking Introduction To The Theory Of The Integer Quantum Hall Effect
  - Interactive Elements Introduction To The Theory Of The Integer Quantum Hall Effect
8. Staying Engaged with Introduction To The Theory Of The Integer Quantum Hall Effect
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Introduction To The Theory Of The Integer Quantum Hall Effect
9. Balancing eBooks and Physical Books Introduction To The Theory Of The Integer Quantum Hall Effect
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Introduction To The Theory Of The Integer Quantum Hall Effect
10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Introduction To The Theory Of The Integer Quantum Hall Effect
  - Setting Reading Goals Introduction To The Theory Of The Integer Quantum Hall Effect
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Introduction To The Theory Of The Integer Quantum Hall Effect
  - Fact-Checking eBook Content of Introduction To The Theory Of The Integer Quantum Hall Effect
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
  - Integration of Multimedia Elements

- Interactive and Gamified eBooks

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