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KEY=HALL - RIVERA SAIGE

The Quantum Hall Effect

Springer Science & Business Media After a foreword by Klaus von Klitzing, the first chapters of this book discuss the prehistory and the theoretical basis as well as the implications of the discovery of the Quantum Hall effect on superconductivity, superfluidity, and metrology, including experimentation. The second half of this volume is concerned with the theory of and experiments on the many body problem posed by fractional effect. Specific unsolved problems are mentioned throughout the book and a summary is made in the final chapter. The quantum Hall effect was discovered on about the hundredth anniversary of Hall's original work, and the finding was announced in 1980 by von Klitzing, Dorda and Pepper. Klaus von Klitzing was awarded the 1985 Nobel prize in physics for this discovery.

Quantum Physics

A Text for Graduate Students

Springer Science & Business Media Develops quantum theory from its basic assumptions, beginning with statics, followed by dynamics and details of applications and the needed computational techniques. Most of the book deals with particle systems, as that is where most of the applications lie; the treatment of quantum field theory is confined to fundamental ideas and their consequences.

The Quantum Hall Effect

Springer Science & Business Media analyze the Hall effect in the plateau region relative to the fundamental value 2 h/e i expected in the simple one-electron picture for integer filling factors of Landau levels. Subsequent work in my laboratory in Wiirzburg using a super conducting solenoid confirmed the constancy of the Hall resistance both in Dorda's samples and in samples supplied by M. Pepper of the Cavendish Laboratory. With technical assistance from the Physikalisch-Technische Bundesanstalt in Braunschweig, an absolute measurement of the Hall resistance confirmed the 2 fundamental quantization relation RIJ = h/ei to an accuracy of about 1 part in]05. Recalling the practical applications of the Josephson effect, my initial thinking was oriented toward the idea of a resistance standard, but various groups at national laboratories which are involved in high precision measurements of fun damental constants pointed out that, in addition, the quantized Hall resistance yields a new fundamental measure of the fine structure constant Ci. These then were the initial events which led to the remarkable surge of interest within both the metrology and condensed matter physics communities in quantum transport in inversion layer systems. Subsequent developments have been many and varied and are described in detail in this volume.

Interacting Electrons and Quantum Magnetism

Springer Science & Business Media In the excitement and rapid pace of developments, writing pedagogical texts has low priority for most researchers. However, in transforming my lecture l notes into this book, I found a personal benefit: the organization of what I understand in a (hopefully simple) logical sequence. Very little in this text is my original contribution. Most of the knowledge was collected from the research literature. Some was acquired by conversations with colleagues; a kind of physics oral tradition passed

between disciples of a similar faith. For many years, diagramatic perturbation theory has been the major theoretical tool for treating interactions in metals, semiconductors, itiner ant magnets, and superconductors. It is in essence a weak coupling expan sion about free quasiparticles. Many experimental discoveries during the last decade, including heavy fermions, fractional quantum Hall effect, high temperature superconductivity, and quantum spin chains, are not readily accessible from the weak coupling point of view. Therefore, recent years have seen vigorous development of alternative, nonperturbative tools for handling strong electron-electron interactions. I concentrate on two basic paradigms of strongly interacting (or con strained) quantum systems: the Hubbard model and the Heisenberg model. These models are vehicles for fundamental concepts, such as effective Ha miltonians, variational ground states, spontaneous symmetry breaking, and quantum disorder. In addition, they are used as test grounds for various nonperturbative approximation schemes that have found applications in diverse areas of theoretical physics.

Mathematical Physics of Quantum Mechanics

Selected and Refereed Lectures from QMath9

Springer This selection of outstanding articles – an outgrowth of the QMath9 meeting for young scientists – covers new techniques and recent results on spectral theory, statistical mechanics, Bose-Einstein condensation, random operators, magnetic Schrödinger operators and more. The book’s pedagogical style makes it a useful introduction to the research literature for postgraduate students. For more expert researchers it will serve as a concise source of modern reference.

Phase Transitions: Mathematics, Physics, Biology... - Proceedings Of The Conference

World Scientific In Search of Biohappiness deals with methods of converting agro-biodiversity hotspots into happy spots. This involves concurrent attention to conservation, and sustainable and equitable use. Bioresources constitute the feedstock for the biotechnology industry. The aim of the book is to promote an era of biohappiness based on the conversion of bioresources into jobs and income in an environmentally sustainable manner.The scope of Biohappiness extends to include all aspects of conservation such as in situ, ex situ and community conservation, and also covers conservation issues relating to mangroves and other coastal

bioresources, whose importance has grown with the emerging possibility of significant sea-level increase from global warming. Concrete examples of how local tribal families have taken to the establishment of gene, seed, grain and water banks in villages — thus linking conservation, cultivation, consumption and commerce in a mutually-reinforcing manner — are provided in this book.Since the first edition, biohappiness is now universally considered to be the major objective of research and development in the field of biodiversity. This edition brings the position up-to-date, and furthers the cause of biohappiness through the inclusion of a new section on its latest developments.

Partial Differential Operators and Mathematical Physics International Conference in Holzhau, Germany, July 3–9, 1994

Birkhäuser The book contains the contributions to the conference on "Partial Differential Equations" held in Holzhau (Germany) in July 1994, where outstanding specialists from analysis, geometry and mathematical physics reviewed recent progress and new interactions in these areas. Topics of special interest at the conference and which now form the core of this volume are hyperbolic operators, spectral theory for elliptic operators, eta-invariant, singular configura- tions and asymptotics, Bergman-kernel, attractors of non-autonomous evolution equations, pseudo-differential boundary value problems, Mellin pseudo- differential operators, approximation and stability problems for elliptic operators, and operator determinants. In spectral theory adiabatic and semiclassical limits, Dirichlet decoupling and domain perturbations, capacity of obstacles, limiting absorption problems, N-body scattering, and number of bound states are considered. Schrödinger operators are studied with magnetic fields, with random and with many-body potentials, and for nonlinear problems. In semigroup theory the Feller property, errors for product formulas, fractional powers of generators, and functional integration for relativistic semigroups are analyzed.

First European Congress of Mathematics Paris, July 6-10,

1992

Vol. II: Invited Lectures (Part 2)

Nelson Thornes Table of Contents: D. Duffie: Martingales, Arbitrage, and Portfolio Choice • J. Fröhlich: Mathematical Aspects of the Quantum Hall Effect • M. Giaquinta: Analytic and Geometric Aspects of Variational Problems for Vector Valued Mappings • U. Hamenstädt: Harmonic Measures for Leafwise Elliptic Operators Along Foliations • M. Kontsevich: Feynman Diagrams and Low-Dimensional Topology • S.B. Kuksin: KAM-Theory for Partial Differential Equations • M. Laczkovich: Paradoxical Decompositions: A Survey of Recent Results • J.-F. Le Gall: A Path-Valued Markov Process and its Connections with Partial Differential Equations • I. Madsen: The Cyclotomic Trace in Algebraic K-Theory • A.S. Merkurjev: Algebraic K-Theory and Galois Cohomology • J. Nekovár: Values of L-Functions and p-Adic Cohomology • Y.A. Neretin: Mantles, Trains and Representations of Infinite Dimensional Groups • M.A. Nowak: The Evolutionary Dynamics of HIV Infections • R. Piene: On the Enumeration of Algebraic Curves - from Circles to Instantons • A. Quarteroni: Mathematical Aspects of Domain Decomposition Methods • A. Schrijver: Paths in Graphs and Curves on Surfaces • B. Silverman: Function Estimation and Functional Data Analysis • V. Strassen: Algebra and Complexity • P. Tukia: Generalizations of Fuchsian and Kleinian Groups • C. Viterbo: Properties of Embedded Lagrange Manifolds • D. Voiculescu: Alternative Entropies in Operator Algebras • M. Wodzicki : Algebraic K-Theory and Functional Analysis • D. Zagier: Values of Zeta Functions and Their Applications

Mathematical Physics 2000

World Scientific Mathematical physics has made enormous strides over the past few decades, with the emergence of many new disciplines and with revolutionary advances in old disciplines. One of the especially interesting features is the link between developments in mathematical physics and in pure mathematics. Many of the exciting advances in mathematics owe their origin to mathematical physics — superstring theory, for example, has led to remarkable progress in geometry — while very pure mathematics, such as number theory, has found unexpected applications. The beginning of a new millennium is an appropriate time to survey the present state of the field and look forward to likely advances in the future. In this book, leading experts give personal views on their subjects and on the wider field of mathematical physics. The topics covered range widely over the whole field, from quantum field

theory to turbulence, from the classical three-body problem to non-equilibrium statistical mechanics. Contents: Modern Mathematical Physics: What It Should Be (L D Faddeev)New Applications of the Chiral Anomaly (J Fröhlich & B Pedrini)Fluctuations and Entropy Driven Space–Time Intermittency in Navier–Stokes Fluids (G Gallavotti)Superstrings and the Unification of the Physical Forces (M B Green)Questions in Quantum Physics: A Personal View (R Haag)What Good are Quantum Field Theory Infinities? (R Jackiw)Constructive Quantum Field Theory (A Jaffe)Fourier's Law: A Challenge to Theorists (F Bonetto et al.)The “Corpuscular” Structure of the Spectra of Operators Describing Large Systems (R A Minlos)Vortex- and Magneto-Dynamics — A Topological Perspective (H K Moffatt)Gauge Theory: The Gentle Revolution (L O'Raifeartaigh)Random Matrices as Paradigm (L Pastur)Wavefunction Collapse as a Real Gravitational Effect (R Penrose)Schrödinger Operators in the Twenty-First Century (B Simon)The Classical Three-Body Problem — Where is Abstract Mathematics, Physical Intuition, Computational Physics Most Powerful? (H A Posch & W Thirring)Infinite Particle Systems and Their Scaling Limits (S R S Varadhan)Supersymmetry: A Personal View (B Zumino) Readership: Mathematicians and physicists. Keywords:London (GB);Proceedings;Congress;Mathematical Physics

Ludwig Faddeev Memorial Volume: A Life In Mathematical Physics

World Scientific Ludwig Faddeev is widely recognized as one of the titans of 20th century mathematical physics. His fundamental contributions to scattering theory, quantum gauge theories, and the theory of classical and quantum completely integrable systems played a key role in shaping modern mathematical physics. Ludwig Faddeev's major achievements include the solution of the three-body problem in quantum mechanics, the mathematical formulation of quantum gauge theories and corresponding Feynman rules, Hamiltonian and algebraic methods in mathematical physics, with applications to gauge theories with anomalies, quantum systems with constraints and solitons, the discovery of the algebraic structure of classical and quantum integrable systems and quantum groups, and solitons with the topology of knots. Faddeev's name is imprinted in many areas of mathematics and theoretical physics, including "Faddeev's equations" and "Faddeev's Green function" in scattering theory, "Faddeev-Popov ghosts" and "Faddeev-Popov determinant" in gauge theories, "Gardner-Faddeev-Zakharov bracket" for the KdV equation, "Faddeev-Zamolodchikov algebra" in quantum integrable systems, "Faddeev-Reshetikhin-Takhtajan construction" in the theory of quantum groups, knotted solitons in the "Skyrme-Faddeev model" and many others. Ludwig Faddeev founded the St. Petersburg school of modern mathematical physics and distinguished himself by serving the mathematics community for over three decades including his leadership of the International Mathematical Union in the period of 1986-1990. He was conferred numerous prizes and memberships of prestigious institutions in

recognition of the importance of his work. These include the Dannie Heineman Prize for Mathematical Physics, the Dirac Medal, the Max Planck Medal, the Shaw Prize and the Lomonosov Gold Medal among others. A gathering of contributions from some of the biggest names in mathematics and physics, this volume serves as a tribute to this legendary figure. Volume contributors include: Fields medalist Sir Michael Atiyah, Jürg Fröhlich, Roman Jackiw, Vladimir Korepin, Nikita Nekrasov, André Neveu, Alexander M Polyakov, Samson Shatashvili, Fedor Smirnov as well as Nobel laureates Frank Wilczek and C N Yang. "Ludwig and I had been good friends since the early 1970s. We had overlapping interests in several areas of physics. He was very powerful mathematically. I had written in several places that he should have shared the 1999 Nobel Prize in Physics with 't Hooft and Veltman" C N Yang, Nobel Laureate in Physics 1997 in Seoul. Faddeev with Baxter and Yang. 2005 in Tsinghua University. Left to right: Faddeev, Yang, Niemi and Ge.

Mathematical Methods of Many-Body Quantum Field Theory

CRC Press Mathematical Methods of Many-Body Quantum Field Theory offers a comprehensive, mathematically rigorous treatment of many-body physics. It develops the mathematical tools for describing quantum many-body systems and applies them to the many-electron system. These tools include the formalism of second quantization, field theoretical perturbation theo

Advances in Quantum Phenomena

Springer Science & Business Media Proceedings of a NATO ASI held in Erice, Sicily, February 16-18, 1994

Frontiers In Physics, High Technology And Mathematics - Ictp 25th Anniversary Conference

#N/A The International Centre for Theoretical Physics was founded in 1964 by Prof. Abdus Salam. To celebrate its 25th anniversary, a group of distinguished speakers was assembled to present overviews in Physics, High Technology and Mathematics with a look at the future. This Proceedings serves as a valuable record of this memorable occasion.

Modern Condensed Matter Physics

Cambridge University Press Comprehensive and accessible coverage from the basics to advanced topics in modern quantum condensed matter physics.

Physics Of Semiconductors, The - Proceedings Of The Xxi International Conference (In 2 Volumes)

World Scientific

On Three Levels

Micro-, Meso-, and Macro-Approaches in Physics

Springer Science & Business Media This volume contains the proceedings of a five-day NATO Advanced Research Workshop "On Three Levels, the mathematical physics of micro-, meso-, and macro phenomena," conducted from July 19 to 23 in Leuven, Belgium. The main purpose of the workshop was to bring together and to confront where relevant, classical and quantum approaches in the rigorous study of the relation between the various levels of physical description. The reader will find here discussions on a variety of topics involving a broad range of scales. For the micro-level, contributions are presented on models of reaction-diffusion pro cesses, quantum groups and quantum spin systems. The reports on quantum disorder, the quantum Hall effect, semi-classical approaches of wave mechanics and the random Schrodinger equation can be situated on the meso-level. Discussions on macroscopic quantum effects and large scale fluctuations are dealing with the macroscopic level of description. These three levels are however not independent and emphasis is put on relating these scales of description. This is especially the case for the contributions on kinetic and hydrodynamicallimits, the discussions on large deviations and the strong and weak coupling limits. The advisory board was composed of J.L. Lebowitz, J.T. Lewis and E.H. Lieb. The organizing committee was formed by Ph.A. Martin, G.L. Sewell, E.R. Speer and A.

The Spin

Poincaré Seminar 2007

Springer Science & Business Media This book is the eighth in a series of Proceedings for the S´ eminaire Poincar´ e, which is directed towards a large audience of physicists and of mathematicians. 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 aspects are covered, with some historical background. Inspired by the Bourbaki seminar in mathematics in its organization, hence nicknamed “Bourbaphy”, this Poincar´ e SeminarisheldattheInstitutHenriPoincar´ einParis,withcontributionsprepared inadvance.Particularcareisdevotedtothepedagogicalnatureofthepresentation so as to ful?ll the goal of being readable by a large audience of scientists. This new volume of the Poincar´ e Seminar series “The Spin” corresponds to the eleventh such Seminar, held on December 8, 2007. It describes how this once mysterious quantum reality called spin has become ubiquitous in modern physics from the most theoretical aspects down to the most practical applications of miniaturizing electronic and computer devices or helping medical diagnosis.

Non-perturbative Quantum Field Theory: Mathematical Aspects And Applications

World Scientific Compiled to illustrate the recent history of Quantum Field Theory and its trends, this collection of selected reprints by Jürg Fröhlich, a leading theoretician in the field, is a comprehensive guide of the more mathematical aspects of the subject. Results and methods of the past fifteen years are reviewed. The analytical methods employed are non-perturbative and, for the larger part, mathematically rigorous. Most articles are review articles surveying certain important developments in quantum field theory and guiding the reader towards the original literature.The volume begins with a comprehensive introduction by Jürg Fröhlich.The theory of phase transitions and continuous symmetry breaking is reviewed in the first section. The second section discusses the non-perturbative quantization of topological solitons. The third section is devoted to the study of gauge fields. A paper on the triviality of λϖ4 — theory in four and more dimensions is found in the fourth section, while the fifth contains two articles on “random geometry”.

The sixth and final part addresses topics in low-dimensional quantum field theory, including braid statistics, two-dimensional conformal field theory and an application to condensed matter theory.

Quantum Mechanics: Fundamentals

Springer Science & Business Media Quantum mechanics was already an old and solidly established subject when the first edition of this book appeared in 1966. The context in which a graduate text on quantum mechanics is studied today has changed a good deal, however. In 1966, most entering physics graduate students had a quite limited exposure to quan tum mechanics in the form of wave mechanics. Today the standard undergraduate curriculum contains a large dose of elementary quantum mechanics, and often intro duces the abstract formalism due to Dirac. Back then, the study of the foundations by theorists and experimenters was close to dormant, and very few courses spent any time whatever on this topic. At that very time, however, John Bell's famous theorem broke the ice, and there has been a great flowering ever since, especially in the laboratory thanks to the development of quantum optics, and more recently because of the interest in quantum computing. And back then, the Feynman path integral was seen by most as a very imaginative but rather useless formulation of quantum mechanics, whereas it now plays a large role in statistical physics and quantum field theory, especially in computational work. For these and other reasons, this book is not just a revision of the 1966 edition. It has been rewritten throughout, is differently organized, and goes into greater depth on many topics that were in the old edition.

Quantum Field Theory

A Modern Perspective

Springer Science & Business Media Quantum field theory, which started with Paul Dirac’s work shortly after the discovery of quantum mechanics, has produced an impressive and important array of results. Quantum electrodynamics, with its extremely accurate and well-tested predictions, and the standard model of electroweak and chromodynamic (nuclear) forces are examples of successful theories. Field theory has also been applied to a variety of phenomena in condensed matter physics, including superconductivity, superfluidity and the quantum Hall effect. The concept of the renormalization group has given us a new perspective on field theory in general and on critical phenomena in particular. At this stage, a strong case can be made that quantum field theory

is the mathematical and intellectual framework for describing and understanding all physical phenomena, except possibly for a quantum theory of gravity. Quantum Field Theory: A Modern Perspective presents Professor Nair's view of certain topics in field theory loosely knit together as it grew out of courses on field theory and particle physics taught at Columbia University and the City College of CUNY. The first few chapters, up to Chapter 12, contain material that generally goes into any course on quantum field theory, although there are a few nuances of presentation which readers may find to be different from other books. This first part of the book can be used for a general course on field theory, omitting, perhaps, the last three sections in Chapter 3, the last two in Chapter 8 and sections 6 and 7 in Chapter 10. The remaining chapters cover some of the more modern developments over the last three decades, involving topological and geometrical features. The introduction given to the mathematical basis of this part of the discussion is necessarily brief and should be accompanied by books on the relevant mathematical topics as indicated in the bibliography. Professor Nair also concentrates on developments pertinent to a better understanding of the standard model. There is no discussion of supersymmetry, supergravity, developments in field theory inspired by string theory, etc. There is also no detailed discussion of the renormalization group. Each of these topics would require a book in its own right to do justice to the topic. Quantum Field Theory: A Modern Perspective serves as a portal to so many more topics of detailed and ongoing research, referring readers to more detailed treatments for many specific topics. The book also contains extensive references, providing readers a more comprehensive perspective on the literature and the historical development of the subject. V. Parameswaran Nair is Professor of Physics at City College of The City University of New York (CUNY). Professor Nair has held Visiting Professorships at The Abdus Salam International Center for Theoretical Physics, Rockefeller University, Institute for Advanced Study at Princeton, and Massachusetts Institute of Technology.

Philosophers Look at Quantum Mechanics

Springer This edited volume explores the philosophical implications of quantum mechanics. It features papers from venues of the International Ontology Congress (IOC) up to 2016. IOC is a worldwide platform for dialogue and reflection on the interactions between science and philosophy. The collection features philosophers as well as physicists, including David Albert, Harvey Brown, Jeffrey Bub, Otávio Bueno, James Cushing, Steven French, Victor Gomez-Pin, Carl Hoefer, Simon Kochen, Peter Lewis, Tim Maudlin, Peter Mittlestatedt, Roland Omnès, Juha Saatsi, Albert Solé, David Wallace, and Anton Zeilinger. Since the early days of quantum mechanics, philosophers have studied the subject with growing technical skill and fruitfulness. Their efforts have unveiled intellectual bridges between physics and philosophy. These connections have helped fuel the contemporary debate about the scope and limits of realism and understanding in the interpretation of physical theories and scientific theories in general. The philosophical analysis of quantum

mechanics is now one of the most sophisticated and productive areas in contemporary philosophy, as the papers in this collection illustrate.

Geometry, Particles, and Fields

Springer Science & Business Media Geometry, Particles and Fields is a direct reprint of the first edition. From a review of the first edition: "The present volume is a welcome edition to the growing number of books that develop geometrical language and use it to describe new developments in particle physics...It provides clear treatment that is accessible to graduate students with a knowledge of advanced calculus and of classical physics...The second half of the book deals with the principles of differential geometry and its applications, with a mathematical machinery of very wide range. Here clear line drawings and illustrations supplement the multitude of mathematical definitions. This section, in its clarity and pedagogy, is reminiscent of Gravitation by Charles Misner, Kip Thorne and John Wheeler...Felsager gives a very clear presentation of the use of geometric methods in particle physics...For those who have resisted learning this new language, his book provides a very good introduction as well as physical motivation. The inclusion of numerous exercises, worked out, renders the book useful for independent study also. I hope this book will be followed by others from authors with equal flair to provide a readable excursion into the next step." PHYSICS TODAY Bjoern Felsager is a high school teacher in Copenhagen. Educated at the Niels Bohr Institute, he has taught at the Universities of Copenhagen and Odense.

Recent Developments in Quantum Mechanics

Proceedings of the Brasov Conference, Poiana Brasov 1989, Romania

Springer Science & Business Media Proceedings of the Brasov Conference, Poiana Brasov 1989, Romania

Introduction to Superstrings and M-Theory

Springer Science & Business Media Called by some "the theory of everything," superstrings may solve a problem which has eluded physicists for the past 50 years -- the final unification of the two great theories of the twentieth century, general relativity and quantum field theory. This is a course-tested comprehensive introductory graduate text on superstrings which stresses the most current areas of interest, not covered in other presentation, including: string field theory, multi loops, Teichmueller spaces, conformal field theory, and four-dimensional strings. The book begins with a simple discussion of point particle theory, and uses the Feynman path integral technique to unify the presentation of superstrings. Prerequisites are an aquaintance with quantum mechanics and relativity. This second edition has been revised and updated throughout.

Fractional Quantum Hall Effects: New Developments

World Scientific The fractional quantum Hall effect has been one of the most active areas of research in quantum condensed matter physics for nearly four decades, serving as a paradigm for unexpected and exotic emergent behavior arising from interactions. This book, featuring a collection of articles written by experts and a Foreword by Klaus von Klitzing, the discoverer of quantum Hall effect and winner of 1985 Nobel Prize in physics, aims to provide a coherent account of the exciting new developments and the current status of the field.

The Routledge Companion to Philosophy of Physics

Routledge The Routledge Companion to Philosophy of Physics is a comprehensive and authoritative guide to the state of the art in the philosophy of physics. It comprisess 54 self-contained chapters written by leading philosophers of physics at both senior and junior levels, making it the most thorough and detailed volume of its type on the market – nearly every major perspective in the field is represented. The Companion’s 54 chapters are organized into 12 parts. The first seven parts cover all of the major physical theories investigated by philosophers of physics today, and the last five explore key themes that unite the study of these theories. I. Newtonian Mechanics II. Special Relativity III. General Relativity IV. Non-Relativistic Quantum Theory V. Quantum Field Theory VI. Quantum Gravity VII. Statistical Mechanics and Thermodynamics VIII. Explanation IX. Intertheoretic Relations X. Symmetries XI. Metaphysics XII. Cosmology The difficulty level of the chapters has been carefully pitched so as to offer both accessible summaries for

those new to philosophy of physics and standard reference points for active researchers on the front lines. An introductory chapter by the editors maps out the field, and each part also begins with a short summary that places the individual chapters in context. The volume will be indispensable to any serious student or scholar of philosophy of physics.

High Magnetic Field Science and Its Application in the United States

Current Status and Future Directions

National Academies Press The Committee to Assess the Current Status and Future Direction of High Magnetic Field Science in the United States was convened by the National Research Council in response to a request by the National Science Foundation. This report answers three questions: (1) What is the current state of high-field magnet science, engineering, and technology in the United States, and are there any conspicuous needs to be addressed? (2) What are the current science drivers and which scientific opportunities and challenges can be anticipated over the next ten years? (3) What are the principal existing and planned high magnetic field facilities outside of the United States, what roles have U.S. high field magnet development efforts played in developing those facilities, and what potentials exist for further international collaboration in this area? A magnetic field is produced by an electrical current in a metal coil. This current exerts an expansive force on the coil, and a magnetic field is "high" if it challenges the strength and current-carrying capacity of the materials that create the field. Although lower magnetic fields can be achieved using commercially available magnets, research in the highest achievable fields has been, and will continue to be, most often performed in large research centers that possess the materials and systems know-how for forefront research. Only a few high field centers exist around the world; in the United States, the principal center is the National High Magnetic Field Laboratory (NHMFL). High Magnetic Field Science and Its Application in the United States considers continued support for a centralized high-field facility such as NHFML to be the highest priority. This report contains a recommendation for the funding and siting of several new high field nuclear magnetic resonance magnets at user facilities in different regions of the United States. Continued advancement in high-magnetic field science requires substantial investments in magnets with enhanced capabilities. High Magnetic Field Science and Its Application in the United States contains recommendations for the further development of all-superconducting, hybrid, and higher field pulsed magnets that meet ambitious but achievable goals.

New Symmetry Principles in Quantum Field Theory

Springer Science & Business Media Soon after the discovery of quantum mechanics, group theoretical methods were used extensively in order to exploit rotational symmetry and classify atomic spectra. And until recently it was thought that symmetries in quantum mechanics should be groups. But it is not so. There are more general algebras, equipped with suitable structure, which admit a perfectly conventional interpretation as a symmetry of a quantum mechanical system. In any case, a "trivial representation" of the algebra is defined, and a tensor product of representations. But in contrast with groups, this tensor product needs to be neither commutative nor associative. Quantum groups are special cases, in which associativity is preserved. The exploitation of such "Quantum Symmetries" was a central theme at the Ad vanced Study Institute. Introductory lectures were presented to familiarize the participants with the al gebras which can appear as symmetries and with their properties. Some models of local field theories were discussed in detail which have some such symmetries, in par ticular conformal field theories and their perturbations. Lattice models provide many examples of quantum theories with quantum symmetries. They were also covered at the school. Finally, the symmetries which are the cause of the solubility of inte grable models are also quantum symmetries of this kind. Some such models and their nonlocal conserved currents were discussed.

Quantum Simulators

IOS Press The last century has been characterized by the development of information theory and the consequent transformative impact of new technologies on societies around the world. It seems likely that the tremendous progress in nanoscience – the ability to manipulate microscopic systems at the level of a single atom – and the emergence of quantum information science, will be the key components of the next revolution; that of the new quantum technologies. Indeed, the ability to manipulate and control quantum systems has already found a variety of potential applications, ranging from the development of molecular nanoscale machines which exploit quantum coherence for their functioning, to metrological schemes where quantum effects are used to enhance the accuracy of measurement and detection systems to achieve higher statistical precision than is possible using purely classical approaches. This book presents the proceedings of the Enrico Fermi Summer School on Quantum Simulators (Course 198) held in Varenna, Italy, 22-27 July 2016. Topics covered included: cold atoms in optical lattices; trapped ions; solid state implementations; quantum many-body physics; quantum photonics; hybrid quantum systems; and transport phenomena. The book will be of interest to all those whose work is connected to the rapidly growing field of quantum technologies.

Modern Semiconductor Physics and Device Applications

CRC Press This textbook provides a theoretical background for contemporary trends in solid-state theory and semiconductor device physics. It discusses advanced methods of quantum mechanics and field theory and is therefore primarily intended for graduate students in theoretical and experimental physics who have already studied electrodynamics, statistical physics, and quantum mechanics. It also relates solid-state physics fundamentals to semiconductor device applications and includes auxiliary results from mathematics and quantum mechanics, making the book useful also for graduate students in electrical engineering and material science. Key Features: Explores concepts common in textbooks on semiconductors, in addition to topics not included in similar books currently available on the market, such as the topology of Hilbert space in crystals Contains the latest research and developments in the field Written in an accessible yet rigorous manner

Lie Theory and Its Applications in Physics

Varna, Bulgaria, June 2015

Springer This volume presents modern trends in the area of symmetries and their applications based on contributions from the workshop "Lie Theory and Its Applications in Physics", held near Varna, Bulgaria, in June 2015. Traditionally, Lie theory is a tool to build mathematical models for physical systems.Recently, the trend has been towards geometrization of the mathematical description of physical systems and objects. A geometric approach to a system yields in general some notion of symmetry, which is very helpful in understanding its structure. Geometrization and symmetries are employed in their widest sense, embracing representation theory, algebraic geometry, number theory, infinite-dimensional Lie algebras and groups, superalgebras and supergroups, groups and quantum groups, noncommutative geometry, symmetries of linear and nonlinear partial differential operators (PDO), special functions, and others. Furthermore, the necessary tools from functional analysis are included.“div>This is a large interdisciplinary and interrelated field, and the present volume is suitable for a broad audience of mathematicians, mathematical physicists, and theoretical physicists, including researchers and graduate students interested in Lie Theory.

Fluctuating geometries in statistical mechanics and field theory

North-Holland Hardbound. This session of was organized with two principal purposes. Firstly to introduce a common language and culture to a mixed audience, composed of field theorists, string theorists, condensed matter physicists and statistical mechanicians. Secondly, to expose young researchers to the recent advances in various areas of theoretical physics, where the concepts of extended objects, geometry and fluctuations are currently playing an important role.Courses included an introduction to the problem of random paths in disordered media; theoretical and numerical approaches to quantized geometries, from random paths to surfaces/strings to four-dimensional gravity; physics of amphiphilic membranes and the models of random surfaces used to describe them; defects in various physical systems; recent developments on the formulation of two-dimensional gauge theories as string theories. Problems of condensed matter physics were surveyed and a seminar on the renor

Laser Cooling and Trapping

Springer Science & Business Media Intended for advanced undergraduates and beginning graduates with some basic knowledge of optics and quantum mechanics, this text begins with a review of the relevant results of quantum mechanics, before turning to the electromagnetic interactions involved in slowing and trapping atoms and ions, in both magnetic and optical traps. The concluding chapters discuss a broad range of applications, from atomic clocks and studies of collision processes, to diffraction and interference of atomic beams at optical lattices and Bose-Einstein condensation.

Unification and Supersymmetry

The Frontiers of Quark-Lepton Physics

Springer Science & Business Media Derived from a course given at the University of Maryland for advanced graduate students, this book deals with some of the latest developments in our attempts to construct a unified theory of the fundamental interactions of

nature. Among the topics covered are spontaneous symmetry breaking, grand unified theories, supersymmetry, and supergravity. the book starts with a quick review of elementary particle theory and continues with a discussion of composite quarks, leptons, Higgs bosons, and CP violation; it concludes with consideration of supersymmetric unification schemes, in which bosons and leptons are considered in some sense equivalent. The third edition will be completely revised and brought up to date, particularly by including discussions of the many experimental developments in recent years.

Quantum Field Theory of Many-Body Systems

From the Origin of Sound to an Origin of Light and Electrons

OUP Oxford For most of the last century, condensed matter physics has been dominated by band theory and Landau's symmetry breaking theory. In the last twenty years, however, there has been the emergence of a new paradigm associated with fractionalisation, topological order, emergent gauge bosons and fermions, and string condensation. These new physical concepts are so fundamental that they may even influence our understanding of the origin of light and fermions in the universe. This book is a pedagogical and systematic introduction to the new concepts and quantum field theoretical methods (which have fuelled the rapid developments) in condensed matter physics. It discusses many basic notions in theoretical physics which underlie physical phenomena in nature. Topics covered are dissipative quantum systems, boson condensation, symmetry breaking and gapless excitations, phase transitions, Fermi liquids, spin density wave states, Fermi and fractional statistics, quantum Hall effects, topological and quantum order, spin liquids, and string condensation. Methods covered are the path integral, Green's functions, mean-field theory, effective theory, renormalization group, bosonization in one- and higher dimensions, non-linear sigma-model, quantum gauge theory, dualities, slave-boson theory, and exactly soluble models beyond one-dimension. This book is aimed at teaching graduate students and bringing them to the frontiers of research in condensed matter physics.

American Journal of Physics

The Physics of Semiconductors

An Introduction Including Nanophysics and Applications

Springer The 3rd edition of this successful textbook contains ample material for a comprehensive upper-level undergraduate or beginning graduate course, guiding readers to the point where they can choose a special topic and begin supervised research. The textbook provides a balance between essential aspects of solid-state and semiconductor physics, on the one hand, and the principles of various semiconductor devices and their applications in electronic and photonic devices, on the other. It highlights many practical aspects of semiconductors such as alloys, strain, heterostructures, nanostructures, that are necessary in modern semiconductor research but typically omitted in textbooks. Coverage also includes additional advanced topics, such as Bragg mirrors, resonators, polarized and magnetic semiconductors, nanowires, quantum dots, multi-junction solar cells, thin film transistors, carbon-based nanostructures and transparent conductive oxides. The text derives explicit formulas for many results to support better understanding of the topics. The Physics of Semiconductors requires little or no prior knowledge of solid-state physics and evolved from a highly regarded two-semester course. In the third edition several topics are extended and treated in more depth including surfaces, disordered materials, amorphous semiconductors, polarons, thermopower and noise. More than 1800 references guide the reader to historic and current literature including original and review papers and books.

Quantum Hall Effect

World Scientific This book is a compilation of major reprint articles on one of the most intriguing phenomena in modern physics: the quantum Hall effect. Together with a detailed introduction by the editor, this volume serves as a stimulating and valuable reference for students and research workers in condensed matter physics and for those with a particle physics background. The papers have been chosen with the intention of emphasizing the topological aspects of the quantum Hall effect and its connections with other branches of theoretical physics, such as topological quantum field theories and string theory. The contents include sections on integer effect, fractional effect, effect of global topology, effective theories, edge states and non-Abelian statistics.

Modern Perspectives In Many-body Physics: Proceedings Of The Sixth Physics Summer School

World Scientific

Quantum Theory of Many-Body Systems

Techniques and Applications

Springer Science & Business Media Intended for graduates in physics and related fields, this is a self-contained treatment of the physics of many-body systems from the point of view of condensed matter. The approach, quite traditionally, covers all the important diagram techniques for normal and superconducting systems, including the zero-temperature perturbation theory, and the Matsubara, Keldysh, and Nambu-Gorov formalisms. The aim is not to be exhaustive, but to present just enough detail to enable students to follow the current research literature or to apply the techniques to new problems. Many of the examples are drawn from mesoscopic physics, which deals with systems small enough that quantum coherence is maintained throughout the volume, and which therefore provides an ideal testing ground for many-body theories. '