Quantum Field Theory In Condensed Matter Physics Theoretical And Mathematical Physics

Quantum Field Theory of Many-Body SystemsIntroduction to Effective Field TheoryRelativistic Quantum Field TheoryDynamical Symmetry Breaking In Quantum Field TheoriesQuantum Field Theory and TopologyLow-Dimensional Quantum Field Theories for Condensed Matter PhysicistsLow-dimensional Quantum Field Theories for Condensed Matter PhysicistsAn Introduction To Quantum Field TheoryQuantum Field Theory in a NutshellQuantum Field Theory IiQuantum Field TheoryQuantum Field Theory in Strongly Correlated Electronic SystemsIntroduction to Quantum Field TheoryLectures on Field Theory and TopologyQuantum Field TheoryMany-Body Quantum Theory in Condensed Matter PhysicsStatistical Physics of FieldsField Theories for Low-Dimensional Condensed Matter SystemsField Theories of Condensed Matter PhysicsStrongly Coupled Field Theories for Condensed Matter and Quantum Information TheoryQuantum Field TheoryLecture Notes on Field Theory in Condensed Matter PhysicsField Theory of Non-Equilibrium SystemsA Modern Introduction to Quantum Field TheoryCondensed Matter Field TheoryQuantum Field Theory in Condensed Matter PhysicsQuantum Field Theory and the Standard ModelNonequilibrium Quantum Field TheoryIntroduction to Classical and Quantum Field TheoryQuantum Field Theory and Critical PhenomenaThe Quantum Theory of FieldsQuantum Field Theory in Condensed

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Quantum Field Theory of Many-Body Systems

A fully updated edition of the classic text by acclaimed physicist A. Zee Since it was first published, Quantum Field Theory in a Nutshell has quickly established itself as the most accessible and comprehensive introduction to this profound and deeply fascinating area of theoretical physics. Now in this fully revised and expanded edition, A. Zee covers the latest advances while providing a solid conceptual foundation for students to build on, making this the most up-to-date and modern textbook on quantum field theory available. This expanded edition features several additional chapters, as well as an entirely new section describing recent developments in quantum field theory such as gravitational waves, the helicity spinor formalism, on-shell gluon scattering, recursion relations for amplitudes with complex momenta, and the hidden connection between Yang-Mills theory and Einstein gravity. Zee also provides added exercises, explanations, and examples, as well as detailed appendices, solutions to selected exercises, and suggestions for further reading. The most accessible and comprehensive introductory textbook available Features a fully revised, updated, and expanded text Covers the latest exciting advances in the field Includes new exercises Offers a one-of-a-kind resource for students and researchers Leading universities that have adopted this book include: Arizona State University Boston University Brandeis University Brown University California Institute of Technology Carnegie Mellon College of William & Mary Cornell Harvard University Massachusetts Institute of Technology Northwestern University Ohio State University Princeton University Purdue University - Main Campus Rensselaer Polytechnic Institute Rutgers University - New Brunswick Stanford University University of California - Berkeley University of Central Florida University of Chicago University of Michigan University of Montreal University of Notre Dame Vanderbilt University Virginia Tech University

Introduction to Effective Field Theory

The physics of non-equilibrium many-body systems is one of the most rapidly expanding areas of theoretical physics. Traditionally used in the study of laser physics and superconducting kinetics, these techniques have more recently found applications in the study of dynamics of cold atomic gases, mesoscopic and nano-mechanical systems. The book gives a self-contained presentation of the modern functional approach to non-equilibrium field-theoretical methods. They are applied to examples ranging from biophysics to the kinetics of superfluids and superconductors. Its step-by-step treatment gives particular emphasis to the pedagogical aspects, making it ideal as a reference for advanced graduate students and researchers in condensed matter physics.

Relativistic Quantum Field Theory

This book is especially addressed to young researchers in theoretical physics with a basic background in Field Theory and Condensed Matter Physics. The topics were chosen so as to offer the largest possible overlap between the two expertises, selecting a few key problems in Condensed Matter Theory which have been recently revisited within a field-theoretic approach. The presentation of the material is aimed not only at providing the reader with an overview of this exciting frontier area of modern theoretical physics, but also at elucidating most of the tools needed for a technical comprehen sion of the many papers appearing in current issues of physics journals and, hopefully, to enable the reader to tackle research problems in this area of physics. This makes the material a live creature: while not pretending it to be exhaustive, it is tutorial enough to be useful to young researchers as a starting point in anyone of the topics covered in the book.

Dynamical Symmetry Breaking In Quantum Field Theories

This modern text combines fundamental principles with advanced topics and recent techniques in a rigorous and self-contained treatment of quantum field theory.Beginning with a review of basic principles, starting with quantum mechanics and special relativity, students can refresh their knowledge of elementary aspects of quantum field theory and perturbative calculations in the Standard Model. Results and tools relevant to many applications are covered, including canonical quantization, path integrals, non-Abelian gauge theories, and the renormalization group. Advanced topics are explored, with detail given on effective field theories, quantum anomalies, stable extended field configurations, lattice field theory, and field theory at a finite temperature or in the strong field regime. Two chapters are dedicated to new methods for calculating scattering amplitudes (spinor-helicity, on-shell recursion, and generalized unitarity), equipping students with practical skills for research. Accessibly written, with numerous worked examples and end-of-chapter problems, this is an essential text for graduate students. The breadth of coverage makes it an equally excellent reference for researchers.

Quantum Field Theory and Topology

The application of field theoretic techniques to problems in condensed matter physics has generated an array of concepts and mathematical techniques to attack a range of problems such as the theory of quantum phase transitions, the quantum

Hall effect, and quantum wires. While concepts such as the renormalization group, topology, and bosonization h

Low-Dimensional Quantum Field Theories for Condensed Matter Physicists

Wilson lines (also known as gauge links or eikonal lines) can be introduced in any gauge field theory. Although the concept of the Wilson exponentials finds an enormously wide range of applications in a variety of branches of modern quantum field theory, from condensed matter and lattice simulations to quantum chromodynamics, high-energy effective theories and gravity, there are surprisingly few books or textbooks on the market which contain comprehensive pedagogical introduction and consecutive exposition of the subject. The objective of this book is to get the potential reader acquainted with theoretical and mathematical foundations of the concept of the Wilson loops in the context of modern quantum field theory, to teach him/her to perform independently some elementary calculations with Wilson lines, and to familiarize him/her with the recent development of the subject in different important areas of research. The target audience of the book consists of graduate and postgraduate students working in various areas of quantum field theory, as well as researchers from other fields.

Low-dimensional Quantum Field Theories for Condensed Matter Physicists

This is the first introductory textbook on quantum field theory to be written from the point of view of condensed matter physics. As such, it presents the basic concepts and techniques of statistical field theory, clearly explaining how and why they are integrated into modern (and classical) field theory, and includes the latest developments. Written by an expert in the field, with a broad experience in teaching and training, it manages to present such substantial topics as phases and phase transitions or solitons and instantons in an accessible and concise way. Divided into two parts, the first covers fundamental physics and the mathematics background needed by students in order to enter the field, while the second part discusses applications of quantum field theory to a few basic problems. The emphasis here lies on how modern concepts of quantum field theory are embedded in these approaches, and also on the limitations of standard quantum field theory techniques in facing 'real' physics problems. Throughout, there are numerous end-of-chapter problems, and a free solutions manual is available for lecturers.

An Introduction To Quantum Field Theory

Presenting the physics of the most challenging problems in condensed matter using the conceptual framework of quantum field theory, this book is of great interest to physicists in condensed matter and high energy and string theorists, as well as mathematicians. Revised and updated, this second edition features new chapters on the renormalization group, the Luttinger liquid, gauge theory, topological fluids, topological insulators and quantum entanglement. The book begins with the basic concepts and tools, developing them gradually to bring readers to the issues currently faced at the frontiers of research, such as topological phases of matter, quantum and classical critical phenomena, quantum Hall effects and superconductors. Other topics covered include one-dimensional strongly correlated systems, quantum ordered and disordered phases, topological structures in condensed matter and in field theory and fractional statistics.

Quantum Field Theory in a Nutshell

Independent electrons and static crystals -- Vibrating crystals -- Interacting electrons -- Interactions in action -- Functional formulation of quantum field theory -- Quantum fields in action -- Symmetries: explicit or secret -- Classical topological excitations -- Quantum topological excitations -- Duality, bosonization and generalized statistics -- Statistical transmutation -- Pseudo quantum electrodynamics -- Quantum field theory methods in condensed matter -- Metals, Fermi liquids, Mott and Anderson insulators -- The dynamics of polarons --

Polyacetylene -- The Kondo effect -- Quantum magnets in 1D: Fermionization, bosonization, Coulomb gases and 'all that' -- Quantum magnets in 2D: nonlinear sigma model, CP1 and 'all that' -- The spin-fermion system: a quantum field theory approach -- The spin glass -- Quantum field theory approach to superfluidity -- Quantum field theory approach to superconductivity -- The cuprate high-temperature superconductors -- The pnictides: iron based superconductors -- The quantum Hall effect -- Graphene -- Silicene and transition metal dichalcogenides -- Topological insulators -- Non-abelian statistics and quantum computation

Quantum Field Theory Ii

This book presents a selection of advanced lectures from leading researchers, providing recent theoretical results on strongly coupled quantum field theories. It also analyzes their use for describing new quantum states, which are physically realizable in condensed matter, cold-atomic systems, as well as artificial materials. It particularly focuses on the engineering of these states in quantum devices and novel materials useful for quantum information processing. The book offers graduate students and young researchers in the field of modern condensed matter theory an updated review of the most relevant theoretical methods used in strongly coupled field theory and string theory. It also provides the tools for understanding their relevance in describing the emergence of new quantum states in a variety of physical settings. Specifically, this proceedings book summarizes new and previously unrelated developments in modern condensed matter physics, in particular: the interface of condensed matter theory and quantum information theory; the interface of condensed matter physics and the mathematics emerging from the classification of the topological phases of matter, such as topological insulators and topological superconductors; and the simulation of condensed matter systems with cold atoms in optical lattices.

Quantum Field Theory

A comprehensive, graduate-level textbook introducing quantum field theory, giving equal emphasis to operator and path integral formalisms.

Quantum Field Theory in Strongly Correlated Electronic Systems

The phenomenon of dynamical symmetry breaking (DSB) in quantum field theory is discussed in a detailed and comprehensive way. The deep connection between this phenomenon in condensed matter physics and particle physics is emphasized. The realizations of DSB in such realistic theories as quantum chromodynamics and electroweak theory are considered. Issues intimately connected with DSB such as critical phenomenona and effective lagrangian approach are also discussed.

Introduction to Quantum Field Theory

This book is a course in modern quantum field theory as seen through the eyes of a theorist working in condensed matter physics. It contains a gentle introduction to the subject and therefore can be used even by graduate students. The introductory parts include a derivation of the path integral representation, Feynman diagrams and elements of the theory of metals including a discussion of Landau-Fermi liquid theory. In later chapters the discussion gradually turns to more advanced methods used in the theory of strongly correlated systems. The book contains a thorough exposition of such non-perturbative techniques as 1/N-expansion, bosonization (Abelian and non-Abelian), conformal field theory and theory of integrable systems. The book is intended for graduate students, postdoctoral associates and independent researchers working in condensed matter physics.

Lectures on Field Theory and Topology

This is an approachable introduction to the important topics and recent developments in the field of condensed matter physics. First, the general language of quantum field theory is developed in a way appropriate for dealing with systems having a large number of degrees of freedom. This paves the way for a description of the basic processes in such systems. Applications include various aspects of superfluidity and superconductivity, as well as a detailed description of the fractional quantum Hall liquid.

Quantum Field Theory

Many-Body Quantum Theory in Condensed Matter Physics

Providing a broad review of many techniques and their application to condensed matter systems, this book begins with a review of thermodynamics and statistical mechanics, before moving onto real and imaginary time path integrals and the link between Euclidean quantum mechanics and statistical mechanics. A detailed study of the Ising, gauge-Ising and XY models is included. The renormalization group is developed and applied to critical phenomena, Fermi liquid theory and the renormalization of field theories. Next, the book explores bosonization and its applications to one-dimensional fermionic systems and the correlation functions of homogeneous and random-bond Ising models. It concludes with Bohm–Pines and Chern–Simons theories applied to the quantum Hall effect. Introducing the reader to a variety of techniques, it opens up vast areas of condensed matter theory for both graduate students and researchers in theoretical, statistical and condensed matter physics.

Statistical Physics of Fields

Comprehensive introduction to quantum field theory by Nobel Laureate Steven Weinberg, now available in paperback.

Field Theories for Low-Dimensional Condensed Matter Systems

The aim of this book is to introduce a graduate student to selected concepts in condensed matter physics for which the language of field theory is ideally suited. The examples considered in this book are those of superfluidity for weakly interacting bosons, collinear magnetism, and superconductivity. Quantum phase transitions are also treated in the context of quantum dissipative junctions and interacting fermions constrained to one-dimensional position space. The style of presentation is sufficiently detailed and comprehensive that it only presumes familiarity with undergraduate physics.

Field Theories of Condensed Matter Physics

Volume 1 of this three-part series introduces the fundamental concepts of quantum field theory using the formalism of canonical quantization. This volume is intended for use as a text for an introductory quantum field theory course that can include both particle and condensed matter physics students. Dr. Strickland starts with a brief review of classical field theory and uses this as a jumping off point for the quantization of classical field, thereby promoting them to proper quantum fields. He then presents the formalism for real and complex scalar field theories, fermion field quantization, gauge field quantization, toy models of the nuclear interaction, and finally the full Lagrangian for QED and its renormalization. Part of IOP Series in Nuclear Medicine.

Strongly Coupled Field Theories for Condensed Matter and Quantum Information Theory

The importance and the beauty of modern quantum field theory resides in the power and variety of its methods and ideas, which find application in domains as different as particle physics, cosmology, condensed matter, statistical mechanics and critical phenomena. This book introduces the reader to the modern developments in a manner which assumes no previous knowledge of quantum field theory. Along with standard topics like Feynman diagrams, the book discusses effective lagrangians, renormalization group equations, the path integral formulation, spontaneous symmetry breaking and non-abelian gauge theories. The inclusion of more advanced topics will also make this a most useful book for graduate students and researchers.

Quantum Field Theory

This textbook grew out of lecture notes the author used in delivering a quantum field theory (QFT) course for students (both in high energy physics and condensed matter) who already had an initial exposure to the subject.It begins with the path integral method of quantization presented in a systematic and clear-cut manner. Perturbation theory is generalized beyond tree level, to include radiative corrections (loops). Renormalization procedures and the Wilsonian renormalization group (RG flow) are discussed, asymptotic freedom of non-Abelian gauge theories is derived, and some applications in Quantum Chromodynamics (QCD) are considered, with a brief digression into the Standard Model (SM). The SM case requires a study of the spontaneous breaking of gauge symmetry, a phenomenon which would be more appropriate to call 'Higgsing of the gauge bosons.' Other regimes attainable in gauge theories are explained as well. In the condensed matter part, the Heisenberg and Ising model are discussed. The present textbook differs from many others in that it is relatively concise and, at the same time, teaches students to carry out actual calculations which they may encounter in QFT-related applications.

Lecture Notes on Field Theory in Condensed Matter Physics

The book is an introduction to quantum field theory applied to condensed matter physics. The topics cover modern applications in electron systems and electronic properties of mesoscopic systems and nanosystems. The textbook is developed for a graduate or advanced undergraduate course with exercises which aim at giving students the ability to confront real problems.

Field Theory of Non-Equilibrium Systems

Modern introduction to quantum field theory for graduates, providing intuitive, physical explanations supported by real-world applications and homework problems.

A Modern Introduction to Quantum Field Theory

"Quantum field theory is the mathematical and conceptual framework that describes the physics of the very small, including subatomic particles and quasiparticles. It is used to address a range of problems across subfields, from high-energy physics and gravitation to statistical physics and condensed matter physics. Despite the breadth of its applications, however, the teaching of quantum field theory has historically been strongly oriented toward high-energy physics students, while others-particularly in condensed matter and statistical physics-are typically taught in a separate course, or take an alternate sequence in many-body and statistical physics. Author Eduardo Fradkin strongly believes that this separation is both artificial and detrimental to all groups' understanding of quantum field theory. This textbook, developed from a graduate course Fradkin has taught for decades at the University of Illinois, offers a new, "multicultural" approach to the subject that seeks to remedy this fragmentation. It covers both basic techniques and topics at the frontiers of current research, and integrates modern concepts and examples from high-energy, statistical, and condensed-matter physics alike. Extensive problem sets further illustrate applications across a range of subfields. The book will be suitable for students across physical subdisciplines who have mastered graduate-level quantum mechanics, and will be a useful reference for researchers"--

Condensed Matter Field Theory

This book is a pedagogical and systematic introduction to new concepts and quantum field theoretical methods in condensed matter physics, which may have an impact on our understanding of the origin of light, electrons and other elementary particles in the universe. Emphasis is on clear physical principles, while at the same time bringing students to the fore of today's research.

Quantum Field Theory in Condensed Matter Physics

Presenting a variety of topics that are only briefly touched on in other texts, this book provides a thorough introduction to the techniques of field theory. Covering Feynman diagrams and path integrals, the author emphasizes the path integral approach, the Wilsonian approach to renormalization, and the physics of non-abelian gauge theory. It provides a thorough treatment of quark confinement and chiral symmetry breaking, topics not usually covered in other texts at this level. The Standard Model of particle physics is discussed in detail. Connections with condensed matter physics are explored, and there is a brief, but detailed, treatment of non-perturbative semi-classical methods. Ideal for graduate students in high energy physics and condensed matter physics, the book contains many problems,which help students practise the key techniques of quantum field theory.

Quantum Field Theory and the Standard Model

A gentle introduction to the physics of quantized fields and many-body physics. Based on courses taught at the University of Illinois, it concentrates on the basic conceptual issues that many students find difficult, and emphasizes the physical and visualizable aspects of the subject. While the text is intended for students with a wide range of interests, many of the examples are drawn from condensed matter physics because of the tangible character of such systems. The first part of the book uses the Hamiltonian operator language of traditional quantum mechanics to treat simple field theories and related topics, while the Feynman path integral is introduced in the second half where it is seen as indispensable for understanding the connection between renormalization and critical as well as non-perturbative phenomena.

Nonequilibrium Quantum Field Theory

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.

Introduction to Classical and Quantum Field Theory

Following on from the successful first (1984) and revised (1993) editions, this extended and revised text is designed as a short and simple introduction to quantum field theory for final year physics students and for postgraduate students beginning research in theoretical and experimental particle physics. The three main objectives of the book are to: Explain the basic physics and formalism of quantum field theory To make the reader proficient in theory calculations using Feynman diagrams To introduce the reader to gauge theories, which play a central role in elementary particle physics. Thus, the first ten chapters deal with QED in the canonical formalism, and are little changed from the first edition. A brief introduction to gauge theories (Chapter 11) is then followed by two sections, which may be read independently of each other. They cover QCD and related topics (Chapters 12-15) and the unified electroweak theory (Chapters 16 - 19) respectively. Problems are provided at the end of each chapter. New to this edition: Five new chapters, giving an introduction to quantum chromodynamics and the methods used to understand it: in particular, path integrals and the renormalization group. The treatment of electroweak interactions has been revised and updated to take account of more recent experiments.

Quantum Field Theory and Critical Phenomena

This well-received work is now available in a new edition. It is an advanced text on quantum field theory--which is not only the accepted framework for describing all fundamental interactions except gravity, but also for understanding second-order phase transitions in statistical mechanics. The book approaches this subject in terms of path and functional integrals. A Euclidean metric has been adopted and the language of partition and correlation functions is used. Renormalization and the renormalization group are also discussed. Full mathematical details are provided. The text is intended for theoretical particle physicists and statistical physicists at the graduate level and above.

The Quantum Theory of Fields

In this book the author extends the concepts introduced in his Quantum Field Theory in Condensed Matter Physics to situations in which the strong electronic correlations are crucial for the understanding of the observed phenomena. Starting from a model field theory to illustrate the basic ideas, more complex systems are analyzed in turn. A special chapter is devoted to the description of antiferromagnets, doped Mott insulators, and quantum Hall liquids from the point of view of gauge theory.

Quantum Field Theory in Condensed Matter Physics

This advanced, accessible textbook on effective field theories uses worked examples to bring this important topic to a wider audience.

Quantum Field Theory for the Gifted Amateur

Bringing together the key ideas from nonequilibrium statistical mechanics and powerful methodology from quantum field theory, this book captures the essence of nonequilibrium quantum field theory. Beginning with the foundational aspects of the theory, the book presents important concepts and useful techniques, discusses issues of basic interest, and shows how thermal field, linear response, kinetic theories and hydrodynamics emerge. It also illustrates how these concepts and methodology are applied to current research topics including nonequilibrium phase transitions, thermalization in relativistic heavy ion collisions, the nonequilibrium dynamics of Bose-Einstein condensation, and the generation of structures from quantum fluctuations in the early Universe. Divided into five parts, each part addresses a particular stage in the conceptual and technical development of the subject.

Wilson Lines in Quantum Field Theory

This volume contains a set of pedagogical reviews covering the most recent applications of low-dimensional quantum field theory in condensed matter physics, written by experts who have made major contributions to this rapidly developing field of research. The main purpose is to introduce active young researchers to new ideas and new techniques which are not covered by the standard textbooks. Contents: Some Geometry and Topology (G Marmo & G Morandi)Gauge Symmetries, Topology and Quantisation (A P Balachandran)The Chern-Simons-

Landau-Ginzburg Theory of the Fractional Quantum Hall Effect (S C Zhang)Universitality in the Fractional Quantum Hall (E Fradkin & A Lopez)Anyons and Anyon Superconductivity (A L Fetter)Bosonization: How to Make It Work for You in Condensed Matter (R Shankar)Methods of Conformal Field Theory in Condensed Matter Physics (A W W Ludwig)Integrable Models in Condensed Matter Physics (N Andrei)Quantum Antiferromagnets in Two Dimensions (S Sachdev) Readership: Researchers and graduate students. keywords:

Quantum Field Theory

In recent years topology has firmly established itself as an important part of the physicist's mathematical arsenal. It has many applications, first of all in quantum field theory, but increasingly also in other areas of physics. The main focus of this book is on the results of quantum field theory that are obtained by topological methods. Some aspects of the theory of condensed matter are also discussed. Part I is an introduction to quantum field theory: it discusses the basic Lagrangians used in the theory of elementary particles. Part II is devoted to the applications of topology to quantum field theory. Part III covers the necessary mathematical background in summary form. The book is aimed at physicists interested in applications of topology to physics and at mathematicians wishing to familiarize themselves with quantum field theory and the mathematical methods used in this field. It is accessible to graduate students in physics and mathematics.

Quantum Field Theory Approach to Condensed Matter Physics

While many scientists are familiar with fractals, fewer are familiar with scale-invariance and universality which underlie the ubiquity of their shapes. These properties may emerge from the collective behaviour of simple fundamental constituents, and are studied using statistical field theories. Initial chapters connect the particulate perspective developed in the companion volume, to the coarse grained statistical fields studied here. Based on lectures taught by Professor Kardar at MIT, this textbook demonstrates how such theories are formulated and studied. Perturbation theory, exact solutions, renormalization groups, and other tools are employed to demonstrate the emergence of scale invariance and universality, and the non-equilibrium dynamics of interfaces and directed paths in random media are discussed. Ideal for advanced graduate courses in statistical physics, it contains an integrated set of problems, with solutions to selected problems at the end of the book and a complete set available to lecturers at www.cambridge.org/9780521873413.

Quantum Field Theory and Condensed Matter

Quantum field theory provides the theoretical backbone to most modern physics. It explains the standard model of particle physics and the existence of the Higgs boson, the physics of states of matter such as metals, magnets and superconductors, and allows us to understand the behaviour of polymers and biological molecules. However, quantum field theory has a reputation for difficulty, reinforced by a selection of weighty and inaccessible books on the subject aimedfirmly at those who will make future advances in the subject. The authors of this book believe the subject is too important to be restricted to the professionals and have designed this book to bringquantum field theory to a wider audience of physicists. The book is packed with worked examples, witty diagrams, and applications intended to introduce a new audience to this revolutionary theory.

Modern Quantum Field Theory

This primer is aimed at elevating graduate students of condensed matter theory to a level where they can engage in independent research. Topics covered include second quantisation, path and functional field integration, mean-field theory and collective phenomena.

The Physics of Quantum Fields

These lectures recount an application of stable homotopy theory to a concrete problem in low energy physics: the classification of special phases of matter. While the joint work of the author and Michael Hopkins is a focal point, a general geometric frame of reference on quantum field theory is emphasized. Early lectures describe the geometric axiom systems introduced by Graeme Segal and Michael Atiyah in the late 1980s, as well as subsequent extensions. This material provides an entry point for mathematicians to delve into quantum field theory. Classification theorems in low dimensions are proved to illustrate the framework. The later lectures turn to more specialized topics in field theory, including the relationship between invertible field theories and stable homotopy theory, extended unitarity, anomalies, and relativistic free fermion systems. The accompanying mathematical explanations touch upon (higher) category theory, duals to the sphere spectrum, equivariant spectra, differential cohomology, and Dirac operators. The outcome of computations made using the Adams spectral sequence is presented and compared to results in the condensed matter literature obtained by very different means. The general perspectives and specific applications fuse into a compelling story at the interface of contemporary mathematics and theoretical physics.

Field Theories in Condensed Matter Physics

An Introduction to Quantum Field Theory is a textbook intended for the graduate physics course covering relativistic quantum mechanics, quantum electrodynamics, and Feynman diagrams. The authors make these subjects accessible through carefully worked examples illustrating the technical aspects of the subject, and intuitive explanations of what is going on behind the mathematics. After presenting the basics of quantum electrodynamics, the authors discuss the theory of renormalization and its relation to statistical mechanics, and introduce the renormalization group. This discussion sets the stage for a discussion of the physical principles that underlie the fundamental interactions of elementary particle physics and their description by gauge field theories.