Classical Theory Of Gauge Fields

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Field Theory - Pierre Ramond 2020-09-29
Presents recent advances of perturbative relativistic field theory in a pedagogical and straightforward way. For graduate students who intend to specialize in high-energy physics.
The Photon - Trilochan Pradhan 2001
This book is about Maxwell's electromagnetic theory of light. First, it is a fully relativistic theory without having a non-relativistic limit. There arise many difficulties in quantising the electromagnetic field and in the physical interpretation of the wavefunction of its quanta. Further, the first quantisation of the Maxwell equations similar to quantisation of classical mechanics by the Schrodinger method, has not been discussed in most books on quantum mechanics. Second, the Maxwell field is the simplest gauge field possessing symmetry with respect to Poincare group of transformations in addition to scale, duality and special conformal transformations whose local versions give rise to new interaction of photons through new gauge fields. One of these gauge fields couples to the spin density of the photon and other particles and can bind fermion-antifermion pairs to give transverse photons. Another interesting aspect of the electromagnetic field is its coherence properties and their interpretation in terms of quantised theory.
Natural and Gauge Natural Formalism for Classical Field Theorie - L. Fatibene 2013-06-29
In this book the authors develop and work out applications to gravity and gauge theories and their interactions with generic matter fields, including spinors in full detail. Spinor fields in particular appear to be the prototypes of truly gauge-natural objects, which are not purely gauge nor purely natural, so that they are a paradigmatic example of the intriguing relations between gauge natural geometry and physical phenomenology. In particular, the gauge natural framework for spinors is developed in this book in full detail, and it is shown to be fundamentally related to the interaction between fermions and dynamical tetrad gravity.
Gauge Field Theories Theoretical Studies and Computer Simulations - Giarczynski 1987-06-22

Advanced Classical Field Theory - G. Giachetta 2009
Contemporary quantum field theory is mainly developed as quantization of classical fields. Therefore, classical field theory and its BRST extension is the necessary step towards quantum field theory. This book aims to provide a complete mathematical foundation of Lagrangian classical field theory and its BRST extension for the purpose of quantization. Based on the standard geometric formulation of theory of nonlinear differential operators, Lagrangian field theory is treated in a very general setting. Reducible degenerate Lagrangian theories of even and odd fields on an arbitrary smooth manifold are considered. The second Noether theorems generalized to these theories and formulated in the homology terms provide the strict mathematical formulation of BRST extended classical field theory. The most physically relevant field theories OCo gauge theory on principal bundles, gravitation theory on natural bundles, theory of spinor fields and topological field theory OCo are presented in a complete way. This book is designed for theoreticians and mathematical physicists specializing in field theory. The authors have tried throughout to provide the necessary mathematical background, thus making the exposition self-contained.
Special Relativity and Classical Field Theory - Leonard Susskind 2017-09-26
The third volume in the bestselling physics series cracks open Einstein's special relativity and field theory Physicist Leonard Susskind and data engineer Art Friedman are back. This time, they introduce readers to Einstein's special relativity and Maxwell's classical field theory. Using their typical brand of real math, enlightening drawings, and humor, Susskind and Friedman walk us through the complexities of waves, forces, and particles by exploring special relativity and electromagnetism. It's a must-read for both devotees of the series and any armchair physicist who wants to improve their knowledge of physics' deepest truths.
Gauging What's Real - Richard Healey 2007-09-27
Gauge theories have provided our most successful representations of the fundamental forces of nature. But how do such representations work? Healey aims to answer this question, and defends a distinctive thesis which proves that loops rather than points are the locations of fundamental properties.
Introduction to Classical and Quantum Field Theory - Tai-Kai Ng 2009-04-27
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.
Particles and Quantum Fields - Hagen Kleinert 2016-05-30
This is an introductory book on elementary particles and their interactions. It starts out with many-body Schrödinger theory and second quantization and leads, via its generalization, to relativistic fields of various spins and to gravity. The text begins with the best known quantum field theory so far, the quantum electrodynamics of photon and electrons (QED). It continues by developing the theory of strong interactions between the elementary constituents of matter (quarks). This is possible due to the property called asymptotic freedom. On the way one has to tackle the problem of removing various infinities by renormalization. The divergent sums of infinitely many diagrams are performed with the renormalization group or by variational perturbation theory (VPT). The latter is an outcome of the Feynman-Kleinert variational approach to path integrals discussed in two earlier books of the author, one representing a comprehensive treatise on path integrals, the other dealing with critial phenomena. Unlike ordinary perturbation theory, VPT produces uniformly convergent series which are valid from weak to strong couplings, where they describe critical phenomena. The present book develops the theory of effective actions which allow to treat quantum phenomena with classical formalism. For example, it derives the observed anomalous power laws of strongly interacting theories from an extremum of the action. Their fluctuations are not based on Gaussian distributions, as in the perturbative treatment of quantum field theories, or in asymptotically-free theories, but on deviations from the average which are much larger and which obey power-like distributions. Exactly solvable models are discussed and their physical properties are compared with those derived from general methods. In the last chapter we discuss the problem of

quantizing the classical theory of gravity. Contents: FundamentalsField Formulation of Many-Body Quantum PhysicsInteracting Nonrelativistic ParticlesFree Relativistic Particles and FieldsClassical RadiationRelativistic Particles and Fields in External Electromagnetic PotentialQuantization of Relativistic Free FieldsContinuous Symmetries and Conservation Laws. Noether's TheoremScattering and Decay of ParticlesQuantum Field Theoretic Perturbation TheoryExtracting Finite Results from Perturbation Series. Regularization, RenormalizationQuantum ElectrodynamicsFormal Properties of Perturbation TheoryFunctional-Integral Representation of Quantum Field TheorySystematic Graphical Construction of Feynman DiagramsSpontaneous Symmetry BreakdownScalar Quantum ElectrodynamicsExactly Solvable O(N)-Symmetric ϕ4-Theory for Large NNonlinear σ-ModelThe Renormalization GroupCritical Properties of Nonlinear σ-ModelFunctional-Integral Calculation of Effective Action. Loop ExpansionExactly Solvable O(N)-Symmetric Four-Fermion Theory in 2+ε Dimensions Internal Symmetries of Strong InteractionsSymmetries Linking Internal and Spacetime PropertiesHadronization of Quark TheoriesWeak InteractionsNonabelian Gauge Theory of Strong InteractionsCosmology with General Curvature-Dependent LagrangianEinstein Gravity from Fluctuating Conformal GravityPurely Geometric Part of Dark Matter Readership: Students and researchers in theoretical physics.

Connections in Classical and Quantum Field Theory - L Mangiarotti 2000-04-28

Geometrical notions and methods play an important role in both classical and quantum field theory, and a connection is a deep structure which apparently underlies the gauge-theoretical models in field theory and mechanics. This book is an encyclopaedia of modern geometric methods in theoretical physics. It collects together the basic mathematical facts about various types of connections, and provides a detailed exposition of relevant physical applications. It discusses the modern issues concerning the gauge theories of fundamental fields. The authors have tried to give all the necessary mathematical background, thus making the book self-contained. This book should be useful to graduate students, physicists and mathematicians who are interested in the issue of deep interrelations between theoretical physics and geometry. keywords:Lagrangian Field Theory;Hamiltonian Field Theory;Classical Mechanics;BRST Formalism;Topological Field Theories;Non-Commutative Geometry;Theoretical Physics;Mathematical Physics;Fibre Bundle;Connection;Jet Manifold;Gauge Theory;Gravitation;Theory;Quantum Field;Geometric Quantization;Supergeometry;BRST;Theory “this book certainly offers a valuable supplement to the existing literature on the impact of connection theory on theoretical physics.” Mathematical Reviews

Classical Field Theory - Florian Scheck 2014-06-11

The book describes Maxwell's equations first in their integral, directly testable form, then moves on to their local formulation. The first two chapters cover all essential properties of Maxwell's equations, including their symmetries and their covariance in a modern notation. Chapter 3 is devoted to Maxwell theory as a classical field theory and to solutions of the wave equation. Chapter 4 deals with important applications of Maxwell theory. It includes topical subjects such as metamaterials with negative refraction index and solutions of Helmholtz' equation in paraxial approximation relevant for the description of laser beams. Chapter 5 describes non-Abelian gauge theories from a classical, geometric point of view, in analogy to Maxwell theory as a prototype, and culminates in an application to the U(2) theory relevant for electroweak interactions. The last chapter 6 gives a concise summary of semi-Riemannian geometry as the framework for the classical field theory of gravitation. The chapter concludes with a discussion of the Schwarzschild solution of Einstein's equations and the classical tests of general relativity (perihelion precession of Mercury, and light deflection by the sun). ------ Textbook features: detailed figures, worked examples, problems and solutions, boxed inserts, highlighted special topics, highlighted important math etc., helpful summaries, appendix, index.

Problem Book in Quantum Field Theory - Voja Radovanovic 2008-01-24

The Problem Book in Quantum Field Theory contains about 200 problems with solutions or hints that help students to improve their understanding and develop skills necessary for pursuing the subject. It deals with the Klein-Gordon and Dirac equations, classical field theory, canonical quantization of scalar, Dirac and electromagnetic fields, the processes in the lowest order of perturbation theory, renormalization and regularization. The solutions are presented in a systematic and complete manner. The material covered and the level of exposition make the book appropriate for graduate and undergraduate students in physics, as well as for teachers and researchers.

Gauge Fields - L. D. Faddeev 1991-07-21

Classical Solutions in Quantum Field Theory - Erick J. Weinberg 2012-08-16

An overview of classical solutions and their consequences in quantum field theory, high energy physics and cosmology for graduates and researchers.

From Classical to Quantum Fields - Laurent Baulieu 2017

Quantum Field Theory has become the universal language of most modern theoretical physics. This introductory textbook shows how this beautiful theory offers the correct mathematical framework to describe and understand the fundamental interactions of elementary particles. The book begins with a brief reminder of basic classical field theories, electrodynamics and general relativity, as well as their symmetry properties, and proceeds with the principles of quantisation following Feynman's path integral approach. Special care is used at every step to illustrate the correct mathematical formulation of the underlying assumptions. Gauge theories and the problems encountered in their quantisation are discussed in detail. The last chapters contain a full description of the Standard Model of particle physics and the attempts to go beyond it, such as grand unified theories and supersymmetry. Written for advanced undergraduate and beginning graduate students in physics and mathematics, the book could also serve as a reference for active researchers in the field.

Advanced Classical Field Theory - G. Giachetta 2009

Contemporary quantum field theory is mainly developed as quantization of classical fields. Therefore, classical field theory and its BRST extension is the necessary step towards quantum field theory. This book aims to provide a complete mathematical foundation of Lagrangian classical field theory and its BRST extension for the purpose of quantization. Based on the standard geometric formulation of theory of nonlinear differential operators, Lagrangian field theory is treated in a very general setting. Reducible degenerate Lagrangian theories of even and odd fields on an arbitrary smooth manifold are considered. The second Noether theorems generalized to these theories and formulated in the homology terms provide the strict mathematical formulation of BRST extended classical field theory. The most physically relevant field theories ? gauge theory on principal bundles, gravitation theory on natural bundles, theory of spinor fields and topological field theory ? are presented in a complete way.This book is designed for theoreticians and mathematical physicists specializing in field theory. The authors have tried throughout to provide the necessary mathematical background, thus making the exposition self-contained.

Perturbative Algebraic Quantum Field Theory - Kasia Rejzner 2016-03-16

Perturbative Algebraic Quantum Field Theory (pAQFT), the subject of this book, is a complete and mathematically rigorous treatment of perturbative quantum field theory (pQFT) that doesn’t require the use of divergent quantities and works on a large class of Lorenzian manifolds. We discuss in detail the examples of scalar fields, gauge theories and the effective quantum gravity. pQFT models describe a wide range of physical phenomena and have remarkable agreement with experimental results. Despite this success, the theory suffers from many conceptual problems. pAQFT is a good candidate to solve many, if not all, of these conceptual problems. Chapters 1-3 provide some background in mathematics and physics. Chapter 4 concerns classical theory of the scalar field, which is subsequently quantized in chapters 5 and 6. Chapter 7 covers gauge theory and chapter 8 discusses effective quantum gravity. The book aims to be accessible to researchers and graduate students, who are interested in the mathematical foundations of pQFT.

Gauge Fields - Moshe Carmeli 1989

This volume reviews the most recent progress on new exact solutions of the Yang-Mills SU(2) gauge field equations. In order to have a better understanding of the physical meaning of the Yang-Mills fields, the motion of a particle in these fields, first in general and then, in particular fields were discussed.

Gauge Field Theories - Sergeĭ Vladimirovich Koni□a□gin 2000-03-13

An expanded and up-dated book examining gauge theories and their symmetries.

Fundamental Forces of Nature - Kerson Huang 2007

Gauge fields are the messengers carrying signals between elementary particles, enabling them to interact with each other. Originating at the level of quarks, these basic interactions percolate upwards, through

nuclear and atomic physics, through chemical and solid state physics, to make our everyday world go round. This book tells the story of gauge fields, from Maxwell's 1860 theory of electromagnetism to the 1954 theory of Yang and Mills that underlies the Standard Model of elementary particle theory. In the course of the narration, the author introduces people and events in experimental and theoretical physics that contribute to ideas that have shaped our conception of the physical world.

Geometrodynamics of Gauge Fields - Eckehard W. Mielke 2017-01-22

This monograph aims to provide a unified, geometrical foundation of gauge theories of elementary particle physics. The underlying geometrical structure is unfolded in a coordinate-free manner via the modern mathematical notions of fibre bundles and exterior forms. Topics such as the dynamics of Yang-Mills theories, instanton solutions and topological invariants are included. By transferring these concepts to local space-time symmetries, generalizations of Einstein's theory of gravity arise in a Riemann-Cartan space with curvature and torsion. It provides the framework in which the (broken) Poincaré gauge theory, the Rainich geometrization of the Einstein-Maxwell system, and higher-dimensional, non-abelian Kaluza-Klein theories are developed. Since the discovery of the Higgs boson, concepts of spontaneous symmetry breaking in gravity have come again into focus, and, in this revised edition, these will be exposed in geometric terms. Quantizing gravity remains an open issue: formulating it as a de Sitter type gauge theory in the spirit of Yang-Mills, some new progress in its topological form is presented. After symmetry breaking, Einstein’s standard general relativity with cosmological constant emerges as a classical background. The geometrical structure of BRST quantization with non-propagating topological ghosts is developed in some detail.

Introduction to Classical Field Theory - Jarrett L Lancaster 2018-09-05

This book is a short introduction to classical field theory, most suitable for undergraduate students who have had at least intermediate-level courses in electromagnetism and classical mechanics. The main theme of the book is showcasing role of fields in mediating action-at-a-distance interactions. Suitable technical machinery is developed to explore at least some aspect of each of the four known fundamental forces in nature. Beginning with the physically-motivated introduction to field theory, the text covers the relativistic formulation of electromagnetism in great detail so that aspects of gravity and the nuclear interaction not usually encountered at the undergraduate level can be covered by using analogies with familiar electromagentism. Special topics such as the behavior of gravity in extra, compactified dimensions, magnetic monopoles and electromagnetic duality, and the Higgs mechanism are also briefly considered.

The Global Approach to Quantum Field Theory - Bryce Seligman DeWitt 2003

This new volume takes a complete look at how classical field theory, quantum mechanics and quantum field theory are interrelated. It takes a global approach and discusses the importance of quantization by relating it to different theories such as tree amplitude and conservation laws. There arespecial chapters devoted to Euclideanization and renormalization, space and time inversion and the closed-time-path formalism.

Classical Field Theory - Florian Scheck 2018-03-09

Scheck’s successful textbook presents a comprehensive treatment, ideally suited for a one-semester course. The textbook describes Maxwell's equations first in their integral, directly testable form, then moves on to their local formulation. The first two chapters cover all essential properties of Maxwell's equations, including their symmetries and their covariance in a modern notation. Chapter 3 is devoted to Maxwell's theory as a classical field theory and to solutions of the wave equation. Chapter 4 deals with important applications of Maxwell's theory. It includes topical subjects such as metamaterials with negative refraction index and solutions of Helmholtz' equation in paraxial approximation relevant for the description of laser beams. Chapter 5 describes non-Abelian gauge theories from a classical, geometric point of view, in analogy to Maxwell's theory as a prototype, and culminates in an application to the U(2) theory relevant for electroweak interactions. The last chapter 6 gives a concise summary of semi-Riemannian geometry as the framework for the classical field theory of gravitation. The chapter concludes with a discussion of the Schwarzschild solution of Einstein's equations and the classical tests of general relativity. The new concept of this edition presents the content divided into two tracks: the fast track for master's students, providing the essentials, and the intensive track for all wanting to get in depth knowledge of the field. Cleary labeled material and sections guide students through the preferred level of treatment. Numerous problems and worked examples will provide successful access to Classical Field Theory.

Modern Quantum Field Theory - Tom Banks 2008-09-18

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.

Classical Theory of Gauge Fields - Valery Rubakov 2002-05-26

Based on a highly regarded lecture course at Moscow State University, this is a clear and systematic introduction to gauge field theory. It is unique in providing the means to master gauge field theory prior to the advanced study of quantum mechanics. Though gauge field theory is typically included in courses on quantum field theory, many of its ideas and results can be understood at the classical or semi-classical level. Accordingly, this book is organized so that its early chapters require no special knowledge of quantum mechanics. Aspects of gauge field theory relying on quantum mechanics are introduced only later and in a graduated fashion--making the text ideal for students studying gauge field theory and quantum mechanics simultaneously. The book begins with the basic concepts on which gauge field theory is built. It introduces gauge-invariant Lagrangians and describes the spectra of linear perturbations, including perturbations above nontrivial ground states. The second part focuses on the construction and interpretation of classical solutions that exist entirely due to the nonlinearity of field equations: solitons, bounces, instantons, and sphalerons. The third section considers some of the interesting effects that appear due to interactions of fermions with topological scalar and gauge fields. Mathematical digressions and numerous problems are included throughout. An appendix sketches the role of instantons as saddle points of Euclidean functional integral and related topics. Perfectly suited as an advanced undergraduate or beginning graduate text, this book is an excellent starting point for anyone seeking to understand gauge fields.

Classical Field Theory and the Stress-Energy Tensor - Mark S. Swanson 2015-10-12

This book is a concise introduction to the key concepts of classical field theory for beginning graduate students and advanced undergraduate students who wish to study the unifying structures and physical insights provided by classical field theory without dealing with the additional complication of quantization. In that regard, there are many important aspects of field theory that can be understood without quantizing the fields. These include the action formulation, Galilean and relativistic invariance, traveling and standing waves, spin angular momentum, gauge invariance, subsidiary conditions, fluctuations, spinor and vector fields, conservation laws and symmetries, and the Higgs mechanism, all of which are often treated briefly in a course on quantum field theory.

Quantum Electrodynamics - V B Berestetskii 2012-12-02

Several significant additions have been made to the second edition, including the operator method of calculating the bremsstrahlung cross-section, the calcualtion of the probabilities of photon-induced pair production and photon decay in a magnetic field, the asymptotic form of the scattering amplitudes at high energies, inelastic scattering of electrons by hadrons, and the transformation of electron-positron pairs into hadrons.

Quantum Field Theory - Anthony G. Williams 2022

"This textbook offers a detailed and uniquely self-contained presentation of quantum and gauge field theories. Writing from a modern perspective, the author begins with a discussion of advanced dynamics and special relativity before guiding students steadily through the fundamental principles of relativistic quantum mechanics and classical field theory. This foundation is then used to develop the full theoretical framework of quantum and gauge field theories. The introductory, opening half of the book allows it to be used for a variety of courses, from advanced undergraduate to graduate level, and students lacking a formal background in more elementary topics will benefit greatly from this approach. Williams provides full

derivations wherever possible and adopts a pedagogical tone without sacrificing rigor. Worked examples are included throughout the text and end-of-chapter problems help students to reinforce key concepts. A fully worked solutions manual is available online for instructors"--

Classical Field Theory - Florian Scheck 2012-05-08

The book describes Maxwell's equations first in their integral, directly testable form, then moves on to their local formulation. The first two chapters cover all essential properties of Maxwell's equations, including their symmetries and their covariance in a modern notation. Chapter 3 is devoted to Maxwell theory as a classical field theory and to solutions of the wave equation. Chapter 4 deals with important applications of Maxwell theory. It includes topical subjects such as metamaterials with negative refraction index and solutions of Helmholtz' equation in paraxial approximation relevant for the description of laser beams. Chapter 5 describes non-Abelian gauge theories from a classical, geometric point of view, in analogy to Maxwell theory as a prototype, and culminates in an application to the U(2) theory relevant for electroweak interactions. The last chapter 6 gives a concise summary of semi-Riemannian geometry as the framework for the classical field theory of gravitation. The chapter concludes with a discussion of the Schwarzschild solution of Einstein's equations and the classical tests of general relativity (perihelion precession of Mercury, and light deflection by the sun). ------ Textbook features: detailed figures, worked examples, problems and solutions, boxed inserts, highlighted special topics, highlighted important math etc., helpful summaries, appendix, index.

Classical Field Theory - Horaţiu Năstase 2019-03-14

Classical field theory predicts how physical fields interact with matter, and is a logical precursor to quantum field theory. This introduction focuses purely on modern classical field theory, helping graduates and researchers build an understanding of classical field theory methods before embarking on future studies in quantum field theory. It describes various classical methods for fields with negligible quantum effects, for instance electromagnetism and gravitational fields. It focuses on solutions that take advantage of classical field theory methods as opposed to applications or geometric properties. Other fields covered includes fermionic fields, scalar fields and Chern–Simons fields. Methods such as symmetries, global and local methods, Noether theorem and energy momentum tensor are also discussed, as well as important solutions of the classical equations, in particular soliton solutions.

Quantization of Gauge Systems - Marc Henneaux 2020-06-16

This book is a systematic study of the classical and quantum theories of gauge systems. It starts with Dirac's analysis showing that gauge theories are constrained Hamiltonian systems. The classical foundations of BRST theory are then laid out with a review of the necessary concepts from homological algebra. Reducible gauge systems are discussed, and the relationship between BRST cohomology and gauge invariance is carefully explained. The authors then proceed to the canonical quantization of gauge systems, first without ghosts (reduced phase space quantization, Dirac method) and second in the BRST context (quantum BRST cohomology). The path integral is discussed next. The analysis covers indefinite metric systems, operator insertions, and Ward identities. The antifield formalism is also studied and its equivalence with canonical methods is derived. The examples of electromagnetism and abelian 2-form gauge fields are treated in detail. The book gives a general and unified treatment of the subject in a self-contained manner. Exercises are provided at the end of each chapter, and pedagogical examples are covered in the text.

Introduction to the Classical Theory of Particles and Fields - Boris Kosyakov 2007-07-11

This volume is intended as a systematic introduction to gauge field theory for advanced undergraduate and graduate students in high energy physics. The discussion is restricted to the classical (non-quantum) theory in Minkowski spacetime. Particular attention has been given to conceptual aspects of field theory, accurate definitions of basic physical notions, and thorough analysis of exact solutions to the equations of motion for interacting systems.

Classical Fields - Moshe Carmeli 1982

Introduction to Gauge Field Theory Revised Edition - D. Bailin 1993-01-01

Introduction to Gauge Field Theory provides comprehensive coverage of modern relativistic quantum field theory, emphasizing the details of actual calculations rather than the phenomenology of the applications. Forming a foundation in the subject, the book assumes knowledge of relativistic quantum mechanics, but not of quantum field theory. The book is ideal for graduate students, advanced undergraduates, and researchers in the field of particle physics.

Electrodynamics and Classical Theory of Fields and Particles - A. O. Barut 2012-04-30

Comprehensive graduate-level text by a distinguished theoretical physicist reveals the classical underpinnings of modern quantum field theory. Topics include space-time, Lorentz transformations, conservation laws, equations of motion, Green’s functions, and more. 1964 edition.

Classical Theory of Gauge Fields - Valery Rubakov 2009-02-09

Based on a highly regarded lecture course at Moscow State University, this is a clear and systematic introduction to gauge field theory. It is unique in providing the means to master gauge field theory prior to the advanced study of quantum mechanics. Though gauge field theory is typically included in courses on quantum field theory, many of its ideas and results can be understood at the classical or semi-classical level. Accordingly, this book is organized so that its early chapters require no special knowledge of quantum mechanics. Aspects of gauge field theory relying on quantum mechanics are introduced only later and in a graduated fashion--making the text ideal for students studying gauge field theory and quantum mechanics simultaneously. The book begins with the basic concepts on which gauge field theory is built. It introduces gauge-invariant Lagrangians and describes the spectra of linear perturbations, including perturbations above nontrivial ground states. The second part focuses on the construction and interpretation of classical solutions that exist entirely due to the nonlinearity of field equations: solitons, bounces, instantons, and sphalerons. The third section considers some of the interesting effects that appear due to interactions of fermions with topological scalar and gauge fields. Mathematical digressions and numerous problems are included throughout. An appendix sketches the role of instantons as saddle points of Euclidean functional integral and related topics. Perfectly suited as an advanced undergraduate or beginning graduate text, this book is an excellent starting point for anyone seeking to understand gauge fields.

Chaos and Gauge Field Theory - T S Biró 1995-03-07

This book introduces a rapidly growing new research area — the study of dynamical properties of elementary fields. The methods used in this field range from algebraic topology to parallel computer programming. The main aim of this research is to understand the behavior of elementary particles and fields under extreme circumstances, first of all at high temperature and energy density generated in the largest accelerators of the world and supposed to be present in the early evolution of our Universe shortly after the Big Bang. In particular, chaos is rediscovered in a new appearance in these studies: in gauge theories the well-known divergence of initially adjacent phase space trajectories leads over into a quasi-thermal distribution of energy with a saturated average distance of different field configurations. This particular behavior is due to the compactness of the gauge group. Generally this book is divided into two main parts: the first part mainly deals with the “classical” discovery of chaos in gauge field theory while the second part presents methods and research achievements in recent years. One chapter is devoted entirely to the presentation and discussion of computational problems. The major theme, returning again and again throughout the book, is of course the phenomenon with a thousand faces — chaos itself. This book is intended to be a research book which introduces the reader to a new research field, presenting the basic new ideas in detail but just briefly touching on the problems of other related fields, like perturbative or lattice gauge theory, or dissipative chaos. The terminology of these related fields are, however, used. Exercises are also included in this book. They deepen the reader's understanding of special issues and at the same time offer more information on related problems. For the convenience of the fast reader, solutions are presented right after the problems. Contents:IntroductionChaotic DynamicsChaos in Gauge TheoryTopological Field TheoriesLattice Gauge TheoryHamiltonian Lattice Gauge TheoryComputing SU(2) Gauge TheoryChaos in Lattice Gauge TheoryApplications and ExtensionsBeyond the Classical TheoryChaos and Confinement Readership: Nonlinear scientists, high energy physicists, mathematicians and engineers. keywords:Non-Abelian Gauge Fields;Periodic Orbits;Lyapunov Exponents;Classical and Quantum Yangâ□□Mills Mechanics;Higgs Mechanism;Self-Thermalization via Chaos;Chaos and Confinement;Quark-

Gluon Plasma;Lattice Gauge Theory;Monte Carlo Methods;Physics;Field Theory;Chaos;Gauge;Lattice;Thermalization;Entropy;Computing “This book is a good place to approach the research area of chaos applied to gauge field theories.” Mathematical Reviews

Quantum Field Theory - Anthony G. Williams 2022-08-04

This textbook offers a detailed and self-contained presentation of quantum field theory, suitable for advanced undergraduate and graduate level courses. The author provides full derivations wherever possible and adopts a pedagogical tone without sacrificing rigour. A fully worked solutions manual is available online for instructors.

Introduction to Quantum Field Theory with Applications to Quantum Gravity - Iosif L. Buchbinder 2021-03-01

Applications of quantum field theoretical methods to gravitational physics, both in the semiclassical and the full quantum frameworks, require a careful formulation of the fundamental basis of quantum theory, with special attention to such important issues as renormalization, quantum theory of gauge theories, and especially effective action formalism. The first part of this graduate textbook provides both a conceptual and technical introduction to the theory of quantum fields. The presentation is consistent, starting from elements of group theory, classical fields, and moving on to the effective action formalism in general gauge theories. Compared to other existing books, the general formalism of renormalization in described in more detail, and special attention paid to gauge theories. This part can serve as a textbook for a one-semester introductory course in quantum field theory. In the second part, we discuss basic aspects of quantum field theory in curved space, and perturbative quantum gravity. More than half of Part II is written with a full exposition of details, and includes elaborated examples of simplest calculations. All chapters include exercises ranging from very simple ones to those requiring small original investigations. The selection of material of the second part is done using the “must-know” principle. This means we included detailed expositions of relatively simple techniques and calculations, expecting that the interested reader will be able to learn more advanced issues independently after working through the basic material, and completing the exercises.