Classical Theory Of Gauge Fields

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.

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.

By the end of the 1970s, it was clear that all the known forces of nature (including, in a sense, gravity) were examples of gauge theories, characterized by invariance under symmetry transformations chosen independently at each position and each time. These ideas culminated with the finding of the W and Z gauge bosons (and perhaps also the Higgs boson). This important book brings together the key papers in the history of gauge theories, including the discoveries of: the role of gauge transformations in the quantum theory of electrically charged particles in the 1920s; nonabelian gauge groups in the 1950s; vacuum symmetry-breaking in the 1960s; asymptotic freedom in the 1970s. A short introduction explains the significance of the papers, and the connections between them.

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.

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.

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Physical situations in which quantum systems communicate continuously to their classically described environment are not covered by contemporary quantum theory, which requires a temporary separation of quantum degrees of freedom from classical ones. A generalization would be needed to cover these situations. An incomplete proposal is advanced for combining the quantum and classical degrees of freedom into a unified objective description. It is based on the use of certain quantum-classical structures of light that arise from gauge invariance to coordinate the quantum and classical degrees of freedom. Also discussed is the question of where experimenters should look to find phenomena pertaining to the quantum-classical connection. 17 refs.

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.

Four forces are dominant in physics: gravity, electromagnetism and the weak and strong nuclear forces. Quantum electrodynamics - the highly successful theory of the electromagnetic interaction - is a gauge field theory. In this short book Dr Aitchison gives an introduction to these theories, a knowledge of which is essential in understanding modern particle physics.

This volume is a compilation of works which, taken together, give a complete and consistent presentation of instanton calculus in non-Abelian gauge theories, as it exists now. Some of the papers reproduced are instanton classics. Among other things, they show from a historical perspective how the instanton solution has been found, the motivation behind it and how the physical meaning of instantons has been revealed. Other papers are devoted to different aspects of instanton formalism including instantons in supersymmetric gauge theories. A few unsolved problems associated with instantons are described in great detail. The papers are organized into several sections that are linked both logically and historically, accompanied by extensive comments.

This book starts from a set of common basic principles to establish the basic formalisms of all disciplines of fundamental physics, including quantum field theory, quantum mechanics, statistical mechanics, thermodynamics, general relativity, electromagnetism, and classical mechanics. Instead of the traditional pedagogic way, the author arranges the subjects and formalisms in a logical order, i.e. all the formulas are derived from the formulas before them. The formalisms are also kept self-contained. Most mathematical tools are given in the appendices. Although this book covers all the disciplines of fundamental physics, it contains only a single volume because the contents are kept concise and treated as an integrated entity, which is consistent with the motto that simplicity is beauty, unification is beauty, and thus physics is beauty.This can be used as an advanced textbook for graduate students. It is also suitable for physicists who wish to have an overview of fundamental physics.

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.

In recent years, gauge fields have attracted much attention in elementary par ticle physics. The reason is that great progress has been achieved in solving a number of important problems of field theory and elementary particle physics by means of the quantum theory of gauge fields. This refers, in particular, to constructing unified gauge models and theory of strong interactions between the elementary particles. This book expounds the fundamentals of the quantum theory of gauge fields and its application for constructing unified gauge models and the theory of strong interactions. In writing the book, the authors' aim was three-fold: firstly, to outline the basic ideas underlying the unified gauge models and the theory of strong inter actions; secondly, to discuss the major unified gauge models, the theory of strong interactions and their experimental implications; and, thirdly, to acquaint the reader with a rather special mathematical approach (path-in tegral method) which has proved to be well suited for constructing the quantum theory of gauge fields. Gauge fields are a vigorously developing area. In this book, we have select ed for presentation the more or less traditional and commonly accepted mate rial. There also exist a number of different approaches which are presently being developed. The most important of them are touched upon in the Conclusion.

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.

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.

Almost all theories of fundamental interactions are nowadays based on the gauge concept. Starting with the historical example of quantum electrodynamics, we have been led to the successful unified gauge theory of weak and electromagnetic interactions, and finally to a non abelian gauge theory of strong interactions with the notion of permanently confined quarks. The. early theoretical work on gauge theories was devoted to proofs of renormalizability, investigation of short distance behaviour, the discovery of asymptotic freedom, etc . . , aspects which were accessible to tools extrapolated from renormalised perturbation theory. The second phase of the subject is concerned with the problem of quark confinement which necessitates a non-perturbative understanding of gauge theories. This phase has so far been marked by the introduc tion of ideas from geometry, topology and statistical mechanics in particular the theory of phase transitions. The 1979 Cargese Institute on "Recent Developments on Gauge Theories" was devoted to a thorough discussion of these non-perturbative, global aspects of non-abelian gauge theories. In the lectures and seminars reproduced in this volume the reader wilf find detailed reports on most of the important developments of recent times on non perturbative gauge fields by some of the leading experts and innovators in this field. Aside from lectures on gauge fields proper, there were lectures on gauge field concepts in condensed matter physics and lectures by mathematicians on global aspects of the calculus of variations, its relation to geometry and topology, and related topics.

This invaluable book presents gravitation and gauge fields as interrelated topics with a common physical and mathematical foundation, such as gauge theory of gravitation and other fields, giving emphasis to the physicist's point of view. About half of the material is devoted to Einstein's general relativity theory, and the rest to gauge fields that naturally blend well with gravitation, including spinor formulation, classification of SU(2) gauge fields and null-tetrad formulation of the Yang-Mills field in the presence of gravitation. The text includes a useful introduction to the physical foundation of the theory of gravitation. It also provides the mathematical theory of the geometry of curved space-times needed to describe Einstein's general relativity theory.

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.

Based on his own work, the author synthesizes the most promising approaches and ideals in field theory today. He presents such subjects as statistical mechanics, quantum field theory and their interrelation, continuous global symmetry, non-Abelian gauge fields, instantons and the quantam theory of loops, and quantum strings and random surfaces. This book is aimed at postgraduate students studying field theory and statistical mechanics, and for research workers in continuous global theory.

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.

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

The study of classical electromagnetic fields is an adventure. The theory is complete mathematically and we are able to present it as an example of classical Newtonian experimental and mathematical philosophy. There is a set of foundational experiments, on which most of the theory is constructed. And then there is the bold theoretical proposal of a field-field interaction from James Clerk Maxwell. This textbook presents the theory of classical fields as a mathematical structure based solidly on laboratory experiments. Here the student is introduced to the beauty of classical field theory as a gem of theoretical physics. To keep the discussion fluid, the history is placed in a beginning chapter and some of the mathematical proofs in the appendices. Chapters on Green's Functions and Laplace's Equation and a discussion of Faraday's Experiment further deepen the understanding. The chapter on Einstein's relativity is an integral necessity to the text. Finally, chapters on particle motion and waves in a dispersive medium complete the picture. High quality diagrams and detailed end-of-chapter questions enhance the learning experience.

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.

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.

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

Translated from the 6th Russian edition, this latest edition contains seven new sections with chapters on General Relativity, Gravitational Waves and Relativistic Cosmology, where Professor Lifshitz's interests lay. The text of the 3rd English edition has been thoroughly revised and additional problems inserted

This is original, well-written work of interest Presents for the first time (physical) field theories written in sheaf-theoretic language Contains a wealth of minutely detailed, rigorous computations, ususally absent from standard physical treatments Author's mastery of the subject and the rigorous treatment of this text make it invaluable

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.

Covers principal fiber bundles and connections; curvature; particle fields, Lagrangians, and gauge invariance; inhomogeneous field equations; free Dirac electron fields; calculus on frame bundle; and unification of gauge fields and gravitation. 1981 edition

This is an introduction to the basic tools of mathematics needed to understand the relation between knot theory and quantum gravity. The book begins with a rapid course on manifolds and differential forms, emphasizing how these provide a proper language for formulating Maxwell's equations on arbitrary spacetimes. The authors then introduce vector bundles, connections and curvature in order to generalize Maxwell theory to the Yang-Mills equations. The relation of gauge theory to the newly discovered knot invariants such as the Jones polynomial is sketched. Riemannian geometry is then introduced in order to describe Einstein's equations of general relativity and show how an attempt to quantize gravity leads to interesting applications of knot theory.

This textbook addresses graduate students starting to specialize in theoretical physics. It provides didactic introductions to the main topics in the theory of fields, while taking into account the contemporary view of the subject. The student will find concise explanations of basic notions essential for applications of the theory of fields as well as for frontier research in theoretical physics. One third of the book is devoted to classical fields. Each chapter contains exercises of varying degree of difficulty with hints or solutions, plus summaries and worked examples as useful. It aims to deliver a unique combination of classical and quantum field theory in one compact course.

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.

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

It is well known that classical electrodynamics is riddled with internal inconsistencies springing from the fact that it is a linear, Abelian theory in which the potentials are unphysical. This volume offers a self-consistent hypothesis which removes some of these problems, as well as builds a framework on which linear and nonlinear optics are treated as a non-Abelian gauge field theory based on the emergence of the fundamental magnetizing field of radiation, the B(3) field. Contents: Interaction of Electromagnetic Radiation with One Fermion; The Field Equations of Classical O (3) b Electrodynamics; Origin of Electrodynamics in the General Theory of Gauge Fields; Nonlinear Propagation in O (3) b Electrodynamics: Solitons and Instantons; Physical Phase Effects in O (3) b Electrodynamics; Quantum Electrodynamics and the B (3) Field; Quantum Chaos, Topological Indices and Gauge Theories; Field Theory of O (3) b QED and Unification with Weak and Nuclear Interactions; Potential Applications of O (3) b QED; Duality and Fundamental Problems. Readership: Graduate and undergraduates in physics (electromagnetism), differential geometry & topology, electrical & electronic engineering, theoretical & physical chemistry, chaos and dynamical systems.

Like any books on a subject as vast as this, this book has to have a point-of-view to guide the selection of topics. Naber takes the view that the rekindled interest that mathematics and physics have shown in each other of late should be fostered, and that this is best accomplished by allowing them to cohabit. The book weaves together rudimentary notions from the classical gauge theory of physics with the topological and geometrical concepts that became the mathematical models of these notions. The reader is asked to join the author on some vague notion of what an electromagnetic field might be, to be willing to accept a few of the more elementary pronouncements of quantum mechanics, and to have a solid background in real analysis and linear algebra and some of the vocabulary of modern algebra. In return, the book offers an excursion that begins with the definition of a topological space and finds its way eventually to the moduli space of anti-self-dual SU(2) connections on S4 with instanton number -1.

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. Contents:IntroductionThe Yang-Mills Field Equations and the Null-Tetrad MethodClassification of the Yang-Mills FieldsStatic Solutions of the Sourceless Yang-Mills Field EquationsClassification of Gauge Fields — ApplicationExact Solutions of the Yang-Mills Field EquationsThe Motion of a Test Particle in Classical

Yang-Mills FieldsSummary and Concluding Remarks Readership: High energy physicists, mathematical physicists and mathematicians. Keywords:Yang-Mills Fields;Yang-Mills Field Equations;Eigenspinor-Eigenvalue Method;Electromagnetic Field ;Carmeli Field;Morris Field;Gauge Fields;Null Tetrads;Lorentz Invariance;Gauge Invariance

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.

Classical Theory of Gauge FieldsPrinceton University Press

Annotation Classical field theory is employed by physicists to describe a wide variety of physical phenomena. These include electromagnetism, fluid dynamics, gravitation and quantum mechanics. The central entity of field theory is the field which is usually a multi component function of space and time. Those multi component functions are usually grouped together as vector fields as in the case in electromagnetic theory and fluid dynamics, in other cases they are grouped as tensors as in theories of gravitation and yet in other cases they are grouped as complex functions as in the case of quantum mechanics. In order to know the value of the field one needs to solve a set of coupled partial differential equations with given boundary and initial conditions. The book covers a selection of recent advances in classical field theory involving electromagnetism, fluid dynamics, gravitation and quantum mechanics. Advances in Classical Field Theory will benefit readers by saving them the effort to read through numerous journal articles which would be needed to obtain a coherent picture of classical field theory otherwise. The book is unique in its aim and scope and is not similar to any existing publication.