Quantum Fields And Strings A Course For Mathematicians

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Geometry and Physics Jürgen Jost 2009-08-17 "Geometry and Physics" addresses mathematicians wanting to understand modern physics, and physicists wanting to learn geometry. It gives an introduction to modern quantum field theory and related areas of theoretical high-energy physics from the perspective of Riemannian geometry, and an introduction to modern geometry as needed and utilized in modern physics. Jürgen Jost, a well-known research mathematician and advanced textbook author, also develops important geometric concepts and methods that can be used for the structures of physics. In particular, he discusses the Lagrangians of the standard model and its supersymmetric extensions from a geometric perspective.
Advanced Topics in Quantum Field Theory Mikhail Shifman 2022-04-30 The Second Edition of this systematic, comprehensive text is revised to include topics developed in the last decade. A new final part presents more than 90 problems with detailed solutions, making this an indispensable book for graduate students and researchers in theoretical physics.
Advanced Topics in Quantum Field Theory M. Shifman 2012 Devoted specifically to modern field theory, this is an indispensable book for graduate students and researchers in theoretical physics. It emphasizes nonperturbative phenomena and supersymmetry, and discusses various phases of gauge theories, extended objects and their quantization, and global supersymmetry from a modern perspective.
Topological Quantum Field Theory and Four Manifolds Jose Labastida 2007-07-18 The emergence of topological quantum ?eld theory has been one of the most important breakthroughs which have occurred in the context of ma- ematical physics in the last century, a century characterizedbyindependent developments of the main ideas in both disciplines, physics and mathematics, which has concluded with two decades of strong interaction between them, where physics, as in previous centuries, has acted as a source of new mat- matics. Topological quantum ?eld theories constitute the core of these p- nomena, although the main drivingforce behind it has been the enormous e?ort made in theoretical particle physics to understand string theory as a theory able to unify the four fundamental interactions observed in nature. These theories set up a new realm where both disciplines pro?t from each other. Although the most striking results have appeared on the mathema- calside,theoreticalphysicshasclearlyalsobene?tted,sincethecorresponding developments have helped better to understand aspects of the fundamentals of ?eld and string theory.
Mathematical Aspects of Quantum Field Theories Damien Calaque 2015-01-06 Despite its long history and stunning experimental successes, the mathematical foundation of perturbative quantum field theory is still a subject of ongoing research. This book aims at presenting some of the most recent advances in the field, and at reflecting the diversity of approaches and tools invented and currently employed. Both leading experts and comparative newcomers to the field present their latest findings, helping readers to gain a better understanding of not only quantum but also classical field theories. Though the book offers a valuable resource for mathematicians and physicists alike, the focus is more on mathematical developments. This volume consists of four parts: The first Part covers local aspects of perturbative quantum field theory, with an emphasis on the axiomatization of the algebra behind the operator product expansion. The second Part highlights Chern-Simons gauge theories, while the third examines (semi-)classical field theories. In closing, Part 4 addresses factorization homology and factorization algebras.
Lectures on Field Theory and Topology Daniel S. Freed 2019-08-23 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.

Mathematical Aspects of Quantum Field Theory Edson de Faria 2010-08-12 Over the last century quantum field theory has made a significant impact on the formulation and solution of mathematical problems and inspired powerful advances in pure mathematics. However, most accounts are written by physicists, and mathematicians struggle to find clear definitions and statements of the concepts involved. This graduate-level introduction presents the basic ideas and tools from quantum field theory to a mathematical audience. Topics include classical and quantum mechanics, classical field theory, quantization of classical fields, perturbative quantum field theory, renormalization, and the standard model. The material is also accessible to physicists seeking a better understanding of the mathematical background, providing the necessary tools from differential geometry on such topics as connections and gauge fields, vector and spinor bundles, symmetries and group representations.

Towards the Mathematics of Quantum Field Theory Frédéric Paugam 2014-02-20 This ambitious and original book sets out to introduce to mathematicians (even including graduate students) the mathematical methods of theoretical and experimental quantum field theory, with an emphasis on coordinate-free presentations of the mathematical objects in use. This in turn promotes the interaction between mathematicians and physicists by supplying a common and flexible language for the good of both communities, though mathematicians are the primary target. This reference work provides a coherent and complete mathematical toolbox for classical and quantum field theory, based on categorical and homotopical methods, representing an original contribution to the literature. The first part of the book introduces the mathematical methods needed to work with the physicists' spaces of fields, including parameterized and functional differential geometry, functorial analysis, and the homotopical geometric theory of non-linear partial differential equations, with applications to general gauge theories. The second part presents a large family of examples of classical field theories, both from experimental and theoretical physics, while the third part provides an introduction to quantum field theory, presents various renormalization methods, and discusses the quantization of factorization algebras.

Supergeometry, Super Riemann Surfaces and the Superconformal Action Functional Enno Keßler 2019-08-28 This book treats the two-dimensional non-linear supersymmetric sigma model or spinning string from the perspective of supergeometry. The objective is to understand its symmetries as geometric properties of super Riemann surfaces, which are particular complex super manifolds of dimension 1|1. The first part gives an introduction to the super differential geometry of families of super manifolds. Appropriate generalizations of principal bundles, smooth families of complex manifolds and integration theory are developed. The second part studies uniformization, U(1)-structures and connections on Super Riemann surfaces and shows how the latter can be viewed as extensions of Riemann surfaces by a gravitino field. A natural geometric action functional on super Riemann surfaces is shown to reproduce the action functional of the non-linear supersymmetric sigma model using a component field formalism. The conserved currents of this action can be identified as infinitesimal deformations of the super Riemann surface. This is in surprising analogy to the theory of Riemann surfaces and the harmonic action functional on them. This volume is aimed at both theoretical physicists interested in a careful treatment of the subject and mathematicians who want to become acquainted with the potential applications of this beautiful theory.

Motives, Quantum Field Theory, and Pseudodifferential Operators Alan L. Carey 2010 This volume contains articles related to the conference ``Motives, Quantum Field Theory, and Pseudodifferntial Operators'' held at Boston University in June 2008, with partial support from the Clay Mathematics Institute, Boston University, and the National Science Foundation. There are deep but only partially understood connections between the three conference fields, so this book is intended both to explain the known connections and to offer directions for further research. In keeping with the organization of the conference, this book contains introductory lectures on each of the conference themes and research articles on current topics in these fields. The introductory lectures are suitable for graduate students and new Ph.D.'s in both mathematics and theoretical physics, as well as for senior researchers, since few mathematicians are expert in any two of the conference areas. Among the topics discussed in the introductory lectures are the appearance of multiple zeta values both as periods of motives and in Feynman integral calculations in perturbative QFT, the use of Hopf algebra techniques for renormalization in QFT, and regularized traces of pseudodifferential operators. The motivic interpretation of multiple zeta values points to a fundamental link between motives and QFT, and there are strong parallels between regularized traces and Feynman integral techniques. The research articles cover a range of topics in areas related to the conference themes, including geometric, Hopf algebraic, analytic, motivic and computational aspects of quantum field theory and mirror symmetry. There is no unifying theory of the conference areas at present, so the research articles present the

current state of the art pointing towards such a unification.
Quantum Fields and Strings Pierre Deligne 1999-01-01 Ideas from quantum field theory and string theory have had considerable impact on mathematics over the past 20 years. Advances in many different areas have been inspired by insights from physics. In 1996-97 the Institute for Advanced Study (Princeton, NJ) organized a special year-long program designed to teach mathematicians the basic physical ideas which underlie the mathematical applications. The purpose is eloquently stated in a letter written by Robert MacPherson: ``The goal is to create and convey an understanding, in terms congenial to mathematicians, of some fundamental notions of physics ... [and to] develop the sort of intuition common among physicists for those who are used to thought processes stemming from geometry and algebra.'' These volumes are a written record of the program. They contain notes from several long and many short courses covering various aspects of quantum field theory and perturbative string theory. The courses were given by leading physicists and the notes were written either by the speakers or by mathematicians who participated in the program. The book also includes problems and solutions worked out by the editors and other leading participants. Interspersed are mathematical texts with background material and commentary on some topics covered in the lectures. These two volumes present the first truly comprehensive introduction to this field aimed at a mathematics audience. They offer a unique opportunity for mathematicians and mathematical physicists to learn about the beautiful and difficult subjects of quantum field theory and string theory.
String Field Theory Harold Erbin 2021 This textbook provides an introduction to string field theory (SFT). String theory is usually formulated in the worldsheet formalism, which describes a single string (first-quantization). While this approach is intuitive and could be pushed far due to the exceptional properties of two-dimensional theories, it becomes cumbersome for some questions or even fails at a more fundamental level. These motivations have led to the development of SFT, a description of string theory using the field theory formalism (second-quantization). As a field theory, SFT provides a rigorous and constructive formulation of string theory. The main focus of the book is the construction of the closed bosonic SFT. The accent is put on providing the reader with the foundations, conceptual understanding and intuition of what SFT is. After reading this book, the reader is able to study the applications from the literature. The book is organized in two parts. The first part reviews the notions of the worldsheet theory that are necessary to build SFT (worldsheet path integral, CFT and BRST quantization). The second part starts by introducing general concepts of SFT from the BRST quantization. Then, it introduces off-shell string amplitudes before providing a Feynman diagrams interpretation from which the building blocks of SFT are extracted. After constructing the closed SFT, the author outlines the proofs of several important properties such as background independence, unitarity and crossing symmetry. Finally, the generalization to the superstring is also discussed.
An Invitation to Quantum Field Theory Luis Alvarez-Gaumé 2011-11-26 This book provides an introduction to Quantum Field Theory (QFT) at an elementary level—with only special relativity, electromagnetism and quantum mechanics as prerequisites. For this fresh approach to teaching QFT, based on numerous lectures and courses given by the authors, a representative sample of topics has been selected containing some of the more innovative, challenging or subtle concepts. They are presented with a minimum of technical details, the discussion of the main ideas being more important than the presentation of the typically very technical mathematical details necessary to obtain the final results. Special attention is given to the realization of symmetries in particle physics: global and local symmetries, explicit, spontaneously broken, and anomalous continuous symmetries, as well as discrete symmetries. Beyond providing an overview of the standard model of the strong, weak and electromagnetic interactions and the current understanding of the origin of mass, the text enumerates the general features of renormalization theory as well as providing a cursory description of effective field theories and the problem of naturalness in physics. Among the more advanced topics the reader will find are an outline of the first principles derivation of the CPT theorem and the spin-statistics connection. As indicated by the title, the main aim of this text is to motivate the reader to study QFT by providing a self-contained and approachable introduction to the most exciting and challenging aspects of this successful theoretical framework.
Advanced Concepts in Particle and Field Theory Tristan Hübsch 2015-06-11 Uniting the usually distinct areas of particle physics and quantum field theory, gravity and general relativity, this expansive and comprehensive textbook of fundamental and theoretical physics describes the quest to consolidate the basic building blocks of nature, by journeying through contemporary discoveries in the field, and analysing elementary particles and their interactions. Designed for advanced undergraduates and graduate students and abounding in worked examples and detailed derivations, as well as including historical anecdotes and philosophical and methodological perspectives, this textbook provides students with a unified understanding of all matter at the fundamental level. Topics range from gauge principles, particle decay and scattering cross-sections, the Higgs mechanism and mass generation, to spacetime geometries and supersymmetry. By combining historically separate areas of study and presenting them in a logically consistent manner, students will appreciate the underlying similarities and conceptual connections to be made in these fields.
Geometric Methods for Quantum Field Theory Hernan Ocampo 2001-04-30 Both mathematics and mathematical physics have many active areas of research where the interplay between geometry and quantum field theory has proved extremely fruitful. Duality, gauge field theory, geometric quantization, Seiberg–Witten theory, spectral properties and families of Dirac operators, and the geometry of loop groups offer some striking recent examples of

modern topics which stand on the borderline between geometry and analysis on the one hand and quantum field theory on the other, where the physicist's and the mathematician's perspective complement each other, leading to new mathematical and physical concepts and results. This volume introduces the reader to some basic mathematical and physical tools and methods required to follow the recent developments in some active areas of mathematical physics, including duality, gauge field theory, geometric quantization, Seiberg-Witten theory, spectral properties and families of Dirac operators, and the geometry of loop groups. It comprises seven self-contained lectures, which should progressively give the reader a precise idea of some of the techniques used in these areas, as well as a few short communications presented by young participants at the school.
Contents:Lectures:Introduction to Differentiable Manifolds and Symplectic Geometry (T Wurzbacher)Spectral Properties of the Dirac Operator and Geometrical Structures (O Hijazi)Quantum Theory of Fermion Systems: Topics Between Physics and Mathematics (E Langmann)Heat Equation and Spectral Geometry. Introduction for Beginners (K Wojciechowski)Renormalized Traces as a Geometric Tool (S Paycha)Concepts in Gauge Theory Leading to Electric-Magnetic Duality (T S Tsun)An Introduction to Seiberg-Witten Theory (H Ocampo)Short Communications:Remarks on Duality, Analytical Torsion and Gaussian Integration in Antisymmetric Field Theories (A Cardona)Multiplicative Anomaly for the ?-Regularized Determinant (C Ducourtioux)On Cohomogeneity One Riemannian Manifolds (S M B Kashani)A Differentiable Calculus on the Space of Loops and Connections (M Reiris)Quantum Hall Conductivity and Topological Invariants (A Reyes)Determinant of the Dirac Operator Over the Interval [0,?] (F Torres-Ardila) Readership: Mathematicians and physicists. Keywords:Reviews:“Many texts in theoretical physics do not contain a rigorous account of the mathematics they employ. However, this text does, and it omits no steps in the logic, thus making it very accessible to the mathematical community. Also it emphasizes physics, providing a link between the two disciplines which one rarely finds in a text.”Contemporary Physics
Quantum Mathematical Physics Felix Finster 2016-02-24 Quantum physics has been highly successful for more than 90 years. Nevertheless, a rigorous construction of interacting quantum field theory is still missing. Moreover, it is still unclear how to combine quantum physics and general relativity in a unified physical theory. Attacking these challenging problems of contemporary physics requires highly advanced mathematical methods as well as radically new physical concepts. This book presents different physical ideas and mathematical approaches in this direction. It contains a carefully selected cross-section of lectures which took place in autumn 2014 at the sixth conference ``Quantum Mathematical Physics - A Bridge between Mathematics and Physics'' in Regensburg, Germany. In the tradition of the other proceedings covering this series of conferences, a special feature of this book is the exposition of a wide variety of approaches, with the intention to facilitate a comparison. The book is mainly addressed to mathematicians and physicists who are interested in fundamental questions of mathematical physics. It allows the reader to obtain a broad and up-to-date overview of a fascinating active research area.
Five Lectures on Supersymmetry Daniel S. Freed The lectures featured in this book treat fundamental concepts necessary for understanding the physics behind these mathematical applications. Freed approaches the topic with the assumption that the basic notions of supersymmetric field theory are unfamiliar to most mathematicians. He presents the material intending to impart a firm grounding in the elementary ideas.
Mathematical Foundations of Quantum Field Theory and Perturbative String Theory Hisham Sati 2011-12-07 Conceptual progress in fundamental theoretical physics is linked with the search for the suitable mathematical structures that model the physical systems. Quantum field theory (QFT) has proven to be a rich source of ideas for mathematics for a long time. However, fundamental questions such as ``What is a QFT?'' did not have satisfactory mathematical answers, especially on spaces with arbitrary topology, fundamental for the formulation of perturbative string theory. This book contains a collection of papers highlighting the mathematical foundations of QFT and its relevance to perturbative string theory as well as the deep techniques that have been emerging in the last few years. The papers are organized under three main chapters: Foundations for Quantum Field Theory, Quantization of Field Theories, and Two-Dimensional Quantum Field Theories. An introduction, written by the editors, provides an overview of the main underlying themes that bind together the papers in the volume.
String-Math 2013 Ron Donagi, Michael R. Douglas 2014-12-02 This volume contains the proceedings of the conference `String-Math 2013' which was held June 17-21, 2013 at the Simons Center for Geometry and Physics at Stony Brook University. This was the third in a series of annual meetings devoted to the interface of mathematics and string theory. Topics include the latest developments in supersymmetric and topological field theory, localization techniques, the mathematics of quantum field theory, superstring compactification and duality, scattering amplitudes and their relation to Hodge theory, mirror symmetry and two-dimensional conformal field theory, and many more. This book will be important reading for researchers and students in the area, and for all mathematicians and string theorists who want to update themselves on developments in the math-string interface.
Topology and Quantum Theory in Interaction David Ayala 2018-10-25 This volume contains the proceedings of the NSF-CBMS Regional Conference on Topological and Geometric Methods in QFT, held from July 31–August 4, 2017, at Montana State University in Bozeman, Montana. In recent decades, there has been a movement to axiomatize quantum field theory into a mathematical structure. In a different direction, one can ask to test these axiom systems against physics. Can they be used to rederive known facts about quantum theories or, better yet, be the framework in which to solve open problems? Recently, Freed and Hopkins have provided a solution to a

classification problem in condensed matter theory, which is ultimately based on the field theory axioms of Graeme Segal. Papers contained in this volume amplify various aspects of the Freed–Hopkins program, develop some category theory, which lies behind the cobordism hypothesis, the major structure theorem for topological field theories, and relate to Costello's approach to perturbative quantum field theory. Two papers on the latter use this framework to recover fundamental results about some physical theories: two-dimensional sigma-models and the bosonic string. Perhaps it is surprising that such sparse axiom systems encode enough structure to prove important results in physics. These successes can be taken as encouragement that the axiom systems are at least on the right track toward articulating what a quantum field theory is.

A Short Introduction to String Theory Thomas Mohaupt 2022-03-31 Suitable for graduate students in physics and mathematics, this book presents a concise and pedagogical introduction to string theory. It focuses on explaining the key concepts of string theory, such as bosonic strings, D-branes, supersymmetry and superstrings, and on clarifying the relationship between particles, fields and strings, without assuming an advanced background in particle theory or quantum field theory, making it widely accessible to interested readers from a range of backgrounds. Important ideas underpinning current research, such as partition functions, compactification, gauge symmetries and T-duality are analysed both from the world-sheet (conformal field theory) and the space-time (effective field theory) perspective. Ideal for either self-study or a one semester graduate course, A Short Introduction to String Theory is an essential resource for students studying string theory, containing examples and homework problems to develop understanding, with fully worked solutions available to instructors.

The Abel Prize 2013-2017 Helge Holden 2019-02-23 The book presents the winners of the Abel Prize in mathematics for the period 2013–17: Pierre Deligne (2013); Yakov G. Sinai (2014); John Nash Jr. and Louis Nirenberg (2015); Sir Andrew Wiles (2016); and Yves Meyer (2017). The profiles feature autobiographical information as well as a scholarly description of each mathematician’s work. In addition, each profile contains a Curriculum Vitae, a complete bibliography, and the full citation from the prize committee. The book also includes photos for the period 2003–2017 showing many of the additional activities connected with the Abel Prize. As an added feature, video interviews with the Laureates as well as videos from the prize ceremony are provided at an accompanying website (http://extras.springer.com/). This book follows on The Abel Prize: 2003-2007. The First Five Years (Springer, 2010) and The Abel Prize 2008-2012 (Springer 2014), which profile the work of the previous Abel Prize winners.

Factorization Algebras in Quantum Field Theory: Kevin Costello 2016-12-15 Factorization algebras are local-to-global objects that play a role in classical and quantum field theory which is similar to the role of sheaves in geometry: they conveniently organize complicated information. Their local structure encompasses examples like associative and vertex algebras; in these examples, their global structure encompasses Hochschild homology and conformal blocks. In this first volume, the authors develop the theory of factorization algebras in depth, but with a focus upon examples exhibiting their use in field theory, such as the recovery of a vertex algebra from a chiral conformal field theory and a quantum group from Abelian Chern-Simons theory. Expositions of the relevant background in homological algebra, sheaves and functional analysis are also included, thus making this book ideal for researchers and graduates working at the interface between mathematics and physics.

Noncommutative Geometry, Quantum Fields and Motives Alain Connes 2019-03-13 The unifying theme of this book is the interplay among noncommutative geometry, physics, and number theory. The two main objects of investigation are spaces where both the noncommutative and the motivic aspects come to play a role: space-time, where the guiding principle is the problem of developing a quantum theory of gravity, and the space of primes, where one can regard the Riemann Hypothesis as a long-standing problem motivating the development of new geometric tools. The book stresses the relevance of noncommutative geometry in dealing with these two spaces. The first part of the book deals with quantum field theory and the geometric structure of renormalization as a Riemann-Hilbert correspondence. It also presents a model of elementary particle physics based on noncommutative geometry. The main result is a complete derivation of the full Standard Model Lagrangian from a very simple mathematical input. Other topics covered in the first part of the book are a noncommutative geometry model of dimensional regularization and its role in anomaly computations, and a brief introduction to motives and their conjectural relation to quantum field theory. The second part of the book gives an interpretation of the Weil explicit formula as a trace formula and a spectral realization of the zeros of the Riemann zeta function. This is based on the noncommutative geometry of the adèle class space, which is also described as the space of commensurability classes of Q-lattices, and is dual to a noncommutative motive (endomotive) whose cyclic homology provides a general setting for spectral realizations of zeros of L-functions. The quantum statistical mechanics of the space of Q-lattices, in one and two dimensions, exhibits spontaneous symmetry breaking. In the low-temperature regime, the equilibrium states of the corresponding systems are related to points of classical moduli spaces and the symmetries to the class field theory of the field of rational numbers and of imaginary quadratic fields, as well as to the automorphisms of the field of modular functions. The book ends with a set of analogies between the noncommutative geometries underlying the mathematical formulation of the Standard Model minimally coupled to gravity and the moduli spaces of Q-lattices used in the study of the zeta function.

What Is a Quantum Field Theory? Michel Talagrand 2022-03-17 Quantum field theory (QFT) is one of the great

achievements of physics, of profound interest to mathematicians. Most pedagogical texts on QFT are geared toward budding professional physicists, however, whereas mathematical accounts are abstract and difficult to relate to the physics. This book bridges the gap. While the treatment is rigorous whenever possible, the accent is not on formality but on explaining what the physicists do and why, using precise mathematical language. In particular, it covers in detail the mysterious procedure of renormalization. Written for readers with a mathematical background but no previous knowledge of physics and largely self-contained, it presents both basic physical ideas from special relativity and quantum mechanics and advanced mathematical concepts in complete detail. It will be of interest to mathematicians wanting to learn about QFT and, with nearly 300 exercises, also to physics students seeking greater rigor than they typically find in their courses.

Quantum Mechanics for Mathematicians Leon Armenovich Takhtadzhi?an 2008 This book provides a comprehensive treatment of quantum mechanics from a mathematics perspective and is accessible to mathematicians starting with second-year graduate students. It addition to traditional topics, like classical mechanics, mathematical foundations of quantum mechanics, quantization, and the Schrodinger equation, this book gives a mathematical treatment of systems of identical particles with spin, and it introduces the reader to functional methods in quantum mechanics. This includes the Feynman path integral approach to quantum mechanics, integration in functional spaces, the relation between Feynman and Wiener integrals, Gaussian integration and regularized determinants of differential operators, fermion systems and integration over anticommuting (Grassmann) variables, supersymmetry and localization in loop spaces, and supersymmetric derivation of the Atiyah-Singer formula for the index of the Dirac operator. Prior to this book, mathematicians could find these topics only in physics textbooks and in specialized literature. This book is written in a concise style with careful attention to precise mathematics formulation of methods and results.Numerous problems, from routine to advanced, help the reader to master the subject. In addition to providing a fundamental knowledge of quantum mechanics, this book could also serve as a bridge for studying more advanced topics in quantum physics, among them quantum field theory. Prerequisites include standard first-year graduate courses covering linear and abstract algebra, topology and geometry, and real and complex analysis.

A Mathematical Introduction to Conformal Field Theory Martin Schottenloher 2008-09-11 The first part of this book gives a self-contained and mathematically rigorous exposition of classical conformal symmetry in n dimensions and its quantization in two dimensions. The second part surveys some more advanced topics of conformal field theory.

Factorization Algebras in Quantum Field Theory Kevin Costello 2016-12-15 This first volume develops factorization algebras with a focus upon examples exhibiting their use in field theory, which will be useful for researchers and graduates.

Nonperturbative Quantum-field-theoretic Methods and Their Applications Z. Horv th 2001 Contents: Conformal Boundary Conditions OCo and What They Teach Us (V B Petkova & J-B Zuber); A Physical Basis for the Entropy of the AdS 3 Black Hole (S Fernando & F Mansouri); Spinon Formulation of the Kondo Problem (A Klmper & J R Reyes-Martinez); Boundary Integrable Quantum Field Theories (P Dorey); Finite Size Effects in Integrable Quantum Field Theories (F Ravanini); Nonperturbative Analysis of the Two-Frequency Sine-Gordon Model (Z Bajnok et al.); Screening in Hot SU(2) Gauge Theory and Propagators in 3D Adjoint Higgs Model (A Cucchieri et al.); Effective Average Action in Statistical Physics and Quantum Field Theory (Ch Wetterich); Phase Transitions in Non-Hermitean Matrix Models and the OC Single RingOCO Theorem (J Feinberg et al.); Unraveling the Mystery of Flavor (A Falk); The Nahm Transformation on R 2 X T 2 (C Ford); A 2D Integrable Axion Model and Target Space Duality (P Forgics); Supersymmetric Ward Identities and Chiral Symmetry Breaking in SUSY QED (M L Walker); and other papers. Readership: Theoretical, mathematical and high energy physicists."

Quantum Field Theory: A Tourist Guide for Mathematicians Gerald B. Folland 2021-02-03 Quantum field theory has been a great success for physics, but it is difficult for mathematicians to learn because it is mathematically incomplete. Folland, who is a mathematician, has spent considerable time digesting the physical theory and sorting out the mathematical issues in it. Fortunately for mathematicians, Folland is a gifted expositor. The purpose of this book is to present the elements of quantum field theory, with the goal of understanding the behavior of elementary particles rather than building formal mathematical structures, in a form that will be comprehensible to mathematicians. Rigorous definitions and arguments are presented as far as they are available, but the text proceeds on a more informal level when necessary, with due care in identifying the difficulties. The book begins with a review of classical physics and quantum mechanics, then proceeds through the construction of free quantum fields to the perturbation-theoretic development of interacting field theory and renormalization theory, with emphasis on quantum electrodynamics. The final two chapters present the functional integral approach and the elements of gauge field theory, including the Salam–Weinberg model of electromagnetic and weak interactions.

Gauge Fields and Strings Polyakov 1987-09-14 "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."--Provided by publisher.

Quantum Fields and Strings Pierre Deligne 1999-01-01 Ideas from quantum field theory and string theory have had

considerable impact on mathematics over the past 20 years. Advances in many different areas have been inspired by insights from physics. In 1996-97 the Institute for Advanced Study (Princeton, NJ) organized a special year-long program designed to teach mathematicians the basic physical ideas which underlie the mathematical applications. The purpose is eloquently stated in a letter written by Robert MacPherson: "The goal is to create and convey an understanding, in terms congenial to mathematicians, of some fundamental notions of physics ... [and to] develop the sort of intuition common among physicists for those who are used to thought processes stemming from geometry and algebra." These volumes are a written record of the program. They contain notes from several long and many short courses covering various aspects of quantum field theory and perturbative string theory. The courses were given by leading physicists and the notes were written either by the speakers or by mathematicians who participated in the program. The book also includes problems and solutions worked out by the editors and other leading participants. Interspersed are mathematical texts with background material and commentary on some topics covered in the lectures. These two volumes present the first truly comprehensive introduction to this field aimed at a mathematics audience. They offer a unique opportunity for mathematicians and mathematical physicists to learn about the beautiful and difficult subjects of quantum field theory and string theory.

Quantum Fields and Strings Pierre Deligne 1999 Ideas from quantum field theory and string theory have had considerable impact on mathematics since the 1980s. Advances in many different areas have been inspired by insights from physics. In 1996-97 the Institute for Advanced Study (Princeton, NJ) organized a special year-long programme designed to teach mathematicians the basic physical ideas which underlie the mathematical applications.

A Modern Introduction to Quantum Field Theory Michele Maggiore 2005 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.

Progress in String Theory Juan M Maldacena 2005-07-12 Intended mainly for advanced graduate students in theoretical physics, this comprehensive volume covers recent advances in string theory and field theory dualities. It is based on the annual lectures given at the School of the Theoretical Advanced Study Institute (2003) a traditional event that brings together graduate students in high energy physics for an intensive course given by leaders in their fields. The first lecture by Paul Aspinwall is a description of branes in Calabi–Yau manifolds, which includes an introduction to the modern ideas of derived categories and their relation to D-branes. Juan Maldacena's second lecture is a short introduction to the AdS/CFT correspondence with a short discussion on its plane wave limit. Tachyon condensation for open strings is discussed in the third lecture by Ashoke Sen while Eva Silverstein provides a useful summary of the various attempts to produce four-dimensional physics out of string theory and M-theory in the fourth lecture. Matthew Strassler's fifth lecture is a careful discussion of a theory that has played a very important role in recent developments in string theory — a quantum field theory that produces a duality cascade which also has a large N gravity description. The sixth lecture by Washington Taylor explains how to perform perturbative computations using string field theory. The written presentation of these lectures is detailed yet straightforward, and they will be of great use to both students and experienced researchers in high energy theoretical physics. Contents:D-Branes on Calabi-Yau Manifolds (P S Aspinwall)Lectures on AdS/CFT (J M Maldacena)Tachyon Dynamics in Open String Theory (A Sen)TASI/PITP/ISS Lectures on Moduli and Microphysics (E Silverstein)The Duality Cascade (M J Strassler)Perturbative Computations in String Field Theory (W Taylor) Readership: Graduates, academics and researchers in high energy, particle, theoretical and mathematical physics. Keywords:String Theory;M-Theory;Supersymmetry;Field Theory;AdS/CFTKey Features:An ongoing series of lecture notes featuring an intensive course of advanced learning in high energy physics

A Short Introduction to String Theory Thomas Mohaupt 2022-04-07 A concise and pedagogical introduction to string theory for graduate students featuring examples and homework problems.

Topology, Geometry and Quantum Field Theory GEOMETRY SYMPOSIUM ON TOPOLOGY (AND QUANTUM FIELD THEORY (2002 : OXFORD, ENGLAND) AUTOR) 2004-06-28 Visionary articles explaining approaches to important problems on the interface of pure mathematics and mathematical physics.

String Theory Research Progress Ferenc N. Balogh 2008 String theory is a model of fundamental physics whose building blocks are one-dimensional extended objects called strings, rather than the zero-dimensional point particles that form the basis for the standard model of particle physics. The phrase is often used as shorthand for Superstring theory, as well as related theories such as M-theory. By replacing the point-like particles with strings, an apparently consistent quantum theory of gravity emerges. Moreover, it may be possible to 'unify' the known natural forces (gravitational, electromagnetic, weak nuclear and strong nuclear) by describing them with the same set of equations. Studies of string theory have revealed that it predicts higher-dimensional objects called branes. String theory strongly suggests the existence of ten or eleven (in M-theory) space-time dimensions, as opposed to the

usual four (three spatial and one temporal) used in relativity theory.
Introduction to Superstrings and M-Theory Michio Kaku 2012-12-06 Called by some "the theory of everything," superstrings may solve a problem which has eluded physicists for the past 50 years -- the final unification of the two great theories of the twentieth century, general relativity and quantum field theory. This is a course-tested comprehensive introductory graduate text on superstrings which stresses the most current areas of interest, not covered in other presentation, including: string field theory, multi loops, Teichmueller spaces, conformal field theory, and four-dimensional strings. The book begins with a simple discussion of point particle theory, and uses the Feynman path integral technique to unify the presentation of superstrings. Prerequisites are an aquaintance with quantum mechanics and relativity. This second edition has been revised and updated throughout.
Quantum Fields and Strings: A Course for Mathematicians P Deligne 1999