Quantum Topology and Global Anomalies
A Baadhio 1996-09-03

Anomalies are ubiquitous features in quantum field theories. They can ruin the consistency of such theories and put significant restrictions on their viability, especially in dimensions higher than four. Global gauge and gravitational anomalies are to date, one of the scant powerful and probing tools available to physicists in the pursuit of uniqueness. This monograph is one of the very few that specializes in the study of global anomalies in quantum field theories. A discussion of various issues associated to three dimensional physics — the Chern–Simons–Witten theories — widen the scope of this book. Topics discussed here comprises: the ongoing quest for three-manifolds invariant, the role of the mapping class groups in (a) the detection and cancellation of global anomalies, (b) formulating three-manifolds invariant; the geometric quantization of Chern-Simons-Witten theories; deformation quantization; study of chiral and gravitational anomalies; anomalies and the Atiyah-Patodi-Singer Index theorem; exotic spheres; global gravitational anomalies in some six and ten dimensional supergravity and superstring theories, with an additional case study of Witten SU(2) Global Gauge Anomalies. In addition, five chapters lay out the mathematical basis for a thorough use of the topics above. One chapter focuses on the relationship between Teichmüller spaces, moduli spaces and mapping class groups. Another chapter is devoted to mapping class groups and arithmetic groups. Gauge theories on Riemann surfaces are studies in well over two chapters, the first one centered on the theory of bundles and the second on connections. Many readers will find this a useful book, especially theoretical physicists and mathematicians. The material presented here will be of interest to both the experts who will find complete, detailed and precise descriptions of important topics of current interest in mathematical physics, and to students and newcomers to the field, who will appreciate the vast amount of information provided here, especially on global anomalies.

Contents:
The Ongoing Quest for Three-Manifold Invariants
Mapping Class Groups and 3-Manifold Invariants
Teichmüller Spaces and Mapping Class Groups
Mapping Class Groups and Arithmetic Groups
Weil-Petersson Geometry of Teichmüller Spaces
Gauge Theories on Riemann Surfaces I: Bundles
Gauge Theories on Riemann Surfaces II: Connections
Geometric Quantization of Chern–Simons–Witten Theories
Deformation Quantization
Chiral and Gravitational Anomalies
Anomalies and the Index Theorem
Global Anomalies Mapping Class Groups and Global Anomalies
Exotic Spheres

Global Anomalies and Quantum Topology
A. Baadhio 2007-12-11

Anomalies in Quantum Field Theory
Reinhold A. Bertlmann 2000-11-02

This text presents the different aspects of the study of anomalies. Much emphasis is now being placed on the formulation of the theory using the mathematical ideas of differential geometry and topology. It includes derivations and calculations.

Path Integrals and Quantum Anomalies
Kazuo Fujikawa 2004-04-29

The Feynman path integrals are becoming increasingly important in the applications of quantum mechanics and field
theory. The path integral formulation of quantum anomalies, i.e. the quantum breaking of certain symmetries, can now cover all the known quantum anomalies in a coherent manner. In this book the authors provide an introduction to the path integral method in quantum field theory and its applications to the analyses of quantum anomalies. No previous knowledge of field theory beyond advanced undergraduate quantum mechanics is assumed. The book provides the first coherent introductory treatment of the path integral formulation of chiral and Weyl anomalies, with applications to gauge theory in two and four dimensions, conformal field theory and string theory. Explicit and elementary path integral calculations of most of the quantum anomalies covered are given. The conceptual basis of the path integral bosonization in two-dimensional theory, which may have applications to condensed matter theory, for example, is clarified. The book also covers the recent interesting developments in the treatment of fermions and chiral anomalies in lattice gauge theory.

Quantum Topology-Louis H. Kauffman 1993
This book constitutes a review volume on the relatively new subject of Quantum Topology. Quantum Topology has its inception in the 1984/1985 discoveries of new invariants of knots and links (Jones, Homfly and Kauffman polynomials). These invariants were rapidly connected with quantum groups and methods in statistical mechanics. This was followed by Edward Witten's introduction of methods of quantum field theory into the subject and the formulation by Witten and Michael Atiyah of the concept of topological quantum field theories. This book is a review volume of on-going research activity. The papers derive from talks given at the Special Session on Knot and Topological Quantum Field Theory of the American Mathematical Society held at Dayton, Ohio in the fall of 1992. The book consists of a self-contained article by Kauffman, entitled Introduction to Quantum Topology and eighteen research articles by participants in the special session. This book should provide a useful source of ideas and results for anyone interested in the interface between topology and quantum field theory.

Quantization of Singular Symplectic Quotients-N.P. Landsman 2012-12-06 This is the first exposition of the quantization theory of singular symplectic (Marsden-Weinstein) quotients and their applications to physics. The reader will acquire an introduction to the various techniques used in this area, as well as an overview of the latest research approaches. These involve classical differential and algebraic geometry, as well as operator algebras and noncommutative geometry. Thus one will be amply prepared to follow future developments in this field.

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.

Differential Topology and Quantum Field Theory Charles Nash 1991 The remarkable developments in differential topology and how these recent advances have been applied as a primary research tool in quantum field theory are presented here in a style reflecting the genuinely two-sided interaction between mathematical physics and applied mathematics. The author,

Roman Jackiw: 80th Birthday Festschrift
Antti Niemi 2020-07-14 Professor Roman Jackiw is a theoretical physicist renowned for his many fundamental contributions and discoveries in quantum and classical field theories, ranging from high energy physics and gravitation to condensed matter and the physics of fluids. Among his major achievements is the establishment of the presence of the famous Adler-Bell-Jackiw anomalies in quantum field theory, a discovery with far-reaching implications for the structure of the Standard Model of particle physics and all attempts to go beyond it. Other important contributions, among many, that one may mention here are the topological mass term in gravity and gauge theories, and the fractionalization of fermion number and charge in the presence of topological objects. Roman Jackiw, a Professor Emeritus at the MIT Center for Theoretical Physics, is the recipient of several international awards including the Dannie Heineman Prize for Mathematical Physics and the Dirac Medal of the ICTP. He is a member of the US National Academy of Sciences and honorary doctor of Kiev, Montreal, Tours, Turin and Uppsala universities. To celebrate his 80th birthday, many students and colleagues of Professor Jackiw have come together to share interesting anecdotes of working with him as well as their latest research, some of it inspired by his work. Edited by his former students Antti Niemi and Terry Tomboulis together with his long-time friend KK Phua, this festschrift volume is a must-have collection for all theoretical physicists.

Quantum Field Theory for Mathematicians
Robin Ticciati 1999-06-13 This should be a useful reference for anybody with an interest in quantum theory.

A Survey of Knot Theory
Akio Kawauchi 2012-12-06 Knot theory is a rapidly developing field of research with many applications, not only for mathematics. The present volume, written by a well-known specialist, gives a complete survey of this theory from its very beginnings to today's most recent research results. An indispensable book for everyone concerned with knot theory.

Topology, Geometry and Quantum Field Theory

Geometric and Topological Methods for Quantum Field Theory
Alexander Cardona 2013-05-09 “Based on lectures given at the renowned Villa de Leyva summer school, this book provides a unique presentation of modern geometric methods in quantum field theory.”
Written by experts, it enables readers to enter some of the most fascinating research topics in this subject. Covering a series of topics on geometry, topology, algebra, number theory methods and their applications to quantum field theory, the book covers topics such as Dirac structures, holomorphic bundles and stability, Feynman integrals, geometric aspects of quantum field theory and the standard model, spectral and Riemannian geometry and index theory. This is a valuable guide for graduate students and researchers in physics and mathematics wanting to enter this interesting research field at the borderline between mathematics and physics”--

**Exotic Smoothness And Physics: Differential Topology And Spacetime Models**

Torsten Asselmeyer-maluga 2007-01-23 The recent revolution in differential topology related to the discovery of non-standard (“exotic”) smoothness structures on topologically trivial manifolds such as R^4 suggests many exciting opportunities for applications of potentially deep importance for the spacetime models of theoretical physics, especially general relativity. This rich panoply of new differentiable structures lies in the previously unexplored region between topology and geometry. Just as physical geometry was thought to be trivial before Einstein, physicists have continued to work under the tacit — but now shown to be incorrect — assumption that differentiability is uniquely determined by topology for simple four-manifolds. Since diffeomorphisms are the mathematical models for physical coordinate transformations, Einstein's relativity principle requires that these models be physically inequivalent. This book provides an introductory survey of some of the relevant mathematics and presents preliminary results and suggestions for further applications to spacetime models.

**Cosmological Implications of Quantum Anomalies**

Neil David Barrie 2018-07-21 The successes of the standard models of particle physics and cosmology are many, but have proven incapable of explaining all the phenomena that we observe. This book investigates the potentially important role of quantum physics, particularly quantum anomalies, in various aspects of modern cosmology, such as inflation, the dynamical generation of the visible and dark matter in the universe, and gravitational waves. By doing so, the authors demonstrate that exploring the links between cosmology and particle physics is key to helping solve the mysteries of our Universe.

**Contemporary Problems in Mathematical Physics**

Jan Govaerts 2004-12-08 The COPROMAPH Conference series has now evolved into a significant international arena where fundamental concepts in mathematical and theoretical physics and their physics applications can be conceived, developed and disseminated. Basic ideas for addressing a variety of contemporary problems in mathematical and theoretical physics are presented in a nonintimidating atmosphere. Experts provide the reader the fundamentals to predict new possibilities in physics and other fields. The proceedings have been selected for coverage in:

- Index to Scientific & Technical Proceedings® (ISTP® / ISI Proceedings)
- Index to Scientific & Technical Proceedings (ISTP CDROM version / ISI Proceedings)
- CC Proceedings — Engineering & Physical Sciences

Contents:

- Lectures on Diffeomorphisms Groups in Quantum Physics (G A Goldin)
- On the Road Towards the Quantum Geometer's Universe: An Introduction to Four-Dimensional Supersymmetric Quantum Field Theory (J Govaerts)
- Theoretical Methods of Modern Classical and Quantum Physics: A Stochastic Streamflow Model Based on a Minimum Energy Expenditure Concept (A Afouda et al.)
- Regge Poles Trajectories for Nonsingular Potentials: The Thomas-Fermi Potentials (Z Felfli et al.)
- Proposed Differential Equation for Spin 1/2 (H V Mweene)
- Influence of Diseases and Arterial Prostheses on Solitary Blood Waves: Characteristics of an Ideal Prosthesis (S Noubissié & P Woafo)
- Coherent States, Wavelets and Geometric Methods in Theoretical Physics: Vector Coherent States over Matrix Domains (S T Ali)
- Wavelet Analysis and Some of Its Applications in Physics (J-P Antoine)
- Some Variations on the Berezin Quantization Method (M Engliš)
- Variational Analysis, PDE's and Image Analysis: The Big Picture and a Sampling of Details (N D George & K R Vixie)
- Functional Analysis Special Functions and Orthogonal Polynomials: On Generalized Continuous D Semi-Classical Orthogonal Polynomials of Class One (E S Azatassou & M N Hounkonnou)

Readership: Researchers and professionals in physics and mathematics.

Keywords: Mathematical Physics; Theoretical Physics
Topological Quantum Numbers in Nonrelativistic Physics - David J Thouless
1998-03-12 Topological quantum numbers are distinguished from quantum numbers based on symmetry because they are insensitive to the imperfections of the systems in which they are observed. They have become very important in precision measurements in recent years, and provide the best measurements of voltage and electrical resistance. This book describes the theory of such quantum numbers, starting with Dirac's argument for the quantization of electric charge, and continuing with discussions on the helium superfluids, flux quantization and the Josephson effect in superconductors, the quantum Hall effect, solids and liquid crystals, and topological phase transitions. The accompanying reprints include some of the classic experimental and theoretical papers in this area. Physicists — both experimental and theoretical — who are interested in the topic will find this book an invaluable reference.

Contents: Quantization of Electric Charge Circulation and Vortices in Superfluid 4He Superconductivity and Flux Quantization Josephson Effects Superfluid 3He The Quantum Hall Effect Solids and Liquid Crystals Topological Phase Transitions

Readership: Researchers and graduate students in condensed matter physics and quantum mechanics. keywords: Topological Quantum Numbers; Nonrelativistic Physics

An Introduction to Two-Dimensional Quantum Field Theory with (0,2) Supersymmetry - Ilarion V. Melnikov 2019-02-11 This book introduces two-dimensional supersymmetric field theories with emphasis on both linear and non-linear sigma models. Complex differential geometry, in connection with supersymmetry, has played a key role in most developments of the last thirty years in quantum field theory and string theory. Both structures introduce a great deal of rigidity compared to the more general categories of non-supersymmetric theories and real differential geometry, allowing for many general conceptual results and detailed quantitative predictions. Two-dimensional (0,2) supersymmetric quantum field theories provide a natural arena for the fruitful interplay between geometry and quantum field theory. These theories play an important role in string theory and provide generalizations, still to be explored fully, of rich structures such as mirror symmetry. They also have applications to non-perturbative four-dimensional physics, for instance as descriptions of surface defects or low energy dynamics of solitonic strings in four-dimensional supersymmetric theories. The purpose of these lecture notes is to acquaint the reader with these fascinating theories, assuming a background in conformal theory, quantum field theory and differential geometry at the beginning graduate level. In order to investigate the profound relations between structures from complex geometry and field theory the text begins with a thorough examination of the basic structures of (0,2) quantum field theory and conformal field theory. Next, a simple class of Lagrangian theories, the (0,2) Landau-Ginzburg models, are discussed, together with the resulting renormalization group flows, dynamics, and symmetries. After a thorough introduction and examination of (0,2) non-linear sigma models, the text introduces linear sigma models that, in particular, provide a unified treatment of non-linear sigma models and Landau-Ginzburg theories. Many exercises, along with discussions of relevant mathematical notions and important open problems in the field, are included in the text.

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.

**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.

**Discrete Gauge Theory**  
Robert Oeckl 2005 This book provides an introduction to topological quantum field theory as well as discrete gauge theory with quantum groups. In contrast to much of the existing literature, the present approach is at the same time intuitive and mathematically rigorous, making extensive use of suitable diagrammatic methods. It provides a highly unified description of lattice gauge theory, topological quantum field theory and models of quantum (super)gravity. The reader is thus in a unique position to understand the relations between these subjects as well as the underlying groundwork.

**The Superworld I**  
Antonino Zichichi 2013-03-13 From Book News, Inc. Lecture-papers from the 24th Course of the International School cover: two-dimensional superspaces; four-dimensional supergravities from superstrings; heterotic superstrings; anomalies, strings and algebraic geometry; ions and sparticles; proton decay in the superworld; superstring phenomenology; and the end of the superworld. Annotation copyright Book News, Inc. Portland, Or.

**Encyclopaedia of Mathematics**  
Michiel Hazewinkel 2012-12-06 This is the first Supplementary volume to Kluwer's highly acclaimed Encyclopaedia of Mathematics. This additional volume contains nearly 600 new entries written by experts and covers developments and topics not included in the already published 10-volume set. These entries have been arranged alphabetically throughout. A detailed index is included in the book. This Supplementary volume enhances the existing 10-volume set. Together, these eleven volumes represent the most authoritative, comprehensive up-to-date Encyclopaedia of Mathematics available.

**Nonperturbative Quantum Field Theory**  
G. Hooft 2012-12-06 During the past 15 years, quantum field theory and classical statistical mechanics have merged into a single field, and the need for nonperturbative methods for the description of critical phenomena in statistical mechanics as well as for problems in elementary particle physics are generally acknowledged. Such methods formed the central theme of the 1987 Cargese Advanced Study Institut. e on "Nonperturbative Quantum Field Theory." The use of conformal symmetry has been of central interest in recent years, and was a main subject at the ASI. Conformal invariant quantum field theory describes statistical mechanical systems exactly at a critical point, and can be analysed to a remarkable extent by group theoretical methods. Very strong results have been obtained for 2-dimensional systems. Conformal field theory is also the basis of string theory, which offers some hope of providing a unified theory of all interactions between elementary particles. Accordingly, a number of lectures and seminars were presented on these two topics. After syst. ematic introductory lectures, conformal field theory on Riemann surfaces, orbifolds, sigma models, and application of loop group theory and Grassmannians were discussed, and some ideas
on modular geometry were presented. Other lectures combined traditional techniques of constructive quantum field theory with new methods such as the use of index-theorems and infinite dimensional (Kac Moody) symmetry groups. The problems encountered in a quantum mechanical description of black holes were discussed in detail.

**Cumulative Book Index** - 1997 A world list of books in the English language.

**Topological Aspects of Condensed Matter Physics** - Claudio Chamon 2017-02-16 This book contains lecture notes by world experts on one of the most rapidly growing fields of research in physics. Topological quantum phenomena are being uncovered at unprecedented rates in novel material systems. The consequences are far reaching, from the possibility of carrying currents and performing computations without dissipation of energy, to the possibility of realizing platforms for topological quantum computation. The pedagogical lectures contained in this book are an excellent introduction to this blooming field. The lecture notes are intended for graduate students or advanced undergraduate students in physics and mathematics who want to immerse in this exciting XXI century topic. This Les Houches Summer School presents an overview of this field, along with a sense of its origins and its placement on the map of fundamental physics advancements. The School comprised a set of basic lectures (part 1) aimed at a pedagogical introduction of the fundamental concepts, which was accompanied by more advanced lectures (part 2) covering individual topics at the forefront of today's research in condensed-matter physics.

**Topological Matter** - Dario Bercioux 2018-10-03 This book covers basic and advanced aspects in the field of Topological Matter. The chapters are based on the lectures presented during the Topological Matter School 2017. It provides graduate level content introducing the basic concepts of the field, including an introductory session on group theory and topological classification of matter. Different topological phases such as Weyls semi-metals, Majoranas fermions and topological superconductivity are also covered. A review chapter on the major experimental achievements in the field is also provided. The book is suitable not only for master, graduate and young postdoctoral researchers, but also to senior scientists who want to acquaint themselves with the subject.

**Current Algebra and Anomalies** - Sam Treiman 2014-07-14 Current algebra remains our most successful analysis of fundamental particle interactions. This collection of surveys on current algebra and anomalies is a successor volume to Lectures on Current Algebra and Its Applications (Princeton Series in Physics, 1972). Originally published in 1986. The Princeton Legacy Library uses the latest print-on-demand technology to again make available previously out-of-print books from the distinguished backlist of Princeton University Press. These editions preserve the original texts of these important books while presenting them in durable paperback and hardcover editions. The goal of the Princeton Legacy Library is to vastly increase access to the rich scholarly heritage found in the thousands of books published by Princeton University Press since its founding in 1905.

**Diverse Topics in Theoretical and Mathematical Physics** - Roman W. Jackiw 1995 In this volume, topics are drawn from field theory, especially gauge field theory, as applied to particle, condensed matter and gravitational physics, and concern a variety of interesting subjects. These include geometrical topological effects in quantum theory, fractional charge, time travel, relativistic quantized fields in and out of thermal equilibrium and quantum modifications of symmetry in physical systems. Many readers will find this a useful volume, especially theoretical physicists and mathematicians. The material will be of interest to both the expert who will find well-presented novel and stimulating viewpoints of various subjects and the novice who will find complete, detailed and precise descriptions of important topics of current interest, in theoretical and mathematical physics.


**Geometry, Topology and Quantization** - P.
Quantization schemes consider the feasibility of arriving at a quantum system from a classical one and these involve three major procedures viz. i) geometric quantization, ii) Klauder quantization, and iii) stochastic quantization. In geometric quantization we have to incorporate a hermitian line bundle to effectively generate the quantum Hamiltonian operator from a classical Hamiltonian. Klauder quantization also takes into account the role of the connection one-form along with coordinate independence. In stochastic quantization as proposed by Nelson, Schrodinger equation is derived from Brownian motion processes; however, we have difficulty in its relativistic generalization. It has been pointed out by several authors that this may be circumvented by formulating a new geometry where Brownian motion processes are considered in external as well as in internal space and, when the complexified space-time is considered, the usual path integral formulation is achieved. When this internal space variable is considered as a direction vector introducing an anisotropy in the internal space, we have the quantization of a Fermi field. This helps us to formulate a stochastic phase space formalism when the internal extension can be treated as a gauge theoretic extension. This suggests that massive fermions may be considered as Skyrme solitons. The nonrelativistic quantum mechanics is achieved in the sharp point limit.

Quantum Theory, Groups and Representations-Peter Woit 2017-11-01 This text systematically presents the basics of quantum mechanics, emphasizing the role of Lie groups, Lie algebras, and their unitary representations. The mathematical structure of the subject is brought to the fore, intentionally avoiding significant overlap with material from standard physics courses in quantum mechanics and quantum field theory. The level of presentation is attractive to mathematics students looking to learn about both quantum mechanics and representation theory, while also appealing to physics students who would like to know more about the mathematics underlying the subject. This text showcases the numerous differences between typical mathematical and physical treatments of the subject. The latter portions of the book focus on central mathematical objects that occur in the Standard Model of particle physics, underlining the deep and intimate connections between mathematics and the physical world. While an elementary physics course of some kind would be helpful to the reader, no specific background in physics is assumed, making this book accessible to students with a grounding in multivariable calculus and linear algebra. Many exercises are provided to develop the reader’s understanding of and facility in quantum-theoretical concepts and calculations.

Differential Geometry and Mathematical Physics-Gerd Rudolph 2017-03-22 The book is devoted to the study of the geometrical and topological structure of gauge theories. It consists of the following three building blocks:- Geometry and topology of fibre bundles,- Clifford algebras, spin structures and Dirac operators,- Gauge theory. Written in the style of a mathematical textbook, it combines a comprehensive presentation of the mathematical foundations with a discussion of a variety of advanced topics in gauge theory. The first building block includes a number of specific topics, like invariant connections, universal connections, H-structures and the Postnikov approximation of classifying spaces. Given the great importance of Dirac operators in gauge theory, a complete proof of the Atiyah-Singer Index Theorem is presented. The gauge theory part contains the study of Yang-Mills equations (including the theory of instantons and the classical stability analysis), the discussion of various models with matter fields (including magnetic monopoles, the Seiberg-Witten model and dimensional reduction) and the investigation of the structure of the gauge orbit space. The final chapter is devoted to elements of quantum gauge theory including the discussion of the Gribov problem, anomalies and the implementation of the non-generic gauge orbit strata in the framework of Hamiltonian lattice gauge theory. The book is addressed both to physicists and mathematicians. It is intended to be accessible to students starting from a graduate level.

Chern-Simons Theory, Matrix Models, and Topological Strings-Marcos Marino 2005 After an introduction to matrix models and Chern-Simons gauge theory, this book describes in detail the topological string theories that correspond to these gauge theories and develops
the mathematical implication of this duality for the enumerative geometry of Calabi-Yau manifolds and knot theory.

**Superstrings, Geometry, Topology, and C*-algebras**

Robert S. Doran 2010-10-13

This volume contains the proceedings of an NSF-CBMS Conference held at Texas Christian University in Fort Worth, Texas, May 18-22, 2009. The papers, written especially for this volume by well-known mathematicians and mathematical physicists, are an outgrowth of the talks presented at the conference. Topics examined are highly interdisciplinary and include, among many other things, recent results on D-brane charges in $K$-homology and twisted $K$-homology, Yang-Mills gauge theory and connections with non-commutative geometry, Landau-Ginzburg models, $C^*$-algebraic non-commutative geometry and ties to quantum physics and topology, the rational homotopy type of the group of unitary elements in an Azumaya algebra, and functoriality properties in the theory of $C^*$-crossed products and fixed point algebras for proper actions. An introduction, written by Jonathan Rosenberg, provides an instructive overview describing common themes and how the various papers in the volume are interrelated and fit together. The rich diversity of papers appearing in the volume demonstrates the current interplay between superstring theory, geometry/topology, and non-commutative geometry. The book will be of interest to graduate students, mathematicians, mathematical physicists, and researchers working in these areas.

**Geometry, Topology and Physics**

Mikio Nakahara 2018-10-03

Differential geometry and topology have become essential tools for many theoretical physicists. In particular, they are indispensable in theoretical studies of condensed matter physics, gravity, and particle physics. Geometry, Topology and Physics, Second Edition introduces the ideas and techniques of differential geometry and topology at a level suitable for postgraduate students and researchers in these fields. The second edition of this popular and established text incorporates a number of changes designed to meet the needs of the reader and reflect the development of the subject. The book features a considerably expanded first chapter, reviewing aspects of path integral quantization and gauge theories.

Chapter 2 introduces the mathematical concepts of maps, vector spaces, and topology. The following chapters focus on more elaborate concepts in geometry and topology and discuss the application of these concepts to liquid crystals, superfluid helium, general relativity, and bosonic string theory. Later chapters unify geometry and topology, exploring fiber bundles, characteristic classes, and index theorems. New to this second edition is the proof of the index theorem in terms of supersymmetric quantum mechanics. The final two chapters are devoted to the most fascinating applications of geometry and topology in contemporary physics, namely the study of anomalies in gauge field theories and the analysis of Polakov's bosonic string theory from the geometrical point of view. Geometry, Topology and Physics, Second Edition is an ideal introduction to differential geometry and topology for postgraduate students and researchers in theoretical and mathematical physics.

**Quantum Coherence and Reality**

Jeeva S Anandan 1995-02-23

This volume constitutes the proceedings of the above conference, held to celebrate the 60th birthday of Yakir Aharonov. Two Nobel laureates (Norman Ramsey and Charles Townes), members of the National Academy of Sciences and Cresson Medal winners were among the speakers. Among the topics discussed are quantum reality, geometric phases and the Aharonov–Bohm effect, spin and statistics, black holes and quantum gravity. All of these are fundamental to our understanding of quantum theory and are related by being aspects of quantum theory on subjects that Yakir Aharonov has considered. Contents:Dynamic Observation of Flux Lines Based on the AB Effect Principle (A Tonomura)Aharonov Effects for Two Slits and Separated Oscillatory Fields Interferences (N Ramsey)Faster than Fourier (M Berry)Quantum Phase in Action (A Zee)Liberating Exotic Slaves (F Wilczek)Evidence for a Massive Black Hole in the Center of Our Galaxy (C Townes)Black Holes, Wormholes, and the Disappearance of Global Charge (S Coleman)Unitarity of the Black Hole Scattering Matrix (G t' Hooft)Topological Phases and Their Duality in Electromagnetic and Gravitational Fields (J Anandan)Non Locality and Objectivity in Quantum State Reduction (R Penrose)A Non-Polarization EPR Experiment: Observation of High-Visibility Franson Interference Fringes (R Y Chiao et al)Toward "It