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Controlled Diffusion Processes Nov 21 2020 Stochastic control theory is a relatively young branch of mathematics. The beginning of its intensive development falls in the late 1950s and early 1960s. ~urin~ that period an extensive literature appeared on optimal stochastic control using the quadratic performance criterion (see references in Wonham [76]). At the same time, Girsanov [25] and Howard [26] made the first steps in constructing a general theory, based on Bellman's technique of dynamic programming, developed by him somewhat earlier [4]. Two types of engineering problems engendered two different parts of stochastic control theory. Problems of the first type are associated with multistep decision making in discrete time, and are treated in the theory of discrete stochastic dynamic programming. For more on this theory, we note in addition to the work of Howard and Bellman, mentioned above, the books by Derman [8], Mine and Osaki [55], and Dynkin and Yushkevich [12]. Another class of engineering problems which encouraged the development of the theory of stochastic control involves time continuous control of a dynamic system in the presence of random noise. The case where the system is described by a differential equation and the noise is modeled as a time continuous random process is the core of the optimal control theory of diffusion processes. This book deals with this latter theory.
Frontiers in Number Theory, Physics, and Geometry II Aug 19 2020 Ten years after a 1989 meeting of number theorists and physicists at the Centre de Physique des Houches, a second event focused on the broader interface of number theory, geometry, and physics. This book is the first of two volumes resulting from that meeting. Broken into three parts, it covers Conformal Field Theories, Discrete Groups, and Renormalization, offering extended versions of the lecture courses and shorter texts on special topics.
Mathematical Scattering Theory Apr 19 2023 Preliminary facts Basic concepts of scattering theory Further properties of the WO Scattering for relatively smooth perturbations The general setup in stationary scattering theory Scattering for perturbations of trace class type Properties of the scattering matrix (SM) The spectral shift function (SSF) and the trace formula
Quanta of Maths Dec 03 2021 The work of Alain Connes has cut a wide swath across several areas of mathematics and physics. Reflecting its broad spectrum and profound impact on the contemporary mathematical landscape, this collection of articles covers a wealth of topics at the forefront of research in operator algebras, analysis, noncommutative geometry, topology, number theory and physics. Specific themes covered by the articles are as follows: entropy in operator algebras, regular C^*-algebras of integral domains, properly infinite C^*-algebras, representations of free groups and 1-cohomology, Leibniz seminorms and quantum metric spaces; von Neumann algebras, fundamental Group of II_1 factors, subfactors and planar algebras; Baum-Connes conjecture and property T, equivariant K-homology, Hermitian K-theory; cyclic cohomology, local index formula and twisted spectral triples, tangent groupoid and the index theorem; noncommutative geometry and space-time, spectral action principle, quantum gravity, noncommutative ADHM and instantons, non-compact spectral triples of finite volume, noncommutative coordinate algebras; Hopf algebras, Vinberg algebras, renormalization and combinatorics, motivic renormalization and singularities; cyclotomy and analytic geometry over F_1, quantum modular forms; differential K-theory, cyclic theory and S-cohomology.
IoT for Defense and National Security May 28 2021 IoT for Defense and National Security Practical case-based guide illustrating the challenges and solutions of adopting IoT in both secure and hostile environments IoT for Defense and National Security covers topics on IoT security, architecture, robotics, sensing, policy, operations, and more, including the latest results from the premier IoT

research initiative of the U.S. Defense Department, the Internet of Battle Things. The text also discusses challenges in converting defense industrial operations to IoT and summarizes policy recommendations for regulating government use of IoT in free societies. As a modern reference, this book covers multiple technologies in IoT including survivable tactical IoT using content-based routing, mobile ad-hoc networks, and electronically formed beams. Examples of IoT architectures include using KepServerEX for edge connectivity and AWS IoT Core and Amazon S3 for IoT data. To aid in reader comprehension, the text uses case studies illustrating the challenges and solutions for using robotic devices in defense applications, plus case studies on using IoT for a defense industrial base. Written by leading researchers and practitioners of IoT technology for defense and national security, IoT for Defense and National Security also includes information on: Changes in warfare driven by IoT weapons, logistics, and systems IoT resource allocation (monitoring existing resources and reallocating them in response to adversarial actions) Principles of AI-enabled processing for Internet of Battlefield Things, including machine learning and inference Vulnerabilities in tactical IoT communications, networks, servers and architectures, and strategies for securing them Adapting rapidly expanding commercial IoT to power IoT for defense For application engineers from defense-related companies as well as managers, policy makers, and academics, IoT for Defense and National Security is a one-of-a-kind resource, providing expansive coverage of an important yet sensitive topic that is often shielded from the public due to classified or restricted distributions.

Space – Time – Matter Jun 09 2022 This monograph describes some of the most interesting results obtained by the mathematicians and physicists collaborating in the CRC 647 "Space – Time – Matter", in the years 2005 - 2016. The work presented concerns the mathematical and physical foundations of string and quantum field theory as well as cosmology. Important topics are the spaces and metrics modelling the geometry of matter, and the evolution of these geometries. The partial differential equations governing such structures and their singularities, special solutions and stability properties are discussed in detail. Contents Introduction Algebraic K-theory, assembly maps, controlled algebra, and trace methods Lorentzian manifolds with special holonomy – Constructions and global properties Contributions to the spectral geometry of locally homogeneous spaces On conformally covariant differential operators and spectral theory of the holographic Laplacian Moduli and deformations Vector bundles in algebraic geometry and mathematical physics Dyson–Schwinger equations: Fix-point equations for quantum fields Hidden structure in the form factors ofN = 4 SYM On regulating the AdS superstring Constraints on CFT observables from the bootstrap program Simplifying amplitudes in Maxwell-Einstein and Yang-Mills-Einstein supergravities Yangian symmetry in maximally supersymmetric Yang-Mills theory Wave and Dirac equations on manifolds Geometric analysis on singular spaces Singularities and long-time behavior in nonlinear evolution equations and general relativity

Parabolic Equations with Irregular Data and Related Issues Jan 16 2023 This book studies the existence and uniqueness of solutions to parabolic-type equations with irregular coefficients and/or initial conditions. It elaborates on the DiPerna-Lions theory of renormalized solutions to linear transport equations and related equations, and also examines the connection between the results on the partial differential equation and the well-posedness of the underlying stochastic/ordinary differential equation.

Quantum Gravity and Quantum Cosmology Apr 07 2022 Quantum gravity has developed into a fast-growing subject in physics and it is expected that probing the high-energy and high-curvature regimes of gravitating systems will shed some light on how to eventually achieve an ultraviolet complete quantum theory of gravity. Such a theory would provide the much needed information about fundamental problems of classical gravity, such as the initial big-bang singularity, the cosmological constant problem, Planck scale physics and the early-time inflationary evolution of our Universe. While in the first part of this book concepts of quantum gravity are introduced and approached from different angles, the second part discusses these theories in connection with cosmological models and observations, thereby exploring which types of signatures of modern and mathematically rigorous frameworks can be detected by experiments. The third and final part briefly

reviews the observational status of dark matter and dark energy, and introduces alternative cosmological models. Edited and authored by leading researchers in the field and cast into the form of a multi-author textbook at postgraduate level, this volume will be of benefit to all postgraduate students and newcomers from neighboring disciplines wishing to find a comprehensive guide for their future research.

Rearranging Dyson-Schwinger Equations Apr 14 2020 Dyson-Schwinger equations are integral equations in quantum field theory that describe the Green functions of a theory and mirror the recursive decomposition of Feynman diagrams into subdiagrams. Taken as recursive equations, the Dyson-Schwinger equations describe perturbative quantum field theory. However, they also contain non-perturbative information. Using the Hopf algebra of Feynman graphs the author follows a sequence of reductions to convert the Dyson-Schwinger equations to a new system of differential equations.

Polygons, Polyominoes and Polycubes Aug 31 2021 The problem of counting the number of self-avoiding polygons on a square grid, - therbytheirperimeterortheirenclosedarea,is aproblemthatis soeasytostate that, at ?rst sight, it seems surprising that it hasn’t been solved. It is however perhaps the simplest member of a large class of such problems that have resisted all attempts at their exact solution. These are all problems that are easy to state and look as if they should be solvable. They include percolation, in its various forms, the Ising model of ferromagnetism, polyomino enumeration, Potts models and many others. These models are of intrinsic interest to mathematicians and mathematical physicists, but can also be applied to many other areas, including economics, the social sciences, the biological sciences and even to traf?c models. It is the widespread applicab- ity of these models to interesting phenomena that makes them so deserving of our attention. Here however we restrict our attention to the mathematical aspects. Here we are concerned with collecting together most of what is known about polygons, and the closely related problems of polyominoes. We describe what is known, taking care to distinguish between what has been proved, and what is c- tainlytrue,but has notbeenproved. Theearlierchaptersfocusonwhatis knownand on why the problems have not been solved, culminating in a proof of unsolvability, in a certain sense. The next chapters describe a range of numerical and theoretical methods and tools for extracting as much information about the problem as possible, in some cases permittingexactconjecturesto be made.

Heun's Differential Equations May 20 2023 Heun's equation is a second-order differential equation which crops up in a variety of forms in a wide range of problems in applied mathematics. These include integral equations of potential theory, wave propagation, electrostatic oscillation, and Schrodinger's equation. This volume brings together important research work for the first time, providing an important resource for all those interested in this mathematical topic. Both the current theory and the main areas of application are surveyed, and includes contributions from authoritative researchers.

Geometric Mechanics - Part I: Dynamics And Symmetry (2nd Edition) Oct 13 2022 See also GEOMETRIC MECHANICS — Part II: Rotating, Translating and Rolling (2nd Edition) This textbook introduces the tools and language of modern geometric mechanics to advanced undergraduates and beginning graduate students in mathematics, physics and engineering. It treats the fundamental problems of dynamical systems from the viewpoint of Lie group symmetry in variational principles. The only prerequisites are linear algebra, calculus and some familiarity with Hamilton's principle and canonical Poisson brackets in classical mechanics at the beginning undergraduate level.The ideas and concepts of geometric mechanics are explained in the context of explicit examples. Through these examples, the student develops skills in performing computational manipulations, starting from Fermat's principle, working through the theory of differential forms on manifolds and transferring these ideas to the applications of reduction by symmetry to reveal Lie-Poisson Hamiltonian formulations and momentum maps in physical applications.The many Exercises and Worked Answers in the text enable the student to grasp the essential aspects of the subject. In addition, the modern language and application of differential forms is explained in the context of

geometric mechanics, so that the importance of Lie derivatives and their flows is clear. All theorems are stated and proved explicitly.The organisation of the first edition has been preserved in the second edition. However, the substance of the text has been rewritten throughout to improve the flow and to enrich the development of the material. In particular, the role of Noether's theorem about the implications of Lie group symmetries for conservation laws of dynamical systems has been emphasised throughout, with many applications./a

Eisenstein Series and Automorphic Representations Aug 23 2023 Detailed exposition of automorphic representations and their relation to string theory, for mathematicians and theoretical physicists.

Properties of QCD Matter at High Baryon Density Feb 05 2022 This book highlights the discussions by renown researchers on questions emerged during transition from the relativistic heavy-ion collider (RHIC) to the future electron ion collider (EIC). Over the past two decades, the RHIC has provided a vast amount of data over a wide range of the center of mass energies. What are the scientific priorities, after RHIC is shut down and turned to the future EIC? What should be the future focuses of the high-energy nuclear collisions? What are thermodynamic properties of quantum chromodynamics (QCD) at large baryon density? Where is the phase boundary between quark-gluon-plasma and hadronic matter at high baryon density? How does one make connections from thermodynamics learned in high-energy nuclear collisions to astrophysical topics, to name few, the inner structure of compact stars, and perhaps more interestingly, the dynamical processes of the merging of neutron stars? While most particle physicists are interested in Dark Matter, we should focus on the issues of Visible Matter! Multiple heavy-ion accelerator complexes are under construction: NICA at JINR (4 ~ 11 GeV), FAIR at GSI (2 ~ 4.9 GeV SIS100), HIAF at IMP (2 ~ 4 GeV). In addition, the heavy-ion collision has been actively discussed at the J-PARC. The book is a collective work of top researchers from the field where some of the above-mentioned basic questions will be addressed. We believe that answering those questions will certainly advance our understanding of the phase transition in early universe as well as its evolution that leads to today's world of nature.

Homological Mirror Symmetry and Tropical Geometry Feb 22 2021 The relationship between Tropical Geometry and Mirror Symmetry goes back to the work of Kontsevich and Y. Soibelman (2000), who applied methods of non-archimedean geometry (in particular, tropical curves) to Homological Mirror Symmetry. In combination with the subsequent work of Mikhalkin on the “tropical” approach to Gromov-Witten theory and the work of Gross and Siebert, Tropical Geometry has now become a powerful tool. Homological Mirror Symmetry is the area of mathematics concentrated around several categorical equivalences connecting symplectic and holomorphic (or algebraic) geometry. The central ideas first appeared in the work of Maxim Kontsevich (1993). Roughly speaking, the subject can be approached in two ways: either one uses Lagrangian torus fibrations of Calabi-Yau manifolds (the so-called Strominger-Yau-Zaslow picture, further developed by Kontsevich and Soibelman) or one uses Lefschetz fibrations of symplectic manifolds (suggested by Kontsevich and further developed by Seidel). Tropical Geometry studies piecewise-linear objects which appear as “degenerations” of the corresponding algebro-geometric objects.

Stochastic Dynamics Feb 17 2023 Focusing on the mathematical description of stochastic dynamics in discrete as well as in continuous time, this book investigates such dynamical phenomena as perturbations, bifurcations and chaos. It also introduces new ideas for the exploration of infinite dimensional systems, in particular stochastic partial differential equations. Example applications are presented from biology, chemistry and engineering, while describing numerical treatments of stochastic systems.

Stellar Astrophysics Jul 18 2020 Stellar Astrophysics contains a selection of high-quality papers that illustrate the progress made in research into the structure and evolution of stars. Senior undergraduates, graduates, and researchers can now be brought thoroughly up to date in this exciting and ever-developing branch of astronomy.

Motives, Quantum Field Theory, and Pseudodifferential Operators Nov 14 2022 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.

A Geometric Approach to Differential Forms Oct 21 2020 This text presents differential forms from a geometric perspective accessible at the undergraduate level. It begins with basic concepts such as partial differentiation and multiple integration and gently develops the entire machinery of differential forms. The subject is approached with the idea that complex concepts can be built up by analogy from simpler cases, which, being inherently geometric, often can be best understood visually. Each new concept is presented with a natural picture that students can easily grasp. Algebraic properties then follow. The book contains excellent motivation, numerous illustrations and solutions to selected problems.

Scattering Amplitudes and Wilson Loops in Twistor Space Sep 19 2020 Scattering amplitudes are fundamental and rich observables in quantum field theory. Based on the observation that, for massless particles of spin-one or more, scattering amplitudes are much simpler than expected from traditional Feynman diagram techniques, the broad aim of this work is to understand and exploit this hidden structure. It uses methods from twistor theory to provide new insights into the correspondence between scattering amplitudes in supersymmetric Yang-Mills theory and null polygonal Wilson loops. By additionally exploiting the symmetries of the problem, the author succeeds in developing new ways of computing scattering amplitudes.

Special Functions Dec 15 2022 The subject of this book is the theory of special functions, not considered as a list of functions exhibiting a certain range of properties, but based on the unified study of singularities of second-order ordinary differential equations in the complex domain. The number and characteristics of the singularities serve as a basis for classification of each individual special function. Links between linear special functions (as solutions of linear second-order equations), and non-linear special functions (as solutions of Painlevé equations) are presented as a basic and new result. Many applications to different areas of physics are shown and discussed. The book is written from a practical point of view and will address all those scientists whose work involves applications of mathematical methods. Lecturers, graduate students and researchers will find this a useful text and reference work.

Equations of Motion in Relativistic Gravity Oct 01 2021 The present volume aims to be a comprehensive survey on the derivation of the equations of motion, both in General Relativity as well as in alternative gravity theories. The topics covered range from the description of test bodies, to self-gravitating (heavy) bodies, to current and future observations. Emphasis is put on the coverage of various approximation methods (e.g., multipolar, post-Newtonian, self-force methods) which are extensively used in the context of the relativistic problem of motion. Applications discussed in this volume range from the motion of binary systems -- and the gravitational waves emitted by such systems -- to observations of the galactic center. In particular the impact of choices at a fundamental

theoretical level on the interpretation of experiments is highlighted. This book provides a broad and up-do-date status report, which will not only be of value for the experts working in this field, but also may serve as a guideline for students with background in General Relativity who like to enter this field.

Computations in Algebraic Geometry with Macaulay 2 Sep 12 2022 This book presents algorithmic tools for algebraic geometry, with experimental applications. It also introduces Macaulay 2, a computer algebra system supporting research in algebraic geometry, commutative algebra, and their applications. The algorithmic tools presented here are designed to serve readers wishing to bring such tools to bear on their own problems. The first part of the book covers Macaulay 2 using concrete applications; the second emphasizes details of the mathematics.

Loop Quantum Cosmology Jul 30 2021

Tensorial Methods and Renormalization in Group Field Theories Jun 28 2021 The main focus of this thesis is the mathematical structure of Group Field Theories (GFTs) from the point of view of renormalization theory. Such quantum field theories are found in approaches to quantum gravity related, on the one hand, to Loop Quantum Gravity (LQG) and on the other, to matrix- and tensor models. Background material on these topics, including conceptual and technical aspects, are introduced in the first chapters. The work then goes on to explain how the standard tools of Quantum Field Theory can be generalized to GFTs and exploited to study the large cut-off behaviour and renormalization group transformations of the latter. Among the new results derived in this context are a proof of renormalizability of a three-dimensional GFT with gauge group SU(2), which opens the way to applications of the formalism to quantum gravity.

Black Holes in Higher Dimensions Jun 21 2023 The first book devoted to black holes in more than four dimensions, for graduate students and researchers.

On the Geometry of Diffusion Operators and Stochastic Flows Jul 22 2023 Stochastic differential equations, and Hoermander form representations of diffusion operators, can determine a linear connection associated to the underlying (sub)-Riemannian structure. This is systematically described, together with its invariants, and then exploited to discuss qualitative properties of stochastic flows, and analysis on path spaces of compact manifolds with diffusion measures. This should be useful to stochastic analysts, especially those with interests in stochastic flows, infinite dimensional analysis, or geometric analysis, and also to researchers in sub-Riemannian geometry. A basic background in differential geometry is assumed, but the construction of the connections is very direct and itself gives an intuitive and concrete introduction. Knowledge of stochastic analysis is also assumed for later chapters.

Quantum Gravity and the Functional Renormalization Group Jun 16 2020 A self-contained pedagogical introduction to asymptotic safety and the functional renormalization group in quantum gravity, for graduate students and researchers.

Combinatorics and Physics Apr 26 2021 This book is based on the mini-workshop Renormalization, held in December 2006, and the conference Combinatorics and Physics, held in March 2007. Both meetings took place at the Max-Planck-Institut fur Mathematik in Bonn, Germany. Research papers in the volume provide an overview of applications of combinatorics to various problems, such as applications to Hopf algebras, techniques to renormalization problems in quantum field theory, as well as combinatorial problems appearing in the context of the numerical integration of dynamical systems, in noncommutative geometry and in quantum gravity. In addition, it contains several introductory notes on renormalization Hopf algebras, Wilsonian renormalization and motives.

Limit Order Books Jan 04 2022 A limit order book is essentially a file on a computer that contains all orders sent to the market, along with their characteristics such as the sign of the order, price, quantity and a timestamp. The majority of organized electronic markets rely on limit order books to store the list of interests of market participants on their central computer. A limit order book contains all the information available on a specific market and it reflects the way the market moves under the influence of its participants. This book discusses several models of limit order books. It

begins by discussing the data to assess their empirical properties, and then moves on to mathematical models in order to reproduce the observed properties. Finally, the book presents a framework for numerical simulations. It also covers important modelling techniques including agent-based modelling, and advanced modelling of limit order books based on Hawkes processes. The book also provides in-depth coverage of simulation techniques and introduces general, flexible, open source library concepts useful to readers studying trading strategies in order-driven markets.
Geometry of Black Holes Nov 02 2021 Black holes present one of the most fascinating predictions of Einstein's general theory of relativity. There is strong evidence of their existence through observation of active galactic nuclei, including the centre of our galaxy, observations of gravitational waves, and others. There exists a large scientific literature on black holes, including many excellent textbooks at various levels. However, most of these steer clear from the mathematical niceties needed to make the theory of black holes a mathematical theory. Those which maintain a high mathematical standard are either focused on specific topics, or skip many details. The objective of this book is to fill this gap and present a detailed, mathematically oriented, extended introduction to the subject. The book provides a wide background to the current research on all mathematical aspects of the geometry of black hole spacetimes.
Mean Field Games May 16 2020 This volume is based on lectures delivered at the 2020 AMS Short Course “Mean Field Games: Agent Based Models to Nash Equilibria,” held January 13–14, 2020, in Denver, Colorado. Mean field game theory offers a robust methodology for studying large systems of interacting rational agents. It has been extraordinarily successful and has continued to develop since its inception. The six chapters that make up this volume provide an overview of the subject, from the foundations of the theory to applications in economics and finance, including computational aspects. The reader will find a pedagogical introduction to the main ingredients, from the forward-backward mean field game system to the master equation. Also included are two detailed chapters on the connection between finite games and mean field games, with a pedestrian description of the different methods available to solve the convergence problem. The volume concludes with two contributions on applications of mean field games and on existing numerical methods, with an opening to machine learning techniques.
Basic Category Theory Mar 06 2022 A short introduction ideal for students learning category theory for the first time.
Foundations of Mathematics and Physics One Century After Hilbert Jul 10 2022 This book explores the rich and deep interplay between mathematics and physics one century after David Hilbert’s works from 1891 to 1933, published by Springer in six volumes. The most prominent scientists in various domains of these disciplines contribute to this volume providing insight to their works, and analyzing the impact of the breakthrough and the perspectives of their own contributions. The result is a broad journey through the most recent developments in mathematical physics, such as string theory, quantum gravity, noncommutative geometry, twistor theory, Gauge and Quantum fields theories, just to mention a few. The reader, accompanied on this journey by some of the fathers of these theories, explores some far reaching interfaces where mathematics and theoretical physics interact profoundly and gets a broad and deep understanding of subjects which are at the core of recent developments in mathematical physics. The journey is not confined to the present state of the art, but sheds light on future developments of the field, highlighting a list of open problems. Graduate students and researchers working in physics, mathematics and mathematical physics will find this journey extremely fascinating. All those who want to benefit from a comprehensive description of all the latest advances in mathematics and mathematical physics, will find this book very useful too.
The Mathematica GuideBook for Symbolics Dec 23 2020 Provides reader with working knowledge of Mathematica and key aspects of Mathematica symbolic capabilities, the real heart of Mathematica and the ingredient of the Mathematica software system that makes it so unique and powerful Clear organization, complete topic coverage, and an accessible writing style for both novices and experts Website for book with additional materials:

http://www/MathematicaGuideBooks.org Accompanying DVD containing all materials as an electronic book with complete, executable Mathematica 5.1 compatible code and programs, rendered color graphics, and animations

Introduction to Nonlinear Dispersive Equations May 08 2022 This textbook introduces the well-posedness theory for initial-value problems of nonlinear, dispersive partial differential equations, with special focus on two key models, the Korteweg–de Vries equation and the nonlinear Schrödinger equation. A concise and self-contained treatment of background material (the Fourier transform, interpolation theory, Sobolev spaces, and the linear Schrödinger equation) prepares the reader to understand the main topics covered: the initial-value problem for the nonlinear Schrödinger equation and the generalized Korteweg–de Vries equation, properties of their solutions, and a survey of general classes of nonlinear dispersive equations of physical and mathematical significance. Each chapter ends with an expert account of recent developments and open problems, as well as exercises. The final chapter gives a detailed exposition of local well-posedness for the nonlinear Schrödinger equation, taking the reader to the forefront of recent research. The second edition of Introduction to Nonlinear Dispersive Equations builds upon the success of the first edition by the addition of updated material on the main topics, an expanded bibliography, and new exercises. Assuming only basic knowledge of complex analysis and integration theory, this book will enable graduate students and researchers to enter this actively developing field.

Classical and Quantum Aspects of Gravity in Relation to the Emergent Paradigm Mar 26 2021 This thesis explores the connection between gravity and thermodynamics and provides a unification scheme that opens up new directions of exploration. Further elaborating on the Hawking effect and the possibility of singularity avoidance, the author not only discusses the information loss paradox at a broader level but also provides a possible solution to it. As the final frontier, it describes some novel effects arising from the microscopic structure of spacetime. Taken as a whole, the thesis addresses three major research areas in gravitational physics: it starts with classical gravity, proceeds to the black hole information loss paradox, and closes with Planck scale physics. The thesis is written in a lucid and pedagogical style, with an introduction accessible to researchers from other branches of physics and a d iscussion presenting open questions and future directions, which will benefit and hopefully inspire next-generation researchers.

Bäcklund and Darboux Transformations Aug 11 2022 This book explores the deep and fascinating connections that exist between a ubiquitous class of physically important waves known as solitons and the theory of transformations of a privileged class of surfaces as they were studied by eminent geometers of the nineteenth century. Thus, nonlinear equations governing soliton propagation and also mathematical descriptions of their remarkable interaction properties are shown to arise naturally out of the classical differential geometry of surfaces and what are termed Bäcklund-Darboux transformations.This text, the first of its kind, is written in a straightforward manner and is punctuated by exercises to test the understanding of the reader. It is suitable for use in higher undergraduate or graduate level courses directed at applied mathematicians or mathematical physics.

The Principles of Deep Learning Theory Mar 18 2023 This volume develops an effective theory approach to understanding deep neural networks of practical relevance.

Strong Interactions in Spacelike and Timelike Domains Jan 24 2021 Strong Interactions in Spacelike and Timelike Domains: Dispersive Approach provides the theoretical basis for the description of the strong interactions in the spacelike and timelike domains. The book primarily focuses on the hadronic vacuum polarization function, R-ratio of electron-positron annihilation into hadrons, and the Adler function, which govern a variety of the strong interaction processes at various energy scales. Specifically, the book presents the essentials of the dispersion relations for these functions, recaps their perturbative calculation, and delineates the dispersively improved perturbation theory. The book also elucidates the peculiarities of the continuation of the spacelike perturbative results into the timelike domain, which is indispensable for the studies of electron-positron annihilation into hadrons and the related processes. Covers the topics that play an essential role in contemporary

particle physics and future collider projects Applicable for self-education alongside standard textbooks Makes the subject easily accessible without the need of an extensive theoretical background