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Quantum Probability and Related Topics - Rolando Rebolledo 2011
This volume contains current work at the frontiers of research in quantum probability, infinite dimensional stochastic analysis, quantum information and statistics. It presents a carefully chosen collection of articles by experts to highlight the latest developments in those fields. Included in this volume are expository papers which will help increase communication between researchers working in these areas. The tools and techniques presented here will be of great value to research mathematicians, graduate students and applied mathematicians.
Quantum Entanglement and Information Processing - 2004-11-05
It has been recognised recently that the strange features of the quantum world could be used for new information transmission or processing functions such as quantum cryptography or, more ambitiously, quantum computing. These fascinating perspectives renewed the interest in fundamental quantum properties and lead to important theoretical advances, such as quantum algorithms and quantum error correction codes. On the experimental side, remarkable advances have been achieved in quantum optics, solid state physics or nuclear magnetic resonance. This book presents the lecture notes of the Les Houches Summer School on 'Quantum entanglement and information processing'. Following the long tradition of the les Houches schools, it provides a comprehensive and pedagogical approach of the whole field, written by renowned specialists. One major goal of this book is to establish connections between the communities of quantum optics and of quantum electronic devices working in the area of quantum computing. When two communities share the same goals, the universality of physics unavoidably leads to similar developments. However, the communication barrier is often high, and few physicists are able to overcome it. This school has contributed to bridge the existing gap between communities, for the benefit of the future actors in the field of quantum computing. The book thus combines introductory chapters, providing the reader with a sufficiently wide theoretical framework in quantum information, quantum optics and quantum circuits physics, with more specialized presentations of recent theoretical and experimental advances in the field. This

structure makes the book accessible to any graduate student having a good knowledge of basic quantum mechanics, and extremely useful to researchers. · Covers quantum optics, solid state physics and NMR implementations · Pedagogical approach combining introductory lectures and advanced chapters · Written by leading experts in the field · Accessible to all graduate students with a basic knowledge of quantum mechanics

Quantum Optomechanics - Warwick P. Bowen 2015-11-18

Written by leading experimentalist Warwick P. Bowen and prominent theoretician Gerard J. Milburn, Quantum Optomechanics discusses modern developments in this novel field from experimental and theoretical standpoints. The authors share their insight on a range of important topics, including optomechanical cooling and entanglement; quantum limits on measurement precision and how to overcome them via back-action evading measurements; feedback control; single photon and nonlinear optomechanics; optomechanical synchronization; coupling of optomechanical systems to microwave circuits and two-level systems, such as atoms and superconducting qubits; and optomechanical tests of gravitational decoherence. The book first introduces the basic physics of quantum harmonic oscillators and their interactions with their environment. It next discusses the radiation pressure interaction between light and matter, deriving common Hamiltonians used in quantum optomechanics. It then focuses on the linearized regime of quantum optomechanics before exploring scenarios where the simple linearized picture of quantum optomechanics no longer holds. The authors move on to hybrid optomechanical systems in which the canonical quantum optomechanical system is coupled to another quantum object. They explain how an alternative form of a hybrid optomechanical system leads to the phenomenon of synchronization. They also consider the impact of quantum optomechanics on tests of gravitational physics.

Essential Quantum Optics - Ulf Leonhardt 2010-02-18

Covering some of the most exciting trends in quantum optics, this textbook is ideal for advanced undergraduate and graduate students. Each chapter ends with short questions and a more detailed homework problem to show how the ideas discussed can be applied. Solutions to homework problems are available at www.cambridge.org/9780521869782.

Quantum Theory of Optical Coherence - Roy J. Glauber 2007-04-09

A summary of the pioneering work of Glauber in the field of optical coherence phenomena and photon statistics, this book describes the fundamental ideas of modern quantum optics and photonics in a tutorial style. It is thus not only intended as a reference for researchers in the field, but also to give graduate students an insight into the basic theories of the field. Written by the Nobel Laureate himself, the concepts described in this book have formed the basis for three further Nobel Prizes in Physics within the last decade.

Quantum Foundations And Open Quantum Systems: Lecture Notes Of The Advanced School - Nieuwenhuizen Theo M 2014-10-03

The Advanced School on Quantum Foundations and Open Quantum Systems was an exceptional combination of lectures. These comprise lectures in standard physics and investigations on the foundations of quantum physics.On the one hand it included lectures on quantum information, quantum open systems, quantum transport and quantum solid state. On the other hand it included lectures on quantum measurement, models for elementary particles, sub-quantum structures and aspects on the philosophy and principles of quantum physics.The special program of this school offered a broad outlook on the current and near future fundamental research in theoretical physics.The lectures are at the level of PhD students.

Modelling Non-Markovian Quantum Systems Using Tensor Networks - Aidan Strathearn 2020-08-31

This thesis presents a revolutionary technique for modelling the dynamics of a quantum system that is strongly coupled to its immediate environment. This is a challenging but timely problem. In particular it is relevant for modelling decoherence in devices such as quantum information processors, and how quantum information moves between spatially separated parts of a quantum system. The key feature of this work is a novel way to represent the

dynamics of general open quantum systems as tensor networks, a result which has connections with the Feynman operator calculus and process tensor approaches to quantum mechanics. The tensor network methodology developed here has proven to be extremely powerful: For many situations it may be the most efficient way of calculating open quantum dynamics. This work is abounds with new ideas and invention, and is likely to have a very significant impact on future generations of physicists.

Physical Realizations of Quantum Computing -

Hybrid Quantum Systems - Yoshiro Hirayama 2021

This book presents state-of-the-art research on quantum hybridization, manipulation, and measurement in the context of hybrid quantum systems. It covers a broad range of experimental and theoretical topics relevant to quantum hybridization, manipulation, and measurement technologies, including a magnetic field sensor based on spin qubits in diamond NV centers, coherently coupled superconductor qubits, novel coherent couplings between electron and nuclear spin, photons and phonons, and coherent coupling of atoms and photons. Each topic is concisely described by an expert at the forefront of the field, helping readers quickly catch up on the latest advances in fundamental sciences and technologies of hybrid quantum systems, while also providing an essential overview.

Quantum Dots for Quantum Information Technologies - Peter Michler 2017-06-01

This book highlights the most recent developments in quantum dot spin physics and the generation of deterministic superior non-classical light states with quantum dots. In particular, it addresses single quantum dot spin manipulation, spin-photon entanglement and the generation of single-photon and entangled photon pair states with nearly ideal properties. The role of semiconductor microcavities, nanophotonic interfaces as well as quantum photonic integrated circuits is emphasized. The latest theoretical and experimental studies of phonon-dressed light matter interaction, single-dot lasing and resonance fluorescence in QD cavity systems are also provided. The book is written by the leading experts in the field.

Handbook of Optoelectronic Device Modeling and Simulation - Joachim Piprek 2017-10-12

Optoelectronic devices are now ubiquitous in our daily lives, from light emitting diodes (LEDs) in many household appliances to solar cells for energy. This handbook shows how we can probe the underlying and highly complex physical processes using modern mathematical models and numerical simulation for optoelectronic device design, analysis, and performance optimization. It reflects the wide availability of powerful computers and advanced commercial software, which have opened the door for non-specialists to perform sophisticated modeling and simulation tasks. The chapters comprise the know-how of more than a hundred experts from all over the world. The handbook is an ideal starting point for beginners but also gives experienced researchers the opportunity to renew and broaden their knowledge in this expanding field.

Handbook of Applications of Chaos Theory - Christos H. Skiadas 2017-12-19

In addition to explaining and modeling unexplored phenomena in nature and society, chaos uses vital parts of nonlinear dynamical systems theory and established chaotic theory to open new frontiers and fields of study. Handbook of Applications of Chaos Theory covers the main parts of chaos theory along with various applications to diverse areas. Expert contributors from around the world show how chaos theory is used to model unexplored cases and stimulate new applications. Accessible to scientists, engineers, and practitioners in a variety of fields, the book discusses the intermittency route to chaos, evolutionary dynamics and deterministic chaos, and the transition to phase synchronization chaos. It presents important contributions on strange attractors, self-exciting and hidden attractors, stability theory, Lyapunov exponents, and chaotic analysis. It explores the state of the art of chaos in plasma physics, plasma harmonics, and overtone coupling. It also describes flows and turbulence, chaotic interference versus decoherence, and an application of microwave networks to the simulation of quantum graphs. The book proceeds to give a detailed presentation of the chaotic, rogue, and noisy

optical dissipative solitons; parhelic-like circle and chaotic light scattering; and interesting forms of the hyperbolic prism, the Poincaré disc, and foams. It also covers numerous application areas, from the analysis of blood pressure data and clinical digital pathology to chaotic pattern recognition to economics to musical arts and research.

Quantum Information Meets Quantum Matter - Bei Zeng 2019-03-28

This book approaches condensed matter physics from the perspective of quantum information science, focusing on systems with strong interaction and unconventional order for which the usual condensed matter methods like the Landau paradigm or the free fermion framework break down. Concepts and tools in quantum information science such as entanglement, quantum circuits, and the tensor network representation prove to be highly useful in studying such systems. The goal of this book is to introduce these techniques and show how they lead to a new systematic way of characterizing and classifying quantum phases in condensed matter systems. The first part of the book introduces some basic concepts in quantum information theory which are then used to study the central topic explained in Part II: local Hamiltonians and their ground states. Part III focuses on one of the major new phenomena in strongly interacting systems, the topological order, and shows how it can essentially be defined and characterized in terms of entanglement. Part IV shows that the key entanglement structure of topological states can be captured using the tensor network representation, which provides a powerful tool in the classification of quantum phases. Finally, Part V discusses the exciting prospect at the intersection of quantum information and condensed matter physics – the unification of information and matter. Intended for graduate students and researchers in condensed matter physics, quantum information science and related fields, the book is self-contained and no prior knowledge of these topics is assumed.

Quantum Noise - Crispin Gardiner 1999-12-06

This enlarged and updated second edition offers a comprehensive exposition of the quantum stochastic methods that have been developed in the field of quantum optics. Accounting for recent progress in the field, it includes new treatments of photodetection, quantum amplifier theory, non-Markovian quantum stochastic processes, and quantum input-output theory. This is the first book in which quantum noise is described by a mathematically complete theory in a form that is also suited to practical applications.

Quantum Optics - Pierre Meystre 2021-07-24

This book is a thoroughly modern and highly pedagogical graduate-level introduction to quantum optics, a subject which has witnessed stunning developments in recent years and has come to occupy a central role in the 'second quantum revolution'. The reader is invited to explore the fundamental role that quantum optics plays in the control and manipulation of quantum systems, leading to ultracold atoms, circuit QED, quantum information science, quantum optomechanics, and quantum metrology. The building blocks of the subject are presented in a sequential fashion, starting from the simplest physical situations before moving to increasingly complicated ones. This pedagogically appealing approach leads to quantum entanglement and measurement theory being introduced early on and before more specialized topics such as cavity QED or laser cooling. The final chapter illustrates the power of scientific cross-fertilization by surveying cutting-edge applications of quantum optics and optomechanics in gravitational wave detection, tests of fundamental physics, searches for dark matter, geophysical monitoring, and ultraprecise clocks. Complete with worked examples and exercises, this book provides the reader with enough background knowledge and understanding to follow the current journal literature and begin producing their own original research.

Quantum Communication and Information Technologies - Alexander S. Shumovsky 2012-12-06

Remarkable recent developments in the field of quantum communications and quantum information processing include the achievement of quantum teleportation, quantum communication channels based on entangled states, and the discovery of quantum computing algorithms. The present book addresses the physical foundations of the subject, as well as

the technological problems, discussing such aspects as photonics, quantum imaging, engineered entanglement in atomic and other physical systems, Bose-Einstein condensation, and decoherence. Indispensable reading for graduates and Ph.D. students in departments of physics, electrical and electronic engineering, mathematics, and computer science seeking both an orientation as well as advanced training in the field.

Quantum Optics - D.F. Walls 2008-01-03

The formalism of quantum optics is elucidated in the early chapters and the main techniques are introduced. These are applied in the later chapters to problems such as squeezed states of light, resonance fluorescence, laser theory, quantum theory of four-wave mixing, quantum non-demolition measurements, Bell's inequalities, and atom optics. Experimental results are used to illustrate the theory throughout. This yields the most comprehensive and up-to-date coverage of experiment and theory in quantum optics in any textbook.

Quantum Computers, Algorithms, and Chaos - Giulio Casati 2006

"During the last ten years Quantum Information Processing and Communication (QIPC) has established itself as one of the new hot topic fields in physics, with the potential to revolutionize many areas of science and technology. QIPC replaces the laws of classical physics applied to computation and communication with the more fundamental laws of quantum mechanics. This becomes increasingly important due to technological progress going down to smaller and smaller scales where quantum effects start to be dominant. In addition to its fundamental nature, QIPC promises to advance computing power beyond the capabilities of any classical computer, to guarantee secure communication and establish direct links to emerging quantum technologies, such as, for example, quantum based sensors and clocks. One of the outstanding feature of QIPC is its interdisciplinary character: it brings together researchers from physics, mathematics and computer science. In particular, within physics we have seen the emergence of a new QIPC community, which ranges from theoretical to experimental physics, and crosses boundaries of traditionally separated disciplines such as atomic physics, quantum optics, statistical mechanics and solid state physics, all working on different and complementary aspects of QIPC. This publication covers the following topics: Introduction to quantum computing; Quantum logic, information and entanglement; Quantum algorithms; Error-correcting codes for quantum computations; Quantum measurements and control; Quantum communication; Quantum optics and cold atoms for quantum information; Quantum computing with solid state devices; Theory and experiments for superconducting qubits; Interactions in many-body systems: quantum chaos, disorder and random matrices; Decoherence effects for quantum computing; and Flature prospects of quantum information processing."

Physics of Quantum Rings - Vladimir M. Fomin 2018-09-01

This book, now in its second edition, introduces readers to quantum rings as a special class of modern high-tech material structures at the nanoscale. It deals, in particular, with their formation by means of molecular beam epitaxy and droplet epitaxy of semiconductors, and their topology-driven electronic, optical and magnetic properties. A highly complex theoretical model is developed to adequately represent the specific features of quantum rings. The results presented here are intended to facilitate the development of low-cost high-performance electronic, spintronic, optoelectronic and information processing devices based on quantum rings. This second edition includes both new and significantly revised chapters. It provides extensive information on recent advances in the physics of quantum rings related to the spin-orbit interaction and spin dynamics (spin interference in Rashba rings, tunable exciton topology on type II InAs/GaAsSb quantum nanostructures), the electron-phonon interaction in ring-like structures, quantum interference manifestations in novel materials (graphene nanoribbons, MoS2), and the effects of electrical field and THz radiation on the optical properties of quantum rings. The new edition also shares insights into the properties of various novel architectures, including coupled quantum ring-quantum dot chains and concentric quantum rings, topologic states of light in self-assembled

ring-like cavities, and optical and plasmon m.odes in Möbius-shaped resonators.

Quantum Noise - Crispin W. Gardiner 2000-01

This book offers a systematic and comprehensive exposition of the quantum stochastic methods that have been developed in the field of quantum optics. It includes new treatments of photodetection, quantum amplifier theory, non-Markovian quantum stochastic processes, quantum input--output theory, and positive P-representations. It is the first book in which quantum noise is described by a mathematically complete theory in a form that is also suited to practical applications. Special attention is paid to non-classical effects, such as squeezing and antibunching. This second edition has been enlarged so as to take account of rapid progress in the field, and now includes two additional chapters on the stochastic SchrAdinger equation, and on cascaded quantum systems.

Quantum Thermodynamics and Optomechanics - Juliette Monsel 2020-09-18

This thesis demonstrates the potential of two platforms to explore experimentally the emerging field of quantum thermodynamics that has remained mostly theoretical so far. It proposes methods to define and measure work in the quantum regime. The most important part of the thesis focuses on hybrid optomechanical devices, evidencing that they are proper candidates to measure directly the fluctuations of work and the corresponding fluctuation theorem. Such devices could also give rise to the observation of mechanical lasing and cooling, based on mechanisms similar to a heat engine. The final part of the thesis studies how quantum coherence can improve work extraction in superconducting circuits. All the proposals greatly clarify the concept of work since they are based on measurable quantities in state of the art devices.

Lectures on Quantum Computing, Thermodynamics and Statistical Physics - Mikio Nakahara 2013

This book is a collection of lecture notes from the Symposium on Quantum Computing, Thermodynamics, and Statistical Physics, held at Kinki University in March 2012. Quantum information theory has a deep connection with statistical physics and thermodynamics. This volume introduces some of the topics on interface among the mentioned fields. Subjects included in the lecture notes include quantum annealing method, nonequilibrium thermodynamics and spin glass theory, among others. These subjects were presented with much emphasis put in its relevance in quantum information theory. These lecture notes are prepared in a self-contained manner so that a reader with modest background may understand the subjects.

Quantum Computation and Quantum Information - Michael A. Nielsen 2000-10-23

First-ever comprehensive introduction to the major new subject of quantum computing and quantum information.

Noise and Randomness in Living System - Sisir Roy 2022

This book illustrates the role of randomness and noise in living organisms. Traditionally, the randomness and noise have been used in understanding signal processing in communications. This book is divided into two sections, the first of which introduces readers to the various types and sources of noise and the constructive role of noise in non-linear dynamics. It also analyses the importance of randomness and noise in a variety of science and engineering applications. In turn, the second section discusses in detail the functional role of noise in biological processes for example, in case of brain function at the level of ion channel, synaptic level and even at cognitive level. These are described in various chapters. One of the challenging issue finding the neuronal correlates of various meditative states is to understand how brain controls various types of noise so as to reach a state of synchronized oscillatory state of the brain corresponding to the state of Samadhi. This is described in details in one chapter called Noise, Coherence and meditation. The concept of noise and the role of randomness in living organism raise lot of controversy for last few decades. This is discussed in a separate chapter. Finally, the epistemic and ontic nature of randomness as discussed in physical science are investigated in the context of living organism.

Quantum Probability and Related Topics - Rolando Rebolledo 2011-01-19

This volume contains current work at the frontiers of research in quantum probability, infinite dimensional stochastic analysis, quantum

information and statistics. It presents a carefully chosen collection of articles by experts to highlight the latest developments in those fields. Included in this volume are expository papers which will help increase communication between researchers working in these areas. The tools and techniques presented here will be of great value to research mathematicians, graduate students and applied mathematicians. Contents:Existence of the Fock Representation for Current Algebras of the Galilei Algebra (L Accardi et al.)Modular Structures and Landau Levels (F Bagarello)On Spectral Approach to Pascal White Noise Functionals (A Barhoumi et al.)Spectral Analysis for Twisted Waveguides (P Briet)On the Classification of Invarient State of Generic Quantum Markov Semigroups: The Gaussian Gauge Invariant Case (S Hachicha)On Difficulties Appearing in the Study of Stochastic Volterra Equations (A Karczewska)Entanglement Protection and Generation in a Two-Atom System (M Orszag)Hilbert Molecules — Square Roots of Positive Maps (M Skeide)Multiparameter Quantum Stochastic Processes (W J Spring)and other papers Readership: Researchers in mathematical physics, stochastic analysis and probability and statistics. Keywords:Quantum Probability;Quantum Markov Semigroups;Entanglement;Quantum Information;Quantum Statistics;Quantum Dilations;Quantum Measurements;Non-Markovian Open Systems

Optical Fiber Telecommunications Volume VIB - Ivan Kaminow 2013-05-11

Optical Fiber Telecommunications VI (A&B) is the sixth in a series that has chronicled the progress in the R&D of lightwave communications since the early 1970s. Written by active authorities from academia and industry, this edition brings a fresh look to many essential topics, including devices, subsystems, systems and networks. A central theme is the enabling of high-bandwidth communications in a cost-effective manner for the development of customer applications. These volumes are an ideal reference for R&D engineers and managers, optical systems implementers, university researchers and students, network operators, and investors. Volume A is devoted to components and subsystems, including photonic integrated circuits, multicore and few-mode fibers, photonic crystals, silicon photonics, signal processing, and optical interconnections. Volume B is devoted to systems and networks, including advanced modulation formats, coherent detection, Tb/s channels, space-division multiplexing, reconfigurable networks, broadband access, undersea cable, satellite communications, and microwave photonics. All the latest technologies and techniques for developing future components and systems Edited by two winners of the highly prestigious OSA/IEEE John Tyndal award and a President of IEEE's Lasers & Electro-Optics Society (7,000 members) Written by leading experts in the field, it is the most authoritative and comprehensive reference on optical engineering on the market

A Philosophical Approach to Quantum Field Theory - Hans Christian Öttinger 2018-01-11

This text presents an intuitive and robust mathematical image of fundamental particle physics based on a novel approach to quantum field theory, which is guided by four carefully motivated metaphysical postulates. In particular, the book explores a dissipative approach to quantum field theory, which is illustrated for scalar field theory and quantum electrodynamics, and proposes an attractive explanation of the Planck scale in quantum gravity. Offering a radically new perspective on this topic, the book focuses on the conceptual foundations of quantum field theory and ontological questions. It also suggests a new stochastic simulation technique in quantum field theory which is complementary to existing ones. Encouraging rigor in a field containing many mathematical subtleties and pitfalls this text is a helpful companion for students of physics and philosophers interested in quantum field theory, and it allows readers to gain an intuitive rather than a formal understanding.

Open Quantum Systems II - Stéphane Attal 2006-08-29

Understanding dissipative dynamics of open quantum systems remains a challenge in mathematical physics. This problem is relevant in various areas of fundamental and applied physics. Significant progress in the understanding of such systems has been made recently. These books present the mathematical

theories involved in the modeling of such phenomena. They describe physically relevant models, develop their mathematical analysis and derive their physical implications.

Quantum Optics with Semiconductor Nanostructures - Frank Jahnke 2012-07-16

An understanding of the interaction between light and matter on a quantum level is of fundamental interest and has many applications in optical technologies. The quantum nature of the interaction has recently attracted great attention for applications of semiconductor nanostructures in quantum information processing. Quantum optics with semiconductor nanostructures is a key guide to the theory, experimental realisation, and future potential of semiconductor nanostructures in the exploration of quantum optics. Part one provides a comprehensive overview of single quantum dot systems, beginning with a look at resonance fluorescence emission. Quantum optics with single quantum dots in photonic crystal and micro cavities are explored in detail, before part two goes on to review nanolasers with quantum dot emitters. Light-matter interaction in semiconductor nanostructures, including photon statistics and photoluminescence, is the focus of part three, whilst part four explores all-solid-state quantum optics, crystal nanobeam cavities and quantum-dot microcavity systems. Finally, part five investigates ultrafast phenomena, including femtosecond quantum optics and coherent optoelectronics with quantum dots. With its distinguished editor and international team of expert contributors, Quantum optics with semiconductor nanostructures is an essential guide for all those involved with the research, development, manufacture and use of semiconductors nanodevices, lasers and optical components, as well as scientists, researchers and students. A key guide to the theory, experimental realisation, and future potential of semiconductor nanostructures in the exploration of quantum optics Chapters provide a comprehensive overview of single quantum dot systems, nanolasers with quantum dot emitters, and light-matter interaction in semiconductor nanostructures Explores all-solid-state quantum optics, crystal nanobeam cavities and quantum-dot microcavity systems, and investigates ultrafast phenomena

Bose-Einstein Condensation - Lev. P. Pitaevskii 2003-04-03

Bose-Einstein condensation represents a new state of matter and is one of the cornerstones of quantum physics, resulting in the 2001 Nobel Prize. Providing a useful introduction to one of the most exciting fields of physics today, this text will be of interest to a growing community of physicists, and is easily accessible to non-specialists alike.

Physical Realizations of Quantum Computing - Mikio Nakahara 2006

Examines the potential of various physical realizations of a quantum computer in view of the DiVincenzo criteria. In an influential article, DiVincenzo, the keynote speaker of the symposium, proposed 5 criteria that any physical system must satisfy to be a viable quantum computer.

Quantum Noise - Crispin Gardiner 2004-08-27

This book offers a systematic and comprehensive exposition of the quantum stochastic methods that have been developed in the field of quantum optics. It includes new treatments of photodetection, quantum amplifier theory, non-Markovian quantum stochastic processes, quantum input--output theory, and positive P-representations. It is the first book in which quantum noise is described by a mathematically complete theory in a form that is also suited to practical applications. Special attention is paid to non-classical effects, such as squeezing and antibunching. Chapters added to the previous edition, on the stochastic Schrödinger equation, and on cascaded quantum systems, and now supplemented, in the third edition by a chapter on recent developments in various pertinent fields such as laser cooling, Bose-Einstein condensation, quantum feedback and quantum information.

Linear Dynamical Quantum Systems - Hendra I Nurdin 2017-05-11

This monograph provides an in-depth treatment of the class of linear-dynamical quantum systems. The monograph presents a detailed account of the mathematical modeling of these systems using linear algebra and quantum stochastic calculus as the main tools for a treatment that emphasizes a system-theoretic point of view and the control-theoretic formulations of quantum versions of familiar

problems from the classical (non-quantum) setting, including estimation and filtering, realization theory, and feedback control. Both measurement-based feedback control (i.e., feedback control by a classical system involving a continuous-time measurement process) and coherent feedback control (i.e., feedback control by another quantum system without the intervention of any measurements in the feedback loop) are treated. Researchers and graduates studying systems and control theory, quantum probability and stochastics or stochastic control whether from backgrounds in mechanical or electrical engineering or applied mathematics will find this book to be a valuable treatment of the control of an important class of quantum systems. The material presented here will also interest physicists working in optics, quantum optics, quantum information theory and other quantum-physical disciplines.

An Introduction to Quantum Optics and Quantum Fluctuations - Peter W. Milonni 2019-01-31

This is an introduction to the quantum theory of light and its broad implications and applications. A significant part of the book covers material with direct relevance to current basic and applied research, such as quantum fluctuations and their role in laser physics and the theory of forces between macroscopic bodies (Casimir effects). The book includes numerous historical sidelights throughout, and approximately seventy exercises. The book provides detailed expositions of the theory with emphasis on general physical principles. Foundational topics in classical and quantum electrodynamics are addressed in the first half of the book, including the semiclassical theory of atom-field interactions, the quantization of the electromagnetic field in dispersive and dissipative media, uncertainty relations, and spontaneous emission. The second half begins with a chapter on the Jaynes-Cummings model, dressed states, and some distinctly quantum-mechanical features of atom-field interactions, and includes discussion of entanglement, the no-cloning theorem, von Neumann's proof concerning hidden variable theories, Bell's theorem, and tests of Bell inequalities. The last two chapters focus on quantum fluctuations and fluctuation-dissipation relations, beginning with Brownian motion, the Fokker-Planck equation, and classical and quantum Langevin equations. Detailed calculations are presented for the laser linewidth, spontaneous emission noise, photon statistics of linear amplifiers and attenuators, and other phenomena. Van der Waals interactions, Casimir forces, the Lifshitz theory of molecular forces between macroscopic media, and the many-body theory of such forces based on dyadic Green functions are analyzed from the perspective of Langevin noise, vacuum field fluctuations, and zero-point energy.

Quantum Error Correction - Daniel A. Lidar 2013-09-12

Quantum computation and information is one of the most exciting developments in science and technology of the last twenty years. To achieve large scale quantum computers and communication networks it is essential not only to overcome noise in stored quantum information, but also in general faulty quantum operations. Scalable quantum computers require a far-reaching theory of fault-tolerant quantum computation. This comprehensive text, written by leading experts in the field, focuses on quantum error correction and thoroughly covers the theory as well as experimental and practical issues. The book is not limited to a single approach, but reviews many different methods to control quantum errors, including topological codes, dynamical decoupling and decoherence-free subspaces. Basic subjects as well as advanced theory and a survey of topics from cutting-edge research make this book invaluable both as a pedagogical introduction at the graduate level and as a reference for experts in quantum information science.

Handbook of Stochastic Methods - Crispin W. Gardiner 1985-01-01

Quantum Brownian Motion Revisited - Aniello Lampo 2019-04-23

Quantum Brownian motion represents a paradigmatic model of open quantum system, namely a system inextricably coupled to the surrounding environment. Such a model is largely used in physics, for instance in quantum foundations to approach in a quantitative manner the quantum-to-classical transition, but also for more practical purposes as the estimation of decoherence in quantum optics

experiments. This book presents the main techniques aimed to treat the dynamics of the quantum Brownian particle: Born-Markov master equation, Lindblad equation and Heisenberg equations formalism. Particular attention is given to the interaction between the particle and the bath depends non-linearly on the position of the former. This generalization corresponds to the case in which the bath is not homogeneous. An immediate application is the Bose polaron, specifically an impurity embedded in an ultracold gas.

Measuring the Quantum State of Light - Ulf Leonhardt 1997-07-13

Appendix A: Semiclassical approximation

Advances in Open Systems and Fundamental Tests of Quantum Mechanics - Bassano Vacchini 2019-11-01

Quantum mechanics has shown unprecedented success as a physical theory, but it has forced a new view on the description of physical reality. In recent years, important progress has been achieved both in the theory of open quantum systems and in the experimental realization and control of such systems. A great deal of the new results is concerned with the characterization and quantification of quantum memory effects. From this perspective, the 684. WE-Heraeus-Seminar has brought together scientists from different communities, both theoretical and experimental, sharing expertise on open quantum systems, as well as the commitment to the understanding of quantum mechanics. This book consists of many contributions addressing the diversified physics community interested in foundations of quantum mechanics and its applications and it reports about recent results in open quantum systems and their connection with the most advanced experiments testing quantum mechanics.

Fundamentals of Quantum Optics and Quantum Information - Peter Lambropoulos 2007-01-30

This book is an introduction to the two closely related subjects of quantum optics and quantum information. The book gives a simple, self-contained introduction to both subjects, while illustrating the physical principles of quantum information processing using quantum optical systems. To make the book accessible to those with backgrounds other than physics, the authors also include a brief review of quantum mechanics. Furthermore, some aspects of quantum information, for example those pertaining to recent experiments on cavity QED and quantum dots, are described here for the first time in book form.