

Classical And Quantum Information Theory An Introduction For The Telecom Scientist

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Quantum Biological Information Theory Ivan B. Djordjevic 2015-10-05 This book is a self-contained, tutorial-based introduction to quantum information theory and quantum biology. It serves as a single-source reference to the topic for researchers in bioengineering, communications engineering, electrical engineering, applied mathematics, biology, computer science, and physics. The book provides all the essential principles of the quantum biological information theory required to describe the quantum information transfer from DNA to proteins, the sources of genetic noise and genetic errors as well as their effects. Integrates quantum information and quantum biology concepts; Assumes only knowledge of basic concepts of vector algebra at undergraduate level; Provides a thorough introduction to basic concepts of quantum information processing, quantum information theory, and quantum biology; Includes in-depth discussion of the quantum biological channel modelling, quantum biological channel capacity calculation, quantum models of aging, quantum models of evolution, quantum models on tumor and cancer development, quantum modeling of bird navigation compass, quantum aspects of photosynthesis, quantum biological error correction.

An Introductory Path to Quantum Theory Stephen Bruce Sontz 2020-03-16 Since the 17th century, physical theories have been expressed in the language of mathematical equations. This introduction to quantum theory uses that language to enable the reader to comprehend the notoriously non-intuitive ideas of quantum physics. The mathematical knowledge needed for using this book comes from standard undergraduate mathematics courses and is described in detail in the section Prerequisites. This text is especially aimed at advanced undergraduate and graduate students of mathematics, computer science, engineering and chemistry among other disciplines, provided they have the math background even though lacking preparation in physics. In fact, no previous formal study of physics is assumed.

What is Quantum Information? Olimpia Lombardi 2017-04-27 Combining physics and philosophy, this is a uniquely interdisciplinary examination of quantum information science. Suitable as both a discussion of the conceptual and philosophical problems of this field and a comprehensive stand-alone introduction, this book will benefit both experienced and new researchers in quantum information and the philosophy of physics.

Quantum Information Theory Mark M. Wilde 2017-02-06 Developing many of the major, exciting, pre- and post-millennium developments from the ground up, this book is an ideal entry point for graduate students into quantum information theory. Significant attention is given to quantum mechanics for quantum information theory, and careful studies of the important protocols of teleportation, superdense coding, and entanglement distribution are presented. In this new edition, readers can expect to find over 100 pages of new material, including detailed discussions of Bell's theorem, the CHSH game, Tsirelson's theorem, the axiomatic approach to quantum channels, the definition of the diamond norm and its interpretation, and a proof of the Choi–Kraus theorem. Discussion of the importance of the quantum dynamic capacity formula has been completely revised, and many new exercises and references have been added. This new edition will be welcomed by the upcoming generation of quantum information theorists and the already established community of classical information theorists.

Quantum Systems, Channels, Information Alexander S. Holevo 2013-01-01 The subject of this book is theory of quantum system presented from information science perspective. The central role is played by the concept of quantum channel and its entropic and information characteristics. Quantum information theory gives a key to

understanding elusive phenomena of quantum world and provides a background for development of experimental techniques that enable measuring and manipulation of individual quantum systems. This is important for the new efficient applications such as quantum computing, communication and cryptography. Research in the field of quantum informatics, including quantum information theory, is in progress in leading scientific centers throughout the world. This book gives an accessible, albeit mathematically rigorous and self-contained introduction to quantum information theory, starting from primary structures and leading to fundamental results and to exiting open problems.

Classical and Quantum Information Theory Emmanuel Desurvire 2009-02-19 Information theory lies at the heart of modern technology, underpinning all communications, networking, and data storage systems. This book sets out, for the first time, a complete overview of both classical and quantum information theory. Throughout, the reader is introduced to key results without becoming lost in mathematical details. Opening chapters present the basic concepts and various applications of Shannon's entropy, moving on to the core features of quantum information and quantum computing. Topics such as coding, compression, error-correction, cryptography and channel capacity are covered from classical and quantum viewpoints. Employing an informal yet scientifically accurate approach, Desurvire provides the reader with the knowledge to understand quantum gates and circuits. Highly illustrated, with numerous practical examples and end-of-chapter exercises, this text is ideal for graduate students and researchers in electrical engineering and computer science, and practitioners in the telecommunications industry. Further resources and instructor-only solutions are available at www.cambridge.org/9780521881715.

Quantum Computation and Quantum Information Theory C Macchiavello 2001-01-17 Quantum information theory has revolutionised our view on the true nature of information and has led to such intriguing topics as teleportation and quantum computation. The field — by its very nature strongly interdisciplinary, with deep roots in the foundations both of quantum mechanics and of information theory and computer science — has become a major subject for scientists working in fields as diverse as quantum optics, superconductivity or information theory, all the way to computer engineers. The aim of this book is to provide guidance and introduce the broad literature in all the various aspects of quantum information theory. The topics covered range from the fundamental aspects of the theory, like quantum algorithms and quantum complexity, to the technological aspects of the design of quantum-information-processing devices. Each section of the book consists of a selection of key papers (with particular attention to their tutorial value), chosen and introduced by leading scientists in the specific area. An entirely new introduction to quantum complexity has been specially written for the book. Contents: Introductory Concepts Quantum Entanglement Manipulation Quantum Algorithms Quantum Complexity Quantum Error Correction Quantum Channels Entanglement Purification and Long-Distance Quantum Communication Quantum Key Distribution Cavity Quantum Electrodynamics Quantum Computation with Ion Traps Josephson Junctions and Quantum Computation Quantum Computing in Optical Lattices Quantum Computation and Quantum Communication with Electrons NMR Quantum Computing Readership: Physicists. Keywords: Quantum Computation; Quantum Information Theory; Quantum Cryptography; Quantum Error Correction; Quantum Complexity; Quantum Algorithms; Quantum Gates; Foundation of Quantum Mechanics; Quantum Theory; Quantum Channels; Quantum Mechanics

An Introduction to Quantum Computing Phillip Kaye 2007 The authors provide an introduction to quantum computing. Aimed at advanced undergraduate and beginning graduate students in these disciplines, this text is illustrated with diagrams and exercises.

Fundamentals of Quantum Information Hiroyuki Sagawa 2011 This book provides an introduction to the basic ideas and concepts of quantum computation and information for both undergraduate and graduate students. The book starts with the quantum bits and the entangled states which turn out to bring revolutionary ideas in information theory. This book is self-contained and unified in its description of the cross-disciplinary nature of this field. The book aims to provide intuitive and transparent ideas of the subjects, and is not strictly mathematical. Quantum mechanics and mathematical tools (especially, number theory) are explained with many examples and illustrations. The students can obtain practical problem-solving ability by solving the exercises at the end of each chapter. Detailed solutions to all problems are provided at the end of the book.

Quantum Information Masahito Hayashi 2006-04-20 This graduate-level textbook provides a unified viewpoint of quantum information theory that merges key topics from both the information-theoretic and quantum-mechanical viewpoints. The text provides a unified viewpoint of quantum information theory and lucid explanations of those basic results, so that the reader fundamentally grasps advances and challenges. This unified approach makes accessible such advanced topics in quantum communication as quantum teleportation, superdense coding, quantum state transmission (quantum error-correction), and quantum encryption.

Maxwell's Demon 2 Entropy, Classical and Quantum Information, Computing Harvey Leff 2002-12-13 Over 130 years ago, James Clerk Maxwell introduced his hypothetical "demon" as a challenge to the scope of the second law of thermodynamics. Fascination with the demon persisted throughout the development of statistical

and quantum physics, information theory, and computer science, and links have been established between Maxwell's demon and each of

Quantum Information and Consciousness Danko D. Georgiev 2017-12-06 "I loved the book! This book is not just interesting, it is exciting. I have probably read every significant book in the field, and this is the strongest and most convincing one yet. It is also one of the most comprehensive in its explanations. I shall most certainly recommend the book to colleagues." –Richard G. Petty, MD "a very good introduction to the basic theory of quantum systems.... Dr. Georgiev's book aptly prepares the reader to confront whatever might be in store later." –from the Foreword by Prof. James F. Glazebrook, Eastern Illinois University This book addresses the fascinating cross-disciplinary field of quantum information theory applied to the study of brain function. It offers a self-study guide to probe the problems of consciousness, including a concise but rigorous introduction to classical and quantum information theory, theoretical neuroscience, and philosophy of the mind. It aims to address long-standing problems related to consciousness within the framework of modern theoretical physics in a comprehensible manner that elucidates the nature of the mind-body relationship. The reader also gains an overview of methods for constructing and testing quantum informational theories of consciousness.

Quantum Information Theory and the Foundations of Quantum Mechanics Christopher G. Timpson 2013-04-25 Quantum Information Theory and the Foundations of Quantum Mechanics is a conceptual analysis of one the most prominent and exciting new areas of physics, providing the first full-length philosophical treatment of quantum information theory and the questions it raises for our understanding of the quantum world. Beginning from a careful, revisionary, analysis of the concepts of information in the everyday and classical information-theory settings, Christopher G. Timpson argues for an ontologically deflationary account of the nature of quantum information. Against what many have supposed, quantum information can be clearly defined (it is not a primitive or vague notion) but it is not part of the material contents of the world. Timpson's account sheds light on the nature of nonlocality and information flow in the presence of entanglement and, in particular, dissolves puzzles surrounding the remarkable process of quantum teleportation. In addition it permits a clear view of what the ontological and methodological lessons provided by quantum information theory are; lessons which bear on the gripping question of what role a concept like information has to play in fundamental physics. Topics discussed include the slogan 'Information is Physical', the prospects for an informational immaterialism (the view that information rather than matter might fundamentally constitute the world), and the status of the Church-Turing hypothesis in light of quantum computation. With a clear grasp of the concept of information in hand, Timpson turns his attention to the pressing question of whether advances in quantum information theory pave the way for the resolution of the traditional conceptual problems of quantum mechanics: the deep problems which loom over measurement, nonlocality and the general nature of quantum ontology. He marks out a number of common pitfalls to be avoided before analysing in detail some concrete proposals, including the radical quantum Bayesian programme of Caves, Fuchs, and Schack. One central moral which is drawn is that, for all the interest that the quantum information-inspired approaches hold, no cheap resolutions to the traditional problems of quantum mechanics are to be had.

Quantum Information, Computation and Cryptography Fabio Benatti 2010-09-21 This multi-authored textbook addresses graduate students with a background in physics, mathematics or computer science. No research experience is necessary. Consequently, rather than comprehensively reviewing the vast body of knowledge and literature gathered in the past twenty years, this book concentrates on a number of carefully selected aspects of quantum information theory and technology. Given the highly interdisciplinary nature of the subject, the multi-authored approach brings together different points of view from various renowned experts, providing a coherent picture of the subject matter. The book consists of ten chapters and includes examples, problems, and exercises. The first five present the mathematical tools required for a full comprehension of various aspects of quantum mechanics, classical information, and coding theory. Chapter 6 deals with the manipulation and transmission of information in the quantum realm. Chapters 7 and 8 discuss experimental implementations of quantum information ideas using photons and atoms. Finally, chapters 9 and 10 address ground-breaking applications in cryptography and computation.

An Introduction to the Formalism of Quantum Information with Continuous Variables Carlos Navarrete-Benlloch 2016-01-01 Quantum information is an emerging field which has attracted a lot of attention in the last couple of decades. It is a broad subject which extends from the most applied questions (e.g. how to build quantum computers or secure cryptographic systems) to the most theoretical problems concerning the formalism and interpretation of quantum mechanics, its complexity, and its potential to go beyond classical physics. This book is an introduction to quantum information with special emphasis on continuous-variable systems (such as light) which can be described as collections of harmonic oscillators. It covers a selection of basic concepts, focusing on their physical meaning and mathematical treatment. It starts from the very first principles of quantum mechanics, and builds up the concepts and techniques following a logical progression. This is an excellent reference for students with a full semester of standard quantum mechanics and researchers in closely related fields.

Quantum Computer Science N. David Mermin 2007-08-30 In the 1990's it was realized that quantum physics has some spectacular applications in computer science. This book is a concise introduction to quantum computation, developing the basic elements of this new branch of computational theory without assuming any

background in physics. It begins with an introduction to the quantum theory from a computer-science perspective. It illustrates the quantum-computational approach with several elementary examples of quantum speed-up, before moving to the major applications: Shor's factoring algorithm, Grover's search algorithm, and quantum error correction. The book is intended primarily for computer scientists who know nothing about quantum theory, but will also be of interest to physicists who want to learn the theory of quantum computation, and philosophers of science interested in quantum foundational issues. It evolved during six years of teaching the subject to undergraduates and graduate students in computer science, mathematics, engineering, and physics, at Cornell University.

Classical and Quantum Computation Alexei Yu. Kitaev 2002 This book presents a concise introduction to an emerging and increasingly important topic, the theory of quantum computing. The development of quantum computing exploded in 1994 with the discovery of its use in factoring large numbers--an extremely difficult and time-consuming problem when using a conventional computer. In less than 300 pages, the authors set forth a solid foundation to the theory, including results that have not appeared elsewhere and improvements on existing works. The book starts with the basics of classical theory of computation, including NP-complete problems and the idea of complexity of an algorithm. Then the authors introduce general principles of quantum computing and pass to the study of main quantum computation algorithms: Grover's algorithm, Shor's factoring algorithm, and the Abelian hidden subgroup problem. In concluding sections, several related topics are discussed (parallel quantum computation, a quantum analog of NP-completeness, and quantum error-correcting codes). This is a suitable textbook for a graduate course in quantum computing. Prerequisites are very modest and include linear algebra, elements of group theory and probability, and the notion of an algorithm (on a formal or an intuitive level). The book is complete with problems, solutions, and an appendix summarizing the necessary results from number theory.

Classical and Quantum Information Dan C. Marinescu 2011-01-07 A new discipline, Quantum Information Science, has emerged in the last two decades of the twentieth century at the intersection of Physics, Mathematics, and Computer Science. Quantum Information Processing is an application of Quantum Information Science which covers the transformation, storage, and transmission of quantum information; it represents a revolutionary approach to information processing. Classical and Quantum Information covers topics in quantum computing, quantum information theory, and quantum error correction, three important areas of quantum information processing. Quantum information theory and quantum error correction build on the scope, concepts, methodology, and techniques developed in the context of their close relatives, classical information theory and classical error correcting codes. Presents recent results in quantum computing, quantum information theory, and quantum error correcting codes Covers both classical and quantum information theory and error correcting codes The last chapter of the book covers physical implementation of quantum information processing devices Covers the mathematical formalism and the concepts in Quantum Mechanics critical for understanding the properties and the transformations of quantum information

Quantum Computation and Quantum Information Theory Chiara Macchiavello 2000 Quantum Entanglement Manipulation - Quantum Algorithms - Quantum Complexity - Quantum Error Correction - Quantum Channels - Entanglement Purification and Long-Distance Quantum Communication - Quantum Key Distribution - Cavity Quantum Electrodynamics - Quantum Computation with Ion Traps - Josephson Junctions and Quantum Computation - Quantum Computing in Optical Lattices - Quantum Computation and Quantum Communication with Electrons - NMR Quantum Computing.

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.

Classical and Quantum Information Theory Emmanuel Desurvire 2009 Information theory lies at the heart of modern technology, underpinning all communications, networking, and data storage systems. This book sets out, for the first time, a complete overview of both classical and quantum information theory. Throughout, the reader is introduced to key results without becoming lost in mathematical details. Opening chapters present the basic concepts and various applications of Shannon's

entropy, moving on to the core features of quantum information and quantum computing. Topics such as coding, compression, error-correction, cryptography and channel capacity are covered from classical and quantum viewpoints. Employing an informal yet scientifically accurate approach, Desurvire provides the reader with the knowledge to understand quantum gates and circuits. Highly illustrated, with numerous practical examples and end-of-chapter exercises, this text is ideal for graduate students and researchers in electrical engineering and computer science, and practitioners in the telecommunications industry. Further resources and instructor-only solutions are available at www.cambridge.org/9780521881715.

The Theory of Quantum Information John Watrous 2018-04-26 Formal development of the mathematical theory of quantum information with clear proofs and exercises. For graduate students and researchers.

Classical and Quantum Computing Yorick Hardy 2012-12-06 This is a self-contained, systematic and comprehensive introduction to all the subjects and techniques important in scientific computing. The style and presentation are readily accessible to undergraduates and graduates. A large number of examples, accompanied by complete C++ and Java code wherever possible, cover every topic.

Dynamics of Classical and Quantum Fields Girish S. Setlur 2013-12-05 Dynamics of Classical and Quantum Fields: An Introduction focuses on dynamical fields in non-relativistic physics. Written by a physicist for physicists, the book is designed to help readers develop analytical skills related to classical and quantum fields at the non-relativistic level, and think about the concepts and theory through numerous problems. In-depth yet accessible, the book presents new and conventional topics in a self-contained manner that beginners would find useful. A partial list of topics covered includes: Geometrical meaning of Legendre transformation in classical mechanics Dynamical symmetries in the context of Noether's theorem The derivation of the stress energy tensor of the electromagnetic field, the expression for strain energy in elastic bodies, and the Navier Stokes equation Concepts of right and left movers in case of a Fermi gas explained Functional integration is interpreted as a limit of a sequence of ordinary integrations Path integrals for one and two quantum particles and for a fermion in presence of a filled Fermi sea Fermion and boson Fock spaces, along with operators that create and annihilate particles Coherent state path integrals Many-body topics such as Schrieffer Wolff transformation, Matsubara, and Keldysh Green functions Geometrical meaning of the vortex-vortex correlation function in a charged boson fluid Nonlocal particle-hole creation operators which diagonalize interacting many-body systems The equal mix of novel and traditional topics, use of fresh examples to illustrate conventional concepts, and large number of worked examples make this book ideal for an intensive one-semester course for beginning Ph.D. students. It is also a challenging and thought provoking book for motivated advanced undergraduates.

Introduction to Quantum Information Science Masahito Hayashi 2014-08-22 This book presents the basics of quantum information, e.g., foundation of quantum theory, quantum algorithms, quantum entanglement, quantum entropies, quantum coding, quantum error correction and quantum cryptography. The required knowledge is only elementary calculus and linear algebra. This way the book can be understood by undergraduate students. In order to study quantum information, one usually has to study the foundation of quantum theory. This book describes it from more an operational viewpoint which is suitable for quantum information while traditional textbooks of quantum theory lack this viewpoint. The current book bases on Shor's algorithm, Grover's algorithm, Deutsch-Jozsa's algorithm as basic algorithms. To treat several topics in quantum information, this book covers several kinds of information quantities in quantum systems including von Neumann entropy. The limits of several kinds of quantum information processing are given. As important quantum protocols, this book contains quantum teleportation, quantum dense coding, quantum data compression. In particular conversion theory of entanglement via local operation and classical communication are treated too. This theory provides the quantification of entanglement, which coincides with von Neumann entropy. The next part treats the quantum hypothesis testing. The decision problem of two candidates of the unknown state are given. The asymptotic performance of this problem is characterized by information quantities. Using this result, the optimal performance of classical information transmission via noisy quantum channel is derived. Quantum information transmission via noisy quantum channel by quantum error correction are discussed too. Based on this topic, the secure quantum communication is explained. In particular, the quantification of quantum security which has not been treated in existing book is explained. This book treats quantum cryptography from a more practical viewpoint.

Elements of Quantum Computation and Quantum Communication Anirban Pathak 2013-06-20 While there are many available textbooks on quantum information theory, most are either too technical for beginners or not complete enough. Filling this gap, Elements of Quantum Computation and Quantum Communication gives a clear, self-contained introduction to quantum computation and communication. Written primarily for undergraduate students in p

Introduction to Quantum Information Science Vlatko Vedral 2006-09-28 This book offers a concise and up-to-date introduction to the popular field of quantum information. It has originated in a series of invited lecture courses at various universities in different countries. This is reflected in its informal style of exposition and presentation of key results in the subject. In addition to treating quantum communication, entanglement and algorithms in great depth, this book also addresses a

number of interesting miscellaneous topics, such as Maxwell's demon, Landauer's erasure, the Bekenstein bound, and Caratheodory's treatment of the Second Law of thermodynamics. All mathematical derivations are based on clear physical pictures which make even the most involved results - such as the Holevo bound - look comprehensible and transparent. The book is ideal as a first introduction to the subject, but may also appeal to the specialist due to its unique presentation.

Chaos in Classical and Quantum Mechanics Martin C. Gutzwiller 2013-11-27 Describes the chaos apparent in simple mechanical systems with the goal of elucidating the connections between classical and quantum mechanics. It develops the relevant ideas of the last two decades via geometric intuition rather than algebraic manipulation. The historical and cultural background against which these scientific developments have occurred is depicted, and realistic examples are discussed in detail. This book enables entry-level graduate students to tackle fresh problems in this rich field.

Mathematics of Classical and Quantum Physics Frederick W. Byron 2012-04-26 Graduate-level text offers unified treatment of mathematics applicable to many branches of physics. Theory of vector spaces, analytic function theory, theory of integral equations, group theory, and more. Many problems. Bibliography.

Quantum Information Processing János A. Bergou 2021-09-14 This new edition of a well-received textbook provides a concise introduction to both the theoretical and experimental aspects of quantum information at the graduate level. While the previous edition focused on theory, the book now incorporates discussions of experimental platforms. Several chapters on experimental implementations of quantum information protocols have been added: implementations using neutral atoms, trapped ions, optics, and solidstate systems are each presented in its own chapter. Previous chapters on entanglement, quantum measurements, quantum dynamics, quantum cryptography, and quantum algorithms have been thoroughly updated, and new additions include chapters on the stabilizer formalism and the Gottesman-Knill theorem as well as aspects of classical and quantum information theory. To facilitate learning, each chapter starts with a clear motivation to the topic and closes with exercises and a recommended reading list. Quantum Information Processing: Theory and Implementation will be essential to graduate students studying quantum information as well as and researchers in other areas of physics who wish to gain knowledge in the field.

Information Dynamics and Open Systems Roman S. Ingarden 2013-11-11 This book has a long history of more than 20 years. The first attempt to write a monograph on information-theoretic approach to thermodynamics was done by one of the authors (RSI) in 1974 when he published, in the preprint form, two volumes of the book "Information Theory and Thermodynamics" concerning classical and quantum information theory, [153] (220 pp.), [154] (185 pp.). In spite of the encouraging remarks by some of the readers, the physical part of this book was never written except for the first chapter. Now this material is written completely anew and in much greater extent. A few years earlier, in 1970, second author of the present book, (AK), a doctoral student and collaborator of RSI in Toruń, published in Polish, also as a preprint, his habilitation dissertation "Information-theoretical decision scheme in quantum statistical mechanics" [196] (96 pp.). This small monograph presented his original results in the physical part of the theory developed in the Toruń school. Unfortunately, this preprint was never published in English. The present book contains all these results in a much more modern and developed form.

From Classical to Quantum Mechanics Giampiero Esposito 2004-03-11 This 2004 textbook provides a pedagogical introduction to the formalism, foundations and applications of quantum mechanics. Part I covers the basic material which is necessary to understand the transition from classical to wave mechanics. Topics include classical dynamics, with emphasis on canonical transformations and the Hamilton-Jacobi equation, the Cauchy problem for the wave equation, Helmholtz equation and eikonal approximation, introduction to spin, perturbation theory and scattering theory. The Weyl quantization is presented in Part II, along with the postulates of quantum mechanics. Part III is devoted to topics such as statistical mechanics and black-body radiation, Lagrangian and phase-space formulations of quantum mechanics, and the Dirac equation. This book is intended for use as a textbook for beginning graduate and advanced undergraduate courses. It is self-contained and includes problems to aid the reader's understanding.

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.

Quantum Information Theory Masahito Hayashi 2016-11-03 This graduate textbook provides a unified view of quantum information theory. Clearly explaining the necessary mathematical basis, it merges key topics from both information-theoretic and quantum-mechanical viewpoints and provides lucid explanations of the basic results. Thanks to this unified approach, it makes accessible such advanced topics in quantum communication as quantum teleportation, superdense coding, quantum state transmission (quantum error-correction) and quantum encryption. Since the publication of the preceding book Quantum Information: An Introduction, there have been tremendous strides in the field of quantum information. In particular, the following topics – all of which are addressed here – have seen major advances: quantum state discrimination, quantum channel capacity, bipartite and multipartite entanglement, security analysis on quantum communication, reverse Shannon theorem and uncertainty relation. With regard to the analysis of quantum security, the present book employs an improved method for the evaluation of leaked information and

identifies a remarkable relation between quantum security and quantum coherence. Taken together, these two improvements allow a better analysis of quantum state transmission. In addition, various types of the newly discovered uncertainty relation are explained. Presenting a wealth of new developments, the book introduces readers to the latest advances and challenges in quantum information. To aid in understanding, each chapter is accompanied by a set of exercises and solutions.

Quantum Information Processing and Quantum Error Correction Ivan Djordjevic 2012-04-16 Quantum Information Processing and Quantum Error Correction is a self-contained, tutorial-based introduction to quantum information, quantum computation, and quantum error-correction. Assuming no knowledge of quantum mechanics and written at an intuitive level suitable for the engineer, the book gives all the essential principles needed to design and implement quantum electronic and photonic circuits. Numerous examples from a wide area of application are given to show how the principles can be implemented in practice. This book is ideal for the electronics, photonics and computer engineer who requires an easy- to-understand foundation on the principles of quantum information processing and quantum error correction, together with insight into how to develop quantum electronic and photonic circuits. Readers of this book will be ready for further study in this area, and will be prepared to perform independent research. The reader completed the book will be able design the information processing circuits, stabilizer codes, Calderbank-Shor-Steane (CSS) codes, subsystem codes, topological codes and entanglement-assisted quantum error correction codes; and propose corresponding physical implementation. The reader completed the book will be proficient in quantum fault-tolerant design as well. Unique Features Unique in covering both quantum information processing and quantum error correction - everything in one book that an engineer needs to understand and implement quantum-level circuits. Gives an intuitive understanding by not assuming knowledge of quantum mechanics, thereby avoiding heavy mathematics. In-depth coverage of the design and implementation of quantum information processing and quantum error correction circuits. Provides the right balance among the quantum mechanics, quantum error correction, quantum computing and quantum communication. Dr. Djordjevic is an Assistant Professor in the Department of Electrical and Computer Engineering of College of Engineering, University of Arizona, with a joint appointment in the College of Optical Sciences. Prior to this appointment in August 2006, he was with University of Arizona, Tucson, USA (as a Research Assistant Professor); University of the West of England, Bristol, UK; University of Bristol, Bristol, UK; Tyco Telecommunications, Eatontown, USA; and National Technical University of Athens, Athens, Greece. His current research interests include optical networks, error control coding, constrained coding, coded modulation, turbo equalization, OFDM applications, and quantum error correction. He presently directs the Optical Communications Systems Laboratory (OCSL) within the ECE Department at the University of Arizona. Provides everything an engineer needs in one tutorial-based introduction to understand and implement quantum-level circuits Avoids the heavy use of mathematics by not assuming the previous knowledge of quantum mechanics Provides in-depth coverage of the design and implementation of quantum information processing and quantum error correction circuits

Geometry of Quantum States Ingemar Bengtsson 2017-08-18 Quantum information theory is a branch of science at the frontier of physics, mathematics, and information science, and offers a variety of solutions that are impossible using classical theory. This book provides a detailed introduction to the key concepts used in processing quantum information and reveals that quantum mechanics is a generalisation of classical probability theory. The second edition contains new sections and entirely new chapters: the hot topic of multipartite entanglement; in-depth discussion of the discrete structures in finite dimensional Hilbert space, including unitary operator bases, mutually unbiased bases, symmetric informationally complete generalized measurements, discrete Wigner function, and unitary designs; the Gleason and Kochen–Specker theorems; the proof of the Lieb conjecture; the measure concentration phenomenon; and the Hastings' non-additivity theorem. This richly-illustrated book will be useful to a broad audience of graduates and researchers interested in quantum information theory. Exercises follow each chapter, with hints and answers supplied.

Quantum Computing Eleanor G. Rieffel 2014-08-29 A thorough exposition of quantum computing and the underlying concepts of quantum physics, with explanations of the relevant mathematics and numerous examples. The combination of two of the twentieth century's most influential and revolutionary scientific theories, information theory and quantum mechanics, gave rise to a radically new view of computing and information. Quantum information processing explores the implications of using quantum mechanics instead of classical mechanics to model information and its processing. Quantum computing is not about changing the physical substrate on which computation is done from classical to quantum but about changing the notion of computation itself, at the most basic level. The fundamental unit of computation is no longer the bit but the quantum bit or qubit. This comprehensive introduction to the field offers a thorough exposition of quantum computing and the underlying concepts of quantum physics, explaining all the relevant mathematics and offering numerous examples. With its careful development of concepts and thorough explanations, the book makes quantum computing accessible to students and professionals in mathematics, computer science, and engineering. A reader with no prior knowledge of quantum physics (but with sufficient knowledge of linear algebra) will be able to gain a fluent understanding by working through the book.

Introduction to Topological Quantum Matter & Quantum Computation Tudor D. Stanescu 2016-12-19 What is "topological" about topological quantum states? How many

types of topological quantum phases are there? What is a zero-energy Majorana mode, how can it be realized in a solid state system, and how can it be used as a platform for topological quantum computation? What is quantum computation and what makes it different from classical computation? Addressing these and other related questions, *Introduction to Topological Quantum Matter & Quantum Computation* provides an introduction to and a synthesis of a fascinating and rapidly expanding research field emerging at the crossroads of condensed matter physics, mathematics, and computer science. Providing the big picture, this book is ideal for graduate students and researchers entering this field as it allows for the fruitful transfer of paradigms and ideas amongst different areas, and includes many specific examples to help the reader understand abstract and sometimes challenging concepts. It explores the topological quantum world beyond the well-known topological insulators and superconductors and emphasizes the deep connections with quantum computation. It addresses key principles behind the classification of topological quantum phases and relevant mathematical concepts and discusses models of interacting and noninteracting topological systems, such as the torric code and the p-wave superconductor. The book also covers the basic properties of anyons, and aspects concerning the realization of topological states in solid state structures and cold atom systems. Quantum computation is also presented using a broad perspective, which includes fundamental aspects of quantum mechanics, such as Bell's theorem, basic concepts in the theory of computation, such as computational models and computational complexity, examples of quantum algorithms, and elements of classical and quantum information theory.

Classical and Quantum Information Theory China Edition Emmanuel Desurvire 2013-07-11 This complete overview of classical and quantum information theory employs an informal yet accurate approach, for students, researchers and practitioners.

Introduction to Classical and Quantum Field Theory Tai-Kai Ng 2009-04-27 This is the first introductory textbook on quantum field theory to be written from the point of view of condensed matter physics. As such, it presents the basic concepts and techniques of statistical field theory, clearly explaining how and why they are integrated into modern (and classical) field theory, and includes the latest developments. Written by an expert in the field, with a broad experience in teaching and training, it manages to present such substantial topics as phases and phase transitions or solitons and instantons in an accessible and concise way. Divided into two parts, the first covers fundamental physics and the mathematics background needed by students in order to enter the field, while the second part discusses applications of quantum field theory to a few basic problems. The emphasis here lies on how modern concepts of quantum field theory are embedded in these approaches, and also on the limitations of standard quantum field theory techniques in facing 'real' physics problems. Throughout, there are numerous end-of-chapter problems, and a free solutions manual is available for lecturers.