Classical And Quantum Information Theory An Introduction For The Telecom Scientist

Thank you very much for downloading **Classical And Quantum Information Theory An Introduction For The Telecom Scientist**. As you may know, people have look hundreds times for their chosen novels like this Classical And Quantum Information Theory An Introduction For The Telecom Scientist, but end up in harmful downloads.
Rather than enjoying a good book with a cup of tea in the afternoon, instead they are facing with some infectious virus inside their laptop.

Classical And Quantum Information Theory An Introduction For The Telecom Scientist is available in our book collection an online access to it is set as public so you can download it instantly.
Our book servers saves in multiple locations, allowing you to get the most less latency time to download any of our books like this one.
Kindly say, the Classical And Quantum Information Theory An Introduction For The Telecom Scientist is universally compatible with any devices to read

Entropy, Divergence, and Majorization in Classical and Quantum Thermodynamics Takahiro Sagawa 2022-03-23 Rich information-theoretic structure in out-of-equilibrium thermodynamics exists in both the classical and quantum regimes, leading to the fruitful interplay among statistical physics, quantum information theory, and mathematical theories such as matrix analysis and asymptotic probability theory. The main purpose of this book is to clarify how information theory works behind thermodynamics and to shed modern light on it. The book focuses on both purely information-theoretic concepts and their physical implications. From the mathematical point of view, rigorous proofs of fundamental properties of entropies, divergences, and majorization are presented in a self-contained manner. From the physics perspective, modern formulations of thermodynamics are discussed, with a focus on stochastic thermodynamics and resource theory of thermodynamics. In particular, resource theory is a recently developed field as a branch of quantum information theory to quantify "useful resources" and has an intrinsic connection to various fundamental ideas of mathematics and information theory. This book serves as a concise introduction to important ingredients of the information-theoretic formulation of thermodynamics.

Introduction to Quantum Computation and Information Hoi-Kwong Lo 1998 "The book fills a gap between the turgid prose of the burgeoning research literature and the superficial accounts in the popular press." Nature, 1999 "The concepts introduced in this book and the forecast of future directions provided should continue to provide a good primer for the exciting breakthrough anticipated in this field." Mathematics Abstracts, 2001 "Despite its age, this book remains an excellent way to learn the basics of quantum information." Quantum Information and Computation, 2002

General Theory of Information Transfer and Combinatorics Rudolf Ahlswede 2006-12-08 This book collects 63 revised, full-papers contributed to a research project on the "General Theory of Information Transfer and Combinatorics" that was hosted from 2001-2004 at the Center for Interdisciplinary Research (ZIF) of Bielefeld University and several incorporated meetings. Topics covered include probabilistic models, cryptology, pseudo random sequences, quantum models, pattern discovery, language evolution, and network coding.

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.

Quantum Communications Gianfranco Cariolaro 2015-04-08 This book demonstrates that a quantum communication system using the coherent light of a laser can achieve performance orders of magnitude superior to classical optical communications Quantum Communications provides the Masters and PhD signals or communications student with a complete basics-to-applications course in using the principles of quantum mechanics to provide cutting-edge telecommunications. Assuming only knowledge of elementary probability, complex analysis and optics, the book guides its reader through the fundamentals of vector and Hilbert spaces and the necessary quantum-mechanical ideas, simply formulated in four postulates. A turn to practical matters begins with and is then developed by: development of the concept of quantum decision, emphasizing the optimization of measurements to extract useful information from a quantum system; general formulation of a transmitter-receiver system particular treatment of the most popular quantum communications systems—OOK, PPM, PSK and QAM; more realistic performance evaluation introducing thermal noise and system description with density operators; consideration of scarce existing implementations of quantum communications systems and their difficulties with suggestions for future improvement; and separate treatment of quantum information with discrete and continuous states. Quantum Communications develops the engineering student's exposure to quantum mechanics and shows physics students that its theories can have practically beneficial application in communications systems. The use of example and exercise questions (together with a downloadable solutions manual for instructors, available from http://extras.springer.com/) will help to make the material presented really sink in for students and invigorate subsequent research.

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.

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 – made 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.

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 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.

Quantum Key Distribution Ramona Wolf 2021-09-05 This textbook introduces the non-specialist reader to the concepts of quantum key distribution and presents an overview of state-of-the-art quantum communication protocols and applications. The field of quantum cryptography has advanced rapidly in the previous years, not least because with the age of quantum computing drawing closer, traditional encryption methods are at risk. The textbook presents the necessary mathematical tools without assuming much background, making it accessible to readers without experience in quantum information theory. In particular, the topic of classical and quantum entropies is presented in great detail. Furthermore, the author discusses the different types of quantum key distribution protocols and explains several tools for proving the security of these protocols. In addition, a number of applications of quantum key distribution are discussed, demonstrating its value to state-of-the-art cryptography and communication. This book leads the reader through the mathematical background with a variety of worked-out examples and exercises. It is primarily targeted at graduate students and advanced undergraduates in theoretical physics. The presented material is largely self-contained and only basic knowledge in quantum mechanics and linear algebra is required.

Quantum Computation and Quantum Information Theory Chiara Macchiavello 2000 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.

Quantum Zero-Error Information Theory Ello□ B. Guedes 2016-09-02 This book aims at presenting the field of Quantum Information Theory in an intuitive, didactic and self-contained way, taking into account several multidisciplinary aspects. Therefore, this books is particularly suited to students and researchers willing to grasp fundamental concepts in Quantum Computation and Quantum Information areas. The field of Quantum Information Theory has increased significantly over the last three decades. Many results from classical information theory were translated and extended to a scenario where quantum effects become important. Most of the results in this area allows for an asymptotically small probability of error to represent and transmit information efficiently. Claude E.Shannon was the first scientist to realize that error-free classical information transmission can be accomplished under certain conditions. More recently, the concept of error-free classical communication was translated to the quantum context. The so-called Quantum Zero-Error Information Theory completes and extends the Shannon Zero-Error Information Theory.

Quantum Approach to Informatics Stig Stenholm 2005-09-02 An essential overview of quantum information information, whether inscribed as a mark on a stone tablet orencoded as a magnetic domain on a hard drive, must be stored in aphysical object and thus made subject to the laws of physics.Traditionally, information processing such as computation occurredin a framework governed by laws of classical physics. However,information can also be stored and processed using the states ofmatter described by non-classical quantum theory. Understandingthis quantum information, a fundamentally different type ofinformation, has been a major project of physicists and informationtheorists in recent years, and recent experimental research hasstarted to yield promising results. Quantum Approach to Informatics fills the need for a conciseintroduction to this burgeoning new field, offering an intuitiveapproach for readers in both the physics and information sciencecommunities, as well as in related fields. Only a basic backgroundin quantum theory is required, and the text keeps the focus onbringing this theory to bear on contemporary informatics. Insteadof proofs and other highly formal structures, detailed examplespresent the material, making this a uniquely accessibleintroduction to quantum informatics. Topics covered include: * An introduction to quantum information and the qubit * Concepts and methods of quantum theory important forinformatics * The application of information concepts to quantum physics * Quantum information processing and computing * Quantum gates * Error correction using quantum-based methods * Physical realizations of quantum computing circuits A helpful and economical resource for understanding this excitingnew application of quantum theory to informatics, Quantum Approachto Informatics provides students and researchers in physics andinformation science, as well as other interested readers with somescientific background, with an essential overview of the field.

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 stylistic 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 Carathеodory'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.

Quantum Information and Computing Mikio Nakahara 2013 The open research centre project "Interdisciplinary fundamental research toward realization of a quantum computer" has been supported by the Ministry of Education, Japan for five years. This is a collection of the research outcomes by the members engaged in the project. To make the presentation self-contained, it starts with an overview by Mikio Nakahara, which serves as a concise introduction to quantum information and quantum computing. Subsequent contributions include subjects from physics, chemistry, mathematics, and information science, reflecting upon the wide variety of scientists working under this project. These contributions introduce NMR quantum computing and related techniques, number theory and coding theory, quantum error correction, photosynthesis, non-classical correlations and entanglement, neutral atom quantum computer, among others. Each of the contributions will serve as a short introduction to these cutting edge research fields.

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.

Mathematical Methods in Physics Philippe Blanchard 2015-04-07 The second edition of this textbook presents the basic mathematical knowledge and skills that are needed for courses on modern theoretical physics, such as those on quantum mechanics, classical and quantum field theory, and related areas. The authors stress that learning mathematical physics is not a passive process and include numerous detailed proofs, examples, and over 200 exercises, as well as hints linking mathematical concepts and results to the relevant physical concepts and theories. All of the material from the first edition has been updated, and five new chapters have been added on such topics as distributions, Hilbert space operators, and variational methods. The text is divided into three parts: - Part I: A brief introduction to (Schwartz) distribution theory. Elements from the theories of ultra distributions and (Fourier) hyperfunctions are given in addition to some deepер results for Schwartz distributions, thus providing a rather comprehensive introduction to the theory of generalized functions. Basic properties and methods for distributions are developed with applications to constant coefficient ODEs and PDEs. The relation between distributions and holomorphic functions is considered, as well as basic properties of Sobolev spaces. - Part II: Fundamental facts about Hilbert spaces. The basic theory of linear (bounded and unbounded) operators in Hilbert spaces and special classes of linear operators - compact, Hilbert-Schmidt, trace class, and Schr□dinger operators, as needed in quantum physics and quantum information theory - are explored. This section also contains a detailed spectral analysis of all major classes of linear operators, including completeness of generalized eigenfunctions, as well as of (completely) positive mappings, in particular quantum operations. - Part III: Direct methods of the calculus of variations and their applications to boundary- and eigenvalue-problems for linear and nonlinear partial differential operators. The authors conclude with a discussion of the Hohenberg-Kohn variational principle. The appendices contain proofs of more general and deeper results, including completions, basic facts about metrizable Hausdorff locally convex topological vector spaces, Baire's fundamental results and their main consequences, and bilinear functionals. Mathematical Methods in Physics is aimed at a broad community of graduate students in mathematics, mathematical physics, quantum information theory, physics and engineering, as well as researchers in these disciplines. Expanded content and relevant updates will make this new edition a valuable resource for those working in these disciplines.

Quantum Information Processing J□nos 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.

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 special 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 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.

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

Quantum Bio-Informatics IV Luigi Accardi 2011-01-27 The purpose of this proceedings volume is to return to the starting point of bio-informatics and quantum information, fields that are growing rapidly at present, and to seriously attempt mutual interaction between the two, with a view to enumerating and solving the many fundamental problems they entail. For such a purpose, we look for interdisciplinary bridges in mathematics, physics, information and life sciences, in particular, research for new paradigm for information science and life science on the basis of quantum theory. Contents:The QP-DYN Algorithms (L. Accardi et al.)New Types of Quantum Entropies and Additive Information Capacities (V.P. Belavkin)Self-Collapses of Quantum Systems and Brain Activities (K-H. Fichtner et al.)The Passage from Digital to Analogue in White Noise Analysis and Applications (T. Hida)On Quantum Algorithm for Exptime Problem (S. Iriyama & M. Ohya)On Sufficient Algebraic Conditions for Identification of Quantum States (A. Jamio□kowski)Classical Wave Model of Quantum-Like Processing in Brain (A. Khrennikov)Entanglement Mapping vs. Quantum Conditional Probability Operator (D. Chru□ci□ski et al.)Space(-Time) Emergence as Symmetry Breaking Effect (I. Ojima)On the Correspondence between Newtonian and Functional Mechanics (E.V. Piskovskiy & I.V. Volovich)Signaling Network of Environmental Sensing and Adaptation in Plants: Key Roles of Calcium Ion (K. Kuchitsu & T. Kurusu)NetzCope: A Tool for Displaying and Analyzing Complex Networks (M.J. Barber et al.)and other papers Readership: Researchers in quantum information, quantum physics, bio-informatics and life science. Keywords:Quantum Information;Quantum Probability;Quantum Computer;Bioinformatics;Genes;Adaptive Dynamics;White Noise Analysis;Entanglement;Quantum Entropy;Superconductivity Key Features:Quantum informationBio-InformaticsGlobal research mixing the Quantum information and Bio-Informatics with various mathematical sciences

Introduction to the Theory of Quantum Information Processing J□nos A. Bergou 2013-05-18 Introduction to the Theory of Quantum Information Processing provides the material for a one-semester graduate level course on quantum information theory and quantum computing for students who have had a one-year graduate course in quantum mechanics. Many standard subjects are treated, such as density matrices, entanglement, quantum maps, quantum cryptography, and quantum codes. Also included are discussions of quantum machines and quantum walks. In addition, the book provides detailed treatments of several underlying fundamental principles of quantum theory, such as quantum measurements, the no-cloning and no-signaling theorems, and their consequences. Problems of various levels of difficulty supplement the text, with the most challenging problems bringing the reader to the forefront of active research. This book provides a compact introduction to the fascinating and rapidly evolving interdisciplinary field of quantum information theory, and it prepares the reader for doing active research in this area.

A Short Course in Quantum Information Theory Lajos Diosi 2011-06-02 This short and concise primer takes the vantage point of theoretical physics and the unity of physics. It sets out to strip the burgeoning field of quantum information science to its basics by linking it to universal concepts in physics. An extensive lecture rather than a comprehensive textbook, this volume is based on courses delivered over several years to advanced undergraduate and beginning graduate students, but essentially it addresses anyone with a working knowledge of basic quantum physics. Readers will find these lectures a most adequate entry point for theoretical studies in this field. For the second edition, the authors has succeeded in adding many new topics while sticking to the conciseness of the overall approach. A new chapter on qubit thermodynamics has been added, while new sections and subsections have been incorporated in various chapter to deal with weak and time-continuous measurements, period-finding quantum algorithms and quantum error corrections. From the reviews of the first edition: "The best things about this book are its brevity and clarity. In around 100 pages it provides a tutorial introduction to quantum information theory, including problems and solutions. ... it's worth a look if you want to quickly get up to speed with the language and central concepts of quantum information theory, including the background classical information theory." (Craig Savage, Australian Physics, Vol. 44 (2), 2007)

Quantum Information Theory Mark M. Wilde 2013-04-18 Finally, here is a modern, self-contained text on quantum information theory suitable for graduate-level courses. Developing the subject 'from the ground up' it covers classical results as well as major advances of the past decade. Beginning with an extensive overview of classical information theory suitable for the non-expert, the author then turns his attention to quantum mechanics for quantum information theory, and the important protocols of teleportation, super-dense coding and entanglement distribution. He develops all of the tools necessary for understanding important results in quantum information theory, including capacity theorems for classical, entanglement-assisted, private and quantum communication. The book also covers important recent developments such as superadditivity of private, coherent and Holevo information, and the superactivation of quantum capacity. This book will be warmly welcomed by the upcoming generation of quantum information theorists and the already established community of classical information theorists.

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 ConceptsQuantum Entanglement ManipulationQuantum AlgorithmsQuantum ComplexityQuantum Error CorrectionQuantum ChannelsEntanglement Purification and Long-Distance Quantum CommunicationQuantum Key DistributionCavity Quantum Electrodynamics:Quantum Computation with Ion TrapsJosephson Junctions and Quantum ComputationQuantum Computing in Optical LatticesQuantum Computation and Quantum Communication with ElectronsNMR 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

Theory of Quantum Information with Memory Mou-Hsiung Chang 2022-08-22 This book provides an up-to-date account of current research in quantum information theory, at the intersection of theoretical computer science, quantum physics, and mathematics. The book confronts many unprecedented theoretical challenges generated by infinite dimensionality and memory effects in quantum communication. The book will also equip readers with all the required mathematical tools to understand these essential questions.

Categories for Quantum Theory Chris Heunen 2019-09-30 Monoidal category theory serves as a powerful framework for describing logical aspects of quantum theory, giving an abstract language for parallel and sequential composition, and a conceptual way to understand many high-level quantum phenomena. This text lays the foundation for this categorical quantum mechanics, with an emphasis on the graphical calculus which makes computation intuitive. Biproducts and dual objects are introduced and used to model superposition and entanglement, with quantum teleportation studied abstractly using these structures. Monoids, Frobenius structures and Hopf algebras are described, and it is shown how they can be used to model classical information and complementary observables. The CP construction, a categorical tool to describe probabilistic quantum systems, is also investigated. The last chapter introduces higher categories, surface diagrams and 2-Hilbert spaces, and shows how the language of duality in monoidal 2-categories can be used to reason about quantum protocols, including quantum teleportation and dense coding. Prior knowledge of linear algebra, quantum information or category theory would give an ideal background for studying this text, but it is not assumed, with essential background material given in a self-contained introductory chapter. Throughout the text links with many other areas are highlighted, such as representation theory, topology, quantum algebra, knot theory, and probability theory, and nonstandard models are presented, such as sets and relations. All results are stated rigorously, and full proofs are given as far as possible, making this book an invaluable reference for modern techniques in quantum logic, with much of the material not available in any other textbook.

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 toric 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.

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.

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.

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 of information has to play in fundamental physics. Topics discussed include the slogan 'Information is Physical', the prospects for an informational materialism (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.

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

Advanced Quantum Communications Sandor Imre 2012-11-27 The book provides an overview of the most advanced quantum informational geometric techniques, which can help quantum communication theorists analyze quantum channels, such as security or additivity properties. Each section addresses an area of major research of quantum information theory and quantum communication networks. The authors present the fundamental theoretical results of quantum information theory, while also presenting the details of advanced quantum ccommunication protocols with clear mathematical and information theoretical background. This book bridges the gap between quantum physics, quantum information theory, and practical engineering.

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 Quantum Computation and Information Hoi-Kwong Lo 1998-10-15 This book aims to provide a pedagogical introduction to the subjects of quantum information and quantum computation. Topics include non-locality of quantum mechanics, quantum computation, quantum cryptography, quantum error correction, fault-tolerant quantum computation as well as some experimental aspects of quantum computation and quantum cryptography. Only knowledge of basic quantum mechanics is assumed. Whenever more advanced concepts and techniques are used, they are introduced carefully. This book is meant to be a self-contained overview. While basic concepts are discussed in detail, unnecessary technical details are excluded. It is well-suited for a wide audience ranging from physics graduate students to advanced researchers. This book is based on a lecture series held at Hewlett-Packard Labs, Basic Research Institute in the Mathematical Sciences (BRIMS), Bristol from November 1996 to April 1997, and also includes other contributions. Contents:Basic Elements of Quantum Information Technology (T P Spiller)The Joy of Entanglement (S Popescu & D Rohrlich)Quantum Information and Its Properties (R Jozsa)Quantum Cryptology (H-K Lo)Experimental Quantum Cryptography (H Zbinden)Quantum Computation: An Introduction (A Barenco)Quantum Error Correction (A M Steane)Fault-Tolerant Quantum Computation (J Preskill)Quantum Computers, Error-Correction and Networking: Quantum Optical Approaches (T Pellizzari)Quantum Computation with Nuclear Magnetic Resonance (I L Chuang)Future Directions for Quantum Information Theory (C H Bennett) Readership: Graduate students and advanced researchers in quantum/classical mechanics, quantum information & computation, theoretical foundations of computer science and information science. Keywords:Quantum Computation;Quantum Cryptography;Quantum Information;Quantum Teleportation;Quantum Error-Correction;Quantum Algorithm;Entanglement;Qubit;Decoherence Reviews: "The book fills a gap between the turgid prose of the burgeoning research literature and the superficial accounts in the popular press." Nature "The concepts introduced in this book and the forecast of future directions provided should continue to provide a good primer for the exciting breakthrough anticipated in this field." Mathematics Abstracts "Despite its age, this book remains an excellent way to learn the basics of quantum information." Quantum Information and Computation "... the expositions are generally very beautiful, and the drawing together of many fundamental issues in one place is something that is extremely useful, given the wide background of ideas that go into the field ... this is an excellent book for anyone who is starting out in the field and would like to have an overview of what the key issues are, and which directions of research are important, without being bogged down by heavy detail." Contemporary Physics

A Short Course in Quantum Information Theory Lajos Diosi 2011-06-03 This short and concise primer takes the vantage point of theoretical physics and the unity of physics. It sets out to strip the burgeoning field of quantum information science to its basics by linking it to universal concepts in physics. An extensive lecture rather than a comprehensive textbook, this volume is based on courses delivered over several years to advanced undergraduate and beginning graduate students, but essentially it addresses anyone with a working knowledge of basic quantum physics. Readers will find these lectures a most adequate entry point for theoretical studies in this field. For the second edition, the authors has succeeded in adding many new topics while sticking to the conciseness of the overall approach. A new chapter on qubit thermodynamics has been added, while new sections and subsections have been incorporated in various chapter to deal with weak and time-continuous measurements, period-finding quantum algorithms and quantum error corrections. From the reviews of the first edition: "The best things about this book are its brevity and clarity. In around 100 pages it provides a tutorial introduction to quantum information theory, including problems and solutions. ... it's worth a look if you want to quickly get up to speed with the language and central concepts of quantum information theory, including the background classical information theory." (Craig Savage, Australian Physics, Vol. 44 (2), 2007)

Quantum Information IV, Proceedings Of The Fourth International Conference Hida Takeyuki 2002-05-30

A Quantum Computation Workbook Mahn-Soo Choi 2022 Teaching quantum computation and information is notoriously difficult, because it requires covering subjects from various fields of science, organizing these subjects consistently in a unified way despite their tendency to favor their specific languages, and overcoming the subjects' abstract and theoretical natures, which offer few examples of actual realizations. In this book, we have organized all the subjects required to understand the principles of quantum computation and information processing in a manner suited to physics, mathematics, and engineering courses as early as undergraduate studies.In addition, we provide a supporting package of quantum simulation software from Wolfram Mathematica, specialists in symbolic calculation software. Throughout the book's main text, demonstrations are provided that use the software package, allowing the students to deepen their understanding of each subject through self-practice. Readers can change the code so as to experiment with their own ideas and contemplate possible applications. The information in this book reflects many years of experience teaching quantum computation and information. The quantum simulation-based demonstrations and the unified organization of the subjects are both time-tested and have received very positive responses from the students who have experienced them.

Quantum Information Processing, Quantum Computing, and Quantum Error Correction Ivan Djordjevic 2021-02-20 The Second Edition of Quantum Information Processing, Quantum Computing, and Quantum Error Correction: An Engineering Approach presents a self-contained introduction to all aspects of the area, teaching the essentials such as state vectors, operators, density operators, measurements, and dynamics of a quantum system. In addition to the fundamental principles of quantum computation, basic quantum gates, basic quantum algorithms, and quantum information processing, this edition has been brought fully up to date, outlining the latest research trends. These include: Key topics include: Quantum error correction codes (QECCs), including stabilizer codes, Calderbank-Shor-Steane (CSS) codes, quantum low-density parity-check (LDPC) codes, entanglement-assisted QECCs, topological codes, and surface codes Quantum information theory, and

quantum key distribution (QKD) Fault-tolerant information processing and fault-tolerant quantum error correction, together with a chapter on quantum machine learning. Both quantum circuits- and measurement-based quantum computational models are described The next part of the book is spent investigating physical realizations of quantum computers, encoders and decoders; including photonic quantum realization, cavity quantum electrodynamics, and ion traps In-depth analysis of the design and realization of a quantum information processing and quantum error correction circuits This fully up-to-date new edition will be of use to engineers, computer scientists, optical engineers, physicists and mathematicians. A self-contained introduction to quantum information processing, and quantum error correction Integrates quantum information processing, quantum computing, and quantum error correction Describes the latest trends in the quantum information processing, quantum error correction and quantum computing Presents the basic concepts of quantum mechanics In-depth presentation of the design and realization of a quantum information processing and quantum error correction circuit