Introduction To Quantum Information Cond Mat

This book constitutes revised selected papers from the 7th Conference on Theory of Quantum Computation, Communication, and Cryptography, TQC 2012, held in Tokyo, Japan, in May 2012. The 12 papers presented were carefully reviewed and selected for inclusion in this book. They contain original research on the rapidly growing, interdisciplinary field of quantum computation, communication and cryptography. Topics addressed are such as quantum algorithms, quantum computation models, quantum complexity theory, simulation of quantum systems, quantum programming languages, quantum cryptography, quantum communication, quantum estimation, quantum measurement, quantum tomography, completely positive maps, decoherence, quantum noise, quantum coding theory, fault-tolerant quantum computing, entanglement theory, and quantum teleportation.

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.

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

Dieses einführende Lehrbuch für Studenten höherer Semester der Physik, Chemie und Informatik behandelt ein in jüngster Zeit dynamisch expandierendes Gebiet der Physik. Das Buch befasst sich u.a. mit den Themen Quanteninformationstheorie , Quantenkommunikation, Quantencomputing, Teleportation, verborgene Parameter, Welcher-Weg-Markierung, Quantenmessprozess, POVM, Quantenkanäle und vermittelt dadurch nicht nur ein vertieftes Verständnis der Quantentheorie, sondern auch ein Basiswissen, um die schnelle Entwicklung des Gebiets zu verfolgen, bzw. in ein Spezialgebiet der Forschung einsteigen zu können. Kommentierte Empfehlungen für weiterführende Literatur sowie Übungsaufgaben helfen dem Leser, rasch einen fundierten Zugang zu den theoretischen Grundlagen zukünftiger Schlüsseltechnologien zu finden. Das Buch kann zur Grundlage von Vorlesungen und Seminaren gemacht werden. Da die benötigten Grundkenntnisse in Mathematik und Quantentheorie in einleitenden Kapiteln dargestellt werden, eignet sich das Buch auch zum Selbststudium.

Introduction to Quantum Computation and Information

Theory and Implementation

ISQM — Tokyo '01

Demystifying Computation

A Gentle Introduction

Fundamentals of Quantum Optics and Quantum Information

This undergraduate book, first published in 2006, introduces quantum information and computation for physicists, mathematicians and computer scientists.

The present book provides to the main ideas and techniques of the rapid progressing field of quantum information and quantum computation using isotope - mixed materials. It starts with an introduction to the isotope physics and then describes of the isotope - based quantum information and quantum computation. The ability to manipulate and control electron and/or nucleus spin in semiconductor devices provides a new route to expand the capabilities of inorganic semiconductor-based electronics and to design innovative devices with potential application in quantum computing. One of the major challenges towards these objectives is to develop semiconductor-based systems and architectures in which the spatial distribution of spins and their properties can be controlled. For instance, to eliminate electron spin decoherence resulting from hyperfine interaction due to nuclear spin background, isotopically controlled devices are needed (i.e., nuclear spin-depleted). In other emerging concepts, the control of the spatial distribution of isotopes with nuclear spins is a prerequisite to implement the quantum bits (or qbits). Therefore, stable semiconductor isotopes are important elements in the development of solid-state quantum information. There are not only different algorithms of quantum computation discussed but also the different models of quantum computers are presented. With numerous illustrations this small book is of great interest for undergraduate students taking courses in mesoscopic physics or nanoelectronics as well as quantum information, and academic and industrial researches working in this

field.

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.

This book describes new trends in the nanoscience of isotopic materials science. Assuming a background in graduate condensed matter physics and covering the fundamental aspects of isotopic materials science from the very beginning, it equips readers to engage in high-level professional research in this area. The book ´s main objective is to provide insight into the question of why solids are the way they are, either because of how their atoms are bonded with one another, because of defects in their structure, or because of how they are produced or processed. Accordingly, it explores the science of how atoms interact, connects the results to real materials properties, and demonstrates the engineering concepts that can be used to produce or improve semiconductors by design. In addition, it shows how the concepts discussed are applied in the laboratory. The book addresses the needs of researchers, graduate students and senior undergraduate students alike. Although primarily written for materials science audience, it will be equally useful to those teaching in electrical engineering, materials science or even chemical engineering or physics curricula. In order to maintain the focus on materials concepts, however, the book does not burden the reader with details of many of the derivations and equations nor does it delve into the details of electrical engineering topics.

Isotope-Based Quantum Information

Physical Realizations of Quantum Computing

Quantum Information Processing and Quantum Error Correction

Quantum Computing

What is Quantum Information?

TASI 2015Proceedings of the 2015 Theoretical Advanced Study Institute in Elementary Particle Physics

"During the last ten years Quantum Information Processing and Communication (QIPC) has established itself as one of the new hot topic fields in physics, with the potential to revolutionize many areas of science and technology. QIPC replaces the laws of classical physics applied to computation and communication with the more fundamental laws of quantum mechanics. This becomes increasingly important due to technological progress going down to smaller and smaller scales where quantum effects start to be dominant. In addition to its fundamental nature, QIPC promises to advance computing power beyond the capabilities of any classical computer, to guarantee secure

communication and establish direct links to emerging quantum technologies, such as, for example, quantum based sensors and clocks. One of the outstanding feature of QIPC is its interdisciplinary character: it brings together researchers from physics, mathematics and computer science. In particular, within physics we have seen the emergence of a new QIPC community, which ranges from theoretical to experimental physics, and crosses boundaries of traditionally separated disciplines such as atomic physics, quantum optics, statistical mechanics and solid state physics, all working on different and complementary aspects of QIPC. This publication covers the following topics: Introduction to quantum computing; Quantum logic, information and entanglement; Quantum algorithms; Error-correcting codes for quantum computations; Quantum measurements and control; Quantum communication; Quantum optics and cold atoms for quantum information; Quantum computing with solid state devices; Theory and experiments for superconducting qubits; Interactions in many-body systems: quantum chaos, disorder and random matrices; Decoherence effects for quantum computing; and Flature prospects of quantum information processing."

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-Corrrection 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;DecoherenceReviews: “ 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

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.

This book gives an overview for practitioners and students of quantum physics and information science. It provides ready access to essential information on quantum information processing and communication, such as definitions, protocols and algorithms. Quantum information science is rarely found in clear and concise form. This book brings together this information from its various sources. It allows researchers and students in a range of areas including physics, photonics, solid-state electronics, nuclear magnetic resonance and information technology, in their applied and theoretical branches, to have this vital material directly at hand.

ISQM--Tokyo '01 : Advanced Research Laboratory, Hitachi, Ltd., Hatoyama, Saitama, Japan, 27-30 August 2001

Quantum Computers, Algorithms, and Chaos

An Introduction to Basic Theoretical Concepts and Experiments

A Hands-On Introduction

Quantum Information

Quantum Computation and Quantum Information Theory

Combining physics, mathematics and computer science, topological quantum computation is a rapidly expanding research area focused on the exploration of quantum evolutions that are immune to errors. In this book, the author presents a variety of different topics developed together for the first time, forming an excellent

introduction to topological quantum computation. The makings of anyonic systems, their properties and their computational power are presented in a pedagogical way. Relevant calculations are fully explained, and numerous worked examples and exercises support and aid understanding. Special emphasis is given to the motivation and physical intuition behind every mathematical concept. Demystifying difficult topics by using accessible language, this book has broad appeal and is ideal for graduate students and researchers from various disciplines who want to get into this new and exciting research field.

Quantum information processing offers fundamental improvements over classical information processing, such as computing power, secure communication, and high-precision measurements. However, the best way to create practical devices is not yet known. This textbook describes the techniques that are likely to be used in implementing optical quantum information processors. After developing the fundamental concepts in quantum optics and quantum information theory, the book shows how optical systems can be used to build quantum computers according to the most recent ideas. It discusses implementations based on single photons and linear optics, optically controlled atoms and solid-state systems, atomic ensembles, and optical continuous variables. This book is ideal for graduate students beginning research in optical quantum information processing. It presents the most important techniques of the field using worked examples and over 120 exercises.

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.

Problem solving in computing is referred to as computational thinking. The theory behind this concept is challenging in its technicalities, yet simple in its ideas. This book introduces the theory of computation from its inception to current form of complexity; from explanations of how the field of computer science was formed using classical ideas in mathematics by Gödel, to conceptualization of the Turing Machine, to its more recent innovations in quantum computation, hypercomputation, vague computing and natural computing. It describes the impact of these in relation to academia, business

and wider society, providing a sound theoretical basis for its practical application. Written for accessibility, Demystifying Computation provides the basic knowledge needed for non-experts in the field, undergraduate computer scientists and students of information and communication technology and software development. Request Inspection Copy Contents:A Brief History of ComputingFrom Hilbert to Gödel to TuringHypercomputationNatural ComputingQuantum ComputingVague ComputingPhysical Reality and Computation Readership: High-School and undergraduate students in computer science, information and communication technology, and software development, and non-experts in the field looking to understand how computation works.

Semiconductor Spintronics and Quantum Computation

Introduction to Topological Quantum Computation

An Introduction to Quantum Computing

Classical and Quantum Information Theory

7th Conference, TQC 2012, Tokyo, Japan, May 17-19, 2012, Revised Selected Papers

Quantum Bio-Informatics

This volume is a compilation of lectures delivered at the TASI 2015 summer school, "New Frontiers in Fields and Strings", held at the University of Colorado Boulder in June 2015. The school focused on topics in theoretical physics of interest to contemporary researchers in quantum field theory and string theory. The lectures are accessible to graduate students in the initial stages of their research careers.

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.

Combining physics and philosophy, this is a uniquely interdisciplinary examination of quantum information science which provides an up-to-date examination of developments in this field. The authors provide coherent definitions and theories of information, taking clearly defined approaches to considering information in connection with quantum mechanics, probability, and correlations. Concepts addressed include entanglement of quantum states, the relation of quantum correlations to quantum information, and the meaning of the informational approach for the foundations of quantum mechanics. Furthermore, the mathematical concept of information in the communicational context, and the notion of pragmatic information are considered. 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.

Recent work in quantum information science has produced a revolution in our understanding of quantum entanglement. Scientists now view entanglement as a physical resource with many important applications. These range from quantum computers, which would be able to compute exponentially faster than classical computers, to quantum cryptographic techniques, which could provide unbreakable codes for the transfer of secret information over public channels. These important advances in the study of quantum entanglement and information touch on deep foundational issues in both physics and philosophy. This interdisciplinary volume brings together fourteen of the world's leading physicists and philosophers of physics to address the most important developments and debates in this exciting area of research. It offers a broad spectrum of approaches to resolving deep foundational challenges - philosophical, mathematical, and physical - raised by quantum information, quantum processing, and entanglement. This book is ideal for historians, philosophers of science and physicists.

Quantum Bio-Informatics III
Quantum Information Processing
An Introduction to the Formalism of Quantum Information with Continuous Variables
Die Quantenphysik auf neuen Wegen
Quantum Information III
New Directions in Quantum Physics

The past few decades of research and development in solid-state semicon ductor physics and electronics have witnessed a rapid growth in the drive to exploit quantum mechanics in the design and function of semiconductor devices. This has been fueled for instance by the remarkable advances in our ability to fabricate nanostructures such as quantum wells, quantum wires and quantum dots. Despite this contemporary focus on semiconductor "quantum devices," a principal quantum mechanical aspect of the electron - its spin has it accounts for an added quan largely been ignored (except in as much as tum mechanical degeneracy). In recent years, however, a new paradigm of electronics based on the spin degree of freedom of the electron has begun to emerge. This field of semiconductor "spintronics" (spin transport electron ics or spin-based electronics) places electron spin rather than charge at the very center of interest. The underlying basis for this new electronics is the intimate connection between the charge and spin degrees of freedom of the electron via the Pauli principle. A crucial implication of this relationship is that spin effects can often be accessed through the orbital properties of the electron in the solid state. Examples for this are optical measurements of the spin state based on the Faraday effect and spin-dependent transport measure ments such as giant magneto-resistance (GMR). In this manner, information can be encoded in not only the electron's charge but also in its spin state, i. e.

An introductory textbook for advanced students of physics, chemistry and computer science, covering an area of physics that has lately witnessed rapid expansion. The topics treated here include quantum information, quantum communication, quantum computing, teleportation and hidden parameters, thus imparting not only a well-founded understanding of quantum theory as such, but also a solid basis of knowledge from which readers can follow the rapid development of the topic or delve deeper into a more specialized branch of research. Commented recommendations for further reading as well as end-of-chapter problems help the reader to quickly access the theoretical basics of future key technologies.

Quantum information is an area of science, which brings together physics, information theory, computer science & mathematics. This book, which is based on two successful lecture courses, is intended to introduce readers to the ideas behind new developments including quantum cryptography, teleportation & quantum computing.

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.

Reprint Volume with Introductory Notes for ISI TMR Network School, 12-23 July 1999, Villa Gualino, Torino, Italy

Entangled Systems
Introduction to Optical Quantum Information Processing
A Mathematical Introduction
Verschränkte Systeme
An Introduction for the Telecom Scientist

Cryptographic Primitives in Blockchain Technology provides an introduction to the mathematical and cryptographic concepts behind blockchain technologies and shows how they are applied in blockchain-based systems.

This book addresses electron spin-qubit based quantum computing and quantum information processing with a strong focus on the background and applications to EPR/ESR technique and spectroscopy. It explores a broad spectrum of topics including quantum computing, information processing, quantum effects in electron-nuclear coupled molecular spin systems, adiabatic quantum computing, heat bath algorithmic cooling with spins, and gateway schemes of quantum control for spin networks to NMR quantum information. The organization of the book places emphasis on relevant molecular qubit spectroscopy. These revolutionary concepts have never before been included in a comprehensive volume that covers theory, physical basis, technological basis, applications, and new advances in this emerging field. Electron Spin Resonance (ESR) Based Quantum Computing, co-edited by leading and renowned researchers Takeji Takui, Graeme Hanson and Lawrence J Berliner, is an ideal resource for students and researchers in the fields of EPR/ESR, NMR and quantum computing. This book also • Explores methods of harnessing quantum effects in electron-nuclear coupled molecular spin systems • Expertly discusses applications of optimal control theory in quantum computing • Broadens the readers' understanding of NMR quantum information processing

This concise, accessible text provides a thorough introduction to quantum computing - an exciting emergent field at the interface of the computer, engineering, mathematical and physical sciences. Aimed at advanced undergraduate and beginning graduate students in these disciplines, the text is technically detailed and is clearly illustrated throughout with diagrams and exercises. Some prior knowledge of linear algebra is assumed, including vector spaces and inner products. However, prior familiarity with topics such as quantum mechanics and computational complexity is not required.

In addition to treating quantum communication, entanglement and algorithms, this book also addresses a number of miscellaneous topics, such as Maxwell's demon, Landauer's erasure, the Bekenstein bound and Caratheodory's treatment of the Second law of thermodyanmics.

Theory of Quantum Computation, Communication, and Cryptography
New Frontiers in Fields and Strings
Philosophy of Quantum Information and Entanglement
An Overview
Proceedings of the 7th International Symposium on Foundations of

Quantum Mechanics in the Light of New Technology
Quantum Computation and Quantum Information

This book discusses fundamental problems in quantum physics, with emphasis on quantum coherence and decoherence. Papers coveting the wide range of quantum physics are included: atom optics, quantum optics, quantum computing, quantum information, cryptography, macroscopic quantum phenomena, mesoscopic physics, physics of precise measurements, and fundamental problems in quantum physics. The book will serve not only as a good introduction to quantum coherence and decoherence for newcomers in this field, but also as a reference for experts.

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

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.

This book discusses fundamental problems in quantum physics, with emphasis on quantum coherence and decoherence. Papers covering the wide range of quantum physics are included: atom optics, quantum optics, quantum computing, quantum information, cryptography, macroscopic quantum phenomena, mesoscopic physics, physics of precise measurements, and fundamental problems in quantum physics. The book will serve not only as a good introduction to quantum coherence and decoherence for newcomers in this field, but also as a reference for experts. Contents:Quantum Computing:Decoherence and Dephasing in Spin-Based Solid State Quantum Computers (S Das Sarma et al.)Quantum-State Manipulations in a Cooper-Pair Box (Y Nakamura et al.)Quantum State Engineering and Josephson Junctions: Charge and Flux Detectors (Yu Makhlin et al.)Quantum Information, Quantum Teleportation, and Entanglement:High-Fidelity Experimental Quantum Teleportation and Entanglement Swapping (A Zeilinger et al.)Experimental Realization of Continuous-Variable Teleportation (A Furusawa)Quantum Optics:Entanglement Manipulation with Atoms and Photons in a Cavity (S Haroche)Generation of Single Photons and Entangled Photon Pairs from a Quantum Dot (Y Yamamoto et al.)Twin Photon Beams for Single Photon Generation (S Takeuchi)Bose-Einstein Condensation and Atom Interferometry:Quantized Vortices in a Bose-Einstein Condensate (J Dalibard et al.)Vortex Excitations in a Bose-Einstein Condensate (S Inouye et al.)Mesoscopic Magnets:Environmental Effects on Quantum Reversal of Mesoscopic Spins (B Barbara et al.)Resistance of Geometrically Confined Magnetic Domain Wall (T Ono et al.)Single Electronics and Superconductors:A Single-Photon Detector in the Far-Infrared Range (O Astafiev et al.)Nanoscale Physics and Atomics:Quantized Conductance of Gold Nanowire Studied by UHV-Electron Microscope with STM (K Takayanagi)Quantum Transport:Quantum Transport in Two-Dimensional Electron Gas in Ultra-Short Period Lateral Superlattices (Y Iye et al.)Enhanced Tunnel Magnetoresistance in Ferromagnetic Single Electron Transistor (R Matsuda et al.)Precise Measurements:Oscillation Phenomena in High Energy Physics: CP Violation in B-Meson Decays and Long Baseline Neutrino Oscillation (K Nakamura)Dynamic Observation of Vortices in High-Tc Superconductors (A Tonomura)Precision Optical Frequency Metrology Using Pulsed Lasers (Th Udem et al.)Interferometric Gravitational Wave Detector in Japan (N Mio)Fundamental Problems in Quantum Physics:Quantum Information Aspects of Black Hole (A Hosoya)and other papers Readership: Undergraduates, graduate students and researchers in quantum physics, atomic physics and optics. Keywords:

Are the DiVincenzo Criteria Fulfilled in 2004? : Osaka, Japan, 7-8 May 2004

Foundations of Quantum Mechanics in the Light of New Technology

Introduction to Isotopic Materials Science

Electron Spin Resonance (ESR) Based Quantum Computing

An Engineering Approach

Cryptographic Primitives in Blockchain Technology

The contributors of this volume are working at the forefront of various realizations of quantum computers. They survey the recent developments in

each realization, in the context of the DiVincenzo criteria, including nuclear magnetic resonance, Josephson junctions, quantum dots, and trapped ions. There are also some theoretical contributions which have relevance in the physical realizations of a quantum computer. This book fills the gap between elementary introductions to the subject and highly specialized research papers to allow beginning graduate students to understand the cutting-edge of research in the shortest possible time. Sample Chapter(s). Chapter 1: DiVincenzo Criteria and Beyond (537 KB). Contents: DiVincenzo Criteria and Beyond (M M Salomaa & M Nakahara); Single-Electron Charge and Spin Qubit in Semiconductor Quantum Dots (T Fujisawa); Superconducting Quantum Computing: Status and Prospects (F K Wilhelm & K Semba); Controlling Three Atomic Qubits (H Hnffer et al.); Liquid-State NMR Quantum Computer: Hamiltonian Formalism and Experiments (Y Kondo et al.); Optical Quantum Computation (K Nemoto & W J Munro). Readership: Graduates students and researchers in physics."

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

A self-contained introduction to the basic theoretical concepts, experimental techniques and recent advances in the fields of quantum communication, quantum information and quantum computation. The introductory and self-contained character of the contributions should make this book particularly attractive to students and active researchers in physics and computer science who want to become acquainted with the underlying basic ideas and recent advances in the rapidly evolving field of quantum information processing.

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.

A Short Introduction to Quantum Information and Quantum Computation

Introduction to Topological Quantum Matter & Quantum Computation
An Introduction
Introduction to Quantum Information Science

Quantum information and computation is a rapidly expanding and cross-disciplinary subject. This book, first published in 2006, gives a self-contained introduction to the field for physicists, mathematicians and computer scientists who want to know more about this exciting subject. After a step-by-step introduction to the quantum bit (qubit) and its main properties, the author presents the necessary background in quantum mechanics. The core of the subject, quantum computation, is illustrated by a detailed treatment of three quantum algorithms: Deutsch, Grover and Shor. The final chapters are devoted to the physical implementation of quantum computers, including the most recent aspects, such as superconducting qubits and quantum dots, and to a short account of quantum information. Written at a level suitable for undergraduates in physical sciences, no previous knowledge of quantum mechanics is assumed, and only elementary notions of physics are required. The book includes many short exercises, with solutions available to instructors through solutions@cambridge.org.