# Lectures On Quantum Information By Dagmar Bruss

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## Quantum Information

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

## Lecture Notes for Physics 229:Quantum Information and Computation

Beautifully illustrated and engagingly written, Twelve Lectures in Quantum Mechanics presents theoretical physics with a breathtaking array of examples and anecdotes. Basdevant’s style is clear and stimulating, in the manner of a brisk lecture that can be followed with ease and enjoyment. Here is a sample of the book’s style, from the opening of Chapter 1: "If one were to ask a passer-by to quote a great formula of physics, chances are that the answer would be 'E = mc2'. There is no way around it: all physics is quantum, from elementary particles, to stellar physics and the Big Bang, not to mention semiconductors and solar cells."

## The Theory of Quantum Information

Quantum information science is a rapidly developing field that not only promises a revolution in computer sciences but also touches deeply the very foundations of quantum physics. This book consists of a set of lectures by leading experts in the field that bridges the gap between standard textbook material and the research literature, thus providing the ne- cessary background for postgraduate students and non-specialist researchers wishing to familiarize themselves with the subject thoroughly and at a high level. This volume is ideally suited as a course book for postgraduate students, and lecturers will find in it a large choice of material for bringing their courses up to date.

## Lectures on Quantum Computation, Quantum Error Correcting Codes and Information Theory

Takes students and researchers on a tour through some of the deepest ideas of maths, computer science and physics.

## Lectures on Quantum Mechanics

Quantum Information Processing is a young and rapidly growing field of research at the intersection of physics, mathematics, and computer science. Its ultimate goal is to harness quantum physics to conceive -- and ultimately build -- "quantum" computers that would dramatically overtake the capabilities of today's "classical" computers. One example of the power of a quantum computer is its ability to efficiently find the prime factors of a larger integer, thus shaking the supposedly secure foundations of standard encryption schemes. This comprehensive textbook on the rapidly advancing field introduces readers to the fundamental concepts of information theory and quantum entanglement, taking into account the current state of research and development. It thus covers all current concepts in quantum computing, both theoretical and experimental, before moving on to the latest implementations of quantum computing and communication protocols. With its series of exercises, this is ideal reading for students and lecturers in physics and informatics, as well as experimental and theoretical physicists, and physicists in industry. Dagmar Bruß graduated at RWTH University Aachen, Germany, and received her PhD in theoretical particle physics from the University of Heidelberg in 1994. As a research fellow at the University of Oxford she started to work in quantum information theory. Another fellowship at ISI Torino, Italy, followed. While being a research assistant at the University of Hannover she completed her habilitation. Since 2004 Professor Bruß has been holding a chair at the Institute of Theoretical Physics at the Heinrich-Heine-University Düsseldorf, Germany. Gerd Leuchs studied physics and mathematics at the University of Cologne, Germany, and received his Ph.D. in 1978. After two research visits at the University of Colorado in Boulder, USA, he headed the German gravitational wave detection group from 1985 to 1989. He became technical director at Nanomach AG in

Switzerland. Since 1994 Professor Leuchs has been holding the chair for optics at the Friedrich-Alexander-University of Erlangen-Nuremberg, Germany. His fields of research span the range from modern aspects of classical optics to quantum optics and quantum information. Since 2003 he has been Director of the Max Planck Research Group for Optics, Information and Photonics at Erlangen.

## Quantum Information

In recent years, there has been much synergy between the exciting areas of quantum information science and ultracold atoms. This volume, as part of the proceedings for the XCI session of Les Houches School of Physics (held for the first time outside Europe in Singapore) brings together experts in both fields. The theme of the school focused on two principal topics: quantum information science and ultracold atomic physics. The topics range from Bose Einstein Condensates to Degenerate Fermi Gases to fundamental concepts in Quantum Information Sciences, including some special topics on Quantum Hall Effects, Quantum Phase Transition, Interactions in Quantum Fluids, Disorder and Interference Phenomenoma, Trapped Ions and Atoms, and Quantum Optical Devices.

## Theory of Quantum Computation, Communication, and Cryptography

"Nobel Laureate Steven Weinberg combines his exceptional physical insight with his gift for clear exposition to provide a concise introduction to modern quantum mechanics. Ideally suited to a one-year graduate course, this textbook is also a useful reference for researchers. Readers are introduced to the subject through a review of the history of quantum mechanics and an account of classic solutions of the Schrèodinger equation, before quantum mechanics is developed in a modern Hilbert space approach. The textbook covers many topics not often found in other books on the subject, including alternatives to the Copenhagen interpretation, Bloch waves and band structure, the Wigner-Eckart theorem, magic numbers, isospin symmetry, the Dirac theory of constrained canonical systems, general scattering theory, the optical theorem, the 'in-in' formalism, the Berry phase, Landau levels, entanglement and quantum computing. Problems are included at the ends of chapters, with solutions available for instructors at www.cambridge.org/9781107028722"--

## Quantum Robotics

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.

## Introduction to the Theory of Quantum Information Processing

This book constitutes the thoroughly refereed post-conference proceedings of the 6th Conference on Theory of Quantum Computation, Communication, and

Cryptography, TQC 2011, held in Madrid, Spain, in May 2011. The 14 revised papers presented were carefully selected from numerous submissions. The papers present new and original research and cover a large range of topics in quantum computation, communication and cryptography, a new and interdisciplinary field at the intersection of computer science, information theory and quantum mechanics.

## Ultracold Gases and Quantum Information

Based on eight extensive lectures selected from those given at the renowned Chris Engelbrecht Summer School in Theoretical Physics in South Africa, this text on the theoretical foundations of quantum information processing and communication covers an array of topics, including quantum probabilities, open systems, and non-Markovian dynamics and decoherence. It also addresses quantum information and relativity as well as testing quantum mechanics in high energy physics. Because these self-contained lectures discuss topics not typically covered in advanced undergraduate courses, they are ideal for post-graduate students entering this field of research. Some of the lectures are written at a more introductory level while others are presented as tutorials that survey recent developments and results in various subfields.

## Lectures on Quantum Computing, Thermodynamics and Statistical Physics

In the 1990's it was realized that quantum physics has some spectacular applications in computer science. This book is a concise introduction to quantum computation, developing the basic elements of this new branch of computational theory without assuming any background in physics. It begins with an introduction to the quantum theory from a computer-science perspective. It illustrates the quantum-computational approach with several elementary examples of quantum speed-up, before moving to the major applications: Shor's factoring algorithm, Grover's search algorithm, and quantum error correction. The book is intended primarily for computer scientists who know nothing about quantum theory, but will also be of interest to physicists who want to learn the theory of quantum computation, and philosophers of science interested in quantum foundational issues. It evolved during six years of teaching the subject to undergraduates and graduate students in computer science, mathematics, engineering, and physics, at Cornell University.

## Adiabatic Quantum Computation and Quantum Annealing

When, in 1984?86, Richard P. Feynman gave his famous course on computation at the California Institute of Technology, he asked Tony Hey to adapt his lecture notes into a book. Although led by Feynman, the course also featured, as occasional guest speakers, some of the most brilliant men in science at that time, including Marvin Minsky, Charles Bennett, and John Hopfield. Although the lectures are now thirteen years old, most of the material is timeless and presents a ?Feynmanesque? overview of many standard and some not-so-standard topics in computer science such as reversible logic gates and quantum computers.

## Quantum Entanglement and Information Processing

Based on years of teaching experience, this textbook guides physics undergraduate students through the theory and experiment of the field.

## Quantum State Estimation

Quantum computers can (in theory) solve certain problems far faster than a classical computer running any known classical algorithm. While existing technologies for building quantum computers are in their infancy, it is not too early to consider their scalability and reliability in the context of the design of large-scale quantum computers. To architect such systems, one must understand what it takes to design and model a balanced, fault-tolerant quantum computer architecture. The goal of this lecture is to provide architectural abstractions for the design of a quantum computer and to explore the systems-level challenges in achieving scalable, fault-tolerant quantum computation. In this lecture, we provide an engineering-oriented introduction to quantum computation with an overview of the theory behind key quantum algorithms. Next, we look at architectural case studies based upon experimental data and future projections for quantum computation implemented using trapped ions. While we focus here on architectures targeted for realization using trapped ions, the techniques for quantum computer architecture design, quantum fault-tolerance, and compilation described in this lecture are applicable to many other physical technologies that may be viable candidates for building a large-scale quantum computing system. We also discuss general issues involved with programming a quantum computer as well as a discussion of work on quantum architectures based on quantum teleportation. Finally, we consider some of the open issues remaining in the design of quantum computers. Table of Contents: Introduction / Basic Elements for Quantum Computation / Key Quantum Algorithms / Building Reliable and Scalable Quantum Architectures / Simulation of Quantum Computation / Architectural Elements / Case Study: The Quantum Logic Array Architecture / Programming the Quantum Architecture / Using the QLA for Quantum Simulation: The Transverse Ising Model / Teleportation-Based Quantum Architectures / Concluding Remarks

## Lectures on Quantum Information

This book offers a concise review of quantum radar theory. Our approach is pedagogical, making emphasis on the physics behind the operation of a hypothetical quantum radar. We concentrate our discussion on the two major models proposed to date: interferometric quantum radar and quantum illumination. In addition, this book offers some new results, including an analytical study of quantum interferometry in the X-band radar region with a variety of atmospheric conditions, a derivation of a quantum radar equation, and a discussion of quantum radar jamming. This book assumes the reader is familiar with the basic principles of non-relativistic quantum mechanics, special relativity, and classical electrodynamics. Our discussion of quantum electrodynamics and its application to quantum radar is brief, but all the relevant equations are presented in the text. In addition, the reader is not required to have any specialized knowledge on classical radar theory. Table of Contents: Introduction / The Photon /

Photon Scattering / Classical Radar Theory / Quantum Radar Theory / Quantum Radar Cross Section / Conclusions

## Quantum Radar

Formal development of the mathematical theory of quantum information with clear proofs and exercises. For graduate students and researchers.

## Representation Theory and Complex Analysis

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.

## Classical and Quantum Computation

A self-contained, graduate-level textbook that develops from scratch classical results as well as advances of the past decade.

## Relativistic Quantum Information

Adiabatic quantum computation (AQC) is an alternative to the better-known gate model of quantum computation. The two models are polynomially equivalent, but otherwise quite dissimilar: one property that distinguishes AQC from the gate model is its analog nature. Quantum annealing (QA) describes a type of heuristic search algorithm that can be implemented to run in the ``native instruction set'' of an AQC platform. D-Wave Systems Inc. manufactures {quantum annealing processor chips} that exploit quantum properties to realize QA computations in hardware. The chips form the centerpiece of a novel computing platform designed to solve NP-hard optimization problems. Starting with a 16-qubit prototype announced in 2007, the company has launched and sold increasingly larger models: the 128-qubit D-Wave One system was announced in 2010 and the 512-qubit D-Wave Two system arrived on the scene in 2013. A 1,000-qubit model is expected to be available in 2014. This monograph presents an introductory overview of this unusual and rapidly developing approach to computation. We start with a survey of basic principles of quantum computation and what is known about the AQC model and the QA algorithm paradigm. Next we review the D-Wave technology stack and discuss some challenges to building and using quantum computing systems at a commercial scale. The last chapter reviews some experimental efforts to understand the properties and capabilities of these unusual platforms. The discussion throughout is aimed at an audience of computer scientists with little background in quantum computation or in physics.

## Quantum Information Theory

Quantum robotics is an emerging engineering and scientific research discipline that explores the application of quantum mechanics, quantum computing, quantum algorithms, and related fields to robotics. This work broadly surveys advances in our scientific understanding and engineering of quantum mechanisms and how these developments are expected to impact the technical capability for robots to sense, plan, learn, and act in a dynamic environment. It also discusses the new technological potential that quantum approaches may unlock for sensing and control, especially for exploring and manipulating quantum-scale environments. Finally, the work surveys the state of the art in current implementations, along with their benefits and limitations, and provides a roadmap for the future.

## Quantum Computer Science

## Quantum Computing for Computer Architects

In this text we present a technical overview of the emerging field of quantum computation along with new research results by the authors. What distinguishes our presentation from that of others is our focus on the relationship between quantum computation and computer science. Specifically, our emphasis is on the computational model of quantum computingrather than on the engineering issues associated with its physical implementation. We adopt this approach for the same reason that a book on computer programming doesn't cover the theory and physical realization of semiconductors. Another distinguishing feature of this text is our detailed discussion of the circuit complexity of quantum algorithms. To the extent possible we have presented the material in a form that is accessible to the computer scientist, but in many cases we retain the conventional physics notation so that the reader will also be able to consult the relevant quantum computing literature. Although we expect the reader to have a solid understanding of linear algebra, we do not assume a background in physics. This text is based on lectures given as short courses and invited presentations around the world, and it has been used as the primary text for a graduatecourse at George Mason University. In all these cases our challenge has been the same: how to present to a generalaudience a concise introduction to the algorithmic structure and applications of quantum computing on an extremely short period of time. The feedback from these courses and presentations has greatly aided in making our exposition of challenging concepts more accessible to a general audience. Table of Contents: Introduction / The Algorithmic Structure of Quantum Computing / Advantages and Limitations of Quantum Computing / Amplitude Amplification / Case Study: Computational Geometry / The Quantum Fourier Transform / Case Study: The Hidden Subgroup / Circuit Complexity Analysis of Quantum Algorithms /

Conclusions / Bibliography

## The Functional Analysis of Quantum Information Theory

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.

## Lectures on Quantum Mechanics

"Quantum computation, one of the latest joint ventures between physics and the theory of computation, is a scientific field whose main goals include the development of hardware and algorithms based on the quantum mechanical properties of those physical systems used to implement such algorithms." "Solving difficult tasks (for example, the Satisfiability Problem and other NP-complete problems) requires the development of sophisticated algorithms, many of which employ stochastic processes as their mathematical basis. Discrete random walks are a popular choice among those stochastic processes." "Inspired on the success of discrete random walks in algorithm development, quantum walks, an emerging field of quantum computation, is a generalization of random walks into the quantum mechanical world." "The purpose of this lecture is to provide a concise yet comprehensive introduction to quantum walks."--BOOK JACKET.

## Quantum Computing for Computer Architects

Quantum computationmay seem to be a topic for science fiction, but small quantum computers have existed for several years and larger machines are on the drawing table. These efforts have been fueled by a tantalizing property: while conventional computers employ a binary representation that allows computational power to scale linearly with resources at best, quantum computations employ quantum phenomena that can interact to allow computational power that is exponential in the number of â€œquantum bitsâ€ in the system. Quantum devices rely on the ability to control and manipulate binary data stored in the phase information of quantum wave functions that describe the electronic states of individual atoms or the polarization states of photons. While existing quantum technologies are in their infancy, we shall see that it is not too early to consider scalability and reliability. In fact, such considerations are a critical link in the development chain of viable device technologies capable of orchestrating reliable control of tens of millions quantum bits in a large-scale system. The goal of this lecture is to provide architectural abstractions common to potential technologies and explore the systemslevel challenges in achieving scalable, fault-tolerant quantum computation.The central premise of the lecture is directed at quantum computation (QC) architectural issues. We stress the fact that the basic tenet of large-scale quantum computing is reliability through system balance: the need to protect and control the quantum information just long enough for the algorithm to complete execution. To architectQCsystems, onemust understand what it takes to design and model a balanced, fault-tolerant quantum architecture just as the concept of balance drives conventional architectural design. For example, the register file depth in classical computers is matched to the number of functional units, the memory bandwidth to the cache miss rate, or the interconnect bandwidth matched to the compute power of each element of a multiprocessor. We provide an engineering-oriented introduction to quantum computation and provide an architectural case study based upon experimental data and future projection for ion-trap technology.We apply the concept of balance to the design of a quantum computer, creating an architecture model that balances both quantum and classical resources in terms of exploitable parallelism in quantum applications. From this framework, we also discuss the many open issues remaining in designing systems to perform quantum computation.

## A Short Course in Quantum Information Theory

This book is a comprehensive survey of most of the theoretical and experimental achievements in the field of quantum estimation of states and operations. Albeit still quite young, this field has already been recognized as a necessary tool for research in quantum optics and quantum information, beyond being a fascinating subject in its own right since it touches upon the conceptual foundations of quantum mechanics. The book consists of twelve extensive lectures that are essentially self-contained and modular, allowing combination of various chapters as a basis for advanced courses and seminars on theoretical or experimental aspects. The last two chapters, for instance, form a self-contained exposition on quantum discrimination problems. The book will benefit graduate students and newcomers to the field as a high-level but accessible textbook, lecturers in search for advanced course material and researchers wishing to consult a modern and authoritative source of reference.

## Lectures on Quantum Mechanics

## Feynman Lectures On Computation

Describes the relation between classical and quantum mechanics. This book contains a discussion of problems related to group representation theory and to scattering theory. It intends to give a mathematically oriented student the opportunity to grasp the main points of quantum theory in a mathematical framework.

## Perspectives in Computation

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.

## Quantum Information, Computation and Communication

Lecture Notes for Physics 229:Quantum Information and ComputationBy John Preskill

## Fundamentals of Quantum Information

A leisurely but mathematically honest presentation of quantum mechanics for graduate students in mathematics with an interest in physics.

## Quantum Walks for Computer Scientists

This book provides readers with a concise introduction to current studies on operator-algebras and their generalizations, operator spaces and operator systems, with a special focus on their application in quantum information science. This basic framework for the mathematical formulation of quantum information can be traced back to the mathematical work of John von Neumann, one of the pioneers of operator algebras, which forms the underpinning of most current mathematical treatments of the quantum theory, besides being one of the most dynamic areas of twentieth century functional analysis. Today, von Neumann’s foresight finds expression in the rapidly growing field of quantum information theory. These notes gather the content of lectures given by a very distinguished group of mathematicians and quantum information theorists, held at the IMSc in Chennai some years ago, and great care has been taken to present the material as a primer on the subject matter. Starting from the basic definitions of operator spaces and operator systems, this text proceeds to discuss several important theorems including Stinespring’s dilation theorem for completely positive maps and Kirchberg’s theorem on tensor products of C*-algebras. It also takes a closer look at the abstract characterization of operator systems and, motivated by the requirements of different tensor products in quantum information theory, the theory of tensor products in operator systems is discussed in detail. On the quantum information side, the book offers a rigorous treatment of quantifying entanglement in bipartite quantum systems, and moves on to review four different areas in which ideas from the theory of operator systems and operator algebras play a natural role: the issue of zero-error communication over quantum channels, the strong subadditivity property of quantum entropy, the different norms on quantum states and the corresponding induced norms on quantum channels, and, lastly, the applications of matrix-valued random variables in the quantum information setting.

## Quantum Computation and Quantum Information

One of the most cited books in physics of all time, Quantum Computation and Quantum Information remains the best textbook in this exciting field of science. This 10th anniversary edition includes an introduction from the authors setting the work in context. This comprehensive textbook describes such remarkable effects as fast quantum algorithms, quantum teleportation, quantum cryptography and quantum error-correction. Quantum mechanics and computer science are introduced before moving on to describe what a quantum computer is, how it can be used to solve problems faster than 'classical' computers and its real-world implementation. It concludes with an in-depth treatment of quantum information. Containing a wealth of figures and exercises, this well-known textbook is ideal for courses on the subject, and will interest beginning graduate students and researchers in physics, computer science, mathematics, and electrical engineering.

## Quantum Computer Science

Presents the lecture notes of the Les Houches Summer School on Quantum entanglement and information processing. This book aims to establish connections between the communities of quantum optics and of quantum electronic devices working in the area of quantum computing. It is useful for graduate students with a basic knowledge of quantum mechanics.

## Lectures on Quantum Computing, Thermodynamics and Statistical Physics

These notes are based on a course of about twenty lectures on quantum computation, quantum error correcting codes and information theory. Shor's Factorization algorithm, Knill-Laflamme theory of error correcting quantum codes and the basic ideas of classical and quantum information theory are discussed. The only background expected of the reader is familiarity with linear algebra in finite dimensional complex vector space and elementary probability theory.

## Lectures on Quantum Mechanics for Mathematics Students

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

## Quantum Entanglement and Information Processing

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

## Theoretical Foundations of Quantum Information Processing and Communication

It has been recognised recently that the strange features of the quantum world could be used for new information transmission or processing functions such as quantum cryptography or, more ambitiously, quantum computing. These fascinating perspectives renewed the interest in fundamental quantum properties and lead to important theoretical advances, such as quantum algorithms and quantum error correction codes. On the experimental side, remarkable advances have been achieved in quantum optics, solid state physics or nuclear magnetic resonance. This book presents the lecture notes of the Les Houches Summer School on ‘Quantum entanglement and information processing’. Following the long tradition of the les Houches schools, it provides a comprehensive and pedagogical approach of the whole field, written by renowned specialists. One major goal of this book is to establish connections between the communities of quantum optics and of quantum electronic devices working in the area of quantum computing. When two communities share the same goals, the universality of physics unavoidably leads to similar developments. However, the communication barrier is often high, and few physicists are able to overcome it. This school has contributed to bridge the existing gap between communities, for the benefit of the future actors in the field of quantum computing. The book thus combines introductory chapters, providing the reader with a sufficiently wide theoretical framework in quantum information, quantum optics and quantum circuits physics, with more specialized presentations of recent theoretical and experimental advances in the field. This structure makes the book accessible to any graduate student having a good knowledge of basic quantum mechanics, and extremely useful to researchers. · Covers quantum optics, solid state physics and NMR implementations · Pedagogical approach combining introductory lectures and advanced chapters · Written by leading experts in the field · Accessible to all graduate students with a basic knowledge of quantum mechanics

## An Introduction to Quantum Computing

Perspectives in Computation covers three broad topics: the computation process & its limitations; the search for computational efficiency; & the role of quantum mechanics in computation.

## Quantum Computing Since Democritus

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)