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## Lectures on Quantum Information | Dagmar Bruß, Gerd Leuchs ...

Course description: This two-term course covers quantum information theory, quantum algorithms, quantum error correction, quantum Shannon theory, and some special topics. Class meetings : Monday and Wednesday 2:30-3:55 in 107 Downs, beginning 2 October 2019. Instructor: John Preskill , 206 Annenberg, X-6691, email: preskill (at) caltech (dot) edu.

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Lectures on Quantum Information Editors: D. Bruss, G. Leuchs WILEY-VCH Verlag Berlin GmbH July 13, 2005

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principle bundles, distribution theory, and much more.

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### Lectures on Quantum Information by Dagmar Bruss: New PAP ...

Qubits and quantum information. Quantum information differs strongly from classical information, epitomized by the bit, in many striking and unfamiliar ways. While the fundamental unit of classical information is the bit, the most basic unit of quantum information is the qubit. Classical information is measured using Shannon entropy, while the quantum mechanical analogue is Von Neumann entropy.

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,

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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

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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 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 necessary 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.

First-ever comprehensive introduction to the major new subject of

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quantum computing and quantum information.

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

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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.

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

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

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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

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

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

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

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quantum cryptography, teleportation & quantum computing.

"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 Schrödinger 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](http://www.cambridge.org/9781107028722)"--

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