

Ángel Rivas · Susana F. Huelga

Open Quantum Systems

An Introduction



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Open Quantum Systems An Introduction Springerbriefs In Physics

**Roberta Croce, Rienk van
Grondelle, Herbert van Amerongen, Ivo
van Stokkum**

Open Quantum Systems An Introduction Springerbriefs In Physics:

Open Quantum Systems Ángel Rivas, Susana F. Huelga, 2011-10-01 In this volume the fundamental theory of open quantum systems is revised in the light of modern developments in the field. A unified approach to the quantum evolution of open systems is presented by merging concepts and methods traditionally employed by different communities such as quantum optics, condensed matter, chemical physics and mathematical physics. The mathematical structure and the general properties of the dynamical maps underlying open system dynamics are explained in detail. The microscopic derivation of dynamical equations including both Markovian and non-Markovian evolutions is also discussed. Because of the step by step explanations this work is a useful reference to novices in this field. However experienced researchers can also benefit from the presentation of recent results.

Open Quantum Systems Dorothea Bahns, Anke Pohl, Ingo Witt, 2019-06-28 This book presents four survey articles on various aspects of open quantum systems specifically addressing quantum Markovian processes, Feller semigroups and nonequilibrium dynamics. The contributions are based on lectures given by distinguished experts at a summer school in Göttingen, Germany. Starting from basic notions the authors of these lecture notes accompany the reader on a journey up to the latest research highlighting new challenges and addressing unsolved problems at the interface between mathematics and physics. Though the book is primarily addressed to graduate students it will also be of interest to researchers.

Dynamics, Information and Complexity in Quantum Systems Fabio Benatti, 2023-08-22 This second edition of *Dynamics, Information and Complexity in Quantum Systems* widens its scope by focussing more on the dynamics of quantum correlations and information in microscopic and mesoscopic systems and their use for metrological and machine learning purposes. The book is divided into three parts: Part One, Classical Dynamical Systems, Addresses classical dynamical systems, classical dynamical entropy and classical algorithmic complexity. Includes a survey of the theory of simple perceptrons and their storage capacity. Part Two, Quantum Dynamical Systems, Focuses on the dynamics of entanglement under dissipative dynamics and its metrological use in finite level quantum systems. Discusses the quantum fluctuation approach to large scale mesoscopic systems and their emergent dynamics in quantum systems with infinitely many degrees of freedom. Introduces a model of quantum perceptron whose storage capacity is computed and compared with the classical one. Part Three, Quantum Dynamical Entropies and Complexities, Devoted to quantum dynamical entropies and algorithmic complexities. This book is meant for advanced students, young and senior researchers working in the fields of quantum statistical mechanics, quantum information and quantum dynamical systems. It is self-contained and the only prerequisites needed are a standard knowledge of statistical mechanics, quantum mechanics and linear operators on Hilbert spaces.

Quantum [Un]Speakables II Reinhold Bertlmann, Anton Zeilinger, 2016-11-15 This self-contained essay collection is published to commemorate half a century of Bell's theorem. Like its much acclaimed predecessor *Quantum Un-Speakables: From Bell to Quantum Information* published 2002 it comprises essays by many of the world's leading quantum physicists and

philosophers These revisit the foundations of quantum theory as well as elucidating the remarkable progress in quantum technologies achieved in the last couple of decades Fundamental concepts such as entanglement nonlocality and contextuality are described in an accessible manner and alongside lively descriptions of the various theoretical and experimental approaches the book also delivers interesting philosophical insights The collection as a whole will serve as a broad introduction for students and newcomers as well as delighting the scientifically literate general reader

Analytical and Approximate Methods for Complex Dynamical Systems Alexander Timokha,2025-03-16 This book presents

Analytical and Approximate Methods for Complex Dynamical Systems and introduces ideas of discontinuous mapping treated as complex dynamical systems Mathematicians of world recognized Ukrainian scientific schools established by M Krylov M Bogolyubov Yu Mitropolskiy and A Sharkovsky used to cooperate for writing the collective book whose purpose consists of illustrating a synergy of combining diverse by idea and technique constructive analytical and approximate approaches and methods in complex dynamical systems which are herein associated with mathematical models of networks conflict economic theories sloshing soft matter and even levitating drops Readers are facilitated to learn contemporary insights fundamentals Parts I and III applications Part II and components of theories of bifurcation synchronization self organization collective dynamics chaos solitons fractional differential equations symmetry reduced order modelling and many others that makes the book useful for both graduate and postgraduate students lecturers researchers and even engineers dealing with multidimensional dynamic systems

Quantum Computing: An Applied Approach Jack D. Hidary,2021-09-29 This book integrates the foundations of quantum computing with a hands on coding approach to this emerging field it is the first to bring these elements together in an updated manner This work is suitable for both academic coursework and corporate technical training The second edition includes extensive updates and revisions both to textual content and to the code Sections have been added on quantum machine learning quantum error correction Dirac notation and more This new edition benefits from the input of the many faculty students corporate engineering teams and independent readers who have used the first edition This volume comprises three books under one cover Part I outlines the necessary foundations of quantum computing and quantum circuits Part II walks through the canon of quantum computing algorithms and provides code on a range of quantum computing methods in current use Part III covers the mathematical toolkit required to master quantum computing Additional resources include a table of operators and circuit elements and a companion GitHub site providing code and updates Jack D Hidary is a research scientist in quantum computing and in AI at Alphabet X formerly Google X

Electrically Driven Quantum Dot Based Single-Photon Sources Markus Kantner,2020-01-25 Semiconductor quantum optics is on the verge of moving from the lab to real world applications When stepping from basic research to new technologies device engineers will need new simulation tools for the design and optimization of quantum light sources which combine classical device physics with cavity quantum electrodynamics This thesis aims to provide a holistic description of

single photon emitting diodes by bridging the gap between microscopic and macroscopic modeling approaches The central result is a novel hybrid quantum classical model system that self consistently couples semi classical carrier transport theory with open quantum many body systems This allows for a comprehensive description of quantum light emitting diodes on multiple scales It enables the calculation of the quantum optical figures of merit together with the simulation of the spatially resolved current flow in complex multi dimensional semiconductor device geometries out of one box The hybrid system is shown to be consistent with fundamental laws of non equilibrium thermodynamics and is demonstrated by numerical simulations of realistic devices

Quantum Dots for Quantum Information Processing: Controlling and Exploiting the Quantum Dot Environment Martin J. A. Schütz,2016-11-15 This thesis offers a comprehensive introduction to surface acoustic waves in the quantum regime It addresses two of the most significant technological challenges in developing a scalable quantum information processor based on spins in quantum dots i decoherence of the electronic spin qubit due to the surrounding nuclear spin bath and ii long range spin spin coupling between remote qubits Electron spins confined in quantum dots QDs are among the leading contenders for implementing quantum information processing To this end the author pursues novel strategies that turn the unavoidable coupling to the solid state environment in particular nuclear spins and phonons into a valuable asset rather than a liability

Ion Traps for Tomorrow's Applications M. Knoop,I.

Marzoli,G. Morigi,2015-07-21 Ion trapping was first accomplished in Europe more than 50 years ago Since then research and development have increased steadily and the last decades have seen a remarkable growth in applications mainly due to the improvement of laser based techniques for spectroscopy cooling and the manipulation of ions Nowadays ion trapping plays a crucial role in a wide range of disciplines including atomic and plasma physics chemistry high precision measurement high energy physics and the emerging field of quantum technologies This book presents lectures and reports from the Enrico Fermi School Ion Traps for Tomorrow's Applications held in Varenna Italy in July 2013 Reflecting the aim of the school to exploit diversity and stimulate cross fertilization the selected topics and highlights in this book partly review the wide range of subjects discussed during the course while providing an overview of this topical domain As well as providing a useful reference guide the book will be a source of inspiration for all those planning to work on ion trapping in the future

Open Quantum Systems II Stéphane Attal,2006-06-07 Understanding dissipative dynamics of open quantum systems remains a challenge in mathematical physics This problem is relevant in various areas of fundamental and applied physics Significant progress in the understanding of such systems has been made recently These books present the mathematical theories involved in the modeling of such phenomena They describe physically relevant models develop their mathematical analysis and derive their physical implications

Light Harvesting in Photosynthesis Roberta Croce,Rienk van Grondelle,Herbert van Amerongen,Ivo van Stokkum,2018-01-12 This landmark collective work introduces the physical chemical and biological principles underlying photosynthesis light absorption excitation energy transfer and charge separation It begins with an

introduction to properties of various pigments and the pigment proteins in plant algae and bacterial systems It addresses the underlying physics of light harvesting and key spectroscopic methods including data analysis It discusses assembly of the natural system its energy transfer properties and regulatory mechanisms It also addresses light harvesting in artificial systems and the impact of photosynthesis on our environment The chapter authors are amongst the field's world recognized experts Chapters are divided into five main parts the first focused on pigments their properties and biosynthesis and the second section looking at photosynthetic proteins including light harvesting in higher plants algae cyanobacteria and green bacteria The third part turns to energy transfer and electron transport discussing modeling approaches quantum aspects photoinduced electron transfer and redox potential modulation followed by a section on experimental spectroscopy in light harvesting research The concluding final section includes chapters on artificial photosynthesis with topics such as use of cyanobacteria and algae for sustainable energy production

Open Quantum Systems III Stéphane Attal, Alain Joye, Claude-Alain Pillet, 2006-08-18 This volume is the third and last of a series devoted to the lecture notes of the Grenoble Summer School on Open Quantum Systems which took place at the Institut Fourier from June 16 to July 4 2003 The contributions presented in this volume correspond to expanded versions of the lecture notes provided by the authors to the students of the Summer School The corresponding lectures were scheduled in the last part of the School devoted to recent developments in the study of Open Quantum Systems Whereas the first two volumes were dedicated to a detailed exposition of the mathematical techniques and physical concepts relevant in the study of Open Systems with no a priori prerequisites the contributions presented in this volume request from the reader some familiarity with these aspects Indeed the material presented here aims at leading the reader already acquainted with the basics in quantum statistical mechanics spectral theory of linear operators C dynamical systems and quantum stochastic differential equations to the front of the current research done on various aspects of Open Quantum Systems Nevertheless pedagogical efforts have been made by the various authors of these notes so that this volume should be essentially self contained for a reader with minimal previous exposure to the themes listed above In any case the reader in need of complements can always turn to these first two volumes The topics covered in these lectures notes start with an introduction to non equilibrium quantum statistical mechanics

The Theory of Open Quantum Systems Heinz-Peter Breuer, Francesco Petruccione, 2002 This book treats the central physical concepts and mathematical techniques used to investigate the dynamics of open quantum systems To provide a self contained presentation the text begins with a survey of classical probability theory and with an introduction into the foundations of quantum mechanics with particular emphasis on its statistical interpretation The fundamentals of density matrix theory quantum Markov processes and dynamical semigroups are developed The most important master equations used in quantum optics and in the theory of quantum Brownian motion are applied to the study of many examples Special attention is paid to the theory of environment induced decoherence its role in the dynamical description of the measurement process and to the

experimental observation of decohering Schrodinger cat states The book includes the modern formulation of open quantum systems in terms of stochastic processes in Hilbert space Stochastic wave function methods and Monte Carlo algorithms are designed and applied to important examples from quantum optics and atomic physics such as Levy statistics in the laser cooling of atoms and the damped Jaynes Cummings model The basic features of the non Markovian quantum behaviour of open systems are examined on the basis of projection operator techniques In addition the book expounds the relativistic theory of quantum measurements and discusses several examples from a unified perspective e g non local measurements and quantum teleportation Influence functional and super operator techniques are employed to study the density matrix theory in quantum electrodynamics and applications to the destruction of quantum coherence are presented The text addresses graduate students and lecturers in physics and applied mathematics as well as researchers with interests in fundamental questions in quantum mechanics and its applications Many analytical methods and computer simulation techniques are developed and illustrated with the help of numerous specific examples Only a basic understanding of quantum mechanics and of elementary concepts of probability theory is assumed

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Joye,claude-alain pillet,2006-06-07 Understanding dissipative dynamics of open quantum systems remains a challenge in mathematical physics This problem is relevant in various areas of fundamental and applied physics Significant progress in the understanding of such systems has been made recently These books present the mathematical theories involved in the modeling of such phenomena They describe physically relevant models develop their mathematical analysis and derive their physical implications

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dissipative dynamics of open quantum systems remains a challenge in mathematical physics This problem is relevant in various areas of fundamental and applied physics Significant progress in the understanding of such systems has been made recently These books present the mathematical theories involved in the modeling of such phenomena They describe physically relevant models develop their mathematical analysis and derive their physical implications

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Systems Far from Equilibrium Gernot Schaller,2014-01-07 This monograph provides graduate students and also professional researchers aiming to understand the dynamics of open quantum systems with a valuable and self contained toolbox Special focus is laid on the link between microscopic models and the resulting open system dynamics This includes how to derive the celebrated Lindblad master equation without applying the rotating wave approximation As typical representatives for non equilibrium configurations it treats systems coupled to multiple reservoirs including the description of quantum transport driven systems and feedback controlled quantum systems Each method is illustrated with easy to follow examples from recent research Exercises and short summaries at the end of every chapter enable the reader to approach the frontiers of current research quickly and make the book useful for quick reference

Open Quantum Systems I Stéphane

Attal,Alain Joye,claude-alain pillet,2006-06-07 Understanding dissipative dynamics of open quantum systems remains a

challenge in mathematical physics This problem is relevant in various areas of fundamental and applied physics Significant progress in the understanding of such systems has been made recently These books present the mathematical theories involved in the modeling of such phenomena They describe physically relevant models develop their mathematical analysis and derive their physical implications **Open Quantum Systems** Bassano Vacchini,2024-12-30 The proposed book is a bridge between the foundations of quantum mechanics and the theory of open quantum systems The treatment of open quantum systems is a rapidly growing subject of interest to an ever increasing number of scientists The main focus is on overcoming the idealization of perfect isolation of a quantum system so as to allow for a more realistic treatment and to provide the relevant background for the development of quantum technologies The book is addressed to students and researchers in the field of open quantum systems and more generally quantum mechanics a wide community of physicists mathematicians and chemists It is devised both to enter the field and to prepare a series of lectures or a one semester course on the topic *Quantum Theory of Open Systems* Edward Brian Davies,1976 *Open Quantum Systems I* Stéphane Attal,Alain Joye,claude-alain pillet,2006-06-07 Understanding dissipative dynamics of open quantum systems remains a challenge in mathematical physics This problem is relevant in various areas of fundamental and applied physics Significant progress in the understanding of such systems has been made recently These books present the mathematical theories involved in the modeling of such phenomena They describe physically relevant models develop their mathematical analysis and derive their physical implications

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