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Quantum Theory: Informational Foundations and Foils



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Quantum Theory Informational Foundations Fundamental

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Mielczarek, Daniele Oriti**



Quantum Theory Informational Foundations Fundamental:

Quantum Theory: Informational Foundations and Foils Giulio Chiribella, Robert W. Spekkens, 2015-12-08 This book provides the first unified overview of the burgeoning research area at the interface between Quantum Foundations and Quantum Information Topics include operational alternatives to quantum theory information theoretic reconstructions of the quantum formalism mathematical frameworks for operational theories and device independent features of the set of quantum correlations Powered by the injection of fresh ideas from the field of Quantum Information and Computation the foundations of Quantum Mechanics are in the midst of a renaissance The last two decades have seen an explosion of new results and research directions attracting broad interest in the scientific community The variety and number of different approaches however makes it challenging for a newcomer to obtain a big picture of the field and of its high level goals Here fourteen original contributions from leading experts in the field cover some of the most promising research directions that have emerged in the new wave of quantum foundations The book is directed at researchers in physics computer science and mathematics and would be appropriate as the basis of a graduate course in Quantum Foundations **Quantum**

Information and Foundations Giacomo Mauro D'Ariano, Paolo Perinotti, 2020-03-23 Quantum information has dramatically changed information science and technology looking at the quantum nature of the information carrier as a resource for building new information protocols designing radically new communication and computation algorithms and ultra sensitive measurements in metrology with a wealth of applications From a fundamental perspective this new discipline has led us to regard quantum theory itself as a special theory of information and has opened routes for exploring solutions to the tension with general relativity based for example on the holographic principle on non causal variations of the theory or else on the powerful algorithm of the quantum cellular automaton which has revealed new routes for exploring quantum fields theory both as a new microscopic mechanism on the fundamental side and as a tool for efficient physical quantum simulations for practical purposes In this golden age of foundations an astonishing number of new ideas frameworks and results spawned by the quantum information theory experience have revolutionized the way we think about the subject with a new research community emerging worldwide including scientists from computer science and mathematics Quantum Foundations, Probability and Information Andrei Khrennikov, Bourama Toni, 2018-06-13 Composed of contributions from leading experts in quantum foundations this volume presents viewpoints on a number of complex problems through informational probabilistic and mathematical perspectives and features novel mathematical models of quantum and subquantum phenomena Rich with multi disciplinary mathematical content this book includes applications of partial differential equations in quantum field theory differential geometry oscillatory processes and vibrations and Feynman integrals for quickly growing potential functions Due to rapid growth in the field in recent years this volume aims to promote interdisciplinary collaboration in the areas of quantum probability information communication and foundation and mathematical physics Many papers discuss

complex yet novel problems that depart from the mainstream of quantum physical studies Others devote explanation to fundamental problems of the conventional quantum theory including its mathematical formalism Overall authors cover a diverse set of topics including quantum and classical field theory and oscillatory processing quantum mechanics from a Darwinian evolutionary perspective and biological applications of quantum theory Together in one volume these essays will be useful to experts in the corresponding areas of quantum theory Theoreticians experimenters mathematicians and even philosophers in quantum physics and quantum probability and information theory can consider this book a valuable resource

Entropy in Foundations of Quantum Physics Marcin Pawłowski, 2020-12-15 This book is a collection of outstanding papers on various aspects of entropy at the foundation of quantum physics The covered topics range from purely foundational issues such as contextuality and Bell and Leggett Garg inequalities to applications such as quantum key distribution teleportation and image encoding The main ingredient binding them together in this book is that in all of the contained papers entropy plays a key role either as a mathematical tool or as a link which bridges the gap between different fields of science

Quantum Theory from First Principles Giacomo Mauro D'Ariano, Giulio Chiribella, Paolo Perinotti, 2017-01-28 Quantum theory is the soul of theoretical physics It is not just a theory of specific physical systems but rather a new framework with universal applicability This book shows how we can reconstruct the theory from six information theoretical principles by rebuilding the quantum rules from the bottom up Step by step the reader will learn how to master the counterintuitive aspects of the quantum world and how to efficiently reconstruct quantum information protocols from first principles Using intuitive graphical notation to represent equations and with shorter and more efficient derivations the theory can be understood and assimilated with exceptional ease Offering a radically new perspective on the field the book contains an efficient course of quantum theory and quantum information for undergraduates It is aimed at researchers professionals and students in physics computer science and philosophy as well as the curious outsider seeking a deeper understanding of the theory

Picturing Quantum Processes Bob Coecke, Aleks Kissinger, 2017-03-16 Quantum phenomena are explained through the language of diagrams setting out an innovative visual method of presenting complex scientific theories Focusing on physical intuition over mathematical formalism and packed with exercises this unique book is accessible to students and researchers across scientific disciplines from undergraduate to Ph D level

The Principles of Quantum Theory, From Planck's Quanta to the Higgs Boson Arkady Plotnitsky, 2016-09-26 The book considers foundational thinking in quantum theory focusing on the role the fundamental principles and principle thinking there including thinking that leads to the invention of new principles which is the book contends one of the ultimate achievements of theoretical thinking in physics and beyond The focus on principles prominent during the rise and in the immediate aftermath of quantum theory has been uncommon in more recent discussions and debates concerning it The book argues however that exploring the fundamental principles and principle thinking is exceptionally helpful in addressing the key issues at stake in quantum

foundations and the seemingly interminable debates concerning them Principle thinking led to major breakthroughs throughout the history of quantum theory beginning with the old quantum theory and quantum mechanics the first definitive quantum theory which it remains within its proper nonrelativistic scope It has the book also argues been equally important in quantum field theory which has been the frontier of quantum theory for quite a while now and more recently in quantum information theory where principle thinking was given new prominence The approach allows the book to develop a new understanding of both the history and philosophy of quantum theory from Planck s quantum to the Higgs boson and beyond and of the thinking the key founding figures such as Einstein Bohr Heisenberg Schr dinger and Dirac as well as some among more recent theorists The book also extensively considers the nature of quantum probability and contains a new interpretation of quantum mechanics the statistical Copenhagen interpretation Overall the book s argument is guided by what Heisenberg called the spirit of Copenhagen which is defined by three great divorces from the preceding foundational thinking in physics reality from realism probability from causality and locality from relativity and defined the fundamental principles of quantum theory accordingly

Qubits and Spacetime Caslav Brukner, Jakub Mielczarek, Daniele Oriti, 2022-08-30 *Quantum Adaptivity in Biology: From Genetics to Cognition* Masanori Asano, Andrei Khrennikov, Masanori Ohya, Yoshiharu Tanaka, Ichiro Yamato, 2015-04-14 This book examines information processing performed by bio systems at all scales from genomes cells and proteins to cognitive and even social systems It introduces a theoretical conceptual principle based on quantum information and non Kolmogorov probability theory to explain information processing phenomena in biology as a whole The book begins with an introduction followed by two chapters devoted to fundamentals one covering classical and quantum probability which also contains a brief introduction to quantum formalism and another on an information approach to molecular biology genetics and epigenetics It then goes on to examine adaptive dynamics including applications to biology and non Kolmogorov probability theory Next the book discusses the possibility to apply the quantum formalism to model biological evolution especially at the cellular level genetic and epigenetic evolutions It also presents a model of the epigenetic cellular evolution based on the mathematical formalism of open quantum systems The last two chapters of the book explore foundational problems of quantum mechanics and demonstrate the power of usage of positive operator valued measures POVMs in biological science This book will appeal to a diverse group of readers including experts in biology cognitive science decision making sociology psychology and physics mathematicians working on problems of quantum probability and information and researchers in quantum foundations

Variation Principle in Informational Macrodynamics Vladimir S. Lerner, 2012-12-06 Information Macrodynamics IMD belong to an interdisciplinary science that represents a new theoretical and computer based methodology for a system informational description and improvement including various activities in such areas as thinking intelligent processes communications management and other nonphysical subjects with their mutual interactions informational superimposition and their information

transferred between interactions The IMD is based on the implementation of a single concept by a unique mathematical principle and formalism rather than on an artificial combination of many arbitrary auxiliary concepts and or postulates and different mathematical subjects such as the game automata catastrophe logical operations theories etc This concept is explored mathematically using classical mathematics as calculus of variation and the probability theory which are potent enough without needing to develop new specified mathematical systemic methods The formal IMD model automatically includes the related results from other fields such as linear nonlinear collective and chaotic dynamics stability theory theory of information physical analogies of classical and quantum mechanics irreversible thermodynamics and kinetics The main IMD goal is to reveal the information regularities mathematically expressed by the considered variation principle VP as a mathematical tool to extract the regularities and define the model which describes the regularities The IMD regularities and mechanisms are the results of the analytical solutions and are not retained by logical argumentation rational introduction and a reasonable discussion The IMD's information computer modeling formalism includes a human being as an observer carrier and producer of information with a restoration of the model during the object observations

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