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From Spinors To Quantum Mechanics By Gerrit Coddens

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Quantum Mechanics in the Geometry of Space-Time
Group Theoretical Foundations of Quantum Mechanics
Quantum Mechanics
Relativistic Quantum Mechanics
Wave Equations
Quantum Theory, Groups and Representations
Spinors and Space-Time: Volume 2, Spinor and Twistor Methods in Space-Time Geometry
Twenty-First Century Quantum Mechanics: Hilbert Space to Quantum Computers
Quantum Mechanics
Lectures on Atomic Physics
Atomic Structure Theory
Do We Really Understand Quantum Mechanics?
An Introduction
QTS-X/LT-XII, Varna, Bulgaria, June 2017
Quantum Theory and Symmetries with Lie Theory and Its Applications in Physics Volume 1
The Theory of Spinors
Spinors in Hilbert Space
Relativistic Quantum Mechanics. Wave Equations
Geometric Algebra for Physicists
Relativistic Quantum Theory of Atoms and Molecules
Gravitomagnetism and Spinor Quantum Mechanics
The Failure of String Theory and the Search for Unity in Physical Law for Unity in Physical Law
Spinors in Hilbert Space
Relativistic Quantum Mechanics

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BENTON HAILEY

Quantum Mechanics in the Geometry of Space-Time World Scientific
Relativistic Quantum Mechanics begins with the Klein-Gordon equation describing its features and motivating the need for a correct relativistic equation for the electron. It then introduces the Dirac equation by linearizing the second order relativistic equation which reveals the spin, spin magnetic moment and the spin-orbit coupling of the electron. After demonstrating the relativistic covariance of the Dirac equation, the discrete transformations of the Dirac spinor, are explained. The Dirac equation for a free electron and an electron in hydrogen atom are solved these solutions are used to interpret the negative energy states in the hole theory' of Dirac. As applications of the Dirac

equation, the scattering of electrons by a Coulomb potential is given in detail and extended to electron-proton scattering. As a further application, the Dirac equation with zero mass is considered to describe the neutrino. The chapter on neutrinos contains a brief description of neutrino oscillations'. The book ends with giving an elementary treatment of spin manifolds with illustrative examples.

Springer
Characteristic of Schwabl's work, this volume features a compelling mathematical presentation in which all intermediate steps are derived and where numerous examples for application and exercises help the reader to gain a thorough working knowledge of the subject. The treatment of relativistic wave equations and their symmetries and the fundamentals of quantum field theory lay the foundations for advanced studies in solid-state physics, nuclear and elementary particle physics. New material has been added to this third edition.

Group Theoretical Foundations of Quantum Mechanics

iUniverse
From Spinors to Quantum Mechanics discusses group theory and its use in quantum mechanics. Chapters 1 to 4 offer an introduction to group theory, and it provides the reader with an exact and clear intuition of what a spinor is, showing that spinors are just a mathematically complete notation for group elements. Chapter 5 contains the first rigorous derivation of the Dirac equation from a simple set of assumptions. The remaining chapters will interest the advanced reader who is interested in the meaning of quantum mechanics. They propose a novel approach to the foundations of quantum mechanics, based on the idea that the meaning of the formalism is already provided by the mathematics.In the traditional approach to quantum mechanics as initiated by Heisenberg, one has to start from a number of experimental results and then derive a set of rules and calculations that reproduce the observed experimental results. In such an inductive approach the underlying assumptions are not given at the outset. The reader has to figure them out, and this has proven to be difficult. The book shows that a different, bottom-up approach to quantum mechanics is possible, which merits further investigation as it demonstrates that with the methods used, the reader can obtain the correct results in a context where one would hitherto not expect this to be possible.
Quantum Mechanics Springer Science & Business Media
Classic undergraduate text explores wave functions for the hydrogen atom, perturbation theory, the Pauli exclusion principle, and the structure of simple and complex molecules. Numerous tables and figures.
Relativistic Quantum Mechanics Springer
When does physics depart the realm of testable hypothesis and come to resemble theology? Peter Woit argues that string theory isn't just going in the wrong direction, it's not even science. Not Even Wrong shows that what many physicists call superstring “theory” is not a theory at all. It makes no predictions, not even wrong ones, and this very lack of falsifiability is what has allowed the subject to survive and flourish. Peter Woit explains why the mathematical conditions for progress in physics are entirely absent from superstring theory today, offering the other side of the story.

Wave Equations Springer Science & Business Media
This book is the first volume of proceedings from the joint conference X International Symposium “Quantum Theory and Symmetries” (QTS-X) and XII International Workshop “Lie Theory and Its Applications in Physics” (LT-XII), held on 19–25 June 2017 in Varna, Bulgaria. The QTS series was founded on the core principle that symmetries underlie all descriptions of quantum systems. It has since evolved into a symposium at the forefront of theoretical and mathematical physics. The LT series covers the whole field of Lie theory in its widest sense, together with its applications in many areas of physics. As an interface between mathematics and physics, the workshop serves as a meeting place for mathematicians and theoretical and mathematical physicists. In dividing the material between the two volumes, the Editor has sought to select papers that are more oriented toward mathematics for the first volume, and those focusing more on physics for the second. However, this division is relative, since many papers are equally suitable for either volume. The topics addressed in this volume represent the latest trends in the fields covered by the joint conferences: representation theory, integrability, entanglement, quantum groups, number theory, conformal geometry, quantum affine superalgebras, noncommutative geometry. Further, they present various mathematical results: on minuscule modules, symmetry breaking operators, Kashiwara crystals, meta-conformal invariance, the superintegrable Zernike system.

Quantum Theory, Groups and Representations

Springer Science & Business Media
Focusing on the principles of quantum mechanics, this text for upper-level undergraduates and graduate students introduces and resolves special physical problems with more than 100 exercises. 1967 edition.
Spinors and Space-Time: Volume 2, Spinor and Twistor Methods in Space-Time Geometry Springer Science & Business Media
This book is designed to make accessible to nonspecialists the still evolving concepts of quantum mechanics and the terminology in which these are expressed. The opening chapters summarize elementary concepts of twentieth century quantum mechanics and describe the mathematical methods employed in the field, with clear explanation of, for example, Hilbert space, complex variables, complex vector spaces and Dirac notation, and the Heisenberg uncertainty principle. After detailed discussion of the Schrödinger equation, subsequent chapters focus on isotropic vectors, used to construct spinors, and on conceptual problems associated with measurement, superposition, and decoherence in quantum systems. Here, due attention is paid to Bell's inequality and the possible existence of hidden variables. Finally, progression toward quantum computation is examined in detail: if quantum computers can be made practicable, enormous enhancements in computing power, artificial intelligence, and secure communication will result. This book will be of interest to a wide readership seeking to understand modern quantum mechanics and its potential applications.

Twenty-First Century Quantum Mechanics: Hilbert Space to Quantum

Computers

Cambridge University Press
Relativistic Quantum Mechanics - Wave Equations concentrates mainly on the wave equations for spin-0 and spin-1/2 particles. Chapter 1 deals with the Klein-Gordon equation and its properties and applications. The chapters that follow introduce the Dirac equation, investigate its covariance properties and present various approaches to obtaining solutions. Numerous applications are discussed in detail, including the two-center Dirac equation, hole theory, CPT symmetry, Klein's paradox, and relativistic symmetry principles. Chapter 15 presents the relativistic wave equations for higher spin (Proca, Rarita-Schwinger, and Bargmann-Wigner). The extensive presentation of the mathematical tools and the 62 worked examples and problems make this a unique text for an advanced quantum mechanics course.

Quantum Mechanics

From Spinors To Quantum Mechanics
Quantum mechanics, its properties including wavefunctions, complex numbers and uncertainty, are necessary and completely reasonable and understandable, with no weirdness. Classical physics is impossible. Much uncertainty comes from Fourier analysis. Waves and particles and collapse of wavefunctions are meaningless. Their seeming appearance in analyzed. Reasons and limitations of superposition are considered. Gravitation is an example of nonlinearity. All objects interact so nonlinearity is universal. How quantum mechanics then fits in is shown. Dirac's equation comes from Poincaré group. Physics is necessarily impossible in any space but that with dimension 3+1. Spin-statistics is a property of rotation groups.
Lectures on Atomic Physics CRC Press
This book continues the fundamental work of Arnold Sommerfeld and David Hestenes formulating theoretical physics in terms of Minkowski space-time geometry. We see how the standard matrix version of the Dirac equation can be reformulated in terms of a real space-time algebra, thus revealing a geometric meaning for the “number i” in quantum mechanics. Next, it is examined in some detail how electroweak theory can be integrated into the Dirac theory and this way interpreted in terms of space-time geometry. Finally, some implications for quantum electrodynamics are considered. The presentation of real quantum electromagnetism is expressed in an addendum. The book covers both the use of the complex and the real languages and allows the reader acquainted with the first language to make a step by step translation to the second one.
Atomic Structure Theory Springer Science & Business Media
Geometric algebra is a powerful mathematical language with applications across a range of subjects in physics and engineering. This book is a complete guide to the current state of the subject with early chapters providing a self-contained introduction to geometric algebra. Topics covered include new techniques for handling rotations in arbitrary dimensions, and the links between rotations, bivectors and the structure of the Lie groups. Following chapters extend the concept of a complex analytic function theory to arbitrary dimensions, with applications in quantum theory and electromagnetism. Later chapters cover advanced topics such as non-Euclidean geometry, quantum entanglement, and gauge theories. Applications such as black holes and cosmic strings are also explored. It can be used as a graduate text for courses on the physical applications of geometric algebra and is also suitable for researchers working in the fields of relativity and quantum theory.

Do We Really Understand Quantum Mechanics?

Springer Science & Business Media
Masterful exposition develops important concepts from experimental evidence and theory related to wave nature of free particles. Topics include classical mechanics of point particles and problems of atomic and molecular structure. 1957 edition.
An Introduction Springer
Quantum mechanics impacts on many areas of physics from pure theory to applications. However it is difficult to interpret, and philosophical contradictions and counter-intuitive results are apparent at a fundamental level. This book presents current understanding of the theory, providing a historical introduction and discussing many of its interpretations. Fully revised from the first edition, this book contains state-of-the-art research including loophole-free experimental Bell test, and theorems on the reality of the wave function including the PBR theorem, and a new section on quantum simulation. More interpretations are now included, and these are described and compared, including discussion of their successes and difficulties. Other sections have been expanded, including quantum error correction codes and the reference section. It is ideal for researchers in physics and maths, and philosophers of science interested in quantum physics and its foundations.

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Springer
Symmetry and Dynamics have played, sometimes dualistic, sometimes complimentary, but always a very essential role in the physicist's description and conception of Nature. These are again the basic underlying themes of the present volume. It collects self-contained introductory contributions on some of the recent developments both in mathematical concepts and in physical applications which are becoming very important in current research. So we see in this volume, on the one hand, differential geometry, group representations, topology and algebras and on the other hand, particle equations, particle dynamics and particle interactions. Specifically, this book contains a complete exposition of the theory of deformations of symplectic algebras and quantization, expository material on topology and geometry in physics, and group representations. On the more physical side, we have studies on the concept of particles, on conformal spinors of Cartan, on gauge and supersymmetric field theories, and on relativistic theory of particle interactions and the theory of magnetic resonances. The contributions collected here were originally delivered at two Meetings in Turkey, at Blacksea University in Trabzon and at the University of Bosphorus in Istanbul. But they have been thoroughly revised, updated and extended for this volume. It is a pleasure for me to acknowledge the support of UNESCO, the support and hospitality of Blacksea and Bosphorus Universities for these two memorable Meetings in Mathematical Physics, and to thank the Contributors for their effort and care in preparing this work.
Quantum Theory and Symmetries with Lie Theory and Its Applications in Physics Volume 1

Cambridge University Press
This edition has been completely revised to include some 20% of new material. Important recent developments such as the theory of Regge poles are now included. Many problems with solutions have been added to those already contained in the book.
The Theory of Spinors Cambridge University Press
This monograph is a sequel to my earlier work, General Relativity and Matter [1], which will be referred to henceforth as GRM. The monograph, GRM, focuses on the full set of implications of General Relativity Theory, as a fundamental theory of matter in all domains, from elementary particle physics to cosmology. It is shown there to exhibit an explicit unification of the gravitational and electromagnetic fields of force with the inertial manifestations of matter, expressing the latter explicitly in terms of a covariant field theory within the structure of this general theory. This monograph will focus, primarily, on the special relativistic limit of the part of this general field theory of matter that deals with inertia, in the domain where quantum mechanics has been evoked in contemporary physics as a funda mental explanation for the behavior of elementary matter. Many of the results presented in this book are based on earlier published works in the journals, which will be listed in the Bibliography. These results will be presented here in an expanded form, with more discussion on the motivation and explanation for the theoretical development of the subject than space would allow in normal journal articles, and they will be presented in one place where there would then be a more unified and coherent explication of the subject.
Spinors in Hilbert Space Butterworth-Heinemann
An explanation of how quantum processes may be visualised without ambiguity, in terms of a simple physical model.
Relativistic Quantum Mechanics. Wave Equations Basic Books
This book is a modern introduction to the ideas and techniques of quantum field theory. After a brief overview of particle physics and a survey of relativistic wave equations and Lagrangian methods, the author develops the quantum theory of scalar and spinor fields, and then of gauge fields. The emphasis throughout is on functional methods, which have played a large part in modern field theory. The book concludes with a brief survey of "topological" objects in field theory and, new to this edition, a chapter devoted to supersymmetry. Graduate students in particle physics and high energy physics will benefit from this book.
Geometric Algebra for Physicists Springer Science & Business Media
1. Hilbert Space The words "Hilbert space" here will always denote what math ematicians call a separable Hilbert space. It is composed of vectors each with a denumerable infinity of coordinates ql' q2' Q3, ... Usually the coordinates are considered to be complex numbers and each vector has a squared length ~rIQrI2. This squared length must converge in order that the q's may specify a Hilbert vector. Let us express qr in terms of real and imaginary parts, qr = Xr + iYr' Then the squared length is l:.r(x; + y;). The x's and y's may be looked upon as the coordinates of a vector. It is again a Hilbert vector, but it is a real Hilbert vector, with only real coordinates. Thus a complex Hilbert vector uniquely determines a real Hilbert vector. The second vector has, at first sight, twice as many coordinates as the first one. But twice a denumerable in finity is again a denumerable infinity, so the second vector has the same number of coordinates as the first. Thus a complex Hilbert vector is not a more general kind of quantity than a real one.