
4 Relativistic Mechanics Home Springer

Quantum Electrodynamics of Strong Fields
Theoretical Physics 1
A Student's Guide with Discussions and Examples
With an Introduction Into Modern Relativistic Quantum Mechanics
Celestial Mechanics
Classical Mechanics
The Genesis of General Relativity
An Account of the de Broglie-Bohm Causal Interpretation of Quantum Mechanics
Quantum Mechanics, Relativity and Cosmology for Everyone
Relativity, Groups, Particles
Fundamental Aspects and New Directions
Stochastic Quantum Mechanics and Quantum Spacetime
The Problem of Time
Classical Mechanics
Handbook of Feynman Path Integrals
Theoretical Physics 4
Tensors
Quantum Mechanics
With a Tribute to Rolf Hagedorn
Symmetries
General Principles of Quantum Mechanics
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Classical Mechanics
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LAYLAH BRENDAN

Quantum Electrodynamics of Strong Fields Springer Science & Business Media

Greiner's lectures, which underlie these volumes, are internationally noted for their clarity, their completeness and for the effort that he has devoted to making physics an integral whole; his enthusiasm for his science is contagious and shines through almost every page. These volumes represent only a part of a unique and Herculean effort to make all of theoretical physics accessible to the interested student. Beyond that, they are of enormous value to the professional physicist and to all others working with quantum phenomena. Again and again the reader will find that, after dipping into a particular volume to review a specific topic, he will end up browsing, caught up by often fascinating new insights and developments with which he had not previously been familiar. Having used a number of Greiner's volumes in their original German in my teaching and research at Yale, I welcome these new and revised English translations and would recommend them enthusiastically to anyone searching for a coherent overview of physics.

Theoretical Physics 1 Springer

With the aid of entertaining short stories, anecdotes, lucid explanations and straight-forward figures, this book challenges the perception that the world of physics is inaccessible to the non-expert. Beginning with Neanderthal man, it traces the evolution of human reason and understanding from paradoxes and optical illusions to gravitational waves, black holes and dark energy. On the way, it provides insights into the mind-boggling advances at the frontiers of physics and cosmology. Unsolved problems and contradictions are highlighted, and contentious issues in modern physics are discussed in a non-dogmatic way in a language comprehensible to the non-scientist. It has something for everyone.

A Student's Guide with Discussions and Examples Springer Science & Business Media

The aim of this book is to demonstrate to a wider audience, as well as to a more skilled audience, the many fascinating aspects of modern celestial mechanics. It sets out to do this without the use of mathematics. After giving the reader the technical tools needed for a basic understanding of the underlying physical phenomena (using only elementary mathematics), facts and figures are provided on historical events, modern discoveries and future applications. Contents are divided into major topics where the three "souls" of modern celestial mechanics (dynamical systems, Solar System and stellar systems, spaceflight dynamics) play a major role.

With an Introduction Into Modern Relativistic Quantum Mechanics Springer Science & Business Media

This book shows how the study of multi-hadron production phenomena in the years after the founding of CERN culminated in Hagedorn's pioneering idea of limiting temperature, leading on to the discovery of the quark-gluon plasma -- announced, in February 2000 at CERN. Following the foreword by Herwig Schopper -- the Director General (1981-1988) of CERN at the key historical juncture -- the first part is a tribute to Rolf Hagedorn (1919-2003) and includes contributions by

contemporary friends and colleagues, and those who were most touched by Hagedorn: Tamás Biró, Igor Dremin, Torleif Ericson, Marek Gaździcki, Mark Gorenstein, Hans Gutbrod, Maurice Jacob, István Montvay, Berndt Müller, Grazyna Odyniec, Emanuele Quercigh, Krzysztof Redlich, Helmut Satz, Luigi Sertorio, Ludwik Turko, and Gabriele Veneziano. The second and third parts retrace 20 years of developments that after discovery of the Hagedorn temperature in 1964 led to its recognition as the melting point of hadrons into boiling quarks, and to the rise of the experimental relativistic heavy ion collision program. These parts contain previously unpublished material authored by Hagedorn and Rafelski: conference retrospectives, research notes, workshop reports, in some instances abbreviated to avoid duplication of material, and rounded off with the editor's explanatory notes. About the editor: Johann Rafelski is a theoretical physicist working at The University of Arizona in Tucson, USA. Born in 1950 in Krakow, Poland, he received his Ph.D. with Walter Greiner in Frankfurt, Germany in 1973. Rafelski arrived at CERN in 1977, where in a joint effort with Hagedorn he contributed greatly to the establishment of the relativistic heavy ion collision, and quark-gluon plasma research fields. Moving on, with stops in Frankfurt and Cape Town, to Arizona, he invented and developed the strangeness quark flavor as the signature of quark-gluon plasma.

Celestial Mechanics Springer Science & Business Media

Relativity: A Journey Through Warped Space and Time Springer Nature

Classical Mechanics Springer Nature

Quantum Thermodynamics is a novel research field which explores the emergence of thermodynamics from quantum theory and addresses thermodynamic phenomena which appear in finite-size, non-equilibrium and finite-time contexts. Blending together elements from open quantum systems, statistical mechanics, quantum many-body physics, and quantum information theory, it pinpoints thermodynamic advantages and barriers emerging from genuinely quantum properties such as quantum coherence and correlations. Owing to recent experimental efforts, the field is moving quickly towards practical applications, such as nano-scale heat devices, or thermodynamically optimised protocols for emergent quantum technologies. Starting from the basics, the present volume reviews some of the most recent developments, as well as some of the most important open problems in quantum thermodynamics. The self-contained chapters provide concise and topical introductions to researchers who are new to the field. Experts will find them useful as a reference for the current state-of-the-art. In six sections the book covers topics such as quantum heat engines and refrigerators, fluctuation theorems, the emergence of thermodynamic equilibrium, thermodynamics of strongly coupled systems, as well as various information theoretic approaches including Landauer's principle and thermal operations. It concludes with a section dedicated to recent quantum thermodynamics experiments and experimental prospects on a variety of platforms ranging from cold atoms to photonic systems, and NV centres.

The Genesis of General Relativity Springer Science & Business Media

This book is a treatise on time and on background independence in physics. It first considers how time is conceived of in each accepted paradigm of physics: Newtonian, special relativity, quantum mechanics (QM) and general relativity (GR). Substantial differences are moreover uncovered

between what is meant by time in QM and in GR. These differences jointly source the Problem of Time: Nine interlinked facets which arise upon attempting concurrent treatment of the QM and GR paradigms, as is required in particular for a background independent theory of quantum gravity. A sizeable proportion of current quantum gravity programs - e.g. geometrodynamical and loop quantum gravity approaches to quantum GR, quantum cosmology, supergravity and M-theory - are background independent in this sense. This book's foundational topic is thus furthermore of practical relevance in the ongoing development of quantum gravity programs. This book shows moreover that eight of the nine facets of the Problem of Time already occur upon entertaining background independence in classical (rather than quantum) physics. By this development, and interpreting shape theory as modelling background independence, this book further establishes background independence as a field of study. Background independent mechanics, as well as minisuperspace (spatially homogeneous) models of GR and perturbations thereabout are used to illustrate these points. As hitherto formulated, the different facets of the Problem of Time greatly interfere with each others' attempted resolutions. This book explains how, none the less, a local resolution of the Problem of Time can be arrived at after various reconceptualizations of the facets and reformulations of their mathematical implementation. Self-contained appendices on mathematical methods for basic and foundational quantum gravity are included. Finally, this book outlines how supergravity is refreshingly different from GR as a realization of background independence, and what background independence entails at the topological level and beyond.

An Account of the de Broglie-Bohm Causal Interpretation of Quantum Mechanics Springer Science & Business Media

R. Shankar has introduced major additions and updated key presentations in this second edition of *Principles of Quantum Mechanics*. New features of this innovative text include an entirely rewritten mathematical introduction, a discussion of Time-reversal invariance, and extensive coverage of a variety of path integrals and their applications. Additional highlights include: - Clear, accessible treatment of underlying mathematics - A review of Newtonian, Lagrangian, and Hamiltonian mechanics - Student understanding of quantum theory is enhanced by separate treatment of mathematical theorems and physical postulates - Unsurpassed coverage of path integrals and their relevance in contemporary physics The requisite text for advanced undergraduate- and graduate-level students, *Principles of Quantum Mechanics, Second Edition* is fully referenced and is supported by many exercises and solutions. The book's self-contained chapters also make it suitable for independent study as well as for courses in applied disciplines.

Quantum Mechanics, Relativity and Cosmology for Everyone Springer Science & Business Media

Rafelski presents Special Relativity in a language deemed accessible to students without any topical preparation - avoiding the burden of geometry, tensor calculus, and space-time symmetries - and yet advancing in highly contemporary context all the way to research frontiers. Special Relativity is presented such that nothing remains a paradox or just apparent, but rather is explained. A text of similar character, content, and scope, has not been available before. This textbook describes Special Relativity when rigid material bodies are introduced describing the reality of body contraction; it shows the relevance of acceleration and the necessary evolution of the theoretical framework when acceleration is critical. This book also presents the evolving views of Einstein about the aether. In

addition to a careful and elementary introduction to relativity complete with exercises, worked examples and many discussions, this volume connects to current research topics so that readers can explore Special Relativity from the foundation to the frontier.

Relativity, Groups, Particles Springer Science & Business Media

Special relativity is the basis of many fields in modern physics: particle physics, quantum field theory, high-energy astrophysics, etc. This theory is presented here by adopting a four-dimensional point of view from the start. An outstanding feature of the book is that it doesn't restrict itself to inertial frames but considers accelerated and rotating observers. It is thus possible to treat physical effects such as the Thomas precession or the Sagnac effect in a simple yet precise manner. In the final chapters, more advanced topics like tensorial fields in spacetime, exterior calculus and relativistic hydrodynamics are addressed. In the last, brief chapter the author gives a preview of gravity and shows where it becomes incompatible with Minkowsky spacetime. Well illustrated and enriched by many historical notes, this book also presents many applications of special relativity, ranging from particle physics (accelerators, particle collisions, quark-gluon plasma) to astrophysics (relativistic jets, active galactic nuclei), and including practical applications (Sagnac gyrometers, synchrotron radiation, GPS). In addition, the book provides some mathematical developments, such as the detailed analysis of the Lorentz group and its Lie algebra. The book is suitable for students in the third year of a physics degree or on a masters course, as well as researchers and any reader interested in relativity. Thanks to the geometric approach adopted, this book should also be beneficial for the study of general relativity. "A modern presentation of special relativity must put forward its essential structures, before illustrating them using concrete applications to specific dynamical problems. Such is the challenge (so successfully met!) of the beautiful book by Éricourgoulhon." (excerpt from the Foreword by Thibault Damour)

Fundamental Aspects and New Directions 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. This third edition has been slightly revised to bring the text up-to-date.

Stochastic Quantum Mechanics and Quantum Spacetime Springer Science & Business Media
Here is a modern introduction to the theory of tensor algebra and tensor analysis. It discusses tensor algebra and introduces differential manifold. Coverage also details tensor analysis, differential forms, connection forms, and curvature tensor. In addition, the book investigates Riemannian and pseudo-Riemannian manifolds in great detail. Throughout, examples and problems are furnished from the theory of relativity and continuum mechanics.

The Problem of Time Springer Science & Business Media

This advanced textbook supplies graduate students with a primer in quantum theory. A variety of processes are discussed with concepts such as potentials, classical current distributions, prescribed external fields dealt with in the framework of relativistic quantum mechanics. Then, in an introduction to field theory, the author emphasizes the deduction of the said potentials or currents. A modern presentation of the subject together with many exercises, unique in its unusual underlying concept of combining relativistic quantum mechanics with basic quantum field theory.

Classical Mechanics Springer Verlag

Formalism of classical mechanics underlies a number of powerful mathematical methods that are widely used in theoretical and mathematical physics. This book considers the basic facts of Lagrangian and Hamiltonian mechanics, as well as related topics, such as canonical transformations, integral invariants, potential motion in geometric setting, symmetries, the Noether theorem and systems with constraints. While in some cases the formalism is developed beyond the traditional level adopted in the standard textbooks on classical mechanics, only elementary mathematical methods are used in the exposition of the material. The mathematical constructions involved are explicitly described and explained, so the book can be a good starting point for the undergraduate student new to this field. At the same time and where possible, intuitive motivations are replaced by explicit proofs and direct computations, preserving the level of rigor that makes the book useful for the graduate students intending to work in one of the branches of the vast field of theoretical physics. To illustrate how classical-mechanics formalism works in other branches of theoretical physics, examples related to electrodynamics, as well as to relativistic and quantum mechanics, are included.

Handbook of Feynman Path Integrals Springer

An explanation of how quantum processes may be visualised without ambiguity, in terms of a simple physical model.

Theoretical Physics 4 Springer Science & Business Media

Der Grundkurs Theoretische Physik deckt in 7 Bänden alle für das Diplom und für Bachelor/Master-Studiengänge maßgeblichen Gebiete ab. Jeder Band vermittelt das im jeweiligen Semester notwendige theoretisch-physikalische Rüstzeug. Übungsaufgaben mit ausführlichen Lösungen dienen der Vertiefung des Stoffs. Der 4. Band behandelt die Gebiete Thermodynamik und Relativitätstheorie. Für die Neuauflage wurde er grundlegend überarbeitet und um 24 Aufgaben ergänzt. Durch die zweifarbige Gestaltung ist der Stoff jetzt noch übersichtlicher gegliedert.

Tensors Springer Science & Business Media

This book provides an introduction into the fundamentals of non-relativistic quantum mechanics. In Part 1, the essential principles are developed. Applications and extensions of the formalism can be found in Part 2. The book includes not only material that is presented in traditional textbooks on quantum mechanics, but also discusses in detail current issues such as interaction-free quantum measurements, neutrino oscillations, various topics in the field of quantum information as well as fundamental problems and epistemological questions, such as the measurement problem, entanglement, Bell's inequality, decoherence, and the realism debate. A chapter on current interpretations of quantum mechanics concludes the book. To develop quickly and clearly the main principles of quantum mechanics and its mathematical formulation, there is a systematic change

between wave mechanics and algebraic representation in the first chapters. The required mathematical tools are introduced step by step. Moreover, the appendix collects compactly the most important mathematical tools that supplementary literature can be largely dispensed. In addition, the appendix contains advanced topics, such as Quantum-Zeno effect, time-delay experiments, Lenz vector and the Shor algorithm. About 250 exercises, most of them with solutions, help to deepen the understanding of the topics.

Springer

I am very happy to accept the translators' invitation to write a few lines of introduction to this book. Of course, there is little need to explain the author. Pauli's first famous work, his article on the theory of relativity in the *Encyklopädie der Mathematischen Wissenschaften* was written at the age of twenty. He afterwards took part in the development of atomic physics from the still essentially classical picture of Bohr's early work to the true quantum mechanics. Thereafter, some of his work concerned the treatment of problems in the framework of the new theory, especially his paper on the hydrogen atom following the matrix method without recourse to Schrodinger's analytic form of the theory. His greatest achievement, the exclusion principle, generally known today under his own name as the Pauli principle, that governs the quantum theory of all problems including more than one electron, preceded the basic work of Heisenberg and Schrodinger, and brought him the Nobel prize. It includes the mathematical treatment of the spin by means of the now so well known Pauli matrices. In 1929, in a paper with Heisenberg, he laid the foundation of quantum electrodynamics and, in doing so, to the whole theory of quantized wave fields which was to become the *via regia* of access to elementary particle physics, since here for the first time processes of generation and annihilation of particles could be described for the case of the photons.

Quantum Mechanics Springer Science & Business Media

When one approaches the study of the quantal relativistic theory of the electron, one may be surprised by the gap which lies between the frame of the experiments, i.e. the real geometry of the space and time, and the abstraction of the complex matrices and spinors formalism employed in the presentation of the theory. This book uses a theory of the electron, introduced by David Hestenes, in which the mathematical language is the same as the one of the geometry of the space and time. Such a language not only allows one to find again the well known results concerning the one-electron atoms theory but furthermore leads easily to the resolution of problems considered for a long time without solution.

With a Tribute to Rolf Hagedorn Springer

Theoretical physics has become a many-faceted science. For the young student it is difficult enough to cope with the overwhelming amount of new scientific material that has to be learned, let alone obtain an overview of the entire field, which ranges from mechanics through electrodynamics, quantum mechanics, field theory, nuclear and heavy-ion science, statistical mechanics, thermodynamics, and solid-state theory to elementary-particle physics. And this knowledge should be acquired in just 8-10 semesters, during which, in addition, a Diploma or Master's thesis has to be worked on or examinations prepared for. All this can be achieved only if the university teachers help to introduce the student to the new disciplines as early on as possible, in order to create interest and excitement that in turn set free essential new energy. At the Johann Wolfgang Goethe University

in Frankfurt we therefore confront the student with theoretical physics immediately, in the first semester. Theoretical Mechanics I and II, Electrodynamics, and Quantum Mechanics I - An Introduction are the basic courses during the first two years. These lectures are supplemented with many mathematical explanations and much support material. After the fourth semester of studies,

graduate work begins, and Quantum Mechanics II - Symmetries, Statistical Mechanics and Thermodynamics, Relativistic Quantum Mechanics, Quantum Electrodynamics, the Gauge Theory of Weak Interactions, and Quantum Chromodynamics are obligatory.

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