

Theory and Applications of the Poincaré Group

by
Y.S. Kim and Marilyn E. Noz

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Fundamental Theories of Physics

Theory And Applications Of The Poincare Group

Fundamental Theories Of Physics

Ajoy Ghatak, S. Lokanathan



Theory And Applications Of The Poincare Group Fundamental Theories Of Physics:

Theory and Applications of the Poincaré Group Young Suh Kim, M. Noz, 2012-12-06 Special relativity and quantum mechanics formulated early in the twentieth century are the two most important scientific languages and are likely to remain so for many years to come In the 1920 s when quantum mechanics was developed the most pressing theoretical problem was how to make it consistent with special relativity In the 1980 s this is still the most pressing problem The only difference is that the situation is more urgent now than before because of the significant quantity of experimental data which need to be explained in terms of both quantum mechanics and special relativity In unifying the concepts and algorithms of quantum mechanics and special relativity it is important to realize that the underlying scientific language for both disciplines is that of group theory The role of group theory in quantum mechanics is well known The same is true for special relativity Therefore the most effective approach to the problem of unifying these two important theories is to develop a group theory which can accommodate both special relativity and quantum mechanics As is well known Eugene P Wigner is one of the pioneers in developing group theoretical approaches to relativistic quantum mechanics His 1939 paper on the inhomogeneous Lorentz group laid the foundation for this important research line It is generally agreed that this paper was somewhat ahead of its time in 1939 and that contemporary physicists must continue to make real efforts to appreciate fully the content of this classic work

Special Relativity and Quantum Theory M. Noz, Young Suh Kim, 2012-12-06 Special relativity and quantum mechanics are likely to remain the two most important languages in physics for many years to come The underlying language for both disciplines is group theory Eugene P Wigner s 1939 paper on the Unitary Representations of the Inhomogeneous Lorentz Group laid the foundation for unifying the concepts and algorithms of quantum mechanics and special relativity In view of the strong current interest in the space time symmetries of elementary particles it is safe to say that Wigner s 1939 paper was fifty years ahead of its time This edited volume consists of Wigner s 1939 paper and the major papers on the Lorentz group published since 1939 This volume is intended for graduate and advanced undergraduate students in physics and mathematics as well as mature physicists wishing to understand the more fundamental aspects of physics than are available from the fashion oriented theoretical models which come and go The original papers contained in this volume are useful as supplementary reading material for students in courses on group theory relativistic quantum mechanics and quantum field theory relativistic electrodynamics general relativity and elementary particle physics This reprint collection is an extension of the textbook by the present editors entitled *Theory and Applications of the Poincare Group* Since this book is largely based on the articles contained herein the present volume should be viewed as a reading for the previous work continuation of and supplementary We would like to thank Professors J Bjorken R Feynman R Hofstadter J

Theory and Applications of the Poincaré Group Sibel Başkal, Young Suh Kim, Marilyn E. Noz, 2024-09-03 This book is intended mainly as a teaching tool directed toward those who desire a deeper understanding of group theory in terms of examples applicable to

the physical world and or of the physical world in terms of the symmetry properties which can best be formulated in terms of group theory Both advanced students and scholars interested in the relationship between group theory and physics will find it instructive In particular those engaged in high energy physics and foundations of quantum mechanics will find this book rich in illustrative examples of relativistic quantum mechanics This new edition contains four new chapters two of which are consistent with Dirac s aim to combine the important developments in physics in the twentieth century namely quantum mechanics and special relativity Moreover these new chapters also discuss various aspects of classical and quantum optics that are now understood to be interrelated Most of the original chapters have been updated either with new material added or in some instances reinterpretation of the original The order of the chapters has been rearranged to create a more cohesive presentation The original purpose of the first edition namely to present examples to which physics students and researchers can relate has not been altered

Theory and Applications of the Poincaré Group Sibel Başkal,Young Suh Kim,Marilyn E. Noz,2024-11-14 This book is intended mainly as a teaching tool directed toward those who desire a deeper understanding of group theory in terms of examples applicable to the physical world and or of the physical world in terms of the symmetry properties which can best be formulated in terms of group theory Both advanced students and scholars interested in the relationship between group theory and physics will find it instructive In particular those engaged in high energy physics and foundations of quantum mechanics will find this book rich in illustrative examples of relativistic quantum mechanics This new edition contains four new chapters two of which are consistent with Dirac s aim to combine the important developments in physics in the twentieth century namely quantum mechanics and special relativity Moreover these new chapters also discuss various aspects of classical and quantum optics that are now understood to be interrelated Most of the original chapters have been updated either with new material added or in some instances reinterpretation of the original The order of the chapters has been rearranged to create a more cohesive presentation The original purpose of the first edition namely to present examples to which physics students and researchers can relate has not been altered

Special Relativity and Quantum Theory M. Noz,Young Suh Kim,1988-11-30

Quantum Mechanics: Theory and Applications Ajoy Ghatak,S. Lokanathan,2004-02-29 An understanding of quantum mechanics is vital to all students of physics chemistry and electrical engineering but requires a lot of mathematical concepts the details of which are given with great clarity in this book Various concepts have been derived from first principles so it can also be used for self study The chapters on the JWKB approximation time independent perturbation theory and effects of magnetic field stand out for their clarity and easy to understand mathematics Two complete chapters on the linear harmonic oscillator provide a very detailed discussion of one of the most fundamental problems in quantum mechanics Operator algebra is used to show the ease with which one can calculate the harmonic oscillator wave functions and study the evolution of the coherent state Similarly three chapters on angular momentum give a detailed account of this important problem Perhaps the most attractive feature of the book is the excellent

balance between theory and applications and the large number of applications in such diverse areas as astrophysics nuclear physics atomic and molecular spectroscopy solid state physics and quantum well structures

Kinetic Theory of Gases and Plasmas PPJM Schram, 2012-12-06 Kinetic theory is the link between the non equilibrium statistical mechanics of many particle systems and macroscopic or phenomenological physics Therefore much attention is paid in this book both to the derivation of kinetic equations with their limitations and generalizations on the one hand and to the use of kinetic theory for the description of physical phenomena and the calculation of transport coefficients on the other hand The book is meant for researchers in the field graduate students and advanced undergraduate students At the end of each chapter a section of exercises is added not only for the purpose of providing the reader with the opportunity to test his understanding of the theory and his ability to apply it but also to complete the chapter with relevant additions and examples that otherwise would have overburdened the main text of the preceding sections The author is indebted to the physicists who taught him Statistical Mechanics Kinetic Theory Plasma Physics and Fluid Mechanics I gratefully acknowledge the fact that much of the inspiration without which this book would not have been possible originated from what I learned from several outstanding teachers In particular I want to mention the late Prof dr H C Brinkman who directed my first steps in the field of theoretical plasma physics my thesis advisor Prof dr N G Van Kampen and Prof dr A N Kaufman whose course on Non Equilibrium Statistical Mechanics in Berkeley I remember with delight

The Present Status of the Quantum Theory of Light Stanley Jeffers, S. Roy, J.P. Vigiér, G. Hunter, 2012-12-06 THE PRESENT STATUS OF THE QUANTUM THEORY OF LIGHT In August of 1995 a group of over 70 physicists met at York University for a three day symposium in honour of Professor Jean Pierre Vigiér The attendance included theoretical and experimental physicists mathematicians astronomers and colleagues concerned with issues in the philosophy of science The symposium was entitled The Present Status of the Quantum Theory of Light in accordance with Professor Vigiér's wishes but in fact encompassed many of the areas to which Professor Vigiér has contributed over his long and distinguished career These include stochastic interpretations of quantum mechanics particle physics and electromagnetic theory The papers presented at the symposium have been arranged in this proceedings in the following approximate order ideas about the nature of light and photons electrodynamics the formulation and interpretation of quantum mechanics and aspects of relativity theory Some of the papers presented deal with alternate interpretations of quantum phenomena in the tradition of Vigiér Bohm et al These interpretations reject the account given in purely probabilistic terms and which deems individual quantum events to be acausal and not amenable to any analysis in space time terms As is well known Einstein and others also rejected the purely statistical account of quantum mechanics As stressed by Professor Vigiér at the symposium the current experimental situation now allows for the first time for individual quantum events to be studied e.g.

Representation Theory Zongzhu Lin, Jianpan Wang, 2009-01-16 Nothing provided

Maximum Entropy and Bayesian Methods Gärdening, Germany 1998 Wolfgang von der Linden, Volker Dose, Rainer Fischer, Roland

Preuss,2012-12-06 In 1978 Edwin T Jaynes and Myron Tribus initiated a series of workshops to exchange ideas and recent developments in technical aspects and applications of Bayesian probability theory The first workshop was held at the University of Wyoming in 1981 organized by C R Smith and W T Grandy Due to its success the workshop was held annually during the last 18 years Over the years the emphasis of the workshop shifted gradually from fundamental concepts of Bayesian probability theory to increasingly realistic and challenging applications The 18th international workshop on Maximum Entropy and Bayesian Methods was held in Garching Munich Germany 27-31 July 1998 Opening lectures by G Larry Bretthorst and by Myron Tribus were dedicated to one of the pioneers of Bayesian probability theory who died on the 30 of April 1998 Edwin Thompson Jaynes Jaynes revealed and advocated the correct meaning of probability as the state of knowledge rather than a physical property This interpretation allowed him to unravel longstanding mysteries and paradoxes Bayesian probability theory the logic of science as E T Jaynes called it provides the framework to make the best possible scientific inference given all available experimental and theoretical information We gratefully acknowledge the efforts of Tribus and Bretthorst in commemorating the outstanding contributions of E T Jaynes to the development of probability theory

Classical Statistical Mechanics G.A. Martynov,2012-12-06 Statistical mechanics deals with systems in which chaos and randomness reign supreme The current theory is therefore firmly based on the equations of classical mechanics and the postulates of probability theory This volume seeks to present a unified account of classical mechanical statistics rather than a collection of unconnected reviews on recent results To help achieve this one element is emphasised which integrates various parts of the prevailing theory into a coherent whole This is the hierarchy of the BBGKY equations which enables a relationship to be established between the Gibbs theory the liquid theory and the theory of nonequilibrium phenomena As the main focus is on the complex theoretical subject matter attention to applications is kept to a minimum The book is divided into three parts The first part describes the fundamentals of the theory embracing chaos in dynamic systems and distribution functions of dynamic systems Thermodynamic equilibrium dealing with Gibbs statistical mechanics and the statistical mechanics of liquids forms the second part Lastly the third part concentrates on kinetics and the theory of nonequilibrium gases and liquids in particular Audience This book will be of interest to graduate students and researchers whose work involves thermophysics theory of surface phenomena theory of chemical reactions physical chemistry and biophysics

Analytic Hyperbolic Geometry and Albert Einstein's Special Theory of Relativity Abraham A. Ungar,2008 This book presents a powerful way to study Einstein's special theory of relativity and its underlying hyperbolic geometry in which analogies with classical results form the right tool It introduces the notion of vectors into analytic hyperbolic geometry where they are called gyrovectors Newtonian velocity addition is the common vector addition which is both commutative and associative The resulting vector spaces in turn form the algebraic setting for the standard model of Euclidean geometry In full analogy Einsteinian velocity addition is a gyrovector addition which is both gyrocommutative and

gyroassociative The resulting gyrovector spaces in turn form the algebraic setting for the Beltrami Klein ball model of the hyperbolic geometry of Bolyai and Lobachevsky Similarly MAbius addition gives rise to gyrovector spaces that form the algebraic setting for the Poincaré ball model of hyperbolic geometry In full analogy with classical results the book presents a novel relativistic interpretation of stellar aberration in terms of relativistic gyrotrigonometry and gyrovector addition Furthermore the book presents for the first time the relativistic center of mass of an isolated system of noninteracting particles that coincided at some initial time t_0 The novel relativistic resultant mass of the system concentrated at the relativistic center of mass dictates the validity of the dark matter and the dark energy that were introduced by cosmologists as ad hoc postulates to explain cosmological observations about missing gravitational force and late time cosmic accelerated expansion The discovery of the relativistic center of mass in this book thus demonstrates once again the usefulness of the study of Einstein's special theory of relativity in terms of its underlying analytic hyperbolic geometry

Sample Chapter s
Chapter 1 Introduction 145 KB Contents Gyrogroups Gyrocommutative Gyrogroups Gyrogroup Extension Gyrovectors and Cogyrovectors Gyrovector Spaces Rudiments of Differential Geometry Gyrotrigonometry Bloch Gyrovector of Quantum Information and Computation Special Theory of Relativity The Analytic Hyperbolic Geometric Viewpoint Relativistic Gyrotrigonometry Stellar and Particle Aberration Readership Undergraduates graduate students researchers and academics in geometry algebra mathematical physics theoretical physics and astronomy

Beyond the Einstein Addition Law and its Gyroscopic Thomas Precession Abraham A. Ungar, 2012-12-06 I cannot define coincidence in mathematics But I shall argue that coincidence can always be elevated or organized into a superstructure which performs a unification along the coincidental elements The existence of a coincidence is strong evidence for the existence of a covering theory Philip 1 Davis Dav81 Alluding to the Thomas gyration this book presents the Theory of gyrogroups and gyrovector spaces taking the reader to the immensity of hyperbolic geometry that lies beyond the Einstein special theory of relativity Soon after its introduction by Einstein in 1905 Einstein's special relativity theory as named by Einstein ten years later became overshadowed by the appearance of general relativity Subsequently the exposition of special relativity followed the lines laid down by Minkowski in which the role of hyperbolic geometry is not emphasized This can doubtlessly be explained by the strangeness and unfamiliarity of hyperbolic geometry Bar98 The aim of this book is to reverse the trend of neglecting the role of hyperbolic geometry in the special theory of relativity initiated by Minkowski by emphasizing the central role that hyperbolic geometry plays in the theory

Clifford Numbers and Spinors Marcel Riesz, 2013-11-11 Marcell Riesz's lectures delivered on October 1957 January 1958 at the University of Maryland College Park have been previously published only informally as a manuscript entitled CLIFFORD NUMBERS AND SPINORS Chapters I-IV As the title says the lecture notes consist of four Chapters I II III and IV However in the preface of the lecture notes Riesz refers to Chapters V and VI which he could not finish Chapter VI is mentioned on pages 13 16 38 and 156 which makes it plausible that Riesz was well aware of what he was

going to include in the final missing chapters The present book makes liesz's classic lecture notes generally available to a wider audience and tries somewhat to fill in one of the last missing chapters This book also tries to evaluate liesz's influence on the present research on Clifford algebras and draws special attention to liesz's contributions in this field often misunderstood

Maximum Entropy and Bayesian Methods Ali Mohammad-Djafari, G. Demoment, 2013-03-14 The Twelfth International Workshop on Maximum Entropy and Bayesian Methods in Sciences and Engineering MaxEnt 92 was held in Paris France at the Centre National de la Recherche Scientifique CNRS July 19-24 1992 It is important to note that since its creation in 1980 by some of the researchers of the physics department at the Wyoming University in Laramie this was the second time that it took place in Europe the first time was in 1988 in Cambridge The two specificities of MaxEnt workshops are their spontaneous and informal characteristics which give the participants the possibility to discuss easily and to make very fruitful scientific and friendship relations among each others This year's organizers had fixed two main objectives i to have more participants from the European countries and ii to give special interest to maximum entropy and Bayesian methods in signal and image processing We are happy to see that we achieved these objectives i we had about 100 participants with more than 50 per cent from the European countries ii we received many papers in the signal and image processing subjects and we could dedicate a full day of the workshop to the image modelling restoration and reconstruction problems

Maximum Entropy and Bayesian Methods C.R. Smith, G. Erickson, Paul O. Neudorfer, 2013-06-29 Bayesian probability theory and maximum entropy methods are at the core of a new view of scientific inference These new ideas along with the revolution in computational methods afforded by modern computers allow astronomers electrical engineers image processors of any type NMR chemists and physicists and anyone at all who has to deal with incomplete and noisy data to take advantage of methods that in the past have been applied only in some areas of theoretical physics This volume records the Proceedings of Eleventh Annual Maximum Entropy Workshop held at Seattle University in June 1991 These workshops have been the focus of a group of researchers from many different fields and this diversity is evident in this volume There are tutorial papers theoretical papers and applications in a very wide variety of fields Almost any instance of dealing with incomplete and noisy data can be usefully treated by these methods and many areas of theoretical research are being enhanced by the thoughtful application of Bayes theorem The contributions contained in this volume present a state of the art review that will be influential and useful for many years to come

Quantum Logic in Algebraic Approach Miklós Rédei, 2013-03-09 This work has grown out of the lecture notes that were prepared for a series of seminars on some selected topics in quantum logic The seminars were delivered during the first semester of the 1993-1994 academic year in the Unit for Foundations of Science of the Department of History and Foundations of Mathematics and Science Faculty of Physics Utrecht University The Netherlands while I was staying in that Unit on a European Community Research Grant and in the Center for Philosophy of Science University of Pittsburgh U S A where I was staying during the 1994-1995 academic year as a Visiting Fellow on a

Fulbright Research Grant and where I also was supported by the Istvan Szechenyi Scholarship Foundation The financial support provided by these foundations by the Center for Philosophy of Science and by the European Community is greatly acknowledged and I wish to thank D Dieks the professor of the Foundations Group in Utrecht and G Massey the director of the Center for Philosophy of Science in Pittsburgh for making my stay at the respective institutions possible I also wish to thank both the members of the Foundations Group in Utrecht especially D Dieks C Lutz F Muller J Uffink and P Vermaas and the participants in the seminars at the Center for Philosophy of Science in Pittsburgh especially N Belnap J Earman A Janis J Norton and J

Theory of the Electron J. Keller, 2005-12-19 In the first century after its discovery the electron has come to be a fundamental element in the analysis of physical aspects of nature This book is devoted to the construction of a deductive theory of the electron starting from first principles and using a simple mathematical tool geometric analysis Its purpose is to present a comprehensive theory of the electron to the point where a connection can be made with the main approaches to the study of the electron in physics The introduction describes the methodology Chapter 2 presents the concept of space time action relativity theory and in chapter 3 the mathematical structures describing action are analyzed Chapters 4 5 and 6 deal with the theory of the electron in a series of aspects where the geometrical analysis is more relevant Finally in chapter 7 the form of geometrical analysis used in the book is presented to elucidate the broad range of topics which are covered and the range of mathematical structures which are implicitly or explicitly included The book is directed to two different audiences of graduate students and research scientists primarily to theoretical physicists in the field of electron physics as well as those in the more general field of quantum mechanics elementary particle physics and general relativity secondly to mathematicians in the field of geometric analysis

Carl Friedrich von Weizsäcker: Major Texts in Physics Michael Drieschner, 2014-06-13 This book presents a collection of texts by the German physicist and philosopher Carl Friedrich von Weizsäcker 1912 2007 for use in seminars on the history epistemology and structure of physics Most texts appear in English for the first time Weizsäcker became famous through his works in physics mainly in the early development of nuclear physics Later he would also become well known as a philosopher and analyst of contemporary culture Texts include the original publications of the Weizsäcker Bethe formula of nuclear masses and the Bethe Weizsäcker cycle which explains the source of energy in the sun both were developed by Bethe at the same time and independently of Weizsäcker Further texts deal with Weizsäcker's explanation of the origin of planets his explanation of the time arrow in Statistical Mechanics and his analyses of Quantum Mechanics and the structure of physics in general

Introduction to Soliton Theory: Applications to Mechanics Ligia Munteanu, Stefania Donescu, 2006-07-06 This monograph is planned to provide the application of the soliton theory to solve certain practical problems selected from the fields of solid mechanics fluid mechanics and biomechanics The work is based mainly on the authors research carried out at their home institutes and on some specified significant results existing in the published literature The methodology to study a given evolution equation is to seek the waves of permanent form to test

whether it possesses any symmetry properties and whether it is stable and solitonic in nature Students of physics applied mathematics and engineering are usually exposed to various branches of nonlinear mechanics especially to the soliton theory The soliton is regarded as an entity a quasi particle which conserves its character and interacts with the surroundings and other solitons as a particle It is related to a strange phenomenon which consists in the propagation of certain waves without attenuation in dissipative media This phenomenon has been known for about 200 years it was described for example by the Joule Verne s novel Les histoires de Jean Marie Cabidoulins d Hetzel but its detailed quantitative description became possible only in the last 30 years due to the exceptional development of computers The discovery of the physical soliton is attributed to John Scott Russell In 1834 Russell was observing a boat being drawn along a narrow channel by a pair of horses

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