V. G. Bagrov and D. M. Gitman

Exact Solutions of
Relativistic Wave Equations

Exact Solutions Of Relativistic Wave Equations Mathematics And Its Applications

Ernest M. Loebl

Exact Solutions Of Relativistic Wave Equations Mathematics And Its Applications:

Exact Solutions of Relativistic Wave Equations V.G. Bagrov,D. Gitman,1990-02-28 Et moi si favait su comment en revenir One service mathematics bllS rendered the je n y serais point aile human race It hal put common sense back Jules Verne where it bdongs on the topmost shelf next to the dusty canister labelled discarded non The series is divergent therefore we may be sense able to do something with it Eric T Bell O Heaviside Mathematics is a tool for thOUght A highly necessary tool in a world where both feedback and non Iinearities abound Similarly all kinds of parts of mathematics serve as tools for other parts and for other sciences Applying a simple rewriting rule to the quote on the right above one finds such statements as One service topology has rendered mathematical physics One service logic has rendered com puter science One service category theory has rendered mathematics All arguably true And all statements obtainable this way form part of the raison d etre of this series *Evolution Processes and the Feynman-Kac Formula* Brian Jefferies,2013-03-09 This book is an outgrowth of ideas originating from 1 Kluvanek Unfortunately Professor Kluvanek did not live to contribute to the project of writing up in a systematic form the circle of ideas to which the present work is devoted It is more than likely that with his input the approach and areas of emphasis of the resulting exposition would have been quite different from what we have here Nevertheless the stamp of Kluvanek s thought and philosophy but not necessarily his approval abounds throughout this book Although the title gives no indication integration theory in vector spaces is a cen tral topic of this work However the various notions of integration developed here are intimately connected with a specific application the representation of evolutions by func tional integrals The representation of a perturbation to the heat semigroup in terms of Wiener measure is known as the Feynman Kac formula but the term has a wider meaning in the present work Traditionally such representations have been used to obtain analytic information about perturbations to free evolutions as an alternative to arguments with a more operator theoretic flavour No applications of this type are given here It is an un derlying assumption of the presentation of this material that representations of the nature of the Feynman Kac formula are worth obtaining and in the process of obtaining them we may be led to new possibly fertile mathematical structures a view largely motivated by the pervasive use of path integrals in quantum physics The Dirac Equation Bernd Thaller,2013-12-01 Ever since its invention in 1929 the Dirac equation has played a fundamental role in various areas of modern physics and mathematics Its applications are so widespread that a description of all aspects cannot be done with sufficient depth within a single volume In this book the emphasis is on the role of the Dirac equation in the relativistic quantum mechanics of spin 1 2 particles We cover the range from the description of a single free particle to the external field problem in quantum electrodynamics Relativistic quantum mechanics is the historical origin of the Dirac equation and has become a fixed part of the education of theoretical physicists There are some famous textbooks covering this area Since the appearance of these standard texts many books both physical and mathematical on the non relativistic Schrodinger equation have been published but only very few on the Dirac equation I

wrote this book because I felt that a modern comprehensive presentation of Dirac s electron theory satisfying some basic requirements of mathematical rigor was still missing **Many-Particle Dynamics and Kinetic Equations** C. Cercignani,U.I. Gerasimenko,D.Y. Petrina,2012-12-06 As our title suggests there are two aspects in the subject of this book The first is the mathematical investigation of the dynamics of infinite systems of in teracting particles and the description of the time evolution of their states The second is the rigorous derivation of kinetic equations starting from the results of the aforementioned investigation As is well known statistical mechanics started in the last century with some papers written by Maxwell and Boltzmann Although some of their statements seemed statistically obvious we must prove that they do not contradict what me chanics predicts In some cases in particular for equilibrium states it turns out that mechanics easily provides the required justification However things are not so easy if we take a step forward and consider a gas is not in equilibrium as is e g the case for air around a flying vehicle Questions of this kind have been asked since the dawn of the kinetic theory of gases especially when certain results appeared to lead to paradoxical conclu sions Today this matter is rather well understood and a rigorous kinetic theory is emerging The importance of these developments stems not only from the need of providing a careful foundation of such a basic physical theory but also to exhibit a prototype of a mathematical construct central to the theory of non equilibrium phenomena of macroscopic size *Guide to Information Sources in Mathematics and Statistics* Martha A. Tucker,Nancy D. Anderson,2004-09-30 This book is a reference for librarians mathematicians and statisticians involved in college and research level mathematics and statistics in the 21st century We are in a time of transition in scholarly communications in mathematics practices which have changed little for a hundred years are giving way to new modes of accessing information Where journals books indexes and catalogs were once the physical representation of a good mathematics library shelves have given way to computers and users are often accessing information from remote places Part I is a historical survey of the past 15 years tracking this huge transition in scholarly communications in mathematics Part II of the book is the bibliography of resources recommended to support the disciplines of mathematics and statistics These are grouped by type of material Publication dates range from the 1800 s onwards Hundreds of electronic resources some online both dynamic and static some in fixed media are listed among the paper resources Amazingly a majority of listed electronic resources are free *Group Theory and Its Applications* Ernest M. Loebl,2014-05-10 Group Theory and its Applications Volume II covers the two broad areas of applications of group theory namely all atomic and molecular phenomena as well as all aspects of nuclear structure and elementary particle theory This volume contains five chapters and begins with the representation and tensor operators of the unitary groups The next chapter describes wave equations both Schr dinger s and Dirac s for a wide variety of potentials These topics are followed by discussions of the applications of dynamical groups in dealing with bound state problems of atomic and molecular physics A chapter explores the connection between the physical constants of motion and the unitary group of the Hamiltonian the symmetry adaptation

with respect to arbitrary finite groups and the Dixon method for computing irreducible characters without the occurrence of numerical errors The last chapter deals with the study of the extension representation and applications of Galilei group This book will prove useful to mathematicians practicing engineers and physicists **Navier-Stokes Equations in Irregular Domains** L. Stupelis,2013-03-14 The analytical basis of Navier Stokes Equations in Irregular Domains is formed by coercive estimates which enable proofs to be given of the solvability of the boundary value problems for Stokes and Navier Stokes equations in weighted Sobolev and H lder spaces and the investigation of the smoothness of their solutions This allows one to deal with the special problems that arise in the presence of edges or angular points in the plane case at the boundary or noncompact boundaries Such problems cannot be dealt with in any of the usual ways Audience Graduate students research mathematicians and hydromechanicians whose work involves functional analysis and its applications to Navier Stokes equations *Orthogonal Polynomials in Two Variables* P.K. Suetin,2022-03-31 Presenting a comprehensive theory of orthogonal polynomials in two real variables and properties of Fourier series in these polynomials this volume also gives cases of orthogonality over a region and on a contour The text includes the classification of differential equations which admits orthogonal polynomials as eigenfunctions and several two dimensional analogies of classical orthogonal polynomials

Computational Strong-Field Quantum Dynamics Dieter Bauer,2017-04-24 This graduate textbook introduces the computational techniques to study ultra fast quantum dynamics of matter exposed to strong laser fields Coverage includes methods to propagate wavefunctions according to the time dependent Schr dinger Klein Gordon or Dirac equation the calculation of typical observables time dependent density functional theory multi configurational time dependent Hartree Fock time dependent configuration interaction singles the strong field approximation and the microscopic particle in cell approach Contents How to propagate a wavefunction Calculation of typical strong field observables Time dependent relativistic wave equations Numerics of the Dirac and the Klein Gordon equation Time dependent density functional theory The multiconfiguration time dependent Hartree Fock method Time dependent configuration interaction singles Strong field approximation and quantum orbits Microscopic particle in cell approach **Conformal Quantum Field Theory in D-dimensions** E.S. Fradkin,Mark Ya. Palchik,2013-03-14 Our prime concern in this book is to discuss some most interesting prosppcts that have occurred recently in conformally invariant quantum field theory in a D diuwnsional space One of the most promising trends is constructing an pxact solution for a cprtain class of models This task seems to be quite feasible in the light of recent resllits The situation here is to some extent similar to what was going on in the past ypars with the two dimensional quantum field theory Our investigation of conformal Ward identities in a D dimensional space carried out as far hack as the late H J7Gs showed that in the D dimensional quantum field theory irrespective of the type of interartion there exists a special set of states of the field with the following property if we rpqllire that one of these states should vanish this determines an exact solution of 3 certain field model These states are analogous to null vectors which determine the minimal

models in the two dimensional field theory On the other hand the recent resparches supplied us with a number of indications on the existencp of an intinite parampter algebra analogous to the Virasoro algebra in spaces of higher dimensions D 2 It has also been shown that this algebra admits an operator rentral expansion It seems to us that the above mentioned models are field theoretical realizations of the representations of these new symmetries for D 2 3 **Quantum Chaos and Mesoscopic Systems** N.E. Hurt,1997-02-28 4 2 Variance of Quantum Matrix Elements 125 4 3 Berry s Trick and the Hyperbolic Case 126 4 4 Nonhyperbolic Case 128 4 5 Random Matrix Theory 128 4 6 Baker s Map and Other Systems 129 4 7 Appendix Baker s Map 129 5 Error Terms 133 5 1 Introduction 133 5 2 The Riemann Zeta Function in Periodic Orbit Theory 135 5 3 Form Factor for Primes 137 5 4 Error Terms in Periodic Orbit Theory Co compact Case 138 5 5 Binary Quadratic Forms as a Model 139 6 Co Finite Model for Quantum Chaology 141 6 1 Introduction 141 6 2 Co finite Models 141 6 3 Geodesic Triangle Spaces 144 6 4 L Functions 145 6 5 Zelditch s Prime Geodesic Theorem 146 6 6 Zelditch s Pseudo Differential Operators 147 6 7 Weyl s Law Generalized 148 6 8 Equidistribution Theory 150 7 Landau Levels and L Functions 153 7 1 Introduction 153 7 2 Landau Model Mechanics on the Plane and Sphere 153 7 3 Landau Model Mechanics on the Half Plane 155 7 4 Selberg s Spectral Theorem 157 7 5 Pseudo Billiards 158 7 6 Landau Levels on a Compact Riemann Surface 159 7 7 Automorphic Forms 160 7 8 Maass Selberg Trace Formula 162 7 9 Degeneracy by Selberg 163 7 10 Hecke Operators 163 7 11 Selberg Trace Formula for Hecke Operators 167 7 12 Eigenvalue Statistics on X 169 7 13 Mesoscopic Devices 170 7 14 Hall Conductance on Leaky Tori 170 7 Instabilities and Nonequilibrium Structures IV E. Tirapegui,W. Zeller,2012-12-06 We have classified the articles presented here in two Sections according to their general content In Part I we have included papers which deal with statistical mechanics math ematical aspects of dynamical systems and sthochastic effects in nonequilibrium systems Part II is devoted mainly to instabilities and self organization in extended nonequilibrium systems The study of partial differential equations by numerical and analytic methods plays a great role here and many works are related to this subject Most recent developments in this fascinating and rapidly growing area are discussed PART I STATISTICAL MECHANICS AND RELATED TOPICS NONEQUILIBRIUM POTENTIALS FOR PERIOD DOUBLING R Graham and A Hamm Fachbereich Physik Universitiit Gesamthochschule Essen D4300 Essen 1 Germany ABSTRACT In this lecture we consider the influence of weak stochastic perturbations on period doubling using nonequilibrium potentials a concept which is explained in section 1 and formulated for the case of maps in section 2 In section 3 nonequilibrium potentials are considered for the family of quadratic maps a at the Feigenbaum attractor with Gaussian noise b for more general non Gaussian noise and c for the case of a strange repeller Our discussion will be informal A more detailed account of this and related material can be found in our papers 1 3 and in the reviews 4 5 where further references to related work are also given 1 *New Technical Books* New York Public Library,1991 Analytic-Bilinear Approach to Integrable Hierarchies L.V. Bogdanov,1999-08-31 The subject of this book is the hierarchies of integrable equations connected with the one

component and multi component loop groups There are many publications on this subject and it is rather well defined Thus the author would like t o explain why he has taken the risk of revisiting the subject The Sato Grassmannian approach and other approaches standard in this context reveal deep mathematical structures in the base of the integrable hi erarchies These approaches concentrate mostly on the algebraic picture and they use a language suitable for applications to quantum field theory Another well known approach the a dressing method developed by S V Manakov and V E Zakharov is oriented mostly to particular systems and ex act classes of their solutions There is more emphasis on analytic properties and the technique is connected with standard complex analysis The language of the a dressing method is suitable for applications to integrable nonlinear PDEs integrable nonlinear discrete equations and as recently discovered for t he applications of integrable systems to continuous and discret e geometry The primary motivation of the author was to formalize the approach to int e grable hierarchies that was developed in the context of the a dressing method preserving the analytic struetures characteristic for this method but omitting the peculiarit ies of the construetive scheme And it was desirable to find a start

Mathematical Reviews ,2004   **The Theory of Anisotropic Elastic Plates** T.S. Vashakmadze,2013-11-27 The main purpose of this work is construction of the mathematical theory of elastic plates and shells by means of which the investigation of basic boundary value problems of the spatial theory of elasticity in the case of cylindrical do mains reduces to the study of two dimensional boundary value problems BVP of comparatively simple structure In this respect in sections 2 5 after the introductory material methods of re duction known in the literature as usually being based on simplifying hypotheses are studied Here in contradiction to classical methods the problems connected with construction of refined theories of anisotropic nonhomogeneous plates with variable thickness without the assumption of any physical and geometrical re strictions are investigated The comparative analysis of such reduction methods was carried out and in particular in section 5 the following fact was established the error transition occuring with substitution of a two dimensional model for the initial problem on the class of assumed solutions is restricted from below Further in section 6 Vekua s method of reduction containing regular pro cess of study of three dimensional problem is investigated In this direction the problems connected with solvability convergence of processes and construction of effective algorithms of approximate solutions are studied   **Theory of Spinors and Its Application in Physics and Mechanics** Vladimir A. Zhelnorovich,2019-10-24 This book contains a systematic exposition of the theory of spinors in finite dimensional Euclidean and Riemannian spaces The applications of spinors in field theory and relativistic mechanics of continuous media are considered The main mathematical part is connected with the study of invariant algebraic and geometric relations between spinors and tensors The theory of spinors and the methods of the tensor representation of spinors and spinor equations are thoroughly expounded in four dimensional and three dimensional spaces Very useful and important relations are derived that express the derivatives of the spinor fields in terms of the derivatives of various tensor fields The problems associated with an invariant description of

spinors as objects that do not depend on the choice of a coordinate system are addressed in detail As an application the author considers an invariant tensor formulation of certain classes of differential spinor equations containing in particular the most important spinor equations of field theory and quantum mechanics Exact solutions of the Einstein Dirac equations nonlinear Heisenberg s spinor equations and equations for relativistic spin fluids are given The book presents a large body of factual material and is suited for use as a handbook It is intended for specialists in theoretical physics as well as for students and post graduate students of physical and mathematical specialties   Fractional Calculus: New Applications in Understanding Nonlinear Phenomena Mehmet Yavuz,Necati Özdemir,2022-12-14 In the last two decades many new fractional operators have appeared often defined using integrals with special functions in the kernel as well as their extended or multivariable forms Modern operators in fractional calculus have different properties which are comparable to those of classical operators These have been intensively studied formodelling and analysing real world phenomena There is now a growing body of research on new methods to understand natural occurrences and tackle different problems This book presents ten reviews of recent fractional operators split over three sections 1 Chaotic Systems and Control covers the Caputo fractional derivative and a chaotic fractional order financial system 2 Heat Conduction covers the Duhamel theorem for time dependent source terms and the Cattaneo Hristov model for oscillatory heat transfer 3 Computational Methods and Their Illustrative Applications covers mathematical analysis for understanding 5 real word phenomena HTLV 1 infection of CD4 T cells traveling waves rumor spreading biochemical reactions and the computational fluid dynamics of a non powered floating object navigating in an approach channel This volume is a resource for researchers in physics biology behavioral sciences and mathematics who are interested in new applications of fractional calculus in the study of nonlinear phenomena

   Stochasticity and Quantum Chaos Z. Haba,Wojciech Cegla,Lech Jakóbczyk,2013-03-07 These are the proceedings of the Third Max Born Symposium which took place at SobOtka Castle in September 1993 The Symposium is organized annually by the Institute of Theoretical Physics of the University of Wroclaw Max Born was a student and later on an assistant at the University of Wroclaw Wroclaw belonged to Germany at this time and was called Breslau The topic of the Max Born Sympo sium varies each year reflecting the developement of theoretical physics The subject of this Symposium Stochasticity and quantum chaos may well be considered as a continuation of the research interest of Max Born Recall that Born treats his Lectures on the mechanics of the atom published in 1925 as a nrst volume of a complete monograph supposedly to be written by another person His lectures concern the quantum mechanics of integrable systems The quantum mechanics of non integrable systems was the subject of the Third Max Born Symposium It is known that classical non integrable Hamiltonian systems show a chaotic behaviour On the other hand quantum systems bounded in space are quasiperi odic We believe that quantum systems have a reasonable classical limit It is not clear how to reconcile the seemingly regular behaviour of quantum systems with the possible chaotic properties of their classical counterparts The quantum proper ties of classically

chaotic systems constitute the main subject of these Proceedings Other topics discussed are the quantum mechanics of dissipative systems quantum measurement theory the role of noise in classical and quantum systems __Wave Equations in Higher Dimensions__ Shi-Hai Dong,2011-07-09 Higher dimensional theories have attracted much attention because they make it possible to reduce much of physics in a concise elegant fashion that unifies the two great theories of the 20th century Quantum Theory and Relativity This book provides an elementary description of quantum wave equations in higher dimensions at an advanced level so as to put all current mathematical and physical concepts and techniques at the reader s disposal A comprehensive description of quantum wave equations in higher dimensions and their broad range of applications in quantum mechanics is provided which complements the traditional coverage found in the existing quantum mechanics textbooks and gives scientists a fresh outlook on quantum systems in all branches of physics In Parts I and II the basic properties of the SO n group are reviewed and basic theories and techniques related to wave equations in higher dimensions are introduced Parts III and IV cover important quantum systems in the framework of non relativistic and relativistic quantum mechanics in terms of the theories presented in Part II In particular the Levinson theorem and the generalized hypervirial theorem in higher dimensions the Schr dinger equation with position dependent mass and the Kaluza Klein theory in higher dimensions are investigated In this context the dependence of the energy levels on the dimension is shown Finally Part V contains conclusions outlooks and an extensive bibliography

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