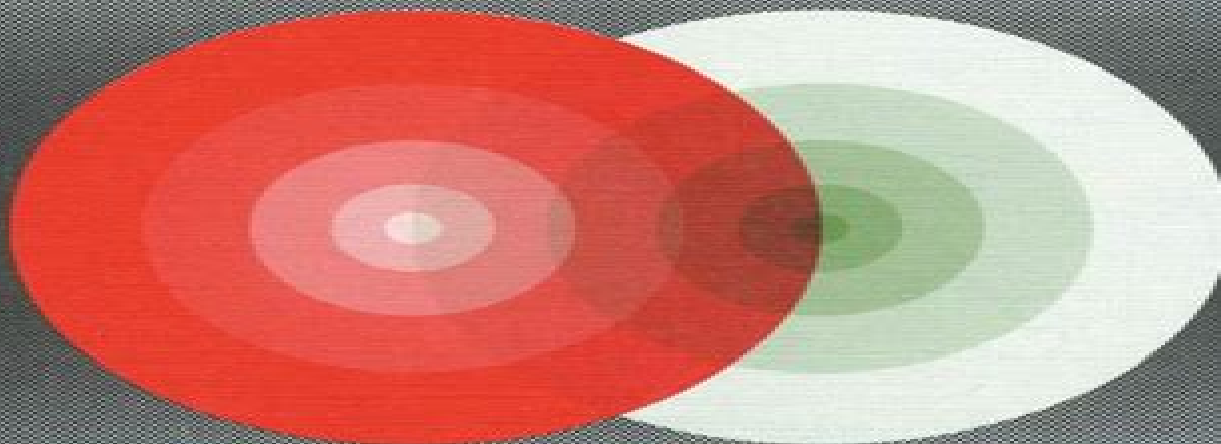


# **New Developments on Fundamental Problems in Quantum Physics**

Edited by  
**Miguel Ferrero and  
Alwyn van der Merwe**

**Kluwer Academic Publishers**



**Fundamental Theories of Physics**

# New Developments On Fundamental Problems In Quantum Physics

**M.A. Trump, W.C. Schieve**



## **New Developments On Fundamental Problems In Quantum Physics:**

**New Developments on Fundamental Problems in Quantum Physics** M. Ferrero, Alwyn van der Merwe, 2012-12-06  
Quantum theory is one of the most fascinating and successful constructs in the intellectual history of mankind. Nonetheless, the theory has very shaky philosophical foundations. This book contains thoughtful discussions by eminent researchers of a spate of experimental techniques newly developed to test some of the stranger predictions of quantum physics. The advances considered include recent experiments in quantum optics, electron and ion interferometry, photon down conversion in nonlinear crystals, single trapped ions interacting with laser beams, atom field coupling in micromaser cavities, quantum computation, quantum cryptography, decoherence and macroscopic quantum effects, the quantum state diffusion model, quantum gravity, the quantum mechanics of cosmology and quantum non locality along with the continuing debate surrounding the interpretation of quantum mechanics. Audience: The book is intended for physicists, philosophers of science, mathematicians, graduate students and those interested in the foundations of quantum theory. **New Developments on Fundamental Problems in Quantum Physics** Miguel Ferrero Melgar, Susana Fernández, 1996 *Current Research in Operational Quantum Logic* Bob Coecke, David Moore, Alexander Wilce, 2013-06-29 The present volume has its origins in a pair of informal workshops held at the Free University of Brussels in June of 1998 and May of 1999 named Current Research 1 in Operational Quantum Logic. These brought together mathematicians and physicists working in operational quantum logic and related areas as well as a number of interested philosophers of science for a rare opportunity to discuss recent developments in this field. After some discussion it was decided that rather than producing a volume of conference proceedings we would try to organize the conferees to produce a set of comprehensive survey papers which would not only report on recent developments in quantum logic but also provide a tutorial overview of the subject suitable for an interested non specialist audience. The resulting volume provides an overview of the concepts and methods used in current research in quantum logic viewed both as a branch of mathematical physics and as an area of pure mathematics. The first half of the book is concerned with the algebraic side of the subject and in particular the theory of orthomodular lattices and posets, effect algebras etc. In the second half of the book special attention is given to categorical methods and to connections with theoretical computer science. At the 1999 workshop we were fortunate to hear three excellent lectures by David J. Foulis represented here by two contributions. Dave's work spanning 40 years has helped to define and continues to reshape the field of quantum logic. **Fundamental Problems in Quantum Physics** M. Ferrero, Alwyn van der Merwe, 2013-06-29 For many physicists quantum theory contains strong conceptual difficulties while for others the apparent conclusions about the reality of our physical world and the ways in which we discover that reality remain philosophically unacceptable. This book focuses on recent theoretical and experimental developments in the foundations of quantum physics including topics such as the puzzles and paradoxes which appear when general relativity and quantum mechanics are combined, the emergence of

classical properties from quantum mechanics stochastic electrodynamics EPR experiments and Bell's Theorem the consistent histories approach and the problem of datum uniqueness in quantum mechanics non local measurements and teleportation of quantum states quantum non demolition measurements in optics and matter wave properties observed by neutron electron and atomic interferometry Audience This volume is intended for graduate students of physics and those interested in the foundations of quantum theory

*Theory of the Electron* J. Keller, 2001-11-30 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

Nonperturbative Quantum Field Theory and the Structure of Matter T. Borne, G. Lochak, H. Stumpf, 2005-12-19 This book which presents a new view of quantum field theory may serve as a research monograph and an alternative textbook examining topics which are not usually treated in conventional works Audience This volume will appeal to researchers concerned with the foundation of the theory of matter and forces including gravitation It will also be interesting to those working with quantum field theoretic methods in various disciplines such as particle physics nuclear physics condensed matter physics and relativity Jacket

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

*Controlled Nucleosynthesis* Stanislav Adamenko, Franco Selleri, Alwyn van der Merwe, 2007-04-17 This book ushers in a new era of experimental and theoretical investigations into collective processes structure formation and self organization of nuclear matter It reports the results of experiments wherein for the first time the nuclei constituting our world those displayed in Mendeleev's table as well as the super heavy ones have been artificially created Pioneering breakthroughs are described achieved at the Proton 21 Laboratory Kiev Ukraine in a variety of new physical and technological directions

*Causality and Locality in Modern Physics* G. Hunter, Stanley Jeffers, J.P. Vigier, 2013-06-29 The Symposium entitled Causality and Locality in Modern Physics and Astronomy Open Questions and Possible Solutions was held at York University Toronto during the last week of August 1997 It was a sequel to a similar symposium entitled The Present Status of the Quantum Theory of Light held at the same venue in August 1995 These symposia came about as a result of discussions between Professor Stanley Jeffers and colleagues on the International Organizing Committee Professor Jeffers was the executive local organizer of the symposia The 1997 symposium attracted over 120 participants representing 26 different countries and academic institutions The broad theme of both symposia was the enigma of modern physics the non local and possibly superluminal interactions implied by quantum mechanics the structure of fundamental particles including the photon the reconciliation of quantum mechanics with the theory of relativity and the nature of gravity and inertia Jean Pierre Vigier was the guest of honour at both symposia He was a lively contributor to the discussions of the presentations The presentations were made as 30 minute lectures or during an evening poster session Some participants did not submit a written account of their presentation at the symposium and not all of the articles submitted for the Proceedings could be included because of the publisher's page limit The titles and authors of the papers that had to be excluded are listed in an appendix

*Probing The Meaning Of Quantum Mechanics: Physical, Philosophical, And Logical Perspectives* Diederik Aerts, Sven Aerts, Christian De Ronde, 2014-03-06 This book provides a new original perspective on one of the most fascinating and important open questions in science What is quantum mechanics talking about Quantum theory is perhaps our best confirmed physical theory However in spite of its great empirical effectiveness and the subsequent technological developments that it gave rise to in the 20th century from the interpretation of the periodic table of elements to CD players holograms and quantum state teleportation it stands even today without a universally accepted interpretation The novelty of the book comes from the multiple viewpoints and the original angles taken by a group of young researchers from Europe and South America who gathered for several years under the auspices of the Center Leo Apostel Each member of the group presented ideas concerning the interpretation of quantum mechanics We had discussions ranging from the philosophical underpinnings of local realism and holism information and decision theoretic approaches to quantum theory all the way to the many worlds interpretation Strikingly in much the same way as different and indeed

incompatible observations are needed to fully describe the physical state of affairs in quantum mechanics the various interpretations of the theory also seem to shed viable but not necessarily compatible perspectives on different aspects of the same grand framework The discussions that followed were both technical and lively but perhaps their most remarkable quality was the absence of rigid points of view that unfortunately seems to paralyze so much of the discussion in this area This book is an expression which can be interesting not only to the specialists but also for the general public attempting to get a grasp on one of the still most fundamental questions of present physics

*Maximum Entropy and Bayesian Methods*  
Garching, Germany 1998 Wolfgang von der Linden, Volker Dose, Rainer Fischer, Roland Preuss, 1999-07-31

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

**Hierarchical Methods V.**  
Kulish, 2006-04-11

The book consists of two Volumes The first the preceding volume is devoted to the general nonlinear theory of the hierarchical dynamic oscillative wave systems This theory has been called the theory of hierarchical oscillations and waves Here two aspects of the proposed theory are discussed The first aspects concern the fundamental nature and the basic concepts and ideas of a new hierarchical approach to studying hierarchical dynamic systems A new hierarchical paradigm is proposed as a basis of a new point of view of such types of systems In turn a set of hierarchical principles is formulated as the fundamental basis of this paradigm Therein the self-resemblance holographic principle plays a key role here An adequate mathematical description factorization of the proposed paradigm is carried out The concepts of structural and dynamic functional operators are put into the basis of this description Electrodynamics is chosen as a convenient basis for an obvious demonstration of some key points of the proposed new theory The second aspect has a purely mathematical nature It is related to the form of factorization i.e. mathematical description of hierarchical types of dynamic models and discussion of the methods of their mathematical analysis A set of the hierarchical asymptotic analytical numerical methods is

given as an evidence of the practical effectiveness of the proposed version of hierarchical theory      Statistical Geometry and Applications to Microphysics and Cosmology S. Roy, 2012-12-06 Recent results from high energy scattering and theoretical developments of string theory require a change in our understanding of the basic structure of space time This book is about the advancement of ideas on the stochastic nature of space time from the 1930s onward In particular the author promotes the concept of space as a set of hazy lumps first introduced by Karl Menger and constructs a novel framework for statistical behaviour at the microlevel The various chapters address topics such as space time fluctuation and random potential non local fields and the origin of stochasticity Implications in astro particle physics and cosmology are also explored Audience This volume will be of interest to physicists chemists and mathematicians involved in particle physics astrophysics and cosmology      *Quantum Mechanics In Nonlinear Systems* Xiao-feng Pang, 2005-04-18 In the history of physics and science quantum mechanics has served as the foundation of modern science This book discusses the properties of microscopic particles in nonlinear systems principles of the nonlinear quantum mechanical theory and its applications in condensed matter polymers and biological systems The book is essentially composed of three parts The first part presents a review of linear quantum mechanics as well as theoretical and experimental fundamentals that establish the nonlinear quantum mechanical theory The theory itself and its essential features are covered in the second part In the final part extensive applications of this theory in physics biology and polymer are introduced The whole volume forms a complete system of nonlinear quantum mechanics The book is intended for researchers graduate students as well as upper level undergraduates

*Theory of High Temperature Superconductivity* S. Fujita, S. Godoy, 2006-04-11 Flux quantization experiments indicate that the carriers Cooper pairs pairons in the supercurrent have charge magnitude  $2e$  and that they move independently Josephson interference in a Superconducting Quantum Interference Device SQUID shows that the centers of masses CM of pairons move as bosons with a linear dispersion relation Based on this evidence we develop a theory of superconductivity in conventional and materials from a unified point of view Following Bardeen Cooper and Schrieffer BCS we regard the phonon exchange attraction as the cause of superconductivity For cuprate superconductors however we take account of both optical and acoustic phonon exchange BCS started with a Hamiltonian containing electron and hole kinetic energies and a pairing interaction with the phonon variables eliminated These electrons and holes were introduced formally in terms of a free electron model which we consider unsatisfactory We define electrons and holes in terms of the curvatures of the Fermi surface Electrons 1 and holes 2 are different and so they are assigned with different effective masses Blatt Schafroth and Butler proposed to explain superconductivity in terms of a Bose Einstein Condensation BEC of electron pairs each having mass  $M$  and a size The system of free massive bosons having a quadratic dispersion relation and moving in three dimensions 3D undergoes a BEC transition at where is the pair density      **The Geometry of Hamilton and Lagrange Spaces** R.

Miron, Dragos Hrimiuc, Hideo Shimada, Sorin V. Sabau, 2006-04-11 The title of this book is no surprise for people working in

the field of Analytical Mechanics However the geometric concepts of Lagrange space and Hamilton space are completely new The geometry of Lagrange spaces introduced and studied in 76 96 was extensively examined in the last two decades by geometers and physicists from Canada Germany Hungary Italy Japan Romania Russia and U S A Many international conferences were devoted to debate this subject proceedings and monographs were published 10 18 112 113 A large area of applicability of this geometry is suggested by the connections to Biology Mechanics and Physics and also by its general setting as a generalization of Finsler and Riemannian geometries The concept of Hamilton space introduced in 105 101 was intensively studied in 63 66 97 and it has been successful as a geometric theory of the Hamiltonian function the fundamental entity in Mechanics and Physics The classical Legendre's duality makes possible a natural connection between Lagrange and Hamilton spaces It reveals new concepts and geometrical objects of Hamilton spaces that are dual to those which are similar in Lagrange spaces Following this duality Cartan spaces introduced and studied in 98 99 are roughly speaking the Legendre duals of certain Finsler spaces 98 66 67 The above arguments make this monograph a continuation of 106 113 emphasizing the Hamilton geometry

**Precisely Predictable Dirac Observables** Heinz Otto Cordes, 2007-01-10 In this book we are attempting to offer a modification of Dirac's theory of the electron we believe to be free of the usual paradoxa so as perhaps to be acceptable as a clean quantum mechanical treatment While it seems to be a fact that the classical mechanics from Newton to Einstein's theory of gravitation offers a very rigorous concept free of contradictions and able to accurately predict motion of a mass point quantum mechanics even in its simplest cases does not seem to have this kind of clarity Almost it seems that everyone of its fathers had his own wave equation For the quantum mechanical 1 body problem with vanishing potentials let us focus on 3 different wave equations I The Klein Gordon equation 3 2 2 2 1 t 1 0 Laplacian  $\nabla^2$  1 This equation may be written as  $\partial_t^2 \psi = \nabla^2 \psi$  Here it may be noted that the operator  $\partial_t^2$  has a well defined positive square root as unbounded self adjoint positive operator of the Hilbert  $L^2$  space  $H^1$  **The Universe of Fluctuations** B. G. Sidharth, 2006-03-30 The Universe of Fluctuations The Architecture of Spacetime and the Universe is a path breaking work which proposes solutions to the impasse and crisis facing fundamental physics and cosmology It describes a cosmological model based on fuzzy spacetime that has correctly predicted a dark energy driven acceleration of our expanding universe with a small cosmological constant at a time when the popular belief was quite the contrary It describes how the Universe is made up of an underpinning of Planck oscillators in a Quantum Vacuum This leads to amongst other things a characterization of gravitation as being distributional over the entire Universe thereby providing an answer to a puzzle brought to light by Weinberg years ago and since overlooked There is also a simple formula for the mass spectrum of all known elementary particles based on QCD dynamics Many other interesting ramifications and experimental tests for the future are also discussed This apart there is a brief survey of some of the existing theories The book is accessible to junior and senior researchers in High Energy Physics and Cosmology as well as the serious graduate student in Physics

**Nuclear Matter in Different Phases and**



**Transitions** Jean-Paul Blaizot,Xavier Campi,Marek Ploszajczak,2012-12-06 Nuclei in their ground states behave as quantum fluids Fermi liquids When the density or the temperature of that fluid increases various phase transitions may occur Thus for moderate excitation energies of the order of a few MeV per nucleon nuclear matter behaves as an ordinary fluid with gaseous and liquid phases and a coexistence region below a critical temperature For higher excitation energies of the order of a few Ge V per nucleon the composition of nuclear matter changes nucleons being gradually turned into baryonic resonances of various kinds Finally when the energy density exceeds some few GeV fm nuclear matter turns into a gas of weakly interacting quarks and gluons This new phase of matter has been called the quark gluon plasma and its existence is a prediction of Quantum Chromodynamics Collisions of heavy ions produce nuclear matter with various degrees of excitation In fact by selecting the impact parameter and the bombarding energy one can produce nuclear matter with specified baryonic density and excitation energy Several major experimental programs are under way for instance at GANIL with the detector INDRA at GSI with the detector ALADIN at the CERN SPS at the AGS of Brookhaven etc or are in preparation RHIC LHC etc The goal of these experiments is to get evidence for the different phases of nuclear matter predicted by the theory and to study their properties

**Classical Relativistic Many-Body Dynamics** M.A. Trump,W.C. Schieve,2013-03-09 in this work we must therefore assume several abstract concepts that hardly need defending at this point in the history of mechanics Most notably these include the concept of the point particle and the concept of the inertial observer The study of the relativistic particle system is undertaken here by means of a particular classical theory which also exists on the quantum level and which is especially suited to the many body system in flat spacetime In its fundamental postulates the theory may be considered to be primarily the work of E C G Stüickelberg in the 1940 s and of L P Horwitz and C Piron in the 1970 s who may be said to have provided the generalization of Stüickelberg s theory to the many body system The references for these works may be found in Chapter 1 The theory itself may be legitimately called off shell Hamiltonian dynamics parameterized relativistic mechanics or even classical event dynamics The most important feature of the theory is probably the use of an invariant world time parameter usually denoted  $T$  which provides an evolution time for the system in such a way as to allow manifest covariance within a Hamiltonian formalism In general this parameter is neither a Lorentz frame time nor the proper time of the particles in the system

The Top Books of the Year New Developments On Fundamental Problems In Quantum Physics The year 2023 has witnessed a noteworthy surge in literary brilliance, with numerous compelling novels enthraling the hearts of readers worldwide. Lets delve into the realm of bestselling books, exploring the captivating narratives that have charmed audiences this year. The Must-Read : Colleen Hoover "It Ends with Us" This poignant tale of love, loss, and resilience has captivated readers with its raw and emotional exploration of domestic abuse. Hoover expertly weaves a story of hope and healing, reminding us that even in the darkest of times, the human spirit can triumph. New Developments On Fundamental Problems In Quantum Physics : Taylor Jenkins Reids "The Seven Husbands of Evelyn Hugo" This spellbinding historical fiction novel unravels the life of Evelyn Hugo, a Hollywood icon who defies expectations and societal norms to pursue her dreams. Reids captivating storytelling and compelling characters transport readers to a bygone era, immersing them in a world of glamour, ambition, and self-discovery. Discover the Magic : Delia Owens "Where the Crawdads Sing" This captivating coming-of-age story follows Kya Clark, a young woman who grows up alone in the marshes of North Carolina. Owens spins a tale of resilience, survival, and the transformative power of nature, captivating readers with its evocative prose and mesmerizing setting. These popular novels represent just a fraction of the literary treasures that have emerged in 2023. Whether you seek tales of romance, adventure, or personal growth, the world of literature offers an abundance of captivating stories waiting to be discovered. The novel begins with Richard Papen, a bright but troubled young man, arriving at Hampden College. Richard is immediately drawn to the group of students who call themselves the Classics Club. The club is led by Henry Winter, a brilliant and charismatic young man. Henry is obsessed with Greek mythology and philosophy, and he quickly draws Richard into his world. The other members of the Classics Club are equally as fascinating. Bunny Corcoran is a wealthy and spoiled young man who is always looking for a good time. Charles Tavis is a quiet and reserved young man who is deeply in love with Henry. Camilla Macaulay is a beautiful and intelligent young woman who is drawn to the power and danger of the Classics Club. The students are all deeply in love with Morrow, and they are willing to do anything to please him. Morrow is a complex and mysterious figure, and he seems to be manipulating the students for his own purposes. As the students become more involved with Morrow, they begin to commit increasingly dangerous acts. The Secret History is a masterful and gripping novel that will keep you speculating until the very end. The novel is a cautionary tale about the dangers of obsession and the power of evil.

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