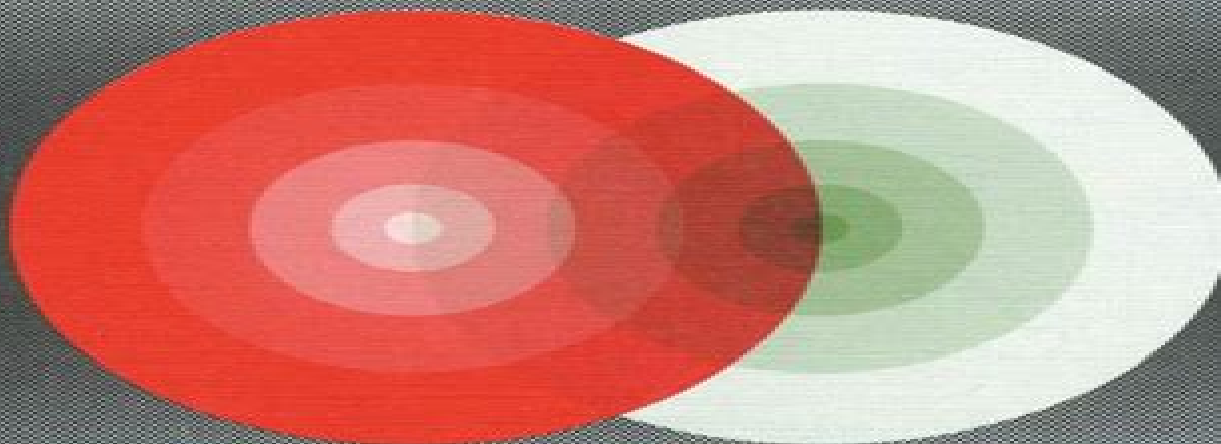


# **New Developments on Fundamental Problems in Quantum Physics**

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

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**Fundamental Theories of Physics**

# New Developments On Fundamental Problems In Quantum Physics

**G. Hunter, Stanley Jeffers, J.P. Vigiér**



## **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. 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      **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 I. Davis, 2013-06-29 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      Causality and Locality in Modern Physics G. Hunter, Stanley Jeffers, J.P. Vigiér, 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 Vigiér 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 of 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 astroparticle 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

### **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

### **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 paradoxes 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  $\square \psi + m^2 \psi = 0$  Laplacian  $\Delta \psi = 0$  This equation may be written as  $\Delta \psi + m^2 \psi = 0$  Here it may be noted that the operator  $\square$  has a well defined positive square root as unbounded self adjoint positive operator of the Hilbert space  $H^1(\mathbb{R}^3)$

**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 1966 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 1951 was intensively studied in 1963 1966 1997 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 1989 1999 are roughly speaking the Legendre duals of certain Finsler spaces 1986 1966 1967 The above arguments make this monograph a continuation of 106 113 emphasizing the Hamilton geometry

**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 Stückelberg 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 Stückelberg'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

**Advances in Atomic, Molecular, and Optical Physics** Benjamin Bederson, Herbert Walther, 1999-09-29 This series established in 1965 is concerned with recent developments in the general area of atomic molecular and optical physics The field is in a state of rapid growth as new experimental and theoretical techniques are used on many old and new problems Topics covered also include related applied areas such as atmospheric science astrophysics surface physics and laser physics

*Relativity in Rotating Frames* G. Rizzi, M.L. Ruggiero, 2013-03-09 Even if the subject is a long standing one this is the first monograph on this field On the one hand this book is intended to give a rather wide review on this field both in a historical and pedagogical perspective on the other hand it aims at critically re examining and discussing the most controversial issues For instance according to some authors the celebrated Sagnac effect is a disproof of the theory of relativity applied to rotating frames according to others it is an astonishing experimental evidence of the relativistic theory In order to give the reader a deeper insight into this research field the contributing authors discuss their



opinions on the main subjects in an enthralling virtual round table in this way the reader can get a direct comparison of the various viewpoints on the most controversial and interesting topics This is particularly expedient since the differences in the various approaches are often based upon subtleties that can be understood only by a direct comparison of the underlying hypotheses *Interpreting quantum mechanics: a historical approach* Favio, Vitery Cala,Édgar Gustavo, Eslava

Castañeda,2016-03-02 This book condenses some of the critical features of the discussion about the interpretative problems of quantum mechanics pointing out some possible ways out of the conundrum In order to set the road for these matters chapter one introduces a conceptual history of the theory and its alternative interpretations Chapter two profiles a taxonomy of the interpretative problems and some possible solutions focused in the so called measurement problem Chapter three questions the thesis of quantum mechanics becoming what it is due to historical contingency Finally in chapter four an argument is advanced to consider one particular interpretation the causal account as an alternative view that may help with the solution of the interpretative knot **Black Holes, Gravitational Radiation and the Universe** B.R. Iyer,B.

Bhawal,2013-06-29 Our esteemed colleague C V Vishveshwara popularly known as Vishu turned sixty on 6th March 1998 His colleagues and well wishers felt that it would be appropriate to celebrate the occasion by bringing out a volume in his honour Those of us who have had the good fortune to know Vishu know that he is unique in a class by himself Having been given the privilege to be the volume s editors we felt that we should attempt something different in this endeavour Vishu is one of the well known relativists from India whose pioneer ing contributions to the studies of black holes is universally recognised He was a student of Charles Misner His Ph D thesis on the stability of the Schwarzschild black hole coordinate invariant characterisation of the stationary limit and event horizon for Kerr black holes and subsequent seminal work on quasi normal modes of black holes have passed on to become the starting points for detailed mathematical investigations on the nature of black holes He later worked on other aspects related to black holes and compact objects Many of these topics have matured over the last thirty years New facets have also developed and become current areas of vigorous research interest No longer are black holes ultracompact objects or event horizons mere idealisations of mathematical physicists but concrete entities that astrophysicists detect measure and look for Astrophysical evidence is mounting up steadily for black holes

## Reviewing **New Developments On Fundamental Problems In Quantum Physics**: Unlocking the Spellbinding Force of Linguistics

In a fast-paced world fueled by information and interconnectivity, the spellbinding force of linguistics has acquired newfound prominence. Its capacity to evoke emotions, stimulate contemplation, and stimulate metamorphosis is really astonishing. Within the pages of "**New Developments On Fundamental Problems In Quantum Physics**," an enthralling opus penned by a very acclaimed wordsmith, readers embark on an immersive expedition to unravel the intricate significance of language and its indelible imprint on our lives. Throughout this assessment, we shall delve into the book's central motifs, appraise its distinctive narrative style, and gauge its overarching influence on the minds of its readers.

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