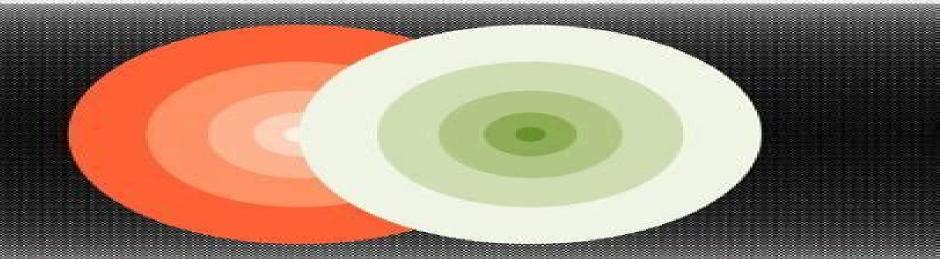
# **Relativity in Rotating Frames**

**Relativistic Physics in Rotating Reference Frames** 

# Guido Rizzi and Matteo Luca Ruggiero

**Kluwer Academic Publishers** 



# **Fundamental Theories of Physics**

# <u>Relativity In Rotating Frames Relativistic Physics In</u> <u>Rotating Reference Frames</u>

John L. Friedman, Nikolaos Stergioulas

#### **Relativity In Rotating Frames Relativistic Physics In Rotating Reference Frames:**

**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 disproval 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

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**Relativistic Forces in Special and General Relativity** Adrian Sfarti,2023-03-28 This book presents a generalization of transforms from the frames co moving with an accelerated particle for uniform circular or linear motion into an inertial frame

of reference The solutions presented here will be of great interest for real time applications because earth bound laboratories are inertial only in approximation The motivation behind this is that real life applications include accelerating and rotating frames with arbitrary orientations more often than the idealized case of inertial frames The book is divided into three main sections the first deals with the theory of dynamics while the second section deals with the application of theory to the derivation of the relativistic fictitious forces Coriolis centrifugal and Euler occurring in a rotating frame and D Alembert for a linearly accelerated frame The third section deals with the Thomas Wigner effect This is the first book on the subject and it will be of great interest for physics students physics professors and engineers Rotating Relativistic Stars John L. Friedman, Nikolaos Stergioulas, 2013-02-11 The masses of neutron stars are limited by an instability to gravitational collapse and an instability driven by gravitational waves limits their spin Their oscillations are relevant to x ray observations of accreting binaries and to gravitational wave observations of neutron stars formed during the coalescence of double neutron star systems This volume includes more than forty years of research to provide graduate students and researchers in astrophysics gravitational physics and astronomy with the first self contained treatment of the structure stability and oscillations of rotating neutron stars This monograph treats the equations of stellar equilibrium key approximations including slow rotation and perturbations of spherical and rotating stars stability theory and its applications from convective stability to the r mode instability and numerical methods for computing equilibrium configurations and the nonlinear evolution of their oscillations The presentation of fundamental equations results and applications is accessible to readers who do not need Special Relativity, Electrodynamics, and General Relativity John B. Kogut, 2018-01-09 the detailed derivations Special Relativity Electrodynamics and General Relativity From Newton to Einstein is intended to teach students of physics astrophysics astronomy and cosmology how to think about special and general relativity in a fundamental but accessible way Designed to render any reader a master of relativity all material on the subject is comprehensible and derivable from first principles The book emphasizes problem solving contains abundant problem sets and is conveniently organized to meet the needs of both student and instructor Fully revised and expanded second edition with improved figures Enlarged discussion of dynamics and the relativistic version of Newton's second law Resolves the twin paradox from the principles of special and general relativity Includes new chapters which derive magnetism from relativity and electrostatics Derives Maxwell s equations from Gauss law and the principles of special relativity Includes new chapters on differential geometry space time curvature and the field equations of general relativity Introduces black holes and gravitational waves as illustrations of the principles of general relativity and relates them to the 2015 and 2017 observational discoveries of LIGO Non-Inertial **Frames and Dirac Observables in Relativity** Luca Lusanna, 2019-07-04 Interpreting general relativity relies on a proper description of non inertial frames and Dirac observables This book describes global non inertial frames in special and general relativity The first part covers special relativity and Minkowski space time before covering general relativity globally

hyperbolic Einstein space time and the application of the 3 1 splitting method to general relativity The author uses a Hamiltonian description and the Dirac Bergmann theory of constraints to show that the transition between one non inertial frame and another is a gauge transformation extra variables describing the frame are gauge variables and the measureable matter quantities are gauge invariant Dirac observables Point particles fluids and fields are also discussed including how to treat the problems of relative times in the description of relativistic bound states and the problem of relativistic centre of mass Providing a detailed description of mathematical methods the book is perfect for theoretical physicists researchers and Special Relativity in General Frames Éric Gourgoulhon, 2016-08-23 students working in special and general relativity Special relativity is the basis of many fields in modern physics particle physics quantum field theory high energy astrophysics etc This theory is presented here by adopting a four dimensional point of view from the start An outstanding feature of the book is that it doesn t restrict itself to inertial frames but considers accelerated and rotating observers It is thus possible to treat physical effects such as the Thomas precession or the Sagnac effect in a simple yet precise manner. In the final chapters more advanced topics like tensorial fields in spacetime exterior calculus and relativistic hydrodynamics are addressed In the last brief chapter the author gives a preview of gravity and shows where it becomes incompatible with Minkowsky spacetime Well illustrated and enriched by many historical notes this book also presents many applications of special relativity ranging from particle physics accelerators particle collisions quark gluon plasma to astrophysics relativistic jets active galactic nuclei and including practical applications Sagnac gyrometers synchrotron radiation GPS In addition the book provides some mathematical developments such as the detailed analysis of the Lorentz group and its Lie algebra The book is suitable for students in the third year of a physics degree or on a masters course as well as researchers and any reader interested in relativity Thanks to the geometric approach adopted this book should also be beneficial for the study of general relativity A modern presentation of special relativity must put forward its essential structures before illustrating them using concrete applications to specific dynamical problems Such is the challenge so successfully met of the beautiful book by ric Gourgoulhon excerpt from the Foreword by Thibault Damour Essential Dynamics and Relativity Peter J. O'Donnell,2014-11-24 Essential Dynamics Relativity provides students with an introduction to the core aspects of dynamics and special relativity The author reiterates important ideas and terms throughout and covers concepts that are often missing from other textbooks at this level He also places each topic within the wider constructs of the theory without jumping from topic to topic to illustrate a point The first section of the book focuses on dynamics discussing the basic aspects of single particle motion and analyzing the motion of multi particle systems The book also explains the dynamical behavior of both composite bodies rigid bodies and objects in non inertial frames of reference rotating reference frames The second section concentrates on relativity The author describes the ideas leading to the inception of special relativity He also formulates fundamental aspects such as time dilation length contraction Lorentz transformations and the visual aids of Minkowski

diagrams necessary to develop more sophisticated ideas He then develops the concepts within the context of relativistic mechanics With many examples throughout and exercises at the end of each chapter this text makes the often daunting and confusing ideas of dynamics and special relativity accessible to undergraduate students studying the subjects for the first Relativity and the Nature of Spacetime Vesselin Petkov, 2006-02-18 Puts the emphasis on conceptual questions Why time is there no such thing as absolute motion What is the physical meaning of relativity of simultaneity But the most important question that is addressed in this book is what is the nature of spacetime or equivalently what is the dimensionality of the world at the macroscopic level Develops answers to these questions via a thorough analysis of relativistic effects and explicitly asking whether the objects involved in those effects are three dimensional or four dimensional Discusses the implication of the result this analysis clearly shows that if the world and the physical objects were three dimensional none of the kinematic relativistic effects and the experimental evidence supporting them would be possible for physics philosophy and our entire world view are discussed **Classical Measurements in Curved Space-Times** Fernando de Felice, Donato Bini,2010-07-29 The theory of relativity describes the laws of physics in a given space time However a physical theory must provide observational predictions expressed in terms of measurements which are the outcome of practical experiments and observations Ideal for readers with a mathematical background and a basic knowledge of relativity this book will help readers understand the physics behind the mathematical formalism of the theory of relativity It explores the informative power of the theory of relativity and highlights its uses in space physics astrophysics and cosmology Readers are given the tools to pick out from the mathematical formalism those quantities that have physical meaning and which can therefore be the result of a measurement The book considers the complications that arise through the interpretation of a measurement which is dependent on the observer who performs it Specific examples of this are given to highlight the awkwardness of the A Broader View of Relativity Jong-Ping Hsu, Leonardo Hsu, 2006 A Broader View of Relativity shows that there problem is still new life in old physics The book examines the historical context and theoretical underpinnings of Einstein's theory of special relativity and describes Broad Relativity a generalized theory of coordinate transformations between inertial reference frames that includes Einstein's special relativity as a special case It shows how the principle of relativity is compatible with multiple concepts of physical time and these different procedures for clock synchronization can be useful for thinking about different physical problems including many body systems and the development of a Lorentz invariant thermodynamics Broad relativity also provides new answers to old questions such as the necessity of postulating the constancy of the speed of light and the viability of Reichenbach s general concept of time The book also draws on the idea of limiting four dimensional symmetry to describe coordinate transformations and the physics of particles and fields in non inertial frames particularly those with constant linear accelerations This new edition expands the discussion on the role that human conventions and unit systems have played in the historical development of relativity theories and includes new results

on the implications of broad relativity for clarifying the status of constants that are truly fundamental and inherent properties of our universe Contents Special Relativity is NOT Incorrect Space Time and Inertial Frames The Novel Creation of the Young Einstein Experimental Tests Group Properties Common Relativity and Quantum Mechanics Extended Relativity Dynamics of Classical and Quantum Particles Group and Lie Algebra Properties of Accelerated Transformation of Spacetime Graphic Representations of the Geometry of Spacetime in Accelerated Frames Two Rocketships with Constant Linear Acceleration On a Gauge Theory of Gravity with Translation Gauge Symmetry in Inertial and Non Inertial Frames Appendices Technical Aspects of Extended Relativity Coordinate Transformations for Rotating Frames and other papers Key Features Includes five new chapters A complete and comprehensive description of Broad Relativity which generalizes Einstein s original theory of special relativity to new physical time systems and a limited class of non inertial frames Brings a fresh viewpoint with new physical implications and predictions to old physics Gives an updated discussion on fundamental physical constants and unit systems and their influence on the development of relativity theories Readership Researchers in the field of relativity theory and advanced undergraduate students as a supplementary text Solving the 111-Year-Old Riddle Bimal. G,2018-04-18 Bimal G s book Solving the 111 Year Old Riddle opens an unexplored window of physics for the readers Through this book the author has aimed to solve the riddles generated by the theories of relativity and quantum mechanics He believes that something is oddly wrong with the explanations and interpretations of these most celebrated theories even though the equations and its predictions are perfect and powerful Puzzling paradoxes and logic defying ideas had confounded the realm of physics ever since the formulation of special theory of relativity in 1905 By flouting reality the theory of guantum mechanics too challenged common sense Both these theories failed to give rational explanations to various natural phenomena This book is a bold attempt to demystify the theories of relativity and quantum mechanics which seem besotted with mathematical formalism than logical reasoning It seeks to unite the two strong pillars of physics fix the inconsistencies between them and fill in the missing link by giving a new avatar to absolute space and time In the process the author puts forth a revolutionary new theory that removes paradoxes in the realm of physics redefines the puzzling inertia and explains the riddling dark matter dark energy along with other natural phenomena and scientific experiments An Introduction to Special Relativity for Radiation and Plasma Physics Greg Tallents, 2022-11-24 An introduction to special relativity and its applications with an emphasis on the interaction and production of light in plasma Relativity and *Engineering* Jean van Bladel, 2012-12-06 The main feature of this book is the emphasis on practice This approach unusual in the relativistic literature may be clarified by quoting some problems discussed in the text the analysis of rocket acceleration to relativistic velocities the influence of gravitational fields on the accuracy of time measurements the operation of optical rotation sensors the evaluation of the Doppler spectrum produced by the linear or ro tional motion of an antenna or scatterer the use of the Cerenkov effect in the design of millimeter wave power generators the influence of the motion of a plasma on

the transmission of electrom netic waves through this medium A correct solution of these and analogous problems requires the use of re lativistic principles This remark remains valid even at low velocities since first order terms in v c often playa fundamental role in the equations The applicational approach used in the text should be acceptable to space engineers nuclear engineers electrical engineers and more generally ap plied physicists Electrical engineers in particular are concerned with relativity by way of the electrodynamics of moving bodies This discipline is of decisive importance for power engineers who are confronted with problems such as the justification of a forcing function D Dt in the circuit equation of a moving loop a correct formulation of Maxwell's equations in rotating coordinate systems the resolution of sliding contact paradoxes a theoretically satisfying analysis of magnetic levitation systems **Relativity and the Dimensionality of the** World Vesselin Petkov, 2007-10-08 All physicists would agree that one of the most fundamental problems of the 21st century physics is the dimensionality of the world In the four dimensional world of Minkowski or Minkowski spacetime the most challenging problem is the nature of the temporal dimension In Minkowski spacetime it is merely one of the four dimensions which means that it is entirely given like the other three spacial dimensions If the temporal dimension were not given in its entirety and only one constantly changing moment of it existed Minkowski spacetime would be reduced to the ordinary three dimensional space But if the physical world represented by Minkowski spacetime is indeed four dimensional with time being the fourth dimension then such a world is drastically different from its image based on our perceptions Minkowski four dimensional world is a block Universe a frozen world in which nothing happens since all moments of time are given at once which means that physical bodies are four dimensional worldtubes containing the whole histories in time of the three dimensional bodies of our everyday experience The implications of a real Minkowski world for physics itself and especially for our world view are enormous The main focus of this volume is the question is spacetime nothing more than a mathematical space which describes the evolution in time of the ordinary three dimensional world or is it a mathematical model of a real four dimensional world with time entirely given as the fourth dimension It contains fourteen invited papers which either directly address the main question of the nature of spacetime or explore issues related to it Reading Bohr: Physics and Philosophy Arkady Plotnitsky, 2006-11-15 Reading Bohr Physics and Philosophy offers a new perspective on Niels Bohr s interpretation of quantum mechanics as complementarity and on the relationships between physics and philosophy in Bohr s work which has had momentous significance for our understanding of quantum theory and of the nature of knowledge in general Philosophically the book reassesses Bohr s place in the Western philosophical tradition from Kant and Hegel on Physically it reconsiders the main issues at stake in the Bohr Einstein confrontation and in the ongoing debates concerning quantum physics It also devotes greater attention than in most commentaries on Bohr to the key developments and transformations of his thinking concerning complementarity Most significant among them were those that occurred first under the impact of Bohr s exchanges with Einstein and second under the impact of developments in quantum theory itself

both quantum mechanics and quantum field theory The importance of quantum field theory for Bohr s thinking has not been adequately addressed in the literature on Bohr to the considerable detriment to our understanding of the history of quantum physics Filling this lacuna is one of the main contributions of the book which also enables us to show why quantum field theory compels us to move beyond Bohr without however simply leaving him behind Relativity, Gravitation and Cosmology Ta-Pei Cheng, 2010 An introduction to Einstein's general theory of relativity this work is structured so that interesting applications such as gravitational lensing black holes and cosmology can be presented without the readers having Classical Electromagnetic Theory Jack Vanderlinde, 2006-01-17 to first learn the difficult mathematics of tensor calculus In questions of science the authority of a thousand is not worth the humble reasoning of a single individual Galileo Galilei physicist and astronomer 1564 1642 This book is a second edition of Classical Electromagnetic Theory which derived from a set of lecture notes compiled over a number of years of teaching elect magnetic theory to fourth year physics and electrical engineering students These students had a previous exposure to electricity and magnetism and the material from the rst four and a half chapters was presented as a review I believe that the book makes a reasonable transition between the many excellent elementary books such as Gri th s Introduction to Electrodynamics and the obviously graduate level books such as Jackson s Classical Electrodynamics or Landau and Lifshitz Elect dynamics of Continuous Media If the students have had a previous exposure to Electromagnetictheory allthematerialcanbereasonablycoveredintwosemesters Neophytes should probable spend a semester on the rst four or ve chapters as well as depending on their mathematical background the Appendices B to F For a shorter or more elementary course the material on spherical waves waveguides and waves in anisotropic media may be omitted without loss of continuity **Physical and Mathematical Aspects of Symmetries** Sergio Duarte, Jean-Pierre Gazeau, Sofiane Faci, Tobias Micklitz, Ricardo Scherer, Francesco Toppan, 2018-01-09 This proceedings records the 31st International Colloquium on Group Theoretical Methods in Physics Group 31 Plenary invited articles propose new approaches to the moduli spaces in gauge theories V Pestun 2016 Weyl Prize Awardee the phenomenology of neutrinos in non commutative space time the use of Hardy spaces in quantum physics contradictions in the use of statistical methods on complex systems and alternative models of supersymmetry This volume s survey articles broaden the colloquia s scope out into Majorana neutrino behavior the dynamics of radiating charges statistical pattern recognition of amino acids and a variety of applications of gauge theory among others This year's proceedings further honors Bertram Kostant 2016 Wigner Medalist as well as S T Ali and L Boyle for their life long contributions to the math and physics communities The aim of the ICGTMP is to provide a forum for physicists mathematicians and scientists of related disciplines who develop or apply methods in group theory to share their research The 31st ICGTMP was held in Rio de Janeiro Brazil from June 19th to June 25th 2016 This was the first time that a colloquium of the prestigious and traditional ICGTMP series which started in 1972 in Marseille France took place in South America The history of the colloquia can be found at http

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