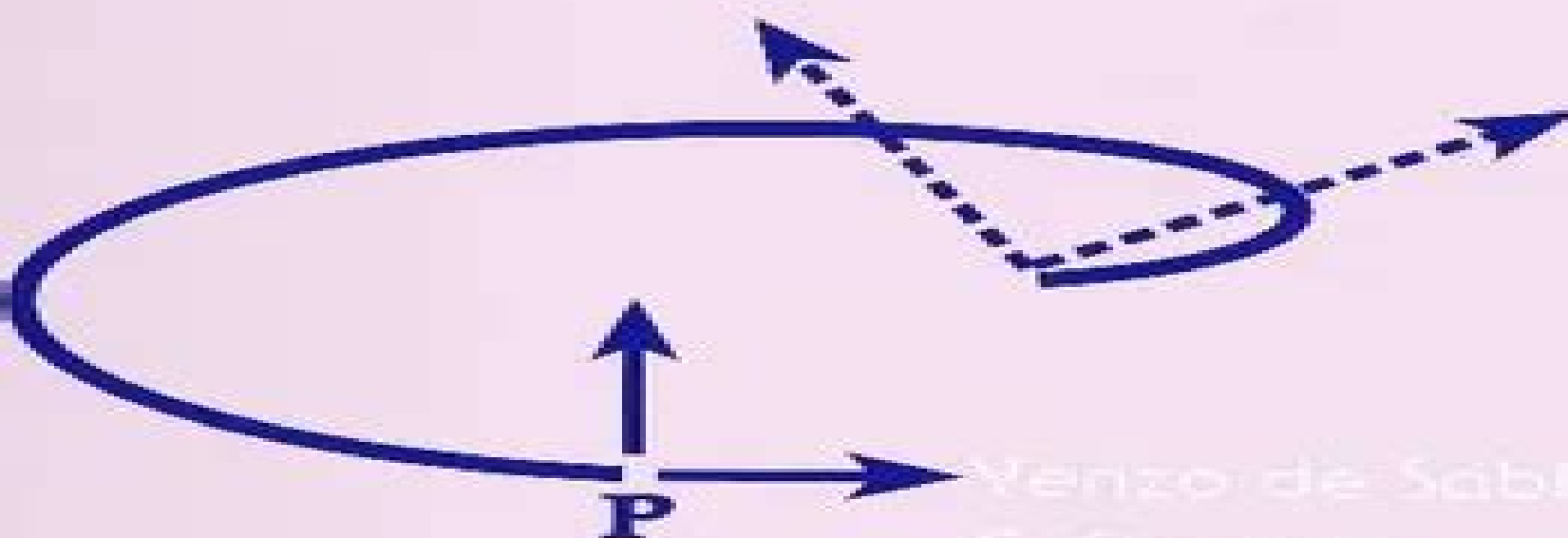


# SPIN AND TORSION IN GRAVITATION



Renzo de Sabbato  
C. Sivaram

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# Spin And Torsion In Gravitation

**Kleinert Hagen**



## **Spin And Torsion In Gravitation:**

**Spin And Torsion In Gravitation** Venzo De Sabbata, C Sivaram, 1994-08-31 This book gives an exposition of both the old and new results of spin and torsion effects on gravitational interactions with implications for particle physics cosmology etc Physical aspects are stressed and measurable effects in relation to other areas of physics are discussed Among the topics discussed are alternative ways of unifying gravity with electroweak and strong interactions by an energy dependent spin torsion coupling constant the idea that all interactions can be understood as originating from spin curvature coupling the possibility of cosmological models with torsion providing a solution to the cosmological constant problem and a demonstration that torsion can lead directly to the quantization of space time itself [Spin In Gravity - Is It Possible To Give An Experimental Basis To Torsion?](#) Venzo De Sabbata, P G Bergmann, P I Pronin, George T Gillies, 1998-07-08 The introduction of spin is believed to be a necessary tool if one wishes to quantize general relativity Then the main problem is to see if the introduction of spin generalizing the general relativity from a geometric point of view i e through the concept of torsion can be experimentally verified The reader can find in this book both theoretical and experimental arguments which show the necessity for the introduction of spin and then of torsion in gravity In fact torsion constitutes the more natural and simple way to introduce spin in general relativity For that reason it is of fundamental importance to see if there are some experiences that indicate if not directly then at least indirectly the presence of torsion This book presents a discussion on experiments with a polarized mass torsion pendulum the search for galactic dark matter interacting with a spin pendulum a description of a space based method for determination of the gravitational constant and space based measurements of spin in gravity as well as a discussion on theoretical arguments for instance the nature of torsion and nonmetricity the viability of gravitational theories with spin torsion and spin spin interaction many dimensional gravitational theories with torsion spinors on curved spaces the spinors in real space time etc We know that until now there has been no evidence for torsion but this fact cannot prevent us from considering in some detail this implement of research that seems to be important from both a geometrical and a physical point of view [Cosmology and Gravitation](#) Peter G. Bergmann, Venzo De Sabbata, 2012-12-06 For the Sixth Course of the International School of Cosmology and Gravitation of the Ettore Majorana Centre for Scientific Culture we choose as the principal topics torsion and supergravity because in our opinion it is one of the principal tasks of today's theoretical physics to attempt to link together the theory of elementary particles and general relativity Our aim was to delineate the present status of the principal efforts directed toward this end and to explore possible directions of work in the near future Efforts to incorporate spin as a dynamic variable into the foundations of the theory of gravitation were pioneered by E Cartan whose contributions to this problem go back half a century According to A Trautman this so called Einstein Cartan theory is the simplest and most natural modification of Einstein's 1916 theory F Hehl has contributed a very detailed and comprehensive analysis of this topic original view of non Riemannian space time Characteristic of Einstein

Cartan theories is the enrichment of Riemannian geometry by torsion the non symmetric part of the otherwise metric compatible affine connection Torsion has a impact on the theory of elementary particles According to V de Sabbata weak interactions can be based on the Einstein Cartan geometry in that the Lagrangian describing weak interactions and torsion interaction possess analogous structures leading to a unification of weak and gravitational forces *Spin in Gravity* Claus Lämmerzahl,1998 *Spin in Gravity* Peter Gabriel Bergmann,1998 The introduction of spin is believed to be a necessary tool if one wishes to quantize general relativity Then the main problem is to see if the introduction of spin generalizing the general relativity from a geometric point of view i.e through the concept of torsion can be experimentally verified The reader can find in this book both theoretical and experimental arguments which show the necessity for the introduction of spin and then of torsion in gravity In fact torsion constitutes the more natural and simple way to introduce spin in general relativity For that reason it is of fundamental importance to see if there are some experiences that indicate if not directly then at least indirectly the presence of torsion This book presents a discussion on experiments with a polarized mass torsion pendulum the search for galactic dark matter interacting with a spin pendulum a description of a space based method for determination of the gravitational constant and space based measurements of spin in gravity as well as a discussion on theoretical arguments for instance the nature of torsion and nonmetricity the viability of gravitational theories with spin torsion and spin spin interaction many dimensional gravitational theories with torsion spinors on curved spaces the spinors in real space time etc We know that until now there has been no evidence for torsion but this fact cannot prevent us from considering in some detail this implement of research that seems to be important from both a geometrical and a physical point of view

**Gravitation and Gauge Symmetries** M Blagojevic,2001-10-25 In the course of the development of electromagnetic weak and strong interactions the concept of internal gauge invariance grew up and established itself as an unavoidable dynamical principle in particle physics It is less known that the principle of equivalence and the basic dynamical properties of the gravitational interaction can also be expressed **Gravitation and Cosmology: From the Hubble Radius to the Planck Scale** Richard L. Amoroso,G. Hunter,Menas Kafatos,J.P. Vigiér,2006-04-11 Jean Pierre Vigiér continually labeled one of les heretiques de la science l'eternel resistant et le patriarche is yet a pillar of modern physics and mathematics with one leg firmly planted in theory and the other in empiricism spanning a career of nearly 60 years with a publication vitae quickly approaching 400 He wrote of his mentor Louis de Broglie Great physicists fight great battles which perhaps applies even more so to Jean Pierre Vigiér himself If fortune allows a visit to Paris reported to be the city of love and certainly one of the most beautiful and interesting cities in the world one has been treated to a visual and cultural feast For example a leisurely stroll from the Musee du Louvre along the Champs Elysees to the Arc de Triomphe would instill even the least creative soul with the entelechies of a poets muse It is perhaps open to theoretical interpretation but if causal conditions have allowed one to be a physicist visiting Paris one may have taken opportunity to visit the portion of the old Latin quarter in place Jussieu

where Pierre et Marie Curie Universite reported to be the best university in France is stationed

**Multivalued Fields: In Condensed Matter, Electromagnetism, And Gravitation** Kleinert Hagen,2008-02-04 This book lays the foundations of the theory of fluctuating multivalued fields with numerous applications Most prominent among these are phenomena dominated by the statistical mechanics of line like objects such as the phase transitions in superfluids and superconductors as well as the melting process of crystals and the electromagnetic potential as a multivalued field that can produce a condensate of magnetic monopoles In addition multivalued mappings play a crucial role in deriving the physical laws of matter coupled to gauge fields and gravity with torsion from the laws of free matter Through careful analysis of each of these applications the book thus provides students and researchers with supplementary reading material for graduate courses on phase transitions quantum field theory gravitational physics and differential geometry

**Modified and Quantum Gravity** Christian Pfeifer,Claus Lämmerzahl,2023-09-30 This book discusses theoretical predictions and their comparison with experiments of extended and modified classical and quantum theories of gravity The goal is to provide a readable access and broad overview over different approaches to the topic to graduate and PhD students as well as to young researchers The book presents both theoretical and experimental insights and is structured in three parts The first addresses the theoretical models beyond special and general relativity such as string theory Poincare gauge theory and teleparallelism as well as Finsler gravity In turn the second part is focused on the observational effects that these models generate accounting for tests and comparisons which can be made on all possible scales from the universe as a whole via binary systems stars black holes satellite experiments down to laboratory experiments at micrometer and smaller scales The last part of this book is dedicated to quantum systems and gravity showing tests of classical gravity with quantum systems and coupling of quantum matter and gravity

**Modified Gravity and Cosmology** Emmanuel N. Saridakis,Ruth Lazkoz,Vincenzo Salzano,Paulo Vargas Moniz,Salvatore Capozziello,Jose Beltrán Jiménez,Mariafelicia De Laurentis,Gonzalo J. Olmo,2021-12-10 With a focus on modified gravity this book presents a review of the recent developments in the fields of gravity and cosmology presenting the state of the art high lighting the open problems and outlining the directions of future research General Relativity and the CDM framework are currently the standard lore and constitute the concordance paradigm of cosmology Nevertheless long standing open theoretical issues as well as possible new observational ones arising from the explosive development of cosmology in the last two decades offer the motivation and lead a large amount of research to be devoted in constructing various extensions and modifications In this review all extended theories and scenarios are first examined under the light of theoretical consistency and are then applied in various geometrical backgrounds such as the cosmological and the spherical symmetric ones Their predictions at both the background and perturbation levels and concerning cosmology at early intermediate and late times are then confronted with the huge amount of observational data that astrophysics and cosmology has been able to offer in the last two decades Theories scenarios and models that successfully and efficiently pass the above

steps are classified as viable and are candidates for the description of Nature allowing readers to get a clear overview of the state of the art and where the field of modified gravity is likely to go This work was performed in the framework of the COST European Action Cosmology and Astrophysics Network for Theoretical Advances and Training Actions CANTATA

Differential Geometry, Gauge Theories, and Gravity M. Göckeler, T. Schücker, 1989-07-28 Cambridge University Press is committed to keeping scholarly work in print for as long as possible A short print run of this academic paperback has been produced using digital technology This technology has enabled Cambridge to keep the book in print for specialists and students when traditional methods of reprinting would not have been feasible While the new digital cover differs from the original the text content is identical to that of previous printings

Gravitational Measurements, Fundamental Metrology and Constants V. de Sabbata, Vitaly N. Melnikov, 2012-12-06 Proceedings of the NATO Advanced Study Institute Erice Italy May 2 12 1987

Quantum Gravity, Generalized Theory of Gravitation, and Superstring Theory-Based Unification Behram N. Kursunogammalu, Stephan L. Mintz, Arnold Perlmutter, 2005-12-27 Held December 16 19 1999 these proceedings are derived from the Global Foundation Inc s Orbis Scientiae 1999 Topics include cosmological parameters unifying elementary particle physics cosmology superstrings and black holes

**Regular Black Holes** Cosimo Bambi, 2023-07-06 Black holes are one of the most fascinating predictions of general relativity They are the natural product of the complete gravitational collapse of matter and today we have a body of observational evidence supporting the existence of black holes in the Universe However general relativity predicts that at the center of black holes there are spacetime singularities where predictability is lost and standard physics breaks down It is widely believed that spacetime singularities are a symptom of the limitations of general relativity and must be solved within a theory of quantum gravity Since we do not have yet any mature and reliable candidate for a quantum gravity theory researchers have studied toy models of singularity free black holes and of singularity free gravitational collapses in order to explore possible implications of the yet unknown theory of quantum gravity This book reviews all main models of regular black holes and non singular gravitational collapses proposed in the literature and discuss the theoretical and observational implications of these scenarios

*Geometrodynamics of Gauge Fields* Eckehard W. Mielke, 2017-01-22 This monograph aims to provide a unified geometrical foundation of gauge theories of elementary particle physics The underlying geometrical structure is unfolded in a coordinate free manner via the modern mathematical notions of fibre bundles and exterior forms Topics such as the dynamics of Yang Mills theories instanton solutions and topological invariants are included By transferring these concepts to local space time symmetries generalizations of Einstein s theory of gravity arise in a Riemann Cartan space with curvature and torsion It provides the framework in which the broken Poincar gauge theory the Rainich geometrization of the Einstein Maxwell system and higher dimensional non abelian Kaluza Klein theories are developed Since the discovery of the Higgs boson concepts of spontaneous symmetry breaking in gravity have come again into focus and in this revised edition these will be exposed in geometric terms

Quantizing gravity remains an open issue formulating it as a de Sitter type gauge theory in the spirit of Yang Mills some new progress in its topological form is presented After symmetry breaking Einstein's standard general relativity with cosmological constant emerges as a classical background The geometrical structure of BRST quantization with non propagating topological ghosts is developed in some detail

**Gravitation and Modern Cosmology** N. Sánchez,A. Zichichi,V. de Sabbata,2013-06-29 Peter Gabriel Bergmann started his work on general relativity in 1936 when he moved from Prague to the Institute for Advanced Study in Princeton Bergmann collaborated with Einstein in an attempt to provide a geometrical unified field theory of gravitation and electromagnetism Within this program they wrote two articles together A Einstein and P G Bergmann Ann Math 39 685 1938 and A Einstein V Bargmann and P G Bergmann Th von Karman Anniversary Volume 212 1941 The search for such a theory was intense in the ten years following the birth of general relativity In recent years some of the geometrical ideas proposed in these publications have proved essential in contemporary attempts towards the unification of all interactions including gravity Kaluza Klein type theories and supergravity theories In 1942 Bergmann published the book Introduction to the Theory of Relativity which included a foreword by Albert Einstein This book is a reference for the subject either as a textbook for classroom use or for individual study A second corrected and enlarged edition of the book was published in 1976 Einstein said in his foreword to the first edition Bergmann's book seems to me to satisfy a definite need Much effort has gone into making this book logically and pedagogically satisfactory and Bergmann has spent many hours with me which were devoted to this end

*On Einstein's Path* Alex Harvey,2012-12-06 Friends and colleagues of Engelbert Schucking came together in a symposium on the 12th and 13th of December 1996 at New York University to celebrate and express to him their respect admiration and affection They came to celebrate his scientific and scholarly achievements the inspirational quality of his teaching his graciousness as a colleague his thoughtful guidance of graduate students his service to the department the university and the physics community at large and not least his open courteous easy accessibility to anyone needing his counselor expertise The announcement was A SYMPOSIUM In Honor of PROF ENGELBERT SCHUCKING Physics Department New York University On December 12th and 13th there will be a Symposium to honor Professor Engel bert Schucking for his service to the University the Department and the Physics Community The December 12th session will run from 1 to 6 PM followed by a reception The following morning the session will run from 9 AM to 1 PM Attendance including the reception is open to all friends and colleagues of Professor Schucking and anyone interested in General Relativity The talks will be presented in Room 121 4 Washington Place the reception will be in the office of Dean Furmankis 5 Washington Square North from 6 15 to 8 00 PM Thursday Afternoon Greetings Alice S

**100 Years of Chronogeometro dynamics: The Status of the Einstein's Theory of Gravitation in Its Centennial Year** Lorenzo Iorio,Elias C. Vagenas,2018-07-10 This book is a printed edition of the Special Issue 100 Years of Chronogeometro dynamics the Status of the Einstein's Theory of Gravitation in Its Centennial Year that was published in

Universe      *The Gravitational Constant: Generalized Gravitational Theories and Experiments* V. de Sabbata, George T. Gillies, Vitaly N. Melnikov, 2004-03-31 An up to date description of progress and current problems with the gravitational constant both in terms of generalized gravitational theories and experiments either in the laboratory using Casimir force measurements or in space at solar system distances and in cosmological observations Contributions cover different aspects of the state and prediction of unified theories of the physical interactions including gravitation as a cardinal link the role of experimental gravitation and observational cosmology in discriminating between them the problem of the precise measurement and stability of fundamental physical constants in space and time and the gravitational constant in particular Recent advances discussed include unified and scalar tensor theories theories in diverse dimensions and their observational windows gravitational experiments in space rotational and torsional effects in gravity basic problems in cosmology early universe as an arena for testing unified models and big bang nucleosynthesis      Introduction To Gravitation Venzo De Sabbata, Maurizio Gasperini, 1986-01-01 This is a comprehensive book easily accessible to those who have a fairly good knowledge of special relativity and electromagnetic theory It is ideal for introducing students to the study of gravitation and relativity following a modern presentation



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