Quantum Gravity, Quantum Cosmology, and Lorentzian Geometries (Lecture Notes in Physics New Series M)

Esposito, Giampiero

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Quantum Gravity Quantum Cosmology Lorentzian Geometries:

Quantum Gravity, Quantum Cosmology and Lorentzian Geometries Giampiero Esposito,1994-01-28 The first aim of this book is to describe recent work on the problem of boundary conditions in one loop quantum cosmology The motivation is to understand whether supersymmetric theories are one loop finite in the presence of boundaries The second aim of the book is to present a recent entirely new study of the singularity problem for space times with torsion The book is written in self contained form In many cases problems have been initially formulated in the simplest possible way and finally presented and solved at increasing levels of complexity Readers will find here a detailed and updated study of quantum cosmology its motivation and application to perturbative quantum gravity Moreover this is the first book which enables the reader to learn techniques used in classical gravity and quantum cosmology The second edition adds new material to both the text and the bibliography **Quantum Gravity, Quantum Cosmology and Lorentzian Geometries** Giampiero Esposito,2014-03-12 This book is aimed at theoretical and mathematical physicists and mathematicians interested in modern gravitational physics I have thus tried to use language familiar to readers working on classical and quantum gravity paying attention both to difficult calculations and to existence theorems and discussing in detail the current literature The first aim of the book is to describe recent work on the problem of boundary conditions in one loop quantum cosmology The motivation of this research was to under stand whether supersymmetric theories are one loop finite in the presence of boundaries with application to the boundary value problemsoccurring in quantum cosmology Indeed higher loop calculations in the absence of boundaries are already available in the litera ture showing that supergravity is not finite I believe however that one loop calculations in the presence of boundaries are more fundamental in that they provide a more direct check of the inconsistency of supersymmetric quantum cosmology from the perturbative point of view It therefore appears that higher order calculations are not strictly needed if the one loop test already yields negative results Even though the question is not yet settled this research has led to many interesting new applications of areas of theoretical and mathematical physics such as twistor theory in flat space self adjointness theory the generalized Riemann zeta function and the theory of boundary counterterms in super gravity I have also compared in detail my work with results by other authors explaining whenever possible the origin of different results the limits of my work and the unsolved problems *Quantum Gravity, Quantum Cosmology and Lorentzian Geometries* Giampiero Esposito,2009-02-13 This book is aimed at theoretical and mathematical physicists and mathematicians interested in modern gravitational physics I have thus tried to use language familiar to readers working on classical and quantum gravity paying attention both to difficult calculations and to existence theorems and discussing in detail the current literature The first aim of the book is to describe recent work on the problem of boundary conditions in one loop quantum cosmology The motivation of this research was to under stand whether supersymmetric theories are one loop finite in the presence of boundaries with application to the boundary value problemsoccurring in quantum cosmology Indeed

higher loop calculations in the absence of boundaries are already available in the litera ture showing that supergravity is not finite I believe however that one loop calculations in the presence of boundaries are more fundamental in that they provide a more direct check of the inconsistency of supersymmetric quantum cosmology from the perturbative point of view It therefore appears that higher order calculations are not strictly needed if the one loop test already yields negative results Even though the question is not yet settled this research has led to many interesting new applications of areas of theoretical and mathematical physics such as twistor theory in flat space self adjointness theory the generalized Riemann zeta function and the theory of boundary counterterms in super gravity I have also compared in detail my work with results by other authors explaining whenever possible the origin of different results the limits of my work and the unsolved problems

Quantum Cosmology - The Supersymmetric Perspective - Vol. 2 Paulo Vargas Moniz,2010-04-27 We read in order to know we are not alone I once heard and perhaps it could also be suggested that we write in order not to be alone to endorse to promote continuity The idea for this book took about 10 years to materialize and it is the author s hope that its content will constitute the beginning of further explorations beyond current horizons More speci cally this book appeals to the reader to engage upon and persevere with a journey moving through the less well explored territories in the evolution of the very early universe and pushing towards new landscapes P haps during or after consulting this book this attitude and this willingness will be embraced by someone somewhere and this person will go on to enrich our quantum cosmological description of the early universe by means of a clearer supersymm ric perspective It is to these creative and inquisitive young minds that the book is addressed The reader will not therefore nd in this book all the answers to all the problems regarding a supersymmetric and quantum description of the early universe and this remark is substantiated in the book by a list of unresolved and challenging problems itself incomplete *Quantum Cosmology - The Supersymmetric Perspective - Vol. 1* Paulo Vargas Moniz,2010-07-02 We read in order to know we are not alone I once heard and perhaps it could also be suggested that we write in order not to be alone to endorse to promote continuity The idea for this book took about ten years to materialize and it is the author s hope that its content will constitute the beginning of further explorations beyond current horizons More speci cally this book appeals to the reader to engage upon and persevere with a journey moving through the less well explored territories in the evolution of the very early universe and pushing towards new landscapes P haps during or after consulting this book this attitude and this willingness will be embraced by someone somewhere and this person will go on to enrich our quantum cosmological description of the early universe by means of a clearer supersymm ric perspective It is to these creative and inquisitive young minds that the book is addressed The reader will not therefore nd in this book all the answers to all the problems regarding a supersymmetric and quantum description of the early universe and this remark is substantiated in the book by a list of unresolved and challenging problems itself incomplete **Analysis, Geometry and Topology of Elliptic Operators** Bernhelm Booss,Krzysztof P. Wojciechowski,2006 Modern theory of elliptic operators or

simply elliptic theory has been shaped by the Atiyah Singer Index Theorem created 40 years ago Reviewing elliptic theory over a broad range 32 leading scientists from 14 different countries present recent developments in topology heat kernel techniques spectral invariants and cutting and pasting noncommutative geometry and theoretical particle string and membrane physics and Hamiltonian dynamics The first of its kind this volume is ideally suited to graduate students and researchers interested in careful expositions of newly evolved achievements and perspectives in elliptic theory The contributions are based on lectures presented at a workshop acknowledging Krzysztof P Wojciechowski s work in the theory of elliptic operators Sample Chapter s Contents 42 KB Contents On the Mathematical Work of Krzysztof P Wojciechowski Selected Aspects of the Mathematical Work of Krzysztof P Wojciechowski M Lesch Gluing Formulae of Spectral Invariants and Cauchy Data Spaces J Park Topological Theories The Behavior of the Analytic Index under Nontrivial Embedding D Bleecker Critical Points of Polynomials in Three Complex Variables L I Nicolaescu Chern Weil Forms Associated with Superconnections S Paycha Heat Kernel Calculations and Surgery Non Laplace Type Operators on Manifolds with Boundary I G Avramidi Eta Invariants for Manifold with Boundary X Dai Heat Kernels of the Sub Laplacian and the Laplacian on Nilpotent Lie Groups K Furutani Remarks on Nonlocal Trace Expansion Coefficients G Grubb An Anomaly Formula for L 2 Analytic Torsions on Manifolds with Boundary X Ma Conformal Anomalies via Canonical Traces S Paycha Noncommutative Geometry An Analytic Approach to Spectral Flow in von Neumann Algebras M T Benameur et al Elliptic Operators on Infinite Graphs J Dodziuk A New Kind of Index Theorem R G Douglas A Note on Noncommutative Holomorphic and Harmonic Functions on the Unit Disk S Klimek Star Products and Central Extensions J Mickelsson An Elementary Proof of the Homotopy Equivalence between the Restricted General Linear Group and the Space of Fredholm Operators T Wurzbacher Theoretical Particle String and Membrane Physics and Hamiltonian Dynamics T Duality for Non Free Circle Actions U Bunke A New Spectral Cancellation in Quantum Gravity G Esposito et al A Generalized Morse Index Theorem C Zhu Readership Researchers in modern global analysis and particle physics   Dirac Operators and Spectral Geometry Giampiero Esposito,1998-08-20 A clear concise and up to date introduction to the theory of the Dirac operator and its wide range of applications in theoretical physics for graduate students and researchers   **Euclidean Quantum Gravity on Manifolds with Boundary** Giampiero Esposito,A.Yu. Kamenshchik,G. Pollifrone,2012-12-06 This book reflects our own struggle to understand the semiclassical behaviour of quantized fields in the presence of boundaries Along many years motivated by the problems of quantum cosmology and quantum field theory we have studied in detail the one loop properties of massless spin l 2 fields Euclidean Maxwell the ory gravitino potentials and Euclidean quantum gravity Hence our book begins with a review of the physical and mathematical motivations for studying physical theories in the presence of boundaries with emphasis on electrostatics vacuum v Maxwell theory and quantum cosmology We then study the Feynman propagator in Minkowski space time and in curved space time In the latter case the corre sponding Schwinger DeWitt asymptotic expansion is given The

following chapters are devoted to the standard theory of the effective action and the geometric im provement due to Vilkovisky the manifestly covariant quantization of gauge fields zeta function regularization in mathematics and in quantum field theory and the problem of boundary conditions in one loop quantum theory For this purpose we study in detail Dirichlet Neumann and Robin boundary conditions for scalar fields local and non local boundary conditions for massless spin l 2 fields mixed boundary conditions for gauge fields and gravitation This is the content of Part I Part II presents our investigations of Euclidean Maxwell theory simple super gravity and Euclidean quantum gravity   Analysis, Geometry And Topology Of Elliptic Operators: Papers In Honor Of Krzysztof P Wojciechowski Matthias Lesch,Weiping Zhang,Slawomir Klimek,Bernhelm Booss-bavnbek,2006-04-25 Modern theory of elliptic operators or simply elliptic theory has been shaped by the Atiyah Singer Index Theorem created 40 years ago Reviewing elliptic theory over a broad range 32 leading scientists from 14 different countries present recent developments in topology heat kernel techniques spectral invariants and cutting and pasting noncommutative geometry and theoretical particle string and membrane physics and Hamiltonian dynamics The first of its kind this volume is ideally suited to graduate students and researchers interested in careful expositions of newly evolved achievements and perspectives in elliptic theory The contributions are based on lectures presented at a workshop acknowledging Krzysztof P Wojciechowski s work in the theory of elliptic operators   **Quantum Gravity: Proceedings Of The Sixth Moscow Quantum Gravity Seminar** V A Berezin,Valery A Rubakov,D V Semikoz,1998-03-09 The Sixth Moscow Quantum Gravity Seminar was a continuation of the series of seminars which has played an important role in the consolidation of the international quantum gravity community and which has greatly affected the development of the field As well as papers presented at the conference this proceedings volume includes the papers of invited speakers who were unable to attend the seminar itself   **Spectral Functions in Mathematics and Physics** Klaus Kirsten,2001-12-13 The literature on the spectral analysis of second order elliptic differential operators contains a great deal of information on the spectral functions for explicitly known spectra The same is not true however for situations where the spectra are not explicitly known Over the last several years the author and his colleagues have developed new   **Nonlinear Functional Analysis and its Applications** E. Zeidler,2013-12-01 The main concern in all scientific work must be the human being himsel This one should never forget among all those diagrams and equations Albert Einstein This volume is part of a comprehensive presentation of nonlinear functional analysis the basic content of which has been outlined in the Preface of Part I A Table of Contents for all five volumes may also be found in Part I The Part IV and the following Part V contain applications to mathematical present physics Our goals are the following i A detailed motivation of the basic equations in important disciplines of theoretical physics ii A discussion of particular problems which have played a significant role in the development of physics and through which important mathe matical and physical insight may be gained iii A combination of classical and modern ideas iv An attempt to build a bridge between the language and thoughts of physicists and mathematicians Weshall always try to

advance as soon as possible to theheart ofthe problern under consideration and to concentrate on the basic ideas **A Window Into Zeta and Modular Physics** Klaus Kirsten,Floyd L. Williams,2010-05-24 Consists of lectures that are part of the MSRI workshops and that introduce students and researchers to the intriguing world of theoretical physics
   Oscillator Representation in Quantum Physics M. Dineykhan,G.V. Efimov,G. Ganbold,S.N. Nedelko,2008-12-16 The investigation ofmost problems of quantum physics leads to the solution of the Schrodinger equation with an appropriate interaction Hamiltonian or potential However the exact solutions are known for rather a restricted set of potentials so that the standard eternal problem that faces us is to find the best effective approximation to the exact solution of the Schrodinger equation under consideration In the most general form this problem can be formulated as follows Let a total Hamiltonian H describing a relativistic quantum field theory or a nonrelativistic quantum mechanics system be given Our problem is to solve the Schrodinger equation Hlft Enlftn n i e to find the energy spectrum En and the proper wave functions lft n including the ground state or vacuum lft 10 The main idea of any ap o proximation technique is to find a decomposition in such a way that Ha describes our physical system in the closest to H manner and the Schrodinger equation HolJt O E O lJt O n n n can be solved exactly The interaction Hamiltonian HI is supposed to give small corrections to the zero approximation which can be calculated In this book we shall consider the problem of a strong coupling regime in quantum field theory calculations ofpath or functional integrals over the Gaussian measure and spectral problems in quantum mechanics Let us con sider these problems briefly *Translation Group and Particle Representations in Quantum Field Theory* Hans-Jürgen Borchers,2008-11-30 At the time I learned quantum field theory it was considered a folk theo rem that it is easy to construct field theories fulfilling either the locality or the spectrum condition The construction of an example for the latter case is particularly easy Take for instance an irreducible representation of the Poincare group with positive energy and as an algebra of observables all compact operators in that representation space This algebra of observables is even an asymptotically Abelian algebra Since it has only a single repre sentation except for multiples of this one it is hardly possible to replace locality in order to obtain a theory with a reasonable physical structure This example shows that it is not sufficient to replace locality by asymptotic Abelian ness The construction of a theory fulfilling locality without a pos itive energy representation was first done by Doplicher Regge and Singer DRS However modern investigations on the locality ideal in the algebra oftest functions started by Alcantara and Yngvason AY seem to indicate that this is a general feature this means that most of the algebras of ob servables fulfilling the locality condition will not have representations that also fulfil the spectrum condition This discussion shows that quantum field theory becomes a subject of interest only if both conditions are satisfied at the same time **The Geometry of Dynamical Triangulations** Jan Ambjorn,Mauro Carfora,Annalisa Marzuoli,1997-09-18 This book analyses in depth the geometrical aspects of the simplicial quantum gravity model known as the dynamical triangulations approach The authors provide a compact and convenient account suitable both to introduce the

non expert reader to the spirit of the subject and to provide a well chosen mathematical route to the heart of the matter for the expert The techniques described in the book are novel and allow points of current interest in the subject of simplicial quantum gravity to be addressed The authors discuss piecewise linear manifolds and give entropy estimates of the number of triangulations of 3 and 4 manifolds Continuum physics is recovered through scaling limits and computer simulation is used to study simplicial quantum gravity extensively The beginner will appreciate the introduction to the field and the expert the comprehensive account of recent results and developments **Handbook of Quantum Gravity** Cosimo Bambi,Leonardo Modesto,Ilya Shapiro,2024-12-03 The search for a theory of quantum gravity is one of the most important and fascinating problems in modern theoretical physics While we do not have yet a complete theory of quantum gravity significant advancements have been done in the past decades In this handbook every section is dedicated to a specific approach towards a theory of quantum gravity and is edited by the leading experts in the field This book represents both a valuable resource for graduate students and an important reference for researchers in quantum gravity *Classical and Quantum Cosmology* Gianluca Calcagni,2017-01-06 This comprehensive textbook is devoted to classical and quantum cosmology with particular emphasis on modern approaches to quantum gravity and string theory and on their observational imprint It covers major challenges in theoretical physics such as the big bang and the cosmological constant problem An extensive review of standard cosmology the cosmic microwave background inflation and dark energy sets the scene for the phenomenological application of all the main quantum gravity and string theory models of cosmology Born of the author s teaching experience and commitment to bridging the gap between cosmologists and theoreticians working beyond the established laws of particle physics and general relativity this is a unique text where quantum gravity approaches and string theory are treated on an equal footing As well as introducing cosmology to undergraduate and graduate students with its pedagogical presentation and the help of 45 solved exercises this book which includes an ambitious bibliography of about 3500 items will serve as a valuable reference for lecturers and researchers **Complex General Relativity** Giampiero Esposito,2006-04-11 This book is written for theoretical and mathematical physicists and mat maticians interested in recent developments in complex general relativity and their application to classical and quantum gravity Calculations are presented by paying attention to those details normally omitted in research papers for pedagogical r sons Familiarity with fibre bundle theory is certainly helpful but in many cases I only rely on two spinor calculus and conformally invariant concepts in gravitational physics The key concepts the book is devoted to are complex manifolds spinor techniques conformal gravity planes surfaces Penrose transform complex 3 1 space time models with non vanishing torsion spin fields and spin potentials 2 2 Problems have been inserted at the end to help the reader to check his und standing of these topics Thus I can find at least four reasons for writing yet another book on spinor and twistor methods in general relativity i to write a textbook useful to ginning graduate students and research workers where two component spinor c culus is the unifying mathematical language *Quantum*

Gravity Claus Kiefer,2025-04-03 The description of Nature in physics currently falls into two parts the microscopic and the macroscopic The microscopic world molecules atoms particles is described by quantum theory whereas the macroscopic world planets stars galaxies universe is ruled by a classical interaction gravity that is described by Einstein s theory of general relativity This book describes in detail the attempts to unify quantum theory and relativity which are essential to understanding the origin of the Universe and the final fate of black holes The construction of a consistent quantum theory is among the most important open problems in fundamental physics This book describes the motivation for constructing such a theory and presents the main approaches These approaches include covariant quantization canonical quantization metric and loop approaches and string theory The book also covers the main applications which include black holes and cosmology This new edition includes updated content throughout as well as further explorations of the holographic principle unimodular gravity quantum gravitational correction terms and possible observations as these are topics that have experienced important developments since the last edition

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Quantum Gravity Quantum Cosmology Lorentzian Geometries Introduction

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