

# EFFECTIVE ACTION IN QUANTUM GRAVITY

I. L. BUCHBINDER   S. D. ODINTSOV   I. L. SHAPIRO



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# Effective Action In Quantum Gravity

**Piero Nicolini, Matthias Kaminski, Jonas  
Mureika, Marcus Bleicher**

## Effective Action In Quantum Gravity:

*Effective Action in Quantum Gravity* I.L Buchbinder,S Odintsov,L Shapiro,1992-01-01 In part one of Effective Action in Quantum Gravity the book describes the principles of quantum field theory and the significance of and theory behind effective action Part two deals with quantum field theory in curved space time and the effective action These two parts provide the tools for understanding the rest of the book which is devoted to selected problems of quantum gravity where the effective action plays a major role The book assumes only a basic understanding of quantum field theory and general relativity and will be of interest to postgraduate students and researchers in theoretical high energy physics and gravitational theory

*Quantum Gravity* Domenico J. W. Giulini,Claus Kiefer,Claus Lämmerzahl,2003-09-16 The relation between quantum theory and the theory of gravitation remains one of the most outstanding unresolved issues of modern physics According to general expectation general relativity as well as quantum field theory in a fixed background spacetime cannot be fundamentally correct Hence there should exist a broader theory comprising both in appropriate limits i e quantum gravity This book gives readers a comprehensive introduction accessible to interested non experts to the main issues surrounding the search for quantum gravity These issues relate to fundamental questions concerning the various formalisms of quantization specific questions concerning concrete processes like gravitational collapse or black hole evaporation and the all important question concerning the possibility of experimental tests of quantum gravity effects

**The Regular Effective Action of Gauge Field Theory and Quantum Gravity** Nazir S. Baaklini,1986 *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

Heat Kernel and Quantum Gravity Ivan G. Avramidi,2003-07-01 This book tackles quantum gravity via the so called background field method and its effective action functional The author presents an explicitly covariant and effective technique to calculate the de Witt coefficients and to analyze the Schwinger de Wit asymptotic expansion of the effective action He also investigates the ultraviolet behaviour of higher derivative quantum gravity The book addresses theoretical physicists graduate students as well as researchers but should also be of interest to physicists working in mathematical or elementary particle physics

*The Vilkovisky-DeWitt Effective Action for Quantum Gravity* Gabor Kunstatter,S.R. Huggins,1987 *New Paths Towards Quantum Gravity* Bernhelm Booß-Bavnbek,Giampiero Esposito,Matthias Lesch,2010-07-23 Aside from the obvious statement that it should be a theory capable of unifying general relativity and quantum field theory not much is known about the true nature of quantum gravity New ideas and there are many of them for this is an exciting field of research often diverge to a

degree where it seems impossible to decide in which of the many possible directions the ongoing developments should be further sustained. The division of the book in two overlapping parts reflects the duality between the physical vision and the mathematical construction. The former is represented by tutorial reviews on non commutative geometry on space time discretization and renormalization and on gauge field path integrals. The latter one by lectures on cohomology on stochastic geometry and on mathematical tools for the effective action in quantum gravity. The book will benefit everyone working or entering the field of quantum gravity research.

Coarse Graining in Quantum Gravity: Bridging the Gap between Microscopic Models and Spacetime-Physics Astrid Eichhorn, Benjamin Bahr, Antonio D. Pereira, 2021-07-15

**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 1/2 fields, Euclidean Maxwell theory, 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 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 corresponding Schwinger-DeWitt asymptotic expansion is given. The following chapters are devoted to the standard theory of the effective action and the geometric improvement 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 1/2 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.

*General Relativity and Gravitation* B. Bertotti, F. de Felice, Alessandro Pascolini, 2012-12-06. The Tenth International Conference on General Relativity and Gravitation GR10 was held from July 3 to July 8 1983 in Padova Italy. These Conferences take place every three years under the auspices of the International Society on General Relativity and Gravitation with the purpose of assessing the current research in the field, critically discussing the progress made and disclosing the points of paramount importance which deserve further investigations. The Conference was attended by about 750 scientists active in the various subfields in which the current research on gravitation and general relativity is articulated and more than 450 communications were submitted. In order to fully exploit this great occurrence of experience and creative capacity and to promote individual contributions to the collective knowledge, the Conference was given a structure of workshops on the most active topics and of general sessions in which the Conference was addressed by invited speakers on general reviews or recent major advancements of the field. The individual communications were collected in a two volume

publication made available to the participants upon their arrival and widely distributed to Scientific Institutions and Research Centres

Gravitational Theories Beyond General Relativity Iberê Kuntz, 2019-05-21 Despite the success of general relativity in explaining classical gravitational phenomena several problems at the interface between gravitation and high energy physics still remain open The purpose of this thesis is to explore quantum gravity and its phenomenological consequences for dark matter gravitational waves and inflation A new formalism to classify gravitational theories based on their degrees of freedom is introduced and in light of this classification it is argued that dark matter is no different from modified gravity Gravitational waves are shown to be damped due to quantum degrees of freedom The consequences for gravitational wave events are also discussed The non minimal coupling of the Higgs boson to gravity is studied in connection with Starobinsky inflation and its implications for the vacuum instability problem is analyzed

*Approaches to Quantum Gravity* Daniele Oriti, 2009-03-05 The theory of quantum gravity promises a revolutionary new understanding of gravity and spacetime valid from microscopic to cosmological distances Research in this field involves an exciting blend of rigorous mathematics and bold speculations foundational questions and technical issues Containing contributions from leading researchers in this field this book presents the fundamental issues involved in the construction of a quantum theory of gravity and building up a quantum picture of space and time It introduces the most current approaches to this problem and reviews their main achievements Each part ends in questions and answers in which the contributors explore the merits and problems of the various approaches This book provides a complete overview of this field from the frontiers of theoretical physics research for graduate students and researchers

**Heat Kernel on Lie Groups and Maximally Symmetric Spaces** Ivan G. Avramidi, 2023-05-27 This monograph studies the heat kernel for the spin tensor Laplacians on Lie groups and maximally symmetric spaces It introduces many original ideas methods and tools developed by the author and provides a list of all known exact results in explicit form and derives them for the heat kernel on spheres and hyperbolic spaces Part I considers the geometry of simple Lie groups and maximally symmetric spaces in detail and Part II discusses the calculation of the heat kernel for scalar spinor and generic Laplacians on spheres and hyperbolic spaces in various dimensions This text will be a valuable resource for researchers and graduate students working in various areas of mathematics such as global analysis spectral geometry stochastic processes and financial mathematics as well in areas of mathematical and theoretical physics including quantum field theory quantum gravity string theory and statistical physics

Literature 1992, Part 1

Astronomisches Recheninstitut, 2013-11-11 Astronomy and Astrophysics Abstracts appearing twice a year has become one of the fundamental publications in the fields of astronomy astrophysics and neighbouring sciences It is the most important English language abstracting journal in the mentioned branches The abstracts are classified under more than a hundred subject categories thus permitting a quick survey of the whole extended material The AAA is a valuable and important publication for all students and scientists working in the fields of astronomy and related sciences As such it represents a

necessary ingredient of any astronomical library all over the world      *Quantum Gravity* M. Markov, 2012-12-06 Three years have passed after the First Moscow Seminar on Quantum Gravity It is a rather long time interval for the modern theoretical physics The talks given at the present Second Seminar which took place in October 13 15 1981 in Moscow contain the discussion of new results obtained during this period and the problems which arose More than one hundred Soviet scientists and a number of the foreign guests attended this Seminar which as the previous one was held by the Nuclear Physics Department of the Academy of Sciences of the USSR and the Institute for Nuclear Research of the Academy of Sciences of the USSR The aim of the Seminar was to discuss the most important problems of the modern Quantum Gravity namely i Quantum Gravity the state of art ii Quantum effects in Cosmology iii Quantum black hole physics iv the recent development in Supergravity and v Quantum Gauge Theories The Editorial Board expresses its sincere gratitude to all physicists who have contributed to these Proceedings for their cooperation with the Board in respect of time limitation accurate and patient fulfilment of all tiresome requirements set by the Board The talks in the Proceedings are arranged in sections in accordance with their presentation at the Seminar      **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

**Fundamental Aspects of Asymptotic Safety in Quantum Gravity** Zoë H. Slade, 2019-07-08 After an extensive introduction to the asymptotic safety approach to quantum gravity this thesis explains recent key advances reported in four influential papers Firstly two exact solutions to the reconstruction problem how to recover a bare action from the effective average action are provided Secondly the fundamental requirement of background independence in quantum gravity is successfully implemented Working within the derivative expansion of conformally reduced gravity the notion of compatibility is developed uncovering the underlying reasons for background dependence generically forbidding fixed points in such models Thirdly in order to understand the true nature of fixed point solutions one needs to study their asymptotic behaviour The author carefully explains how to find the asymptotic form of fixed point solutions within the  $f(R)$  approximation Finally the key findings are summarised and useful extensions of the work are identified The thesis finishes by considering the need to incorporate matter into the formalism in a compatible way and touches upon potential opportunities to test asymptotic safety in the future      **Quantum Gravity and Quantum Cosmology**

Gianluca Calcagni, Lefteris Papantonopoulos, George Siopsis, Nikos Tsamis, 2012-10-31 Quantum gravity has developed into a fast growing subject in physics and it is expected that probing the high energy and high curvature regimes of gravitating systems will shed some light on how to eventually achieve an ultraviolet complete quantum theory of gravity Such a theory would provide the much needed information about

fundamental problems of classical gravity such as the initial big bang singularity the cosmological constant problem Planck scale physics and the early time inflationary evolution of our Universe While in the first part of this book concepts of quantum gravity are introduced and approached from different angles the second part discusses these theories in connection with cosmological models and observations thereby exploring which types of signatures of modern and mathematically rigorous frameworks can be detected by experiments The third and final part briefly reviews the observational status of dark matter and dark energy and introduces alternative cosmological models Edited and authored by leading researchers in the field and cast into the form of a multi author textbook at postgraduate level this volume will be of benefit to all postgraduate students and newcomers from neighboring disciplines wishing to find a comprehensive guide for their future research **1st Karl**

**Schwarzschild Meeting on Gravitational Physics** Piero Nicolini, Matthias Kaminski, Jonas Mureika, Marcus Bleicher, 2015-10-28 These proceedings collect the selected contributions of participants of the First Karl Schwarzschild Meeting on Gravitational Physics held in Frankfurt Germany to celebrate the 140th anniversary of Schwarzschild's birth They are grouped into 4 main themes I The Life and Work of Karl Schwarzschild II Black Holes in Classical General Relativity Numerical Relativity Astrophysics Cosmology and Alternative Theories of Gravity III Black Holes in Quantum Gravity and String Theory IV Other Topics in Contemporary Gravitation Inspired by the foundational principle By acknowledging the past we open a route to the future the week long meeting envisioned as a forum for exchange between scientists from all locations and levels of education drew participants from 15 countries across 4 continents In addition to plenary talks from leading researchers a special focus on young talent was provided a feature underlined by the Springer Prize for the best student and junior presentations **11th Italian Conference on General Relativity and Gravitational Physics, SISSA, Trieste, September 26-30, 1994** Italian Conference on General Relativity and Gravitational Physics 1994, Trieste, Italy, 1996

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