



Quantum Cosmology

**Sydney Coleman, James B Hartle, Tsvi
Piran, Steven Weinberg**



Quantum Cosmology:

Quantum Cosmology Martin Bojowald, 2011-07-15 Consequences of quantum gravity on grander scales are expected to be enormous only such a theory can show how black holes really behave and where our universe came from Applications of loop quantum gravity to cosmology have especially by now shed much light on cosmic evolution of a universe in a fundamental microscopic description Modern techniques are explained in this book which demonstrate how the universe could have come from a non singular phase before the big bang how equations for the evolution of structure can be derived but also what fundamental limitations remain to our knowledge of the universe before the big bang The following topics will be covered in this book Hamiltonian cosmology a general basic treatment of isotropy perturbations and their role for observations useful in general cosmology Effective equations an efficient way to evaluate equations of quantum gravity which is also useful in other areas of physics where quantum theory is involved Loop quantization a new formalism for the atomic picture of space time usually presented at a sophisticated mathematical level but evaluated here from an intuitive physical side The book will start with physical motivations rather than mathematical developments which is more common in other expositions of this field All the required mathematical methods will be presented but will not distract the reader from seeing the underlying physics Simple but representative models will be presented first to show the basic features which are then used to work upwards to a general description of quantum gravity and its applications in cosmology This will make the book accessible to a more general physics readership Quantum Universe, The: Essays on Quantum Mechanics, Quantum

Cosmology and Physics in General James B. Hartle, 2020-04-03 As physics has progressed its most fundamental theories have become more distant from everyday experience posing challenges for understanding notably with quantum mechanics This volume contains twenty nine essays written to address such challenges The essays address issues in quantum mechanics quantum cosmology and physics in general Examples include How do we apply quantum mechanics to the whole universe when all observers are inside What do we mean by past present and future in a four dimensional universe What is the origin of classical predictability in a quantum universe Could physics predict non computable numbers Short personal recollections of Murray Gell Mann and Stephen Hawking are included The essays vary in length style and level but should be accessible to most physicists

Quantum Cosmology And Baby Universes: Proceedings Of 7th Jerusalem Winter School Sydney Coleman, James B Hartle, Tsvi Piran, Steven Weinberg, 1991-08-12 The subject of Quantum Cosmology is concerned with providing a quantum mechanical description of the universe as a whole and within that description to constructing a theory of the universe s initial condition whose predictions can be compared with observation The recent progress in this area has profound implications for physics at all scales The lectures at this School describe these theories and their implications They cover basic quantum mechanics of cosmology proposals for theories of initial conditions and their application to the prediction of the large scale features of our universe A special emphasis of the School is the implication of topological

fluctuations of spacetime wormholes baby universes for the observed coupling constants of the low energy interactions of elementary particles and as a potential explanation for the vanishing of the cosmological constant

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

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

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 understand whether supersymmetric theories are one loop finite in the presence of boundaries with application to the boundary value problems occurring in quantum cosmology Indeed

higher loop calculations in the absence of boundaries are already available in the literature 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 Edgard Elbaz, 2012-12-06 I consider teaching to have been one of my greatest privileges in life I have always attempted to make a matter sometimes difficult sometimes in constant evolution simpler and easier to understand There comes a time then when one feels the necessity to write and publish a book For this reason I have already published in french several lecture books on Classical Mechanics Quantum Mechanics Matrix Optics Electroweak Interaction General Relativity and Gravitation Cosmology Teaching quantum theory has been a particular delight as its constant evolution and enlargement embraces all domains of physics Even if the general layout remains relatively unchanged the evolution of our understanding of the physical world imposes the introduction of new approaches It therefore seemed that a physics textbook even one with a graduate readership in mind had to introduce the Dirac Electron Theory and some rudimentary material on quantum field theory This holds for also for explanations of the spontaneous symmetry breaking of Higgs scalar fields that gives mass to the bosons involved in short range interactions We have deliberately cut down on material on some classical topics of quantum theory to make space for less known methods Examples of the latter include the Feynman path integral 3rd quantization and the interpretation of quantum mechanics in terms of phase focusing coherence

Gravity, Gauge Theories and Quantum Cosmology J.V. Narlikar, T. Padmanabhan, 1986-07-31 For several decades since its inception Einstein's general theory of relativity stood somewhat aloof from the rest of physics Paradoxically the attributes which normally boost a physical theory namely its perfection as a theoretical framework and the extraordinary intellectual achievement underlying it prevented the general theory from being assimilated in the mainstream of physics It was as if theoreticians hesitated to tamper with something that is manifestly so beautiful Happily two developments in the 1970s have narrowed the gap In 1974 Stephen Hawking arrived at the remarkable result that black holes radiate after all And in the second half of the decade particle physicists discovered that the only scenario for applying their grand unified theories was offered by the very early phase in the history of the Big Bang universe In both cases it was necessary to discuss the ideas of quantum field theory in the background of curved spacetime that is basic to general relativity This is however only half the total story If gravity is to be brought into the general fold of theoretical physics we have to know how to quantize it To date this has proved a formidable

task although most physicists would agree that as in the case of grand unified theories quantum gravity will have applications to cosmology in the very early stages of the Big Bang universe In fact the present picture of the Big Bang universe necessarily forces us to think of quantum cosmology

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 specifically 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 Perhaps 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 supersymmetric perspective It is to these creative and inquisitive young minds that the book is addressed The reader will not therefore find 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 Martin Bojowald,2011-08-16 Consequences of quantum gravity on grander scales are expected to be enormous only such a theory can show how black holes really behave and where our universe came from Applications of loop quantum gravity to cosmology have especially by now shed much light on cosmic evolution of a universe in a fundamental microscopic description Modern techniques are explained in this book which demonstrate how the universe could have come from a non singular phase before the big bang how equations for the evolution of structure can be derived but also what fundamental limitations remain to our knowledge of the universe before the big bang The following topics will be covered in this book Hamiltonian cosmology a general basic treatment of isotropy perturbations and their role for observations useful in general cosmology Effective equations an efficient way to evaluate equations of quantum gravity which is also useful in other areas of physics where quantum theory is involved Loop quantization a new formalism for the atomic picture of space time usually presented at a sophisticated mathematical level but evaluated here from an intuitive physical side The book will start with physical motivations rather than mathematical developments which is more common in other expositions of this field All the required mathematical methods will be presented but will not distract the reader from seeing the underlying physics Simple but representative models will be presented first to show the basic features which are then used to work upwards to a general description of quantum gravity and its applications in cosmology This will make the book accessible to a more general physics readership

Quantum Cosmology Remo Ruffini,1987 This detailed survey

comprises reprints on subjects related to the development of quantum cosmology As an introduction an overview is included

Once Before Time Martin Bojowald,2011-11-01 In his introduction to a revolutionary theory of the cosmos Martin

Bojowald shows how the big bang theory may give way to the big bounce theory which describes our universe as an eternal series of expansions and contractions with no beginning and no end In 2000 Bojowald then a twenty seven year old postdoctoral student at Pennsylvania State University used a relatively new theory called loop quantum gravity a cunning combination of Einstein s theory of gravity with quantum mechanics to create a simple model of the universe Loop quantum cosmology or LQC was born and with it a theory that managed to do something even Einstein s general theory of relativity had failed to do illuminate the very birth of the universe

Primordial Cosmology Giovanni Montani,2011 Primordial Cosmology deals with one of the most puzzling and fascinating topics debated in modern physics the nature of the Big Bang singularity The authors provide a self consistent and complete treatment of the very early Universe dynamics passing through a concise discussion of the Standard Cosmological Model a precise characterization of the role played by the theory of inflation up to a detailed analysis of the anisotropic and inhomogeneous cosmological models The most peculiar feature of this book is its uniqueness in treating advanced topics of quantum cosmology with a well traced link to more canonical and pedagogical notions of fundamental cosmology This book traces clearly the backward temporal evolution of the Universe starting with the Robertsonndash Walker geometry and ending with the recent results of loop quantum cosmology in view of the Big Bounce The reader is accompanied in this journey by an initial technical presentation which thanks to the fundamental tools given earlier in the book never seems heavy or obscure

Euclidean Quantum Gravity G. W. Gibbons,Stephen W. Hawking,1993 The Euclidean approach to Quantum Gravity was initiated almost 15 years ago in an attempt to understand the difficulties raised by the spacetime singularities of classical general relativity which arise in the gravitational collapse of stars to form black holes and the entire universe in the Big Bang An important motivation was to develop an approach capable of dealing with the nonlinear non perturbative aspects of quantum gravity due to topologically non trivial spacetimes There are important links with a Riemannian geometry Since its inception the theory has been applied to a number of important physical problems including the thermodynamic properties of black holes quantum cosmology and the problem of the cosmological constant It is currently at the centre of a great deal of interest This is a collection of survey lectures and reprints of some important lectures on the Euclidean approach to quantum gravity in which one expresses the Feynman path integral as a sum over Riemannian metrics As well as papers on the basic formalism there are sections on Black Holes Quantum Cosmology Wormholes and Gravitational Instantons

Quantum Cosmology Игорь Николаевич Таганов,2008

Cosmology of Consciousness Deepak Chopra,Helge Kragh,Michael Mensky,2017-02-15 1 How Consciousness Becomes the Physical Universe Menas Kafatos Rudolph E Tanzi and Deepak Chopra 2 Cosmological Foundations of Consciousness Chris King 3 The Origin of the Modern Anthropic Principle Helge Kragh 4 Consciousness in the Universe Neuroscience Quantum Space Time Geometry Roger Penrose and Stuart Hameroff 5 What Consciousness Does A Quantum Cosmology of Mind Chris J S Clarke 6 Quantum Physics the Multiplicity of Mind Split Brains Fragmented Minds

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Quantum Cosmology - The Supersymmetric Perspective - Vol. 2 Paulo Vargas Moniz, 2010-04-02 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 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

Challenging Routes In Quantum Cosmology Shahram Jalalzadeh, Paulo Vargas Moniz, 2022-07-28 Quantum cosmology has gradually emerged as the focus of devoted research mostly within the second half of last century As we entered the 21st century the subject is still very much alive The outcome of results and templates for investigation have been enlarged some very recent and fascinating Hence this book where the authors bequeath some of their views as they believe this current century is the one where quantum cosmology will be fully accomplished Though some aspects are not discussed namely supersymmetry or loop structures there are perhaps a set of challenges that in the authors opinion remain some since the dawn of quantum mechanics and applications to cosmology Others could have been selected at the readers discretion and opinion The authors put herewith a chart and directions to explore some of which they have worked on or aimed to work more in the twilight of their current efforts Their confidence is that someone will follow in their trails venturing in discovering the proper answer by being able to formulate the right questions beforehand The authors shared foresight is that such discoveries from those formulations will be attained upon endorsing the routes within the challenges herewith indicated

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 Perhaps 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 supersymmetric perspective It is to these creative and inquisitive young minds that the book is addressed The reader will not therefore find 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

New Trends in Mathematical Physics Vidas Sidoravicius, 2009-08-31 This book collects selected papers written by invited and plenary speakers of the 15th International Congress on Mathematical Physics ICMP in the aftermath of the conference In extensive review articles and expository texts as well as advanced research articles the world leading experts present the state of the art in modern mathematical physics New mathematical concepts and ideas are introduced by prominent mathematical physicists and mathematicians covering among others the fields of Dynamical Systems Operator Algebras Partial Differential Equations Probability Theory Random Matrices Condensed Matter Physics Statistical Mechanics General Relativity Quantum Mechanics Quantum Field Theory Quantum Information and String Theory All together the contributions in this book give a panoramic view of the latest developments in mathematical physics They will help readers with a general interest in mathematical physics to get an update on the most recent developments in their field and give a broad overview on actual and future research directions in this fascinating and rapidly expanding area

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