



Alessandro Fabbri  
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# Modeling Black Hole Evaporation

Imperial College Press

# Modeling Black Hole Evaporation

**Andres Gomberoff, Donald Marolf**



## **Modeling Black Hole Evaporation:**

Modeling Black Hole Evaporation Jose Navarro-salas,Alessandro Fabbri,2005-01-24 The scope of this book is two fold the first part gives a fully detailed and pedagogical presentation of the Hawking effect and its physical implications and the second discusses the backreaction problem especially in connection with exactly solvable semiclassical models that describe analytically the black hole evaporation process The book aims to establish a link between the general relativistic viewpoint on black hole evaporation and the new CFT type approaches to the subject The detailed discussion on backreaction effects is also extremely valuable a     *Modeling Black Hole Evaporation* Alessandro Fabbri,Jos  Navarro-Salas,2005 The scope of this book is two fold the first part gives a fully detailed and pedagogical presentation of the Hawking effect and its physical implications and the second discusses the backreaction problem especially in connection with exactly solvable semiclassical models that describe analytically the black hole evaporation process The book aims to establish a link between the general relativistic viewpoint on black hole evaporation and the new CFT type approaches to the subject The detailed discussion on backreaction effects is also extremely valuable     *The Black Hole Information Paradox* Ali Akil,Cosimo Bambi,2025-09-30 This book reviews a few different derivations of the Hawking radiation most main solutions to the paradox proposed in the literature and some analog laboratory experiments A black hole is an object whose gravity is so strong that nothing not even light can escape its grasp However applying quantum field theory on a black hole background Stephen Hawking showed that black holes are not completely black In fact they seem to emit a form of radiation that was named the Hawking radiation The Hawking radiation appears to be thermal and in a quantum state that is independent of the initial state that formed the black hole instead it solely depends on the black hole s total mass spin and electric charge A problem arises when we consider an initial system that collapses forms a black hole and eventually the black hole evaporates completely through Hawking radiation Since Hawking radiation depends solely on the black hole s total mass spin and electric charge it implies that numerous distinct initial states could all lead to the same final state Consequently the intricate details of the initial state seem to be lost which contradicts the unitarity of evolution of closed systems a fundamental principle of quantum mechanics The unitarity principle implies that closed systems evolve in a reversible manner such that knowing a system s final state and the way it evolved one can always determine its initial state The many to one evolution of the black hole initial state to radiation evolution is in a clear contradiction with this principle This is the black hole information paradox The black hole information paradox was found in the 1970s by Stephen Hawking Over the past 50 years it has attracted a lot of interest in the theoretical physics community and is still an active research field Chapters are written by leading experts in the field

## **Classical and Quantum Aspects of Gravity in Relation to the Emergent Paradigm** Sumanta

Chakraborty,2017-08-01 This thesis explores the connection between gravity and thermodynamics and provides a unification scheme that opens up new directions of exploration Further elaborating on the Hawking effect and the possibility of

singularity avoidance the author not only discusses the information loss paradox at a broader level but also provides a possible solution to it As the final frontier it describes some novel effects arising from the microscopic structure of spacetime Taken as a whole the thesis addresses three major research areas in gravitational physics it starts with classical gravity proceeds to the black hole information loss paradox and closes with Planck scale physics The thesis is written in a lucid and pedagogical style with an introduction accessible to researchers from other branches of physics and a discussion presenting open questions and future directions which will benefit and hopefully inspire next generation researchers

*Theoretical Frontiers in Black Holes and Cosmology* Renata Kallosh, Emanuele Orazi, 2016-07-16 These lecture notes are dedicated to the most recent theoretical applications of Black Hole solutions in high energy physics The main motivation of this volume is to present the latest black hole backgrounds that are relevant for gauge gravity correspondence Leading scientists in the field explain effective techniques for finding singular and cosmological solutions embedded in gauged supergravity shedding light on underlying properties and symmetries Starting from a basic level the mathematical structures underlying black holes and cosmologies are revealed helping the reader grasp the connection between theoretical approaches and physical observations with insights into possible future developments from both a theoretical and experimental point of view The topics covered in this volume are based on lectures delivered during the Theoretical Frontiers in Black Holes and Cosmology school held in Natal in June 2015

*Hawking Radiation: From Astrophysical Black Holes To Analogous Systems In Lab* Francesco D Belgiorno, Sergio L Cacciatori, Daniele Faccio, 2018-07-09 The book can be a good introduction to research in the area of black hole physics Also it can serve as a source book for the established researcher in the field The book contains an extensive bibliography the contents of which are amply cited throughout the text The book well documents the historical development of the theory of Hawking radiation and related topics The book is a worthwhile addition to the physics literature on a topic of considerable interest

zbMATH The aim of this book is to provide the reader with a guide to Hawking radiation through a dual approach to the problem After an introductory chapter containing some basic knowledge about black holes and quantum field theory in curved spacetime the first part of the book consists in a survey of methods for deriving and studying Hawking radiation from astrophysical black holes from the original calculation by S W Hawking to the most recent contributions involving tunneling and gravitational anomalies In the second part we introduce analogue gravity and we focus our attention to dielectric black hole systems to which the studies of the present authors are devoted The mutual interchange of knowledge between the aforementioned parts is addressed to render a more comprehensive picture of this very fascinating quantum phenomenon associated with black holes

*New Frontiers in Gravitational Collapse and Spacetime Singularities* Daniele Malafarina, Pankaj S. Joshi, 2024-05-02 The book collects a series of articles to review the advances that have been made in the field of gravitational collapse in general relativity and alternative theories of gravity in the past few years Many approaches to black hole and singularity formation in general relativity and beyond have been proposed over the last few

decades The importance of collapse models is that they provide natural thought experiments where to test the behavior and properties of a variety of approaches to general relativity and its implications for ultra compact objects in the universe

**Proceedings Of The Conference In Honour Of The 90th Birthday Of Freeman Dyson** Kok Khoo Phua, Phil Aik Hui Chan, Ngee-pong Chang, Leong-chuan Kwek, 2014-04-22 Professor Freeman Dyson a great physicist thinker and futurist has been very active in scientific literary and public policy activities throughout his career As a tribute to him on the occasion of his 90th birthday and to celebrate his lifelong contributions in physics mathematics astronomy nuclear engineering and global warming a conference covering a wide range of topics was held in Singapore from 26 to 29 August 2013 Distinguished scientists from around the world including Nobel Laureate Professor David Gross joined Professor Dyson in the celebration with a festival of lectures This memorable volume collects an interesting lecture by Professor Dyson Is a Graviton Detectable contributions by speakers at the conference as well as guest contributions by colleagues who celebrated Dyson s birthday at Rutgers University and Institute for Advanced Study in Princeton About Freeman Dyson Freeman John Dyson FRS born December 15 1923 is an eminent English born American physicist mathematician and futurist He is famous for his work in quantum electrodynamics solid state physics mathematics astronomy and nuclear engineering as well as a renowned and best selling author He has spent most of his life as a professor of physics at the Institute for Advanced Study in Princeton taking time off to advise the US government and write books for the public He has won numerous notable awards including the Enrico Fermi Award Templeton Prize Wolf Prize Pomeranchuk Prize and Henri Poincar Prize **Everything About**

**Gravity - Proceedings Of The Second Lecospa International Symposium** Pisin Chen, 2016-12-29 The proceedings of the 2nd LeCosPA International Symposium Everything about Gravity collects 78 papers contributed by the symposium s Plenary Session and Parallel Session speakers Organizers of the Parallel Sessions have in addition prepared summaries for their own sessions The topics range from quasi local energy in GR in the presence of gravitational radiations a gauge theory perspective of gravity naked black hole firewalls related to the black hole information loss paradox a new theory of spacetime quantization relations between the Schwinger effect and the Hawking radiation and Unruh effect conformal frames in cosmology surprises in nonrelativistic naturalness inflation and tensor fluctuations emergent spacetime for quantum gravity understanding strongly coupled magnetism through holographic principle the detections of dark matter ultra high energy cosmic neutrinos and cosmic rays etc Last but not least the closing remark delivered by John Ellis raised the following question Does cosmological inflation require a modification of Einstein s gravity After 100 years of remarkable success of Einstein s general relativity the development of a successful quantum theory of gravity has become a major goal in physics in the 21st century This volume serves as a valuable reference for scientists who are interested in frontier research topics of gravity **Fourteenth Marcel Grossmann Meeting, The: On Recent Developments In Theoretical And**

**Experimental General Relativity, Astrophysics, And Relativistic Field Theories - Proceedings Of The Mg14**

**Meeting On General Relativity (In 4 Parts)** Massimo Bianchi, Robert T Jantzen, Remo Ruffini, 2017-10-13 The four volumes of the proceedings of MG14 give a broad view of all aspects of gravitational physics and astrophysics from mathematical issues to recent observations and experiments The scientific program of the meeting included 35 morning plenary talks over 6 days 6 evening popular talks and 100 parallel sessions on 84 topics over 4 afternoons Volume A contains plenary and review talks ranging from the mathematical foundations of classical and quantum gravitational theories including recent developments in string theory to precision tests of general relativity including progress towards the detection of gravitational waves and from supernova cosmology to relativistic astrophysics including topics such as gamma ray bursts black hole physics both in our galaxy and in active galactic nuclei in other galaxies and neutron star pulsar and white dwarf astrophysics The remaining volumes include parallel sessions which touch on dark matter neutrinos X ray sources astrophysical black holes neutron stars white dwarfs binary systems radiative transfer accretion disks quasars gamma ray bursts supernovas alternative gravitational theories perturbations of collapsed objects analog models black hole thermodynamics numerical relativity gravitational lensing large scale structure observational cosmology early universe models and cosmic microwave background anisotropies inhomogeneous cosmology inflation global structure singularities chaos Einstein Maxwell systems wormholes exact solutions of Einstein's equations gravitational waves gravitational wave detectors and data analysis precision gravitational measurements quantum gravity and loop quantum gravity quantum cosmology strings and branes self gravitating systems gamma ray astronomy cosmic rays and the history of general relativity

**Collapse of the Wave Function** Shan Gao, 2018-04-26 This is the first single volume about the collapse theories of quantum mechanics which is becoming a very active field of research in both physics and philosophy In standard quantum mechanics it is postulated that when the wave function of a quantum system is measured it no longer follows the Schrödinger equation but instantaneously and randomly collapses to one of the wave functions that correspond to definite measurement results However why and how a definite measurement result appears is unknown A promising solution to this problem are collapse theories in which the collapse of the wave function is spontaneous and dynamical Chapters written by distinguished physicists and philosophers of physics discuss the origin and implications of wave function collapse the controversies around collapse models and their ontologies and new arguments for the reality of wave function collapse This is an invaluable resource for students and researchers interested in the philosophy of physics and foundations of quantum mechanics

Quantum Field Theory in Curved Spacetime Leonard Parker, David Toms, 2009-08-20 Suitable for graduate students this book develops quantum field theory in curved spacetime in a pedagogical style

**Sixteenth Marcel Grossmann Meeting, The: On Recent Developments In Theoretical And Experimental General Relativity, Astrophysics, And Relativistic Field Theories - Proceedings Of The Mg16 Meeting On General Relativity (In 4 Volumes)** Remo Ruffini, Gregory Vereshchagin, 2022-12-15 The proceedings of MG16 give a broad view of all aspects of gravitational physics and astrophysics

from mathematical issues to recent observations and experiments The scientific program of the meeting included 46 plenary presentations 3 public lectures 5 round tables and 81 parallel sessions arranged during the intense six day online meeting All talks were recorded and are available on the ICRANet YouTube channel at the following link [www.icranet.org/video\\_mg16](http://www.icranet.org/video_mg16) These proceedings are a representative sample of the very many contributions made at the meeting They contain 383 papers among which 14 come from the plenary sessions The material represented in these proceedings cover the following topics accretion active galactic nuclei alternative theories of gravity black holes theory observations and experiments binaries boson stars cosmic microwave background cosmic strings dark energy and large scale structure dark matter education exact solutions early universe fundamental interactions and stellar evolution fast transients gravitational waves high energy physics history of relativity neutron stars precision tests quantum gravity strong fields and white dwarf all of them represented by a large number of contributions The online e proceedings are published in an open access format **Effects**

**of Non-locality in Gravity and Quantum Theory** Jens Boos,2021-10-28 This thesis is devoted to the systematic study of non local theories that respect Lorentz invariance and are devoid of new unphysical degrees of freedom Such theories are attractive for phenomenological applications since they are mostly unconstrained by current experiments Non locality has played an increasingly important role in the physics of the last decades appearing in effective actions in quantum field theory and arising naturally in string theory and non commutative geometry It may even be a necessary ingredient for quantum theories of gravity It is a feature of quantum entanglement and may even solve the long standing black hole information loss problem Non locality is a broad concept with many promising and fruitful applications in theoretical and mathematical physics After a historical and pedagogical introduction into the concept of non locality the author develops the notion of non local Green functions to study various non local weak field problems in quantum mechanics quantum field theory gravity and quantum field theory in curved spacetime This thesis fills a gap in the literature by providing a self contained exploration of weak field effects in non local theories thereby establishing a non local intuition which may serve as a stepping stone for studies of the full non linear problem of non locality [The Organisation of Mind](#) Tim Shallice,Richard P. Cooper,2011-03-17

To understand the mind we need to draw equally on the fields of cognitive science and neuroscience But these two fields have very separate intellectual roots and very different styles So how can these two be reconciled in order to develop a full understanding of the mind and brain This is the focus of this landmark new book **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

Evolution of Black Holes in Anti-de Sitter Spacetime and the Firewall Controversy Yen Chin Ong, 2015-11-27 This thesis focuses on the recent firewall controversy surrounding evaporating black holes and shows that in the best understood example concerning electrically charged black holes with a flat event horizon in anti de Sitter AdS spacetime the firewall does not arise The firewall which surrounds a sufficiently old black hole threatens to develop into a huge crisis since it could occur even when spacetime curvature is small which contradicts general relativity However the end state for asymptotically flat black holes is ill understood since their curvature becomes unbounded This issue is avoided by working with flat charged black holes in AdS The presence of electrical charge is crucial since black holes inevitably pick up charges throughout their long lifetime These black holes always evolve toward extremal limit and are then destroyed by quantum gravitational effects This happens sooner than the time required to decode Hawking radiation so that the firewall never sets in as conjectured by Harlow and Hayden Motivated by the information loss paradox the author also investigates the possibility that monster configurations might exist with an arbitrarily large interior bounded by a finite surface area Investigating such an object in AdS shows that in the best understood case such an object much like a firewall cannot exist

*Lectures on Quantum Gravity* Andres Gomberoff, Donald Marolf, 2006-05-30 The 2002 Pan American Advanced Studies Institute School on Quantum Gravity was held at the Centro de Estudios Científicos CECS Valdivia Chile January 4-14 2002 The school featured lectures by ten speakers and was attended by nearly 70 students from over 14 countries A primary goal was to foster interaction and communication between participants from different cultures both in the layman's sense of the term and in terms of approaches to quantum gravity We hope that the links formed by students and the school will persist throughout their professional lives continuing to promote interaction and the essential exchange of ideas that drives research forward This volume contains improved and updated versions of the lectures given at the School It has been prepared both as a reminder for the participants and so that these pedagogical introductions can be made available to others who were unable to attend We expect them to serve students of all ages well

**Literature 1991, Part 2** Astronomisches

Rechen-Institut, 2013-06-29 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

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