

"This delightful account is packed with insights. . . . [Wheeler] is a consummately American physicist whose wide-ranging career spans much of a disturbing century."

—Michael Rorstan, *New York Times Book Review*

# GEONS, BLACK HOLES & QUANTUM FOAM

A LIFE IN  
PHYSICS



EDN FOR  
SMALL PERTURBATIONS  
OF KERR &  
MAXWELL

BLACK HOLES  
ARE  
UNOBSERVABLE

"GRAV.  
HAS  
NOTHING  
TO DO  
WITH PHYSICS"

OBSERVE  
1ST BLACK  
HOLE

- (1) X-RAYS
- (2) GRAVITY
- (3) THERMODYNAMICS

IMPOSSIBLE  
TO QUANTIZE

## JOHN ARCHIBALD WHEELER

with KENNETH FORD

# Geons Black Holes And Quantum Foam

**Yen Chin Ong**



## **Geons Black Holes And Quantum Foam:**

Geons, Black Holes, and Quantum Foam: A Life in Physics John Archibald Wheeler, 2010-06-18 Winner of the American Institute of Physics Science Writing Award This delightful account is packed with insights Wheeler is a consummately American physicist whose wide ranging career spans much of a disturbing century Michael Riordan New York Times Book Review He studied with Niels Bohr taught Richard Feynman and boned up on relativity with his friend and colleague Albert Einstein John Archibald Wheeler s fascinating life brings us face to face with the central characters and discoveries of modern physics He was the first American to learn of the discovery of nuclear fission later coined the term black hole led a renaissance in gravitation physics and helped to build Princeton University into a mecca for physicists From nuclear physics to quantum theory to relativity and gravitation Wheeler s work has set the trajectory of research for half a century His career has brought him into contact with the most brilliant minds of his field Fermi Bethe Rabi Teller Oppenheimer and Wigner are among those he called colleagues and friends In this rich autobiography Wheeler reveals in fascinating detail the excitement of each discovery the character of each colleague and the underlying passion for knowledge that drives him still *The Quantum Revelation* Paul Levy, 2024-12-31 Shows how the revelations emerging from quantum physics can wake us up from the disempowering spell of the scientific materialist worldview and help dispel the collective madness that has befallen our species Explains for readers with no physics background why quantum physics is in the words of Albert Einstein so uncommonly important that it should be everyone s concern Shows how quantum physics can help us awaken to the malleable dreamlike nature of reality a realization that unlocks the creative spirit within us Explaining the world transforming effects of quantum physics Paul Levy shows how discoveries in this field widely considered the greatest in the history of science can wake us up from the disempowering spell of the reductionist materialist worldview thereby helping to dispel the collective madness that has befallen our species He explains how quantum physics helps us to consciously realize our vast evolutionary potential and awaken us to the malleable dreamlike nature of reality a realization that unlocks the creative spirit hidden within our own minds In a radical synthesis of quantum physics with spirituality psychology lucid dreaming and alchemy Levy contemplates the deeper philosophical and metaphysical underpinnings of quantum mechanics exploring what it means that quantum physics has empirically proven that there is no such thing as objective reality and how we are active participants in creating our experience of reality whether we realize it or not Revealing the quantum nature of our world and ourselves *The Quantum Revelation* shows how quantum physics has become a modern day spiritual path for awakening and expanding consciousness with particular relevance for the challenging times we are living through **The Formation of Black Holes in General Relativity** Demetrios Christodoulou, 2009 In 1965 Penrose introduced the fundamental concept of a trapped surface on the basis of which he proved a theorem which asserts that a spacetime containing such a surface must come to an end The presence of a trapped surface implies moreover that there is a region of

spacetime the black hole which is inaccessible to observation from infinity Since that time a major challenge has been to find out how trapped surfaces actually form by analyzing the dynamics of gravitational collapse The present monograph achieves this aim by establishing the formation of trapped surfaces in pure general relativity through the focusing of gravitational waves The theorems proved in this monograph constitute the first foray into the long time dynamics of general relativity in the large that is when the initial data are no longer confined to a suitable neighborhood of trivial data The main new method the short pulse method applies to general systems of Euler Lagrange equations of hyperbolic type and provides the means to tackle problems which have hitherto seemed unapproachable This monograph will be of interest to people working in general relativity geometric analysis and partial differential equations *The Ruin of J. Robert Oppenheimer* Priscilla J.

McMillan,2018-03-18 This groundbreaking Cold War history reveals the government conspiracy to bring down America's most famous scientist On April 12 1954 the nation was astonished to learn that J Robert Oppenheimer was facing charges of violating national security Could the man who led the effort to build the atom bomb really be a traitor In this riveting book Priscilla J McMillan draws on newly declassified U S government documents and materials from Russia as well as in depth interviews to expose the conspiracy that destroyed the director of the Manhattan Project This meticulous narrative recreates the fraught years from 1949 to 1955 when Oppenheimer and a group of liberal scientists tried to head off the cabal of air force officials anti Communist politicians and rival scientists who were trying to seize control of U S policy and build ever more deadly nuclear weapons Retelling the story of Oppenheimer's trial which took place in utmost secrecy she describes how the government made up its own rules and violated many protections of the rule of law McMillan also argues that the effort to discredit Oppenheimer occurring at the height of the McCarthy era and sanctioned by a misinformed President Eisenhower was a watershed in the Cold War poisoning American politics for decades and creating dangers that haunt us today *The Forbidden Universe* Lynn Picknett,Clive Prince,2011-04-01 Secret societies famous scientists ancient Egyptian

mysticism and a fascinating addition to the god versus science debate the Catholic Church By the bestselling authors of *The Templar Revelation* and *Mary Magdalene* *The Forbidden Universe* reveals how the foundations of modern science were based around a desire to destroy the church The great pioneering scientists of the Renaissance and the early Enlightenment including Copernicus Galileo and Sir Isaac Newton were fervent devotees of the philosophical mystical system of Hermeticism Many of the most important scientists of this age including Galileo belonged to a secret society called the Giordani which had the agenda to overthrow the Church and establish a new age of Hermetic supremacy **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 *Exploring Science Through Science Fiction* Barry B. Luukkala, 2013-10-23 The material in this book forms the basis of an interdisciplinary college level course which uses science fiction film as a vehicle for exploring science concepts Unlike traditional introductory level courses the science content is arranged according to major themes in science fiction with a deliberate progression from the highly objective and discipline specific e.g. Reference Frames Physics of Space Travel and Time Travel to the very multi disciplinary and thought provoking e.g. Human Teleportation Science and Society Over 100 references to science fiction films and television episodes are included spanning more than 100 years of cinematic history Some of these are conducive to calculations solutions included *The Magicians* Marcus Chown, 2020-02-18 The spellbinding stories of the scientists whose eureka breakthroughs in modern physics reveal science's astonishing predictive power An excellent popular science book DARA BRIAIN A thoroughly informative and entertaining read ANNA BURNS Booker Prize winning author of *Milkman* One of the best written books about physics I have ever come across POPULAR SCIENCE Highly entertaining and accessible IRISH TIMES Fascinating life enhancing entertainment PROSPECT Thoroughly enjoyable Chown has done it again BBC SKY AT NIGHT *The Magicians* takes us on a breathtaking mind altering tour of the eureka moments of modern physics Charting the spellbinding stories of the scientists who predicted and discovered the existence of unknown planets black holes invisible force fields ripples in the fabric of space time unsuspected subatomic particles and even antimatter Marcus Chown reveals science's greatest mystery its astonishing predictive power *Superradiance* Richard Brito, Vitor Cardoso, Paolo Pani, 2015-07-10 This volume gives a unified picture of the multifaceted subject of superradiance with a focus on recent developments in the field ranging from fundamental physics to astrophysics Superradiance is a radiation enhancement process that involves dissipative systems With a 60 year old history superradiance has played a prominent role in optics quantum mechanics and especially in relativity and astrophysics In Einstein's General Relativity black hole superradiance is permitted by dissipation at the event horizon which allows energy extraction from the vacuum even at the classical level When confined this amplified radiation can give rise to strong instabilities known as blackhole bombs which have applications in searches for dark matter in physics beyond the Standard Model and in analog models of gravity This book

discusses and draws together all these fascinating aspects of superradiance      Signatures of the Artist Steven E. Vigdor, 2018-03-02 How does the scientific enterprise really work to illuminate the origins of life and the universe itself The quest to understand our universe how it may have originated and evolved and especially the conditions that allow it to support the existence of life forms has been a central theme in religion for millennia and in science for centuries In the past half century in particular enormous progress in particle and nuclear physics and cosmology has clarified the essential role of imperfections deviations from perfect symmetry or homogeneity or predictability in establishing conditions that allow for structure in the universe that can support the development of life Many of these deviations are tiny and seem mysteriously fine tuned to allow for life The goal of this book is to review the recent and ongoing scientific research exploring these imperfections in a broad ranging non mathematical approach with an emphasis on the intricate tapestry of elegant experiments that bear on the conditions for habitability in our universe This book makes clear what we know and how we know it as distinct from what we speculate and how we might test it At the same time it attempts to convey a sense of wonderment at the tuning of these imperfections and of the rapid rate at which the boundary between knowledge and speculation is currently shifting      Introducing Einstein's Relativity Ray d'Inverno, James Vickers, 2022-05-12 There is little doubt that Einstein's theory of relativity captures the imagination Not only has it radically altered the way we view the universe but the theory also has a considerable number of surprises in store This is especially so in the three main topics of current interest that this book reaches namely black holes gravitational waves and cosmology The main aim of this textbook is to provide students with a sound mathematical introduction coupled to an understanding of the physical insights needed to explore the subject Indeed the book follows Einstein in that it introduces the theory very much from a physical point of view After introducing the special theory of relativity the basic field equations of gravitation are derived and discussed carefully as a prelude to first solving them in simple cases and then exploring the three main areas of application This new edition contains a substantial extension content that considers new and updated developments in the field Topics include coverage of the advancement of observational cosmology the detection of gravitational waves from colliding black holes and neutron stars and advancements in modern cosmology Einstein's theory of relativity is undoubtedly one of the greatest achievements of the human mind Yet in this book the author makes it possible for students with a wide range of abilities to deal confidently with the subject Based on both authors experience teaching the subject this is achieved by breaking down the main arguments into a series of simple logical steps Full details are provided in the text and the numerous exercises while additional insight is provided through the numerous diagrams As a result this book makes an excellent course for any reader coming to the subject for the first time while providing a thorough understanding for any student wanting to go on to study the subject in depth      *To Infinity and Beyond* Neil deGrasse Tyson, Lindsey Nyx Walker, 2023-09-12 Linked to a special mini season of the award winning StarTalk podcast this enlightening illustrated narrative by the world's most celebrated

astrophysicist explains the universe from the solar system to the farthest reaches of space with authority and humor No one can make the mysteries of the universe more comprehensible and fun than Neil deGrasse Tyson With wit charm and everyday analogies he and StarTalk senior producer Lindsey Nyx Walker bring planetary science down to Earth and principles of astrophysics within reach In this entertaining book illustrated with vivid photographs and art readers travel with him through space and time starting with the Big Bang and voyaging to the far reaches of the universe and beyond Along the way science greets pop culture as Tyson explains the triumphs and bloopers in Hollywood s blockbusters all part of an entertaining ride through the cosmos The book begins as we leave Earth encountering new truths about our planet s atmosphere the nature of sunlight and the many missions that have demystified our galactic neighbors But the farther out we travel the weirder things get What s a void and what s a vacuum How can light be a wave and a particle at the same time When we finally arrive in the blackness of outer space Tyson takes on the spookiest phenomena of the cosmos parallel worlds black holes time travel and more For science junkies and fans of the conundrums that astrophysicists often ponder *To Infinity and Beyond* is an enlightening adventure into the farthest reaches of the cosmos [Dispatches from Planet 3](#) Marcia Bartusiak,2018-09-18

An award winning science writer presents a captivating collection of cosmological essays for the armchair astronomer The galaxy the multiverse and the history of astronomy are explored in this engaging compilation of cosmological tales by multiple award winning science writer Marcia Bartusiak In thirty two concise and engrossing essays the author provides a deeper understanding of the nature of the universe and those who strive to uncover its mysteries Bartusiak shares the back stories for many momentous astronomical discoveries including the contributions of such pioneers as Beatrice Tinsley with her groundbreaking research in galactic evolution and Jocelyn Bell Burnell the scientist who first discovered radio pulsars An endlessly fascinating collection that you can dip into in any order these pieces will transport you to ancient Mars when water flowed freely across its surface to the collision of two black holes a cosmological event that released fifty times more energy than was radiating from every star in the universe and to the beginning of time itself *Trespassing on Einstein's Lawn*

Amanda Geffer,2014-01-14 NAMED ONE OF THE BEST BOOKS OF THE YEAR BY KIRKUS REVIEWS In a memoir of family bonding and cutting edge physics for readers of Brian Greene s *The Hidden Reality* and Jim Holt s *Why Does the World Exist* Amanda Geffer tells the story of how she conned her way into a career as a science journalist and wound up hanging out talking shop and butting heads with the world s most brilliant minds At a Chinese restaurant outside of Philadelphia a father asks his fifteen year old daughter a deceptively simple question How would you define nothing With that the girl who once tried to fail geometry as a conscientious objector starts reading up on general relativity and quantum mechanics as she and her dad embark on a life altering quest for the answers to the universe s greatest mysteries Before Amanda Geffer became an accomplished science writer she was a twenty one year old magazine assistant willing to sneak her and her father Warren into a conference devoted to their physics hero John Wheeler Posing as journalists Amanda and Warren met Wheeler who

offered them cryptic clues to the nature of reality The universe is a self excited circuit he said And The boundary of a boundary is zero Baffled Amanda and Warren vowed to decode the phrases and with them the enigmas of existence When we solve all that they agreed we ll write a book Trespassing on Einstein s Lawn is that book a memoir of the impassioned hunt that takes Amanda and her father from New York to London to Los Alamos Along the way they bump up against quirky science and even quirkier personalities including Leonard Susskind the former Bronx plumber who invented string theory Ed Witten the soft spoken genius who coined the enigmatic M theory even Stephen Hawking What they discover is extraordinary the beginnings of a monumental paradigm shift in cosmology from a single universe we all share to a splintered reality in which each observer has her own Reality the Gefters learn is radically observer dependent far beyond anything of which Einstein or the founders of quantum mechanics ever dreamed with shattering consequences for our understanding of the universe s origin And somehow it all ties back to that conversation to that Chinese restaurant and to the true meaning of nothing Throughout their journey Amanda struggles to make sense of her own life as her journalism career transforms from illusion to reality as she searches for her voice as a writer as she steps from a universe shared with her father to at last carve out one of her own It s a paradigm shift you might call growing up By turns hilarious moving irreverent and profound Trespassing on Einstein s Lawn weaves together story and science in remarkable ways By the end you will never look at the universe the same way again Praise for Trespassing on Einstein s Lawn Nothing quite prepared me for this book Wow Reading it I alternated between depression how could the rest of us science writers ever match this and exhilaration Scientific American To Do Read Trespassing on Einstein s Lawn Reality doesn t have to bite New York A zany superposition of genres It s at once a coming of age chronicle and a father daughter road trip to the far reaches of this universe and 10 500 others The Philadelphia Inquirer

**The Foundations of Spacetime Physics** Antonio Vassallo,2022-09-30 This book provides an up to date overview of the foundations of spacetime physics It features original essays written by world class experts in the physics and philosophy of spacetime The foundational questions regarding the origin and nature of spacetime are branching into new and exciting directions These questions are not restricted to the quantum gravity program but also arise in the context of a well established theory like general relativity Against the background of these quick and diverse developments this volume features a broad range of perspectives on spacetime Part I focuses on the nature of spacetime in non quantum theories such as Newtonian mechanics and relativity Part II explores some intriguing conceptual implications of developing a quantum theory of spacetime The Foundations of Spacetime Physics is an essential resource for scholars and advanced students working in philosophy of physics philosophy of science and scientific metaphysics [Encyclopedia Of Cosmology, The - Set 2: Frontiers In Cosmology \(In 3 Volumes\)](#) Claudia De Rham,Andrew J Tolley,2023-09-21 The second set of The Encyclopedia of Cosmology in three volumes continues this major long lasting seminal reference at the graduate student level laid out by the most prominent researchers in the general field of cosmology Together these volumes will be a



comprehensive review of the most important current topics in cosmology discussing the important concepts and current status in each field covering both theory and observation These three volumes are edited by Dr Giovanni Fazio from the Center for Astrophysics Harvard Smithsonian with each volume authored or edited by specialists in the area Modified Gravity by Claudia de Rham and Andrew Tolley Imperial College Neutrino Physics and Astrophysics edited by Floyd Stecker NASA Goddard Space Flight Center Black Holes edited by Zoltan Haiman Columbia University These volumes follow the earlier publication in 2020 of The Encyclopedia of Cosmology which comprises the following four volumes Galaxy Formation and Evolution by Rennan Barkana Tel Aviv University Numerical Simulations in Cosmology edited by Kentaro Nagamine Osaka University University of Nevada Dark Energy by Shinji Tsujikawa Tokyo University of Science and Dark Matter by Jihn E Kim Seoul National University The Encyclopedia aims to provide an overview of the most important topics in cosmology and serve as an up to date reference in astrophysics

*The Road to Stockholm* István Hargittai, 2002 The Nobel Prize is by far the highest recognition a scientist may receive and the only one with which the general public is familiar Its prestige has reached improbable heights At the same time a lot of myth surrounds the Nobel Prize and this is compounded by the fact that people tend to view scientists with some bewilderment This book introduces the process of selection of the laureates discusses the ingredients for scientific discovery and for getting recognition It reviews the decisive moments of scientific careers en route to the Nobel Prize points to characteristic features of the laureates the importance of mentors and venues in scientific careers and other components of success It also covers some discoverers and discoveries for whom and for which the Nobel Prize never materialized Whereas there is no general recipe for receiving the Nobel Prize there are common features of successful scientific careers The book reveals some information about the scientists lives and careers that may guide other scientists in increasing their chances of becoming more effective and better recognized players although it is not expected to help anyone to receive the Nobel Prize For the general reader *The Road to Stockholm* reveals the human face of scientists and the human side of their endeavours The Nobel Prize has served as inspiration for scientists and the general public for a hundred years this book discusses its problems and celebrates its triumphs

**Modern Classical Physics** Kip S. Thorne, Roger D. Blandford, 2017-09-05 A groundbreaking text and reference book on twenty first century classical physics and its applications This first year graduate level text and reference book covers the fundamental concepts and twenty first century applications of six major areas of classical physics that every masters or PhD level physicist should be exposed to but often isn't statistical physics optics waves of all sorts elastodynamics fluid mechanics plasma physics and special and general relativity and cosmology Growing out of a full year course that the eminent researchers Kip Thorne and Roger Blandford taught at Caltech for almost three decades this book is designed to broaden the training of physicists Its six main topical sections are also designed so they can be used in separate courses and the book provides an invaluable reference for researchers Presents all the major fields of classical physics except three prerequisites classical mechanics electromagnetism

and elementary thermodynamics Elucidates the interconnections between diverse fields and explains their shared concepts and tools Focuses on fundamental concepts and modern real world applications Takes applications from fundamental experimental and applied physics astrophysics and cosmology geophysics oceanography and meteorology biophysics and chemical physics engineering and optical science and technology and information science and technology Emphasizes the quantum roots of classical physics and how to use quantum techniques to elucidate classical concepts or simplify classical calculations Features hundreds of color figures some five hundred exercises extensive cross references and a detailed index An online illustration package is available

**New Challenges and Opportunities in Physics Education** Marilena Streit-Bianchi, Marisa Michelini, Walter Bonivento, Matteo Tiveri, 2023-10-30 This book is invaluable for teachers and students in high school and junior college who struggle to understand the principles of modern physics and incorporate scientific methods in their lessons It provides interactive and multidisciplinary approaches that will help prepare present and future generations to face the technological and social challenges they will face Rather than using a unidirectional didactic approach the authors scientists philosophers communication experts science historians and science education innovators divide the book into two parts the first part Communicating Contemporary Physics examines how new physics developments affect modern culture while the second part Digital Challenges for Physics Learning covers physics education research using ICT plus the experiences of classroom teachers and a range of ideas and projects to innovate physics and STEM teaching

**The Number of the Heavens** Tom Siegfried, 2019-09-17 One of the most controversial cutting edge ideas in cosmology the possibility that there exist multiple parallel universes in fact has a long history Tom Siegfried reminds us that the size and number of the heavens have been contested since ancient times His story offers deep lessons about the nature of science and the quest for understanding

## Enjoying the Melody of Term: An Mental Symphony within **Geons Black Holes And Quantum Foam**

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