Black Holes And Time Warps Einstein

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Three Hundred Years of Gravitation Berkley Publishing Group
It is not an exaggeration to say that one of the most exciting predictions of Einstein's theory of gravitation is that there may exist "black holes": putative objects whose gravitational fields are so strong that no physical bodies or signals can break free of their pull and escape. The proof that black holes do exist, and an analysis of their properties, would have a significance going far beyond astrophysics. Indeed, what is involved is not just the discovery of yet another even if extremely remarkable, astro physical object, but a test of the correctness of our understanding of the properties of space and time in extremely strong gravitational fields. Theoretical research into the properties of black holes, and into the possible corol laries of the hypothesis that they exist, has been carried out with special vigor since the beginning of the 1970's. In addition to those specific features of black holes that are important for the interpretation of their possible astrophysical manifestations, the theory has revealed a number of unexpected characteristics of physical interactions involving black holes. By the middle of the 1980's a fairly detailed understanding had been achieved of the properties of the black holes, their possible astrophysical manifestations, and the specifics of the various physical processes involved. Even though a completely reliable detection of a black hole had not yet been made at that time, several objects among those scrutinized by astrophysicists were considered as strong candidates to be confirmed as being black holes.
The Future of Spacetime Little, Brown
This open access edited volume invites transdisciplinary scholars to re-vision science education in the era of the Anthropocene. The collection assembles the works of educators from many walks of life and areas of practice together to help reorient science education toward the problems and peculiarities associated with the geologic times many call the Anthropocene. It has become evident that science education—the way it is currently institutionalized in various forms of school science, government policy, classroom practice, educational research, and public/private research laboratories—is ill-equipped and ill-conceived to deal with the expansive and urgent contexts of the Anthropocene. Paying homage to myopic knowledge systems, rigid state education directives, and academic-professional communities intent on reproducing the same practices, knowledges, and relationships that have endangered our shared world and shared presents/presence is misdirected. This volume brings together diverse scholars to reimagine the field in times of precarity.
In Search of the Edge of Time Oxford University Press
What is a black hole? How many of them are in our Universe? Can black holes be created in a laboratory or in particle colliders? Can objects similar to black holes be used for space and time travel? This book discusses these and many other questions providing the reader with the tools required to explore the Black Hole Land independently.

100 Years of Relativity A True Book (Relaunch)
A journey through the otherworldly science behind Christopher Nolan’s award-winning film, Interstellar, from executive producer and Nobel Prize-winning physicist Kip Thorne. Interstellar, from acclaimed filmmaker Christopher Nolan, takes us on a fantastic voyage far beyond our solar system. Yet in The Science of Interstellar, Kip Thorne, the Nobel prize-winning physicist who assisted Nolan on the scientific aspects of Interstellar, shows us that the movie’s jaw-dropping events and stunning, never-before-attempted visuals are grounded in real science. Thorne shares his experiences working as the science adviser on the film and then moves on to the science itself. In chapters on wormholes, black holes, interstellar travel, and much more, Thorne’s scientific insights—many of them triggered during the actual scripting and shooting of Interstellar—describe the physical laws that govern our universe and the truly astounding phenomena that those laws make possible. Interstellar and all related characters and elements are trademarks of and © Warner Bros. Entertainment Inc. (s14).
General Relativity for Babies Springer Nature
Do you know: What might happen if you fall into a black hole? That the Universe does not have an edge? That the reason it gets dark at night is proof of the Big Bang? That cosmic particles time-travel through the atmosphere defying death? That our past, present and future might all coexist "out there"? With two remarkable ideas, Albert Einstein revolutionized our view of the Universe. His first was that nothing can travel faster than light-the ultimate speed limit. This simple fact leads to the unavoidable conclusion that space and time must be linked together forever as Spacetime. With his second monumental insight, Einstein showed how Spacetime is warped and stretched by the gravity of all objects in the Universe and even punctured by black holes. But such possible twisting of Spacetime allowed a magic not even Einstein could have imagined: time-travel. Theoretical physicist Jim Al-Khalili finally lays science fiction to rest as he opens up Einstein's Universe. Leading us gently and light-heartedly through the dizzying world of our space and time, he even gives us the recipe for a time machine, capable of taking us Back to the Future, to Alice's Wonderland, or on a trip with the Terminator.
Black Holes Taylor & Francis
Thanks to Einstein''s relativity theories, our notions of space and time underwent profound revisions about a 100 years ago. The resulting interplay between geometry and physics has dominated all of fundamental physics since then. This volume contains contributions from leading researchers, worldwide, who have thought deeply about the nature and consequences of this interplay. The articles take a long-range view of the subject and distill the most important advances in broad terms, making them easily accessible to non-specialists. The first part is devoted to a summary of how relativity theories were born (J Stachel). The second part discusses the most dramatic ramifications of general relativity, such as black holes (P Chrusciel and R Price), space-time singularities (H Nicolai and A Rendall), gravitational waves (P Laguna and P Saulson), the large scale structure of the cosmos (T Padmanabhan); experimental status of this theory (C Will) as well as its practical application to the GPS system (N Ashby). The last part looks beyond Einstein and provides glimpses into what is in store for us in the 21st century. Contributions here include summaries of radical changes in the notions of space and time that are emerging from quantum field theory in curved space-times (Ford), string theory (T Banks), loop quantum gravity (A Ashtekar), quantum cosmology (M Bojowald), discrete approaches (Dowker, Gambini and Pullin) and twistor theory (R Penrose).
Black Holes W. W. Norton & Company
Presents the current understanding of the nature of time and space, and an approachable explanation of Einstein's theory of special relativity; then goes on to connect these to possible time travel along with the accompanying paradoxes involved.
How to Build a Time Machine Springer Science & Business Media
Dive into a mind-bending exploration of the physics of black holes Black holes, predicted by Albert Einstein’s general theory of relativity more than a century ago, have long intrigued scientists and the public with their bizarre and fantastical properties. Although Einstein understood that black holes were mathematical solutions to his equations, he never accepted their physical reality—a viewpoint many shared. This all changed in the 1960s and 1970s, when a deeper conceptual understanding of black holes developed just as new observations revealed the existence of quasars and X-ray binary star systems, whose mysterious properties could be explained by the presence of black holes. Black holes have since been the subject of intense research—and the physics governing how they behave and affect their surroundings is stranger and more mind-bending than any fiction. After introducing the basics of the special and general theories of relativity, this book describes black holes both as astrophysical objects and theoretical “laboratories” in which physicists can test their understanding of gravitational, quantum, and thermal physics. From Schwarzschild black holes to rotating and colliding black holes, and from gravitational radiation to Hawking radiation and information loss, Steven Gubser and Frans Pretorius use creative thought experiments and analogies to explain their subject accessibly. They also describe the decades-long quest to observe the universe in gravitational waves, which recently resulted in the LIGO observatories’ detection of the distinctive gravitational wave “chirp” of two colliding black holes—the first direct observation of black holes’ existence. The Little Book of Black Holes takes readers deep into the mysterious heart of the subject, offering rare clarity of insight into the physics that makes black holes simple yet destructive manifestations of geometric destiny.
Black Holes and Time Warps World Scientific
Stephen Hawking provides the introduction to a work that examines such bizarre phenomena as black holes, wormholes, singularities, gravitational waves, and time machines, exploring the fundamental principles that control the universe.
The Physics of Einstein University of Chicago Press
In this masterfully written and brilliantly informed work, Dr. Rhorne, the Feynman Professor of Theoretical Physics at Caltech, leads readers through an elegant, always human, tapestry of interlocking themes, answering the great question: what principles control our universe and why do physicists think they know what they know? Features an introduction by Stephen Hawking.
Black Holes, Wormholes and Time Machines Cambridge University Press
Richly illustrated with the images from observatories on the ground and in space, and computer simulations, this book shows how black holes were discovered, and discusses our current understanding of their role in cosmic evolution. This second edition covers new discoveries made in the past decade, including definitive proof of a black hole at the center of the Milky Way, evidence that the expansion of the Universe is accelerating, and the new appreciation of the connection between black holes and galaxy formation. There are entirely new chapters on gamma-ray bursts and cosmic feedback. Begelman and Rees blend theoretical arguments with observational results to demonstrate how both approaches contributed to this subject. Clear illustrations and photographs reveal the strange and amazing workings of our universe. The engaging style makes this book suitable for introductory undergraduate courses, amateur astronomers, and all readers interested in astronomy and physics.
A Black Hole Is Not a Hole CRC Press
Albert Einstein’s theory of general relativity describes the effect of gravitation on the shape of space and the flow of time. But for more than four decades after its publication, the theory remained largely a curiosity for scientists; however accurate it seemed, Einstein’s mathematical code—represented by six interlocking equations—was one of the most difficult to crack in all of science. That is, until a twenty-nine-year-old Cambridge graduate solved the great riddle in 1963. Roy Kerr’s solution emerged coincidentally with the discovery of black holes that same year and provided fertile testing ground—at long last—for general relativity. Today, scientists routinely cite the Kerr solution, but even among specialists, few know the story of how Kerr cracked Einstein’s code. Fulvio Melia here offers an eyewitness account of the events leading up to Kerr’s great discovery. Cracking the Einstein Code vividly describes how luminaries such as Karl Schwarzschild, David Hilbert, and Emmy Noether set the stage for the Kerr solution; how Kerr came to make his breakthrough; and how scientists such as Roger Penrose, Kip Thorne, and Stephen Hawking used the accomplishment to refine and expand modern astronomy and physics. Today more than 300 million supermassive black holes are suspected of anchoring their host galaxies across the cosmos, and the Kerr solution is what astronomers and astrophysicists use to describe much of their behavior. By unmasking the history behind the search for a real world solution to Einstein’s field equations, Melia offers a first-hand account of an important but untold story. Sometimes dramatic, often exhilarating, but always attuned to the human element, Cracking the Einstein Code is ultimately a showcase of how important science gets done.
Hawking on the Big Bang and Black Holes W. W. Norton & Company
Epic verse and pulsating paintings merge to shed light on time travel, black holes, gravitational waves and the birth of the universe. Nearly two decades in the making, The Warped Side of Our Universe marks the historic collaboration of Nobel Laureate Kip Thorne and award-winning artist Lia Halloran. It brings to vivid life the wonders and wildness of our universe’s “Warped Side”—objects and phenomena made from warped space and time, from colliding black holes and collapsing wormholes to twisting space vortices and down-cascading time. Through poetic verse and otherworldly paintings, the authors explicate Thorne’s and colleagues’ astrophysical discoveries and speculations, with an epic narrative that asks: How did the universe begin? Can anything travel backward in time? And what weird and marvelous phenomena inhabit the Warped Side? Featuring more than 100 paintings, including a soaring Stephen Hawking, this one-of-a-kind volume, with its multiple gatefolds, takes us on an Odyssean voyage into and through the Warped Side of Our Universe.
Time Storms World Scientific
Einstein's general theory of relativity is widely considered to be one of the most elegant and successful scientific theories ever developed, and it is increasingly being taught in a simplified form at advanced undergraduate level within both physics and mathematics departments. Due to the increasing interest in gravitational physics, in both the academic and the public sphere, driven largely by widely-publicised developments such as the recent observations of gravitational waves, general relativity is also one of the most popular scientific topics pursued through self-study. Modern General Relativity introduces the reader to the general theory of relativity using an example-based approach, before describing some of its most important applications in cosmology and astrophysics, such as gamma-ray bursts, neutron stars, black holes, and gravitational waves. With hundreds of worked examples, explanatory boxes, and end-of-chapter problems, this textbook provides a solid foundation for understanding one of the towering achievements of twentieth-century physics.
Black Holes and Time Warps Icon Books
The award-winning science writer “packs a lot of learning into a deceptively light and enjoyable read” exploring the contentious history of the black hole (New Scientist). For more than half a century, physicists and astronomers engaged in heated dispute over the possibility of black holes in the universe. The strange notion of a space-time abyss from which not even light escapes seemed to confound all logic. Now Marcia Bartusiak, author of Einstein’s Unfinished Symphony and The Day We Found the Universe, recounts the frustrating, exhilarating, and at times humorous battles over one of history’s most dazzling ideas. Bartusiak shows how the black hole helped revive Einstein’s greatest achievement, the general theory of relativity, after decades of languishing in obscurity. Not until astronomers discovered such surprising new phenomena as neutron stars and black holes did the once-sedate universe transform into an Einsteinian cosmos, filled with sources of titanic energy that can be understood only in the light of relativity. Black Hole explains how Albert Einstein, Stephen Hawking, and other leading thinkers completely changed the way we see the universe.
Death By Black Hole W. W. Norton & Company
With his unique knack for making cutting-edge theoretical science effortlessly accessible, world-renowned physicist Paul Davies now tackles an issue that has boggled minds for centuries: Is time travel possible? The answer, insists Davies, is definitely yes—once you iron out a few kinks in the space-time continuum. With tongue placed firmly in cheek, Davies explains the theoretical physics that make visiting the future and revisiting the past possible, then proceeds to lay out a four-stage process for assembling a time machine and making it work. Wildly inventive and theoretically sound, How to Build a Time Machine is creative science at its best—illuminating, entertaining, and thought provoking.
Gravity's Fatal Attraction Springer Science & Business Media
A Princeton astrophysicist explores whether journeying to the past or future is scientifically possible in this “intriguing” volume (Neil deGrasse Tyson). It was H. G. Wells who coined the term “time machine”—but the concept of time travel, both forward and backward, has always provoked fascination and yearning. It has mostly been dismissed as an impossibility in the world of physics; yet theories posited by Einstein, and advanced by scientists including Stephen Hawking and Kip Thorne, suggest that the phenomenon could actually occur. Building on these ideas, J. Richard Gott, a professor who has written on the subject for Scientific American, Time, and other publications, describes how travel to the future is not only possible but has already happened—and contemplates whether travel to the past is also conceivable. This look at the surprising facts behind the science fiction of time

travel “deserves the attention of anyone wanting wider intellectual horizons” (Booklist). “Impressively clear language. Practical tips for chrononauts on their options for travel and the contingencies to prepare for make everything sound bizarrely plausible. Gott clearly enjoys his subject and his excitement and humor are contagious; this book is a delight to read.” —Publishers Weekly

Black Holes & Time Warps: Einstein's Outrageous Legacy (Commonwealth Fund Book Program) Mendon Cottage Books

Introduction Space, the final frontier… to explore strange new worlds, to seek out new life,and new civilizations, to boldly go where no man has gone before. ~ Gene Roddenberry *** The universe is full of surprises! We can find amazing things like galaxies, planets, comets, asteroids, moons, meteorites, and more! One of the strangest objects we can find in space is called a… black hole. Have you ever heard of black holes? What do you know about them? Let’s learn more! Black holes are dark areas in space with strong gravity. Not all black holes are black and we cannot see them, but we know they are there. How do we know they exist even though we can’t see them? Scientists study the things that happen around a black hole, and that tells them a black hole is there. The force of a black hole is so strong light cannot escape. Do you know what happens to light when it gets near a black hole? Strong gravity pulls light and everything else into the center. It is so strong that nothing escapes the powerful force, and everything falls in! Black holes come in lots of different sizes. Some are big, and some are small. Some black holes are so big; they are called supermassive black holes. That’s a big, big hole! Black holes affect not only space but time too. How so? Did you know time changes when you get near a black hole? Yes, it does! This is because of Einstein’s theory of relativity. Let’s find out how black holes work and what else we can learn about this mysterious force in the universe!

Empire of the Stars Sourcebooks, Inc.

This book explores the idea of time travel from the first account in English literature to the latest theories of physicists such as Kip Thorne and Igor Novikov. This very readable work covers a variety of topics including: the history of time travel in fiction; the fundamental scientific concepts of time, spacetime, and the fourth dimension; the speculations of Einstein, Richard Feynman, Kurt Goedel, and others; time travel paradoxes, and much more.

Modern General Relativity Yale University Press

A collection of reviews by prominent researchers in cosmology, relativity and particle physics commemorates the 300th anniversary of Newton's Philosophiae Naturalis Principia Mathematica.

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