Black Hole Astrophysics The Engine Paradigm Springer Praxis Books

Black Hole GravitohydromagneticsCoevolution of Black Holes and Galaxies: Volume 1, Carnegie Observatories Astrophysics SeriesBig BangBlack Holes and Baby Universes and Other EssaysASTROPHYSICS FOR PEOPLE IN A HURRY - Summarized for Busy PeopleIcarus at the Edge of TimeThe Mathematical Theory of Black HolesGravity's EnginesRelativistic AstrophysicsAstrophysical Jets and Their EnginesAccretion Power in AstrophysicsGravity's EnginesA Black Hole Is Not a HoleHigh Energy Astrophysical TechniquesThe Science of InterstellarModern General RelativityMHD Flows in Compact Astrophysical ObjectsBlack HolesBlack Holes: A Laboratory for Testing Strong GravityTheory of Black Hole Accretion DiscsCracking the Einstein CodeAstrophysical Black HolesBlack Holes, Wormholes and Time Machines, Second EditionBlack Hole GravitohydromagneticsBlack Hole AstrophysicsThe Formation and Disruption of Black Hole JetsBlack Hole Blues and Other Songs from Outer SpaceThe Physics and Evolution of Active Galactic NucleiAccretion Power in AstrophysicsBlack Hole PhysicsGravitation and AstrophysicsBlack Hole Astrophysics 2002Black Holes: A Very Short IntroductionThe Astronomy RevolutionAstrophysics of Black HolesExploring Black HolesBlack HoleGravity's Fatal AttractionActive Galactic NucleiThe Kerr Spacetime

Black Hole Gravitohydromagnetics

The ICGA series of conferences is specially aimed to serve the needs of the workers in this research area in the Asia-Pacific region. The previous conferences of this series have attracted a growing number of local, regional and international participants. 2005 was an auspicious year. Not only was it the International Year of Physics, commemorating Einstein''s great achievements of 1905, it also was the anniversary of Einstein''s development of General Relativity: he submitted the final form of his field equations on 25 November, 1915. Nine decades years later, around 40 Taiwan-based participants were joined by over 40 distinguished visitors from Canada, China, France, Japan, Korea, Russia, and the USA, and this volume includes many of the papers that were presented. The depth and breadth of these contributions reflect the high quality of the meeting and the development of the field in the Asia-Pacific region. Sample Chapter(s). Chapter 1: Progress in Testing Newtonian Inverse Square Law (234 KB). Contents: Experimental Tests of Gravity; Numerical Relativity; Cosmology; Astrophysics; Quantum Gravity; Classical Gravity. Readership: Graduate students and researchers in astrophysics, gravitation, cosmology and theoretical physics.

Coevolution of Black Holes and Galaxies: Volume 1, Carnegie Observatories Astrophysics Series

The authoritative story of the headline-making discovery of gravitational waves—by an eminent theoretical astrophysicist and award-winning writer. From the author of How the Universe Got Its Spots and A Madman Dreams of Turing Machines, the epic story of the scientific campaign to record the soundtrack of our universe. Black holes are dark. That is their essence. When black holes collide, they will do so unilluminated. Yet the black hole collision is an event more powerful than any since the origin of the universe. The profusion of energy will emanate as waves in the shape of spacetime: gravitational waves. No telescope will ever record the event; instead, the only evidence would be the sound of spacetime ringing. In 1916, Einstein predicted the existence of gravitational waves, his top priority after he proposed his theory of curved spacetime. One century later, we are recording the first sounds from space, the soundtrack to accompany astronomy's silent movie. In Black Hole Blues and Other Songs from Outer Space, Janna Levin recounts the fascinating story of the obsessions, the aspirations, and the trials of the scientists who embarked on an arduous, fifty-year endeavor to capture these elusive waves. An experimental ambition that began as an amusing thought experiment, a mad idea, became the object of fixation for the original architects—Rai Weiss, Kip Thorne, and Ron Drever. Striving to make the ambition a reality, the original three gradually accumulated an international team of hundreds. As this book was written, two massive instruments of remarkably delicate sensitivity were brought to advanced capability. As the book draws to a close,

five decades after the experimental ambition began, the team races to intercept a wisp of a sound with two colossal machines, hoping to succeed in time for the centenary of Einstein's most radical idea. Janna Levin's absorbing account of the surprises, disappointments, achievements, and risks in this unfolding story offers a portrait of modern science that is unlike anything we've seen before. From the Hardcover edition.

Big Bang

Some 400 years after the first known patent application for a telescope by Hans Lipperhey, The Astronomy Revolution: 400 Years of Exploring the Cosmos surveys the effects of this instrument and explores the questions that have arisen out of scientific research in astronomy and cosmology. Inspired by the international New Vision 400 conference held

Black Holes and Baby Universes and Other Essays

This book consists of about 20 lectures on theoretical and observational aspects of astrophysical black holes, by experts in the field. The basic principles and astrophysical applications of the black hole magnetosphere and the BlandfordOCoZnajek process are reviewed in detail, as well as accretion by black holes, black hole X-Ray binaries, black holes with cosmic strings, and so on. Recent advances in X-Ray observations of galactic black holes and new

understanding of supermassive black holes in AGNs and normal galaxies are also discussed."

ASTROPHYSICS FOR PEOPLE IN A HURRY - Summarized for Busy People

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).

Icarus at the Edge of Time

We have long understood black holes to be the points at which the universe as we know it comes to an end -

mysterious chasms so destructive and unforgiving that not even light can escape their deadly power. Recent research, however, has led to a cascade of new discoveries that have revealed an entirely new, and crucially important, side to black holes. Super-sized versions, often billions of times more massive than the Sun, lurk in every galaxy in the universe. And these chasms don't just vacuum up everything around them; they also spit out huge clouds of matter and energy. In Gravity's Engines, renowned astrophysicist Caleb Scharf reveals how these giant black holes profoundly rearrange the cosmos that surrounds them, controlling the number of stars in the galaxies and, in turn, the entire universe. With lucidity and elegance, Scharf traces the two hundred year history of our attempts to discover the nature of black holes, from an English academic turned clergyman in the late 1700's who first identified these 'dark stars' to Einstein and the great revolutions of relativity and quantum mechanics. Engaging with our deepest questions about our origins, he takes us on an intimate journey through our endlessly colourful universe, revealing how the cosmic capacity for life is ultimately governed by - and perhaps could not exist without - black holes.

The Mathematical Theory of Black Holes

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.

Gravity's Engines

This book summary and analysis is created for individuals who want to extract the essential contents and are too busy to go through the full version. This book is not intended to replace the original book.

Instead, we highly encourage you to buy the full version. What is the true nature of the fabrics of spacetime? Where does humankind belong in the grand scheme of the universe? How exactly is the universe alive within us? Let renowned astrophysicist and acclaimed author Neil deGrasse Tyson guide you through these baffling mysteries of the cosmos. In the modern day, so few people spend their time to contemplate the secrets of the universe. Tyson offers us a closer look at the heavens, with brevity and wit, in twelve comprehensible chapters you can read anytime, anywhere. As you brew your morning coffee or as you wait for your bus ride to work, this book provides just more than enough for you to be fluent in the complex subject of the cosmos. From the Big Bang to supermassive black holes, from general relativity to quantum theory, and from the quest for exoplanets to the quest for extraterrestrial life—Astrophysics for People in a Hurry guarantees to fill you in and bring you up to date. Wait no more, take action and get this book now!

Relativistic Astrophysics

The first comprehensive and up-to-date review of our new understanding of accretion disks around black holes - with chapters from experts from around the world.

Astrophysical Jets and Their Engines

During the first decades after Einstein had developed his Theory of General Relativity, the main effort was

to understand the theory and verify it experimentically. Meanwhile Genral Relativity is one of the experimentally best confirmed theories and has become a powerful tool for the investigation of cosmic processes where strong gravitational fields are involved. This book contains 16 contributions from well-known experts giving a broad overview for non-specialists who want to learn how to purely academic issues like gravitational wave detectors are now put into reality.

Accretion Power in Astrophysics

This is the first comprehensive treatment of active galactic nuclei--the cosmic powerhouses at the core of many distant galaxies. The term active galactic nuclei refers to quasars, radio galaxies, Seyfert galaxies, blazars, and related objects, all of which are believed to share a similar central engine--a supermassive black hole many times the mass of the Sun. Astrophysicists have studied these phenomena for the past several decades and have begun to develop a consensus about many of their properties and internal mechanisms. Julian Krolik, one of the world's leading authorities on the subject, sums up leading ideas from across the entire range of research, making this book an invaluable resource for astronomers, physicists interested in applications of the theory of gravitation, and graduate students. Krolik begins by addressing basic questions about active galactic nuclei: What are they? How can they be found? How do they evolve? He assesses the evidence for massive black holes and considers how they generate power by accretion. He

discusses X-ray and g-ray emission, radio emission and jets, emission and absorption lines, anisotropic appearance, and the relationship between an active nucleus and its host galaxy. He explores the mysteries of what ignites, fuels, and extinguishes active galactic nuclei, and concludes with a general review of where the field now stands. The book is unique in paying careful attention to relevant physics as well as astronomy, reflecting in part the importance of general relativity to understanding active galactic nuclei. Clear, authoritative, and detailed, this is crucial reading for anyone interested in one of the most dynamic areas of astrophysics today.

Gravity's Engines

This book was originally published in 2004. Black holes are among the most mysterious objects in the Universe. Weighing up to several billion Suns, massive black holes have long been suspected to be the central powerhouses of energetic phenomena such as quasars. Advances in astronomy have not only provided spectacular proof of this long-standing paradigm, but have revealed the unexpected result that far from being rare, exotic beasts, they inhabit the center of virtually all large galaxies. Candidate black holes have been identified in increasingly large numbers of galaxies, both inactive and active, to the point where statistical studies are possible. Fresh work has highlighted the close connection between the formation, growth, and evolution of supermassive black holes and their host galaxies. This volume

contains the invited lectures from an international symposium that was held to explore this exciting theme, and is a valuable review for professional astronomers and graduate students.

A Black Hole Is Not a Hole

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.

High Energy Astrophysical Techniques

Accretion flows, winds and jets of compact astrophysical objects and stars are generally described within the framework of hydrodynamical and magnetohydrodynamical (MHD) flows. Analytical analysis of the problem provides profound physical insights, which are essential for interpreting and understanding the results of numerical simulations. Providing such a physical understanding of MHD Flows in Compact Astrophysical Objects is the main goal of this book, which is an updated translation of a successful Russian graduate textbook. The book provides the first detailed introduction into the method of the Grad-Shafranov equation, describing analytically the very broad class of hydrodynamical and MHD flows. It starts with the classical examples of hydrodynamical accretion onto relativistic and nonrelativistic objects. The force-free limit of the Grad-Shafranov equation allows us to analyze in detail the physics of the magnetospheres of radio pulsars and black holes, including the Blandford-Znajek process of energy extraction from a rotating black hole immersed in an external magnetic field. Finally, on the basis of the full MHD version of the Grad-Shafranov equation the author discusses the problems of jet collimation and particle acceleration in Active Galactic Nuclei, radio pulsars, and Young Stellar Objects. The comparison of the analytical results with numerical simulations demonstrates their good agreement. Assuming that the reader is familiar with the basic physical and mathematical concepts of General Relativity, the author uses the 3+1 split approach which allows the formulation of all results in terms of physically clear language of three

dimensional vectors. The book contains detailed derivations of equations, numerous exercises, and an extensive bibliography. It therefore serves as both an introductory text for graduate students and a valuable reference work for researchers in the field.

The Science of Interstellar

A futuristic reimaging of the classic Greek myth, as a boy ventures through deep space and challenges the awesome power of black holes. The beauty of the book lies in the images, provided by NASA and the Hubble Space telescope, and printed on board rather than paper. On board pages.

Modern General Relativity

As a result of significant research over the past 20 years, black holes are now linked to some of the most spectacular and exciting phenomena in the Universe, ranging in size from those that have the same mass as stars to the super-massive objects that lie at the heart of most galaxies, including our own Milky Way. This book first introduces the properties of simple isolated holes, then adds in complications like rotation, accretion, radiation, and magnetic fields, finally arriving at a basic understanding of how these immense engines work. Black Hole Astrophysics • reviews our current knowledge of cosmic black holes and how they generate the most powerful observed pheonomena in the Universe; • highlights the latest, most up-to-date theories and discoveries in this very active area of astrophysical research; • demonstrates

why we believe that black holes are responsible for important phenomena such as quasars, microquasars and gammaray bursts; • explains to the reader the nature of the violent and spectacular outfl ows (winds and jets) generated by black hole accretion.

MHD Flows in Compact Astrophysical Objects

NEW YORK TIMES BESTSELLER THIRTEEN EXTRAORDINARY ESSAYS SHED NEW LIGHT ON THE MYSTERIES OF THE UNIVERSE—AND ON ONE OF THE MOST BRILLIANT THINKERS OF OUR TIME. In his phenomenal bestseller A Brief History of Time, Stephen Hawking literally transformed the way we think about physics, the universe, reality itself. In these thirteen essays and one remarkable extended interview, the man widely regarded as the most brilliant theoretical physicist since Einstein returns to reveal an amazing array of possibilities for understanding our universe. Building on his earlier work, Hawking discusses imaginary time, how black holes can give birth to baby universes, and scientists' efforts to find a complete unified theory that would predict everything in the universe. With his characteristic mastery of language, his sense of humor and commitment to plain speaking, Stephen Hawking invites us to know him better—and to share his passion for the voyage of intellect and imagination that has opened new ways to understanding the very nature of the cosmos. From the Trade Paperback edition.

Black Holes

"The theory of black holes is the most simple consequence of Einstein's relativity theory. Dealing with relativity theory, this book details one of the most beautiful areas of mathematical physics; the theory of black holes. It represents a personal testament to the work of the author, who spent several years working-out the subject matter."--WorldCat.

Black Holes: A Laboratory for Testing Strong Gravity

Based on graduate school lectures in contemporary relativity and gravitational physics, this book gives a complete and unified picture of the present status of theoretical and observational properties of astrophysical black holes. The chapters are written by internationally recognized specialists. They cover general theoretical aspects of black hole astrophysics, the theory of accretion and ejection of gas and jets, stellar-sized black holes observed in the Milky Way, the formation and evolution of supermassive black holes in galactic centers and quasars as well as their influence on the dynamics in galactic nuclei. The final chapter addresses analytical relativity of black holes supporting theoretical understanding of the coalescence of black holes as well as being of great relevance in identifying gravitational wave signals. With its introductory chapters the book is aimed at advanced graduate and post-graduate students, but it will also be useful for specialists.

Theory of Black Hole Accretion Discs

This textbook introduces the current astrophysical observations of black holes, and discusses the leading techniques to study the strong gravity region around these objects with electromagnetic radiation. More importantly, it provides the basic tools for writing an astrophysical code and testing the Kerr paradigm. Astrophysical black holes are an ideal laboratory for testing strong gravity. According to general relativity, the spacetime geometry around these objects should be well described by the Kerr solution. The electromagnetic radiation emitted by the gas in the inner part of the accretion disk can probe the metric of the strong gravity region and test the Kerr black hole hypothesis. With exercises and examples in each chapter, as well as calculations and analytical details in the appendix, the book is especially useful to the beginners or graduate students who are familiar with general relativity while they do not have any background in astronomy or astrophysics.“/p>

Cracking the Einstein Code

Unique, comprehensive overview for researchers and graduate students in observational and theoretical astrophysics, general relativity, and high-energy physics.

Astrophysical Black Holes

This unique book offers a concise, introductory overview of general relativity and black holes,

motivating students to become active participants in carrying out their own investigations. To this end, the book uses calculus and algebra, rather than tensors, to make general relativity accessible to sophomores and juniors. Five chapters introduce basic concepts, and seven projects require the reader to apply these basic concepts to real astronomical applications.

Black Holes, Wormholes and Time Machines, Second Edition

Black holes are a constant source of fascination to many due to their mysterious nature. In this Very Short Introduction, Katherine Blundell addresses a variety of questions, including what a black hole actually is, how they are characterized and discovered, and what would happen if you came too close to one. She explains how black holes form and grow - by stealing material that belongs to stars, as well as how many there may be in the Universe. She also explores the large black holes found in the centres of galaxies, and how black holes give rise to quasars and other spectacular phenomena in the cosmos. ABOUT THE SERIES: The Very Short Introductions series from Oxford University Press contains hundreds of titles in almost every subject area. These pocket-sized books are the perfect way to get ahead in a new subject quickly. Our expert authors combine facts, analysis, perspective, new ideas, and enthusiasm to make interesting and challenging topics highly readable.

Black Hole Gravitohydromagnetics

A comprehensive introduction to the theory underpinning our study of active galactic nuclei and the ways we observe them.

Black Hole Astrophysics

Offers an accessible introduction to black holes requiring no mathematical background.

The Formation and Disruption of Black Hole Jets

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.

Black Hole Blues and Other Songs from Outer Space

This book reviews the phenomenology displayed by relativistic jets as well as the most recent theoretical efforts to understand the physical mechanisms at their origin. Relativistic jets have been observed and studied in Active Galactic Nuclei (AGN) for about half a century and are believed to be fueled by accretion onto a supermassive black hole at the center of the host galaxy. Since the first discovery of relativistic jets associated with so-called "micro-quasars" much more recently, it has seemed clear that much of the physics governing the relativistic outflows in stellar X-ray binaries harboring black holes and in AGN must be common, but acting on very different spatial and temporal scales. With new observational and theoretical results piling up every day, this book

attempts to synthesize a consistent, unified physical picture of the formation and disruption of jets in accreting black-hole systems. The chapters in this book offer overviews accessible not only to specialists but also to graduate students and astrophysicists working in other areas. Covered topics comprise Relativistic jets in stellar systems Launching of AGN jets Parsec-scale AGN jets Kiloparsec-scale AGN jets Black hole magnetospheres Theory of relativistic jets The structure and dynamics of the inner accretion disk The origin of the jet magnetic field X-ray observations, phenomenology, and connection with theory

The Physics and Evolution of Active Galactic Nuclei

This volume is the documentation of the first Course on 'Neutron Stars, Active Galactic Nuclei and Jets', of an Erice School with a wide astro physical scope. The choice of the subject was made because of an apparent similari ty - stressed already at earlier meetings - of four classes of astrophy sical jet sources: Active Galactic Nuclei, Young Stellar Objects, Binary Neutron Stars and Binary White Dwarfs. They share important properties such as their morphology, high variability and large veloci ty gradients as well as - with some inference - their broad spectrum, hypersonic outflow and core/lobe power ratio. Despite this apparent similarity of the four source classes, quite different models have been put forward for their description: (i) The central engine of active galactic nuclei has been generally thought to be a black hole,

in contrast to the central engine of young stellar objects and cometary nebulae which apparently is a pre-T-Tauri star, some six orders of magnitude less compact, and to the central engine of planetary nebulae which mayor may not be a binary white dwarf. (ii) The elongated lobes, or flow patterns, have been often interpreted as highly directional stellar wind outflows whereas in a few well mapped cases, the elongated flow appears to be 'pumped up' through a much narrower channel, or jet, both in the extragalactic and stellar sources.

Accretion Power in Astrophysics

One of The Barnes and Noble Review Editors' Picks: Best Nonfiction of 2012 Selected by The Christian Science Monitor as one of "21 smart nonfiction titles we think you'll enjoy this summer" Selected by The New Scientist as one of 10 books to look out for in 2012 We've long understood black holes to be the points at which the universe as we know it comes to an end. Often billions of times more massive than the Sun, they lurk in the inner sanctum of almost every galaxy of stars in the universe. They're mysterious chasms so destructive and unforgiving that not even light can escape their deadly wrath. Recent research, however, has led to a cascade of new discoveries that have revealed an entirely different side to black holes. As the astrophysicist Caleb Scharf reveals in Gravity's Engines, these chasms in space-time don't just vacuum up everything that comes near them; they also spit out huge beams and clouds of matter. Black holes blow bubbles. With clarity and keen

intellect, Scharf masterfully explains how these bubbles profoundly rearrange the cosmos around them. Engaging with our deepest questions about the universe, he takes us on an intimate journey through the endlessly colorful place we call our galaxy and reminds us that the Milky Way sits in a special place in the cosmic zoo—a "sweet spot" of properties. Is it coincidental that we find ourselves here at this place and time? Could there be a deeper connection between the nature of black holes and their role in the universe and the phenomenon of life? We are, after all, made of the stuff of stars.

Black Hole Physics

This book discusses the state of the art of the basic theoretical and observational topics related to black hole astrophysics. It covers all the main topics in this wide field, from the theory of accretion disks and formation mechanisms of jet and outflows, to their observed electromagnetic spectrum, and attempts to measure the spin of these objects. Black holes are one of the most fascinating predictions of general relativity and are currently a very hot topic in both physics and astrophysics. In the last five years there have been significant advances in our understanding of these systems, and in the next five years it should become possible to use them to test fundamental physics, in particular to predict the general relativity in the strong field regime. The book is both a reference work for researchers and a textbook for graduate students.

Gravitation and Astrophysics

An updated version of the popular graduate text on accretion in astrophysics.

Black Hole Astrophysics 2002

Bringing the material up to date, Black Holes, Wormholes and Time Machines, Second Edition captures the new ideas and discoveries made in physics since the publication of the best-selling first edition. While retaining the popular format and style of its predecessor, this edition explores the latest developments in high-energy astroparticle physics and Big Bang cosmology. The book continues to make the ideas and theories of modern physics easily understood by anyone, from researchers to students to general science enthusiasts. Taking you on a journey through space and time, author Jim Al-Khalili covers some of the most fascinating topics in physics today, including: Black holes Space warps The Big Bang Time travel Wormholes Parallel universes Professor Al-Khalili explains often complex scientific concepts in simple, nontechnical terms and imparts an appreciation of the cosmos, helping you see how time traveling may not be so far-fetched after all.

Black Holes: A Very Short Introduction

An updated version of the popular graduate text on accretion in astrophysics.

The Astronomy Revolution

Black hole gravitohydromagnetics (GHM) is developed from the rudiments to the frontiers of research in this book. GHM describes plasma interactions that combine the effects of gravity and a strong magnetic field, in the vicinity (ergosphere) of a rapidly rotating black hole. This topic was created in response to the astrophysical quest to understand the central engines of radio loud extragalactic radio sources. The theory describes a "torsional tug of war" between rotating ergospheric plasma and the distant asymptotic plasma that extracts the rotational inertia of the black hole. The recoil from the struggle between electromagnetic and gravitational forces near the event horizon is manifested as a powerful pair of magnetized particle beams (jets) that are ejected at nearly the speed of light. This second edition of the book is updated throughout and contains a completely new chapter discussing state of the art and results of numerical simulations of ergospheric disk jets occurring in magnetohydrodynamic accretion flows.

Astrophysics of Black Holes

Budding astronomers and scientists will love this humorous introduction to the extremely complex concept of black holes. With space facts and answers about the galaxies (ours, and others) A Black Hole is NOT a Hole takes readers on a ride that will stretch their minds around the phenomenon known as a black hole. In lively and text, the book starts off with a thorough explanation of gravity and the role it plays in the formation of black holes. Paintings by Michael

Carroll, coupled with real telescopic images, help readers visualize the facts and ideas presented in the text, such as how light bends, and what a supernova looks like. Back matter includes a timeline which sums up important findings discussed throughout, while the glossary and index provide a quick point of reference for readers. Children and adults alike will learn a ton of spacey facts in this far-out book that's sure to excite even the youngest of astrophiles.

Exploring Black Holes

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.

Black Hole

A half century ago, a shocking Washington Post headline claimed that the world began in five cataclysmic minutes rather than having existed for all time; a skeptical scientist dubbed the maverick theory the Big Bang. In this amazingly comprehensible history of the universe, Simon Singh decodes the mystery behind the Big Bang theory, lading us through the development of one of the most extraordinary, important, and awe-inspiring theories in science.

Gravity's Fatal Attraction

Black hole gravitohydromagnetics (GHM) is developed from the rudiments to the frontiers of research in this book. GHM describes plasma interactions that combine the effects of gravity and a strong magnetic field, in the vicinity (ergosphere) of a rapidly rotating black hole. This topic was created in response to the astrophysical quest to understand the central engines of radio loud extragalactic radio sources. The theory describes a "torsional tug of war" between rotating ergospheric plasma and the distant asymptotic plasma that extracts the rotational inertia of the black hole. The recoil from the struggle between electromagnetic and gravitational forces near the event horizon is manifested as a powerful pair of magnetized particle beams (jets) that are ejected at nearly the speed of light. This second edition of the book is updated throughout and contains a completely new chapter discussing state of the art

and results of numerical simulations of ergospheric disk jets occurring in magnetohydrodynamic accretion flows.

Active Galactic Nuclei

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.

The Kerr Spacetime

This textbook presents ultraviolet and X-ray astronomy, gamma-ray astronomy, cosmic ray

astronomy, neutrino astronomy, and gravitational wave astronomy as distinct research areas, focusing on the astrophysics targets and the requirements with respect to instrumentation and observation methods. The purpose of the book is to bridge the gap between the reference books and the specialized literature. For each type of astronomy, the discussion proceeds from the orders of magnitude for observable quantities. The physical principles of photon and particle detectors are then addressed, and the specific telescopes and combinations of detectors, presented. Finally the instruments and their limits are discussed with a view to assisting readers in the planning and execution of observations. Astronomical observations with high-energy photons and particles represent the newest additions to multimessenger astronomy and this book will be of value to all with an interest in the field.