Black Hole

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.

A pedagogical introduction to the physics of black holes. The membrane paradigm represents the four-dimensional spacetime of the black hole's "event horizon" as a two-dimensional membrane in three-dimensional space, allowing the reader to understand and compute the behavior of black holes in complex astrophysical environments.

The basic subjects and main topics covered by this book are: (1) Physics of Black Holes (classical and quantum); (2) Thermodynamics, entropy and internal dynamics; (3) Creation of particles and evaporation; (4) Mini black holes; (5) Quantum mechanics of black holes in curved spacetime; (6) The role of spin and torsion in the black hole physics; (7) Equilibrium geometry and membrane paradigm; (8) Black hole in string and superstring theory; (9) Strings, quantum gravity and black holes; (10) The problem of singularity; (11) Astrophysics of black holes; (12) Observational evidence of black holes. The book reveals the deep connection between gravitational, quantum and statistical physics and also the importance of black hole behaviour in the very early universe. An important new point discussed concerns the introduction of spin in the physics of black holes, showing its central role when correctly put into the Einstein equations through the geometric concept of torsion, with the new concept of a time-temperature uncertainty relation, minimal time, minimal entropy, quantization of entropy and the connection of black hole with wormholes. Besides theoretical aspects, the reader will also find observational evidence for black holes in active galactic nuclei, in binary X-ray sources and in

supernova remnants. The book will thus interest physicists, astronomers, and astrophysicists at different levels of their career who specialize in classical properties, quantum processes, statistical thermodynamics, numerical collapse, observational evidence, general relativity and other related problems.

The supermassive black hole in the center of our Milky Way is the nearest such object and relatively easy to observe and study. Not surprisingly therefore, it is the best studied supermassive black hole. Many astrophysical and even general relativistic effects can be investigated in great detail. The Galactic Black Hole: Lectures on General Relativity and Astrophysics provides a systematic introduction to the physics/astrophysics and mathematics of black holes at a level suitable for graduate students, postdocs, and researchers in physics, astrophysics, astronomy, and applied mathematics. The focus is mainly on the supermassive black hole in the center of our Milky Way but the results can be easily generalized taking it as an example. Leading international experts provide first-hand accounts of the observational and theoretical aspects of this black hole. Topics range from the properties of the Schwarzschild metric and the collapse of a black hole, to quantum gravity, and from the structure of the Galaxy to accretion of matter and the emission properties of the Galactic Center black hole.

Documents the author's professional battles with Stephen Hawking and Gerard 't Hooft over their theories about black holes, a conflict that has significantly influenced the modern scientific community's understanding of the universe's fundamental laws. By the author of The Cosmic Landscape.

Based on Prof. Lüst's Masters course at the University of Munich, this book begins with a short introduction to general relativity. It then presents black hole solutions, and discusses Penrose diagrams, black hole thermodynamics and entropy, the Unruh effect, Hawking radiation, the black hole information problem, black holes in supergravity and string theory, the black hole microstate counting in string theory, asymptotic symmetries in general relativity, and a particular quantum model for black holes. The book offers an up-to-date summary of all the pertinent questions in this highly active field of physics, and is ideal reading for graduate students and young researchers.

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.

This book is based on the lecture notes of a one-semester course on black hole astrophysics given by the author and is aimed at advanced undergraduate and graduate students with an interest in astrophysics. The material included goes beyond that found in classic textbooks and presents details on astrophysical manifestations of black holes. In particular, jet physics and detailed accounts of objects like microquasars, active galactic nuclei, gamma-ray bursts, and ultra-luminous X-ray sources are covered, as well as advanced topics like black holes in alternative theories of gravity. The author avoids unnecessary technicalities and to some degree the book is self-contained. The reader will find some basic general relativity tools in Chapter 1. The appendices provide some additional mathematical details that will be useful for further study, and a guide to the bibliography on the subject.

Provides a comprehensive summary on the physical models and current theory of black hole accretion, growth and mergers, in both the supermassive and stellar-mass cases. This title reviews in-depth research on accretion on all scales, from galactic binaries to intermediate mass and supermassive black holes. Possible future directions of accretion are also discussed. The following main themes are covered: a historical perspective; physical models of accretion onto black holes of all masses; black hole fundamental parameters; and accretion, jets and outflows. An overview and outlook on the topic is also presented. This volume summarizes the status of the study of astrophysical black hole research and is aimed at astrophysicists and graduate students working in this field. Originally published in Space Science Reviews, Vol 183/1-4, 2014.

Best book on Black hole, Bar None. There has never been a Black hole Guide like this. It contains 162 answers, much more than you can imagine; comprehensive answers and extensive details and references, with insights that have never before been offered in print. Get the information you need--fast! This all-embracing guide offers a thorough view of key knowledge and detailed insight. This Guide introduces what you want to know about Black hole. A quick look inside of some of the subjects covered: Black hole information loss paradox - Principles in action, Charged black hole, Malaysia Airlines Flight 370 unofficial disappearance theories - Black hole or meteor strike, Black hole - Event horizon, Rotating black hole - Further reading, Black hole - Gravitational collapse, Black hole - Accretion of matter, Micro black hole - Black holes in quantum theories of gravity, Black hole - Growth, Black hole - Entropy and thermodynamics, Songs from the Black Hole - Demo releases, Black hole (disambiguation) - Government, Black holes in fiction, Arthur Eddington - Dispute with Chandrasekhar on existence of black holes, Supermassive black hole - History of research, Black hole - Evaporation, Black hole - Quiescence and advection-dominated accretion flow, Primordial black holes, Black hole

(disambiguation) - Media, Supermassive black hole - Doppler measurements, Stellar black hole - Candidates, Black holes in fiction - Early works, John Michell - Black holes, Bekenstein bound - Black holes, Songs from the Black Hole - Concept, Stellar black hole - Properties, Songs from the Black Hole - Legacy, List of black holes - Stellar black holes and candidates, Black holes in fiction - Music, Gerard 't Hooft - Quantum gravity and black holes, Black Holes and Time Warps, Stellar mass black hole, Micro black hole - Safety arguments, and much more...

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. Contents: Classical Black HolesThe Hawking EffectNear-Horizon Approximation and Conformal SymmetryStress Tensor, Anomalies and Effective ActionsModels for Evaporating Black Holes Readership: Graduate students and researchers in gravitation, high energy physics and astrophysics. Key Features:Detailed and pedagogical presentation of the Hawking effectDerivation of black hole radiance using the Rindler and AdS space near-horizon approximationExtensive use of two-dimensional conformal symmetry and intuitive derivation of the trace anomaly using equivalence principle argumentsUse of solvable models for the study of backreaction effects and the information loss problem in black hole spacetimesKeywords:Black Holes;Quantum Fields in Curved Space;Semiclassical Gravity;Hawking Effect;Black Hole Evaporation;Conformal Symmetry;Quantum Stress Tensor;Backreaction

One of the open challenges in fundamental physics is to combine Einstein's theory of general relativity with the principles of quantum mechancis. In this thesis, the question is raised whether metric quantum gravity could be fundamental in the spirit of Steven Weinberg's seminal asymptotic safety conjecture, and if so, what are the consequences for the physics of small, possibly Planck-size black holes? To address the first question, new techniques are provided which allow, for the first time, a self-consistent study of high-order polynomial actions including up to 34 powers in the Ricci scalar. These novel insights are then exploited to explain quantum gravity effects in black holes, including their horizon and causal structure, conformal scaling, evaporation, and the thermodynamics of quantum space-time. Results indicate upper limits on black hole temperature, and the existence of small black holes based on asymptotic safety for gravity and thermodynamical arguments.

This book reflects the resurgence of interest in the quantum properties of black holes, culminating most recently in controversial discussions about firewalls. On the thermodynamic side, it describes how new developments allowed the

inclusion of pressure/volume terms in the first law, leading to a new understanding of black holes as chemical systems, experiencing novel phenomena such as triple points and reentrant phase transitions. On the quantum-information side, the reader learns how basic arguments undergirding quantum complementarity have been shown to be flawed; and how this suggests that a black hole may surround itself with a firewall: a violent and chaotic region of highly excited states. In this thorough and pedagogical treatment, Robert Mann traces these new developments from their roots to our present-day understanding, highlighting their relationships and the challenges they present for quantum gravity.

A comprehensive summary of progress made during the past decade on the theory of black holes and relativistic stars, this collection includes discussion of structure and oscillations of relativistic stars, the use of gravitational radiation detectors, observational evidence for black holes, cosmic censorship, numerical work related to black hole collisions, the internal structure of black holes, black hole thermodynamics, information loss and other issues related to the quantum properties of black holes, and recent developments in the theory of black holes in the context of string theory. Volume contributors: Valeria Ferrari, John L. Friedman, James B. Hartle, Stephen W. Hawking, Gary T. Horowitz, Werner Israel, Roger Penrose, Martin J. Rees, Rafael D. Sorkin, Saul A. Teukolsky, Kip S. Thorne, and Robert M. Wald.

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."

Black holes have turned out to be the cornerstone of both physics and popular belief. But what if we were to realize that exact black holes cannot exist, even though their existence is apparently suggested by exact general relativistic solutions, and Roger Penrose won the 2020 Nobel Prize in Physics ‘for the discovery that black hole formation is a robust prediction of the general theory of relativity’? While it might seem far-fetched to claim so, it will be worth remembering that the finest theoretical physicists like Albert Einstein and Paul Dirac did not believe in black holes, and Stephen Hawking finally thought that there are no exact black holes. While the black hole paradigm has become commonplace in popular consciousness, in the last decade, noise has consistently grown about the many physical effects which can inhibit the formation of exact mathematical black holes. In The Rise and Fall of the Black Hole Paradigm, Abhas Mitra shows us how, much before these developments, he had proven why the so-called black holes must only be black hole pretenders. He identified these black hole candidates to be Magnetospheric Eternally Collapsing Objects (MECOs) and, along with Darryl J. Leiter and Stanley L. Robertson, generalized them. Recent evidence for the

existence of strong magnetic fields around so-called black holes may provide confirmations of his claim.

Imprisoned on an abandoned space station orbiting a black hole, Trixie Boudreaux prayed for just one chance to escape…and she failed. When she and the other Black Hole Brides are rescued, she's left adrift between the coward she was and the new universe ahead of her. If only she had a guide she could trust… Nor irThorkonos paid good galactic credits for his captain's commission on the flagship dreadnaught, and how many erstwhile interplanetary pirates have come as far? If he has a secret that the Azthrnos nobles mustn't discover, well, certainly one skittish Earther girl won't be the one to find him out. But when interstellar imprisonment can't hold an old evil, Trixie and Nor must save not only the worlds of Azthronos but each other. Join the Intergalactic Dating Agency, where some hearts are still dreaming of the stars… Intergalactic Dating Agency Big Sky Alien Mail Order Brides #1 ~ Alpha Star #2 ~ Red Shift #3 ~ Dark Matter #4 ~ After Burn Black Hole Brides #1 ~ The Intergalactic Duke's Inconvenient Engagement #2 ~ The Interstellar Rake's Irresistible Kiss #3 ~ The Interdimensional Lord's Earthly Delight

La 4e de couverture indique : "Isaiah is strangely silent on the destruction of Jerusalem and the people's deportation to Babylon in the early sixth century BCE. Frederik Poulsen demonstrates that the exile hides itself as a "black hole" at the center of the composition and thereby has a decisive influence on the literary structure, poetic imagery, and theological message of this prophetic book"

Each chapter in a story about an intergalactic odyssey is followed by nontechnical explanations of physical and astronomical phenomena and theories

A brilliant and heartbreaking new novel for fans of John Green's The Fault in Our Stars and Rainbow Rowell's Eleanor & Park, about two strangers who want to die... and, in meeting each other, learn how to live. I'm getting higher and higher and I feel the swing set creak. 'Be careful,' he says. 'Why?' I'm not thinking about being careful. I'm thinking about one last push, of letting go, of flying, and of falling. 'You aren't allowed to die without me,' he whispers. Aysel and Roman are practically strangers, but they've been drawn into an unthinkable partnership. In a month's time, they plan to commit suicide - together. Aysel knows why she wants to die: being the daughter of a murderer doesn't equal normal, well-adjusted teenager. But she can't figure out why handsome, popular Roman wants to end it all....and why he's even more determined than she is. With the deadline getting closer, something starts to grow between Aysel and Roman - a feeling she never thought she would experience. It seems there might be something to live for, after all - but is Aysel in so deep she can't turn back?

A black hole is a point of extreme mass in space-time with a radius, or event horizon, inside of which all electromagnetic radiation (including light) is trapped by gravity. A black hole is an extremely compact object, collapsed by gravity which has overcome electric and nuclear forces. It is believed that stars appreciably larger than the Sun, once they have exhausted all their nuclear fuel, collapse to form black holes: they are "black" because no light escapes their intense gravity. Material attracted to a black hole, though, gains enormous energy and can radiate part of it before being swallowed up. Some astronomers believe that enormously massive black holes exist in the centre of our galaxy and of other galaxies. This book brings together leading research from throughout the world.

Seattle teenagers of the 1970s are suddenly faced with a devastating, disfiguring, and incurable plague that spreads only through sexual contact.

This 2004 textbook fills a gap in the literature on general relativity by providing the advanced student with practical tools for the computation of many physically interesting quantities. The context is provided by the mathematical theory of black holes, one of the most elegant,

successful, and relevant applications of general relativity. Among the topics discussed are congruencies of timelike and null geodesics, the embedding of spacelike, timelike and null hypersurfaces in spacetime, and the Lagrangian and Hamiltonian formulations of general relativity. Although the book is self-contained, it is not meant to serve as an introduction to general relativity. Instead, it is meant to help the reader acquire advanced skills and become a competent researcher in relativity and gravitational physics. The primary readership consists of graduate students in gravitational physics. It will also be a useful reference for more seasoned researchers working in this field.

A noted professor of physics and astronomy recalls the intellectual journey to understand the galaxy, and universe that contains it, in the twentieth century, looking at the unique features of the Milky Way, the technological advances that have allowed us to research it, and describing a black hole that exists at the very center of our galaxy. (Science & Mathematics)

Emitting no radiation or any other kind of information, black holes mark the edge of the universe--both physically and in our scientific understanding. Yet astronomers have found clear evidence for the existence of black holes, employing the same tools and techniques used to explore other celestial objects. In this sophisticated introduction, leading astronomer Charles Bailyn goes behind the theory and physics of black holes to describe how astronomers are observing these enigmatic objects and developing a remarkably detailed picture of what they look like and how they interact with their surroundings. Accessible to undergraduates and others with some knowledge of introductory college-level physics, this book presents the techniques used to identify and measure the mass and spin of celestial black holes. These key measurements demonstrate the existence of two kinds of black holes, those with masses a few times that of a typical star, and those with masses comparable to whole galaxies--supermassive black holes. The book provides a detailed account of the nature, formation, and growth of both kinds of black holes. The book also describes the possibility of observing theoretically predicted phenomena such as gravitational waves, wormholes, and Hawking radiation. A cutting-edge introduction to a subject that was once on the border between physics and science fiction, this book shows how black holes are becoming routine objects of empirical scientific study.

Black Holes are still considered to be among the most mysterious and fascinating objects in our universe. Awaiting the era of gravitational astronomy, much progress in theoretical modeling and understanding of classical and quantum black holes has already been achieved. The present volume serves as a tutorial, high-level guided tour through the black-hole landscape: information paradox and blackhole thermodynamics, numerical simulations of black-hole formation and collisions, braneworld scenarios and stability of black holes with respect to perturbations are treated in great detail, as is their possible occurrence at the LHC. An outgrowth of a topical and tutorial summer school, this extensive set of carefully edited notes has been set up with the aim of constituting an advanced-level, multi-authored textbook which meets the needs of both postgraduate students and young researchers in the fields of modern cosmology, astrophysics and (quantum) field theory.

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.

A new branch of physics, black hole gravitohydromagnetics (GHM) is developed from the rudiments to the frontiers of research. 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.

"It is said that fact is sometimes stranger than fiction, and nowhere is that more true than in the case of black holes. Black holes are stranger than anything dreamed up by science fiction writers." In 2016 Professor Stephen Hawking delivered the BBC Reith Lectures on a subject that has fascinated him for decades - black holes. In these flagship lectures the legendary physicist argues that if we could only understand black holes and how they challenge the very nature of space and time, we could unlock the secrets of the universe.

'Astrophysics at its sexiest ... packed with revelations ... hugely enjoyable' Sunday Times What would happen if you fell into a black hole? Black holes are the most extraordinary phenomenon in the universe, but they are a riddle that confounds our intuitions. Anything that enters them can never escape, and yet they contain nothing at all. They are bigger on the inside than the outside suggests. They are dark on the outside but not on the inside. They invert time into space and space into time. Black holes are found throughout the universe. They can be microscopic. They can be billions of times larger than our sun. Our solar system is currently orbiting a black hole 26,000 light years away at a speed of 200 km per second. In Black Hole Survival Guide physicist and novelist Janna Levin takes you on a journey into a black hole, explaining what would happen to you in there and why. In the process you'll come to see how their mysteries contain

answers to some of the most profound questions ever asked about the nature of our universe. ** A SUNDAY TIMES SCIENCE BOOK OF THE YEAR 2020**

One small event in 18th-century India has proved an enduring myth, and an enduring puzzle. This work takes us through the history of the buccaneer 'hatmen' of the East India Company, tracing the growth of the fledgling city of Calcutta.

This book overviews the extensive literature on apparent cosmological and black hole horizons. In theoretical gravity, dynamical situations such as gravitational collapse, black hole evaporation, and black holes interacting with non-trivial environments, as well as the attempts to model gravitational waves occurring in highly dynamical astrophysical processes, require that the concept of event horizon be generalized. Inequivalent notions of horizon abound in the technical literature and are discussed in this manuscript. The book begins with a quick review of basic material in the first one and a half chapters, establishing a unified notation. Chapter 2 reminds the reader of the basic tools used in the analysis of horizons and reviews the various definitions of horizons appearing in the literature. Cosmological horizons are the playground in which one should take baby steps in understanding horizon physics. Chapter 3 analyzes cosmological horizons, their proposed thermodynamics, and several coordinate systems. The remaining chapters discuss analytical solutions of the field equations of General Relativity, scalar-tensor, and f(R) gravity which exhibit time-varying apparent horizons and horizons which appear and/or disappear in pairs. An extensive bibliography enriches the volume. The intended audience is master and PhD level students and researchers in theoretical physics with knowledge of standard gravity.

Written by foremost experts, this short book gives a clear description of the physics of quantum black holes. The reader will learn about quantum black holes in four and higher dimensions, primordial black holes, the production of black holes in high energy particle collisions, Hawking radiation, black holes in models of low scale quantum gravity and quantum gravitational aspects of black holes.

This introduction to the fascinating subject of black holes fills a significant gap in the literature which exists between popular, non-mathematical expositions and advanced textbooks at the research level. It is designed for advanced undergraduates and first year postgraduates as a useful stepping-stone to the advanced literature. The book provides an accessible introduction to the exact solutions of Einstein's vacuum field equations describing spherical and axisymmetric (rotating) black holes. The geometry and physical properties of these spacetimes are explored through the motion of particles and light. The use of different coordinate systems, maximal extensions and Penrose diagrams is explained. The association of the surface area of a black hole with its entropy is discussed and it is shown that with the introduction of quantum mechanics black holes cease to be black and can radiate. This result allows black holes to satisfy the laws of thermodynamics and thus be consistent with the rest of physics. In this new edition the problems in each chapter have been revised and solutions are provided. The text has been expanded to include

new material on wormholes and clarify various other issues.

A collection of essays on the cosmos, written by an American Museum of Natural History astrophysicist, includes "Holy Wars," "Ends of the World," and "Hollywood Nights."

Reviewing the fundamental instrumental techniques and current observational results, this book unveils the mysteries of the physical processes in the central parsec of our Milky Way: the super-massive black hole embedded in a central stellar cluster as well as the gas and dust in the circumnuclear region. The observations described cover the entire electromagnetic spectrum from decimeter radio-waves to high energy X-ray and ?-rays, and a comprehensive summary of up-to-date astrophysical interpretations is given. The emphasis is put on observational techniques, image processing aspects, and a detailed presentation of the most cutting-edge work carried out in the near-infrared wavelength regime. These recent results include both the first orbits of stars around the central black hole and the multiwavelength variability of the central source. Contents:Observational Techniques:The GC Across the Electromagnetic SpectrumNIR Imaging Through the AtmosphereSpeckle ImagingSingle Telescope Adaptive OpticsCleaning and DeconvolutionFuture IR InterferometryObservational Results:The Discovery of Sagittarius A?Large-Scale Structures at the Galactic CenterThe Circum Nuclear DiskThe Mini-SpiralRadio FilamentsNear-Infrared Images of the Central Stellar ClusterThe Radio and Infrared Positional Reference FramesNumber Density CountsPolarization of Filaments and StarsStellar Velocities and Orbital AccelerationsSpectroscopyStar Formation at the Galactic Center?Sgr A? Across the Electromagnetic SpectrumAstrophysical Results:The Stellar Velocity FieldScenarios for Star Formation at the Galactic CenterThe Central Dark MassStability of the Enclosed Dark MassAgglomerations of Exotic Particles?The Central Stellar CuspAnalysis of Stellar Orbits Near the Central Black HoleThe Central Black HoleComparison to Nuclei of Other GalaxiesMassive Black Holes at High Redshifts Readership: Graduate and post-graduate students, researchers, astronomers, and astrophysicists. Key Features:Suitable basis for a single semester course at the advanced undergraduate or graduate levelCompact summary of observational results and astrophysical interpretationA bibliography comprising over 400 publications up to the editorial deadline in July 2004Keywords:Galactic Center;Imaging;Wavelengths;Stellar;Astrophysics

This book focuses on one mechanism in black hole physics which has proven to be universal, multifaceted and with a rich phenomenology: rotational superradiance. This is an energy extraction process, whereby black holes can deposit their rotational energy in their surroundings, leading to Penrose processes, black-hole bombs, and even Hawking radiation. Black holes are key players in star formation mechanisms and as engines to some of the most violent events in our universe. Their simplicity and compactness make them perfect laboratories, ideally suited to probe new fields or modifications to the theory of gravity. Thus, black holes can also be used to probe some of the most important open problems in physics, including the nature of dark matter or the strong CP problem in particle physics. This monograph is directed to researchers and graduate students and provides a unified view of the subject, covering the theoretical machinery, experimental efforts in the laboratory, and astrophysics searches. It is focused on recent developments and works out a number of novel examples and applications, ranging from fundamental physics

to astrophysics. Non-specialists with a scientific background should also find this text a valuable resource for understanding the critical issues of contemporary research in black-hole physics. This second edition stresses the role of ergoregions in superradiance, and completes its catalogue of energy-extraction processes. It presents a unified description of instabilities of spinning black holes in the presence of massive fields. Finally, it covers the first experimental observation of superradiance, and reviews the state-of-the-art in the searches for new light fields in the universe using superradiance as a mechanism.

Cosmological and Black Hole Apparent HorizonsSpringer

The foremost observers and theorists discuss the latest developments in the astrophysics of neutron stars, black holes and their interaction in the universe. Often found in compact, interacting binaries, these objects exhibit broadly similar behaviour. The determination of observational signatures that distinguish between these two types of objects is systematically explored. Supernovae and evolutionary scenarios leading to neutron stars and black holes, single or in binaries, are also discussed in detail. There is also a discussion of the decades old mystery of cosmic gamma ray bursts, currently thought to represent enormous stellar explosions at cosmological distances. These could be the result of mergers of a neutron star and its compact binary companion: a literal neutron star-black hole connection. A lucid series of lectures for the advanced graduate student. A unifying text that will appeal to the research astrophysicist and space physicist.