

# Introduction To General Relativity Black Holes And Cosmology

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## ELLE WHEELER

**Modern General Relativity** Introduction to General Relativity, Black Holes, and Cosmology

Introduction to General Relativity, Black Holes, and Cosmology Oxford University Press, USA

**The Little Book of Black Holes** Cambridge University Press  
Unique, comprehensive overview for researchers and graduate students in observational and theoretical astrophysics, general relativity, and high-energy physics.

*Introducing General Relativity* Cambridge University Press

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.

*What Is Relativity?* John Wiley & Sons

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.

*General Relativity* Springer Nature

General relativity is a cornerstone of modern physics, and is of major importance in its applications to cosmology. Plebanski and Krasinski are experts in the field and in this book they provide a thorough introduction to general relativity, guiding the reader through complete derivations of the most important results. Providing coverage from a unique viewpoint, geometrical, physical and astrophysical properties of inhomogeneous cosmological models are all systematically and clearly presented, allowing the reader to follow and verify all derivations. For advanced undergraduates and graduates in physics and

astronomy, this textbook will enable students to develop expertise in the mathematical techniques necessary to study general relativity.

**Introduction to General Relativity** Oxford University Press, USA

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.

*General Relativity* Springer Nature

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.

*General Relativity* Springer

*Introducing General Relativity* An accessible and engaging introduction to general relativity for undergraduates In *Introducing General Relativity*, the authors deliver a structured introduction to the core concepts and applications of General Relativity. The book leads readers from the basic ideas of relativity—including the Equivalence Principle and curved space-time—to more advanced topics, like Solar System tests and gravitational wave detection. Each chapter contains practice problems designed to engage undergraduate students of mechanics, electrodynamics, and special relativity. A wide range of classical and modern topics are covered in detail, from

exploring observational successes and astrophysical implications to explaining many popular principles, like space-time, redshift, black holes, gravitational waves and cosmology. Advanced topic sections introduce the reader to more detailed mathematical approaches and complex ideas, and prepare them for the exploration of more specialized and sophisticated texts.

Introducing General Relativity also offers: Structured outlines to the concepts of General Relativity and a wide variety of its applications Comprehensive explorations of foundational ideas in General Relativity, including space-time curvature and tensor calculus Practical discussions of classical and modern topics in relativity, from space-time to redshift, gravity, black holes, and gravitational waves Optional, in-depth sections covering the mathematical approaches to more advanced ideas Perfect for undergraduate physics students who have studied mechanics, dynamics, and Special Relativity, *Introducing General Relativity* is an essential resource for those seeking an intermediate level discussion of General Relativity placed between the more qualitative books and graduate-level textbooks.

[Lectures on General Relativity, Cosmology and Quantum Black Holes](#) Cambridge University Press

In 1965 Penrose introduced the fundamental concept of a trapped surface, on the basis of which he proved a theorem which asserts that a spacetime containing such a surface must come to an end. The presence of a trapped surface implies, moreover, that there is a region of spacetime, the black hole, which is inaccessible to observation from infinity. Since that time a major challenge has been to find out how trapped surfaces actually form, by analyzing the dynamics of gravitational collapse. The present monograph achieves this aim by establishing the formation of trapped surfaces in pure general relativity through the focusing of gravitational waves. The theorems proved in this monograph constitute the first foray into the long-time dynamics of general relativity in the large, that is, when the initial data are no longer confined to a suitable neighborhood of trivial data. The main new method, the short pulse method, applies to general systems of Euler-Lagrange equations of hyperbolic type and provides the means to tackle problems which have hitherto seemed unapproachable. This monograph will be of interest to people working in general relativity, geometric analysis, and partial differential equations.

**An Introduction to General Relativity** Oxford 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.

[General Relativity and its Applications](#) Springer Science & Business Media

The book aims to give a mathematical presentation of the theory of general relativity (that is, spacetime-geometry-based gravitation theory) to advanced undergraduate mathematics students. Mathematicians will find spacetime physics presented

in the definition-theorem-proof format familiar to them. The given precise mathematical definitions of physical notions help avoiding pitfalls, especially in the context of spacetime physics describing phenomena that are counter-intuitive to everyday experiences. In the first part, the differential geometry of smooth manifolds, which is needed to present the spacetime-based gravitation theory, is developed from scratch. Here, many of the illustrating examples are the Lorentzian manifolds which later serve as spacetime models. This has the twofold purpose of making the physics forthcoming in the second part relatable, and the mathematics learnt in the first part less dry. The book uses the modern coordinate-free language of semi-Riemannian geometry. Nevertheless, to familiarise the reader with the useful tool of coordinates for computations, and to bridge the gap with the physics literature, the link to coordinates is made through exercises, and via frequent remarks on how the two languages are related. In the second part, the focus is on physics, covering essential material of the 20th century spacetime-based view of gravity: energy-momentum tensor field of matter, field equation, spacetime examples, Newtonian approximation, geodesics, tests of the theory, black holes, and cosmological models of the universe. Prior knowledge of differential geometry or physics is not assumed. The book is intended for self-study, and the solutions to the (over 200) exercises are included.

**Spacetime and Geometry** Oxford University Press

Containing the latest, groundbreaking discoveries in the field, this text outlines the basics of Einstein's theory of gravity with a focus on its most important astrophysical consequences, including stellar structures, black holes and the physics of gravitational waves. Blending advanced topics - usually not found in introductory textbooks - with examples, pedagogical boxes, mathematical tools and practical applications of the theory, this textbook maximises learning opportunities and is ideal for master and graduate students in Physics and Astronomy. Key features: • Provides a self-contained and consistent treatment of the subject that does not require advanced previous knowledge of the field. • Explores the subject with a new focus on gravitational waves and astrophysical relativity, unlike current introductory textbooks. • Fully up-to-date, containing the latest developments and discoveries in the field.

[Gravity, Black Holes, and the Very Early Universe](#) University of Chicago Press

Here it is, in a nutshell: the history of one genius's most crucial work - discoveries that were to change the face of modern physics. In the early 1900s, Albert Einstein formulated two theories that would forever change the landscape of physics: the Special Theory of Relativity and the General Theory of Relativity. Respected American academic Professor Tai Chow tells us the story of these discoveries. He details the basic ideas of Einstein, including his law of gravitation. Deftly employing his inimitable writing style, he goes on to explain the physics behind black holes, weaving into his account an explanation of the structure of the universe and the science of cosmology.

[Introduction to General Relativity](#) Addison-Wesley

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.

[A First Course in General Relativity](#) Cambridge University Press

"The metric helps to answer every scientific question about (nonquantum) features of spacetime surrounding a black hole, every possible question about trajectories of light and satellites around the black hole as well as around more familiar centers of

attraction such as Earth and Sun. The metric for a rotating black hole may tell us about quasars, the most powerful steady energy sources in the Universe. The black-hole metric brings preliminary insights about the history and structure of the Cosmos." "Using the metric requires only algebra, elementary differential calculus, and a handful of integrals. This modest mathematics opens the subject to the interested person and paves the way to a deeper study of general relativity for one who will discover new truth about this strange and beautiful Universe, our home."--BOOK JACKET.

Introducing General Relativity Oxford University Press, USA  
Written for advanced undergraduate and graduate students, this is a clear mathematical introduction to Einstein's theory of general relativity and its physical applications. Concentrating on the theory's physical consequences, this approachable textbook contains over 300 exercises to illuminate and extend the discussion.

Introduction to Black Hole Physics Cambridge University Press  
Best-selling, accessible physics-first introduction to GR uses minimal new mathematics and begins with the essential physical applications.

Introduction to General Relativity, Black Holes, and Cosmology  
Columbia University Press

This book provides an introduction to the mathematics and physics of general relativity, its basic physical concepts, its observational implications, and the new insights obtained into the nature of space-time and the structure of the universe. It introduces some of the most striking aspects of Einstein's theory of gravitation: black holes, gravitational waves, stellar models, and cosmology. It contains a self-contained introduction to tensor calculus and Riemannian geometry, using in parallel the language of modern differential geometry and the coordinate notation, more familiar to physicists. The author has strived to

achieve mathematical rigour, with all notions given careful mathematical meaning, while trying to maintain the formalism to the minimum fit-for-purpose. Familiarity with special relativity is assumed. The overall aim is to convey some of the main physical and geometrical properties of Einstein's theory of gravitation, providing a solid entry point to further studies of the mathematics and physics of Einstein equations.

General Relativity and the Einstein Equations Springer Science & Business Media

"This book is a rigorous text for students in physics and mathematics requiring an introduction to the implications and interpretation of general relativity in areas of cosmology. Readers of this text will be well prepared to follow the theoretical developments in the field and undertake research projects as part of an MSc or PhD programme. This ebook contains interactive Q & A technology, allowing the reader to interact with the text and reveal answers to selected exercises posed by the author within the book. This feature may not function in all formats and on reading devices."--Prové de l'editor.

**Exploring Black Holes** Cambridge University Press

This book is about black holes, one of the most intriguing objects of modern theoretical physics and astrophysics. For many years, black holes have been considered as interesting solutions of the Theory of General Relativity with a number of amusing mathematical properties. Now after the discovery of astrophysical black holes, the Einstein gravity has become an important tool for their study. This self-contained textbook combines physical, mathematical, and astrophysical aspects of black hole theory. Pedagogically presented, it contains 'standard' material on black holes as well as relatively new subjects such as the role of hidden symmetries in black hole physics, and black holes in spacetimes with large extra dimensions. The book will appeal to students and young scientists interested in the theory of black holes.