

Einsteins General Relativity Theory Gravity As Dummies

Among the considerations of the two dozen papers are the reception and development of Einstein's theory of general relativity in various institutions around the world; conceptual issues of the theory, especially themes, concepts, and principles associated with his theory of gravity; a number of tech

This collection of papers presents ideas and problems arising over the past 100 years regarding classical and quantum gravity, gauge theories of gravity, and spacetime transformations of accelerated frames. Both Einstein's theory of gravity and the Yang-Mills theory are gauge invariant. The invariance principles in physics have transcended both kinetic and dynamic properties and are at the very heart of our understanding of the physical world. In this spirit, this book attempts to survey the development of various formulations for gravitational and Yang-Mills fields and spacetime transformations of accelerated frames, and to reveal their associated problems and limitations. The aim is to present some of the leading ideas and problems discussed by physicists and mathematicians. We highlight three aspects: formulations of gravity as a Yang-Mills field, first discussed by Utiyama; problems of gravitational theory, discussed by Feynman, Dyson and others; spacetime properties and the physics of fields and particles in accelerated frames of reference. These unfulfilled aspects of Einstein and Yang-Mills' profound thoughts present a great challenge to physicists and mathematicians in the 21st century.

An accesible version of Einstein's masterpiece of theory, written by the genius himself According to Einstein himself, this book is intended "to give an exact insight into the theory of Relativity to those readers who, from a general scientific and philosophical point of view, are interested in the theory, but who are not conversant with the mathematical apparatus of theoretical physics." When he wrote the book in 1916, Einstein's name was scarcely known outside the physics institutes. Having just completed his masterpiece, The General Theory of Relativity—which provided a brand-new theory of gravity and promised a new perspective on the cosmos as a whole—he set out at once to share his excitement with as wide a public as possible in this popular and accessible book. Here published for the first time as a Penguin Classic, this edition of Relativity features a new introduction by bestselling science author Nigel Calder. For more than seventy years, Penguin has been the leading publisher of classic literature in the English-speaking world. With more than 1,700 titles, Penguin Classics represents a global bookshelf of the best works throughout history and across genres and disciplines. Readers trust the series to provide authoritative texts enhanced by introductions and notes by distinguished scholars and contemporary authors, as well as up-to-date translations by award-winning translators.

This classic text and reference monograph applies modern differential geometry to general relativity. A brief mathematical

introduction to gravitational curvature, it emphasizes the subject's geometric essence and stresses the global aspects of cosmology. Suitable for independent study as well as for courses in differential geometry, relativity, and cosmology. 1979 edition.

This book collects lectures on the general theory of relativity given by Dr. Øyvind Grøn at the University of Oslo, Norway. This accessible text allows students to follow the deductions all the way throughout the book.

In the last few years modified gravity theories have been proposed as extensions of Einstein's theory of gravity. Their main motivation is to explain the latest cosmological and astrophysical data on dark energy and dark matter. The study of general relativity at small scales has already produced important results (cf e.g. LNP 863 Quantum Gravity and Quantum Cosmology) while its study at large scales is challenging because recent and upcoming observational results will provide important information on the validity of these modified theories. In this volume, various aspects of modified gravity at large scales will be discussed: high-curvature gravity theories; general scalar-tensor theories; Galileon theories and their cosmological applications; $F(R)$ gravity theories; massive, new massive and topologically massive gravity; Chern-Simons modifications of general relativity (including holographic variants) and higher-spin gravity theories, to name but a few of the most important recent developments. Edited and authored by leading researchers in the field and cast into the form of a multi-author textbook at postgraduate level, this volume will be of benefit to all postgraduate students and newcomers from neighboring disciplines wishing to find a comprehensive guide for their future research.

Einstein's theory of general relativity is a theory of gravity and, as in the earlier Newtonian theory, much can be learnt about the character of gravitation and its effects by investigating particular idealised examples. This book describes the basic solutions of Einstein's equations with a particular emphasis on what they mean, both geometrically and physically. Concepts such as big bang and big crunch-types of singularities, different kinds of horizons and gravitational waves, are described in the context of the particular space-times in which they naturally arise. These notions are initially introduced using the most simple and symmetric cases. Various important coordinate forms of each solution are presented, thus enabling the global structure of the corresponding space-time and its other properties to be analysed. The book is an invaluable resource both for graduate students and academic researchers working in gravitational physics.

In discussing the question of whether General Relativity Theory really needs to be quantized, a simply negative answer cannot be accepted, of course. Such an answer is not satisfying because, first, Einstein's gravitational equations connect gravity and non-gravitational matter and because, second, it can be taken for granted that non-gravitational matter has an atomic or quantum structure such that its energy-momentum tensor standing on the right-hand side of Einstein's equations is formed out of quantum operators. These two facts make it impossible to read the left-hand side of Einstein's

equations as an ordinary classical function. This does not necessarily mean, however, that we must draw the conclusion that General Relativity Theory, similar to electrodynamics, could or should be quantized in a rigorous manner and that this quantization has similar consequences to quantum electrodynamics. In other words, when for reasons of consistency quantization is tried, then one has to ask whether and where the quantization procedure has a physical meaning, i.e., whether there exist measurable effects of quantum gravity. In accordance with these questions, we are mainly dealing with the discussion of the principles of quantized General Relativity Theory and with the estimation of quantum effects including the question of their measurability. This analysis proves that it is impossible to distinguish between classical and quantum General Relativity Theory for the extreme case of Planck's orders of magnitude. In other words, there does not exist a physically meaningful rigorous quantization conception for Einstein's theory.

An astrophysicist offers an entertaining introduction to Einstein's theories, explaining how well they have held up to rigorous testing over the years, and even describing the amazing phenomena readers would actually experience if they took a trip through a black hole.

This book, suitable for interested post-16 school pupils or undergraduates looking for a supplement to their course text, develops our modern view of space-time and its implications in the theories of gravity and cosmology. While aspects of this topic are inevitably abstract, the book seeks to ground thinking in observational and experimental evidence where possible. In addition, some of Einstein's philosophical thoughts are explored and contrasted with our modern views. Written in an accessible yet rigorous style, Jonathan Allday, a highly accomplished writer, brings his trademark clarity and engagement to these fascinating subjects, which underpin so much of modern physics. Features: Restricted use of advanced mathematics, making the book suitable for post-16 students and undergraduates Contains discussions of key modern developments in quantum gravity, and the latest developments in the field, including results from the Laser Interferometer Gravitational-Wave Observatory (LIGO) Accompanied by appendices on the CRC Press website featuring detailed mathematical arguments for key derivations The theory of relativity, explained by the greatest mind of the 20th century. Albert Einstein discusses the special and general theories of relativity, and the core concepts of modern cosmology, including time dilation, the spacetime continuum, and the energy-mass relationship, in simple non-mathematical terms.

Your first love is nothing to joke about. It's powerful, overwhelming, and something that haunts you forever. When your first love is severed, you lose a piece of your soul. Your world shatters. My first love, Amos Marshall, left something behind for me. He promised me forever and gave that to me. It's the GRAVITY that keeps my universe held together. This natural phenomenon keeps me whole to move forward every single day of my life. Back in his hometown with a life-changing secret to reveal, the problem is I'm too greedy to give up the last piece of Amos that I hold dear. Gravitational attraction has a funny way of pulling new people into your life. It's unwanted, but the force is tenacious. Cub Stent storms into my life piecing together my secret. He fills

dark mysterious holes that have been vacant for years. Does my heart have room for a second love? Only Gravity will know. Student-friendly, well illustrated textbook for advanced undergraduate and beginning graduate students in physics and mathematics.

An authoritative interdisciplinary account of the historic discovery of gravitational waves In 1915, Albert Einstein predicted the existence of gravitational waves—ripples in the fabric of spacetime caused by the movement of large masses—as part of the theory of general relativity. A century later, researchers with the Laser Interferometer Gravitational-Wave Observatory (LIGO) confirmed Einstein's prediction, detecting gravitational waves generated by the collision of two black holes. Shedding new light on the hundred-year history of this momentous achievement, *Einstein Was Right* brings together essays by two of the physicists who won the Nobel Prize for their instrumental roles in the discovery, along with contributions by leading scholars who offer unparalleled insights into one of the most significant scientific breakthroughs of our time. This illuminating book features an introduction by Tilman Sauer and invaluable firsthand perspectives on the history and significance of the LIGO consortium by physicists Barry Barish and Kip Thorne. Theoretical physicist Alessandra Buonanno discusses the new possibilities opened by gravitational wave astronomy, and sociologist of science Harry Collins and historians of science Diana Kormos Buchwald, Daniel Kennefick, and Jürgen Renn provide further insights into the history of relativity and LIGO. The book closes with a reflection by philosopher Don Howard on the significance of Einstein's theory for the philosophy of science. Edited by Jed Buchwald, *Einstein Was Right* is a compelling and thought-provoking account of one of the most thrilling scientific discoveries of the modern age.

This book introduces the general theory of relativity and includes applications to cosmology. The book provides a thorough introduction to tensor calculus and curved manifolds. After the necessary mathematical tools are introduced, the authors offer a thorough presentation of the theory of relativity. Also included are some advanced topics not previously covered by textbooks, including Kaluza-Klein theory, Israel's formalism and branes. Anisotropic cosmological models are also included. The book contains a large number of new exercises and examples, each with separate headings. The reader will benefit from an updated introduction to general relativity including the most recent developments in cosmology.

Cosmology deals with the nature of the universe. It can be broadly divided into three great ages. The first began in the 6th century BC with the Pythagorean concept of a spherical Earth that is part of a universe in which the motions of the planets are governed by the harmonious relations of natural laws. The second began in the 16th century with the Copernican revolution. This in turn led into Newton's infinite universe. The third began in the early 20th century with Albert Einstein's theory of general relativity and developed into the expanding universe we know today. Einstein's general theory of relativity extended the new space and time concepts of the special theory of relativity from the domain of electric and magnetic phenomena to all of physics and, particularly, to the theory of gravitation. By building on Einstein's previous work on special relativity, general relativity sought to deal with accelerating frames of reference. This in turn led to the principle of equivalence. By dealing with accelerating frames of reference, general relativity provides astronomers with the best theory to predict the effects of gravity. This book examines in detail new and

important work in this field.

This richly illustrated book is unique in bringing Einstein's relativity to a higher level for the non-specialist than has ever been attempted before, using nothing more than grade-school algebra. Bondi's approach with spacetime diagrams is simplified and expanded, clarifying the famous asymmetric aging-of-twins paradox. Einstein's theory of gravity, general relativity, is simplified for the reader using spacetime diagrams. The theory is applied to important topics in physics such as gravitational waves, gravitational collapse and black holes, time machines, the relationship to the quantum world, galactic motions and cosmology.

One of the most controversial, cutting-edge ideas in cosmology—the possibility that there exist multiple parallel universes—in fact has a long history. Tom Siegfried reminds us that the size and number of the heavens have been contested since ancient times. His story offers deep lessons about the nature of science and the quest for understanding. A thrilling adventure story chronicling the perilous journey of the scientists who set out to prove the theory of relativity--the results of which catapulted Albert Einstein to fame and forever changed our understanding of the universe. In 1911, a relatively unknown physicist named Albert Einstein published his preliminary theory of gravity. But it hadn't been tested. To do that, he needed a photograph of starlight as it passed the sun during a total solar eclipse. So began a nearly decade-long quest by seven determined astronomers from observatories in four countries, who traveled the world during five eclipses to capture the elusive sight. Over the years, they faced thunderstorms, the ravages of a world war, lost equipment, and local superstitions. Finally, in May of 1919, British expeditions to northern Brazil and the island of Príncipe managed to photograph the stars, confirming Einstein's theory. At its heart, this is a story of frustration, faith, and ultimate victory--and of the scientists whose efforts helped build the framework for the big bang theory, catapulted Einstein to international fame, and shook the foundation of physics.

In his conversational style, Anthony Zee examines the nature of gravity and its role in our universe. Zee starts from a birthday gift that Albert Einstein received on his seventy-sixth birthday that worked on the main principle in his theory of gravity. From there Zee leads the reader through the implications of Einstein's theory and its influence on modern physics. Einstein's Universe in a witty and accessible style also examines how the theory of gravity has shaped our understanding of how the universe began, the development of stars and galaxies, and the nature of space itself. The new Oxford edition will include a new afterword by the author that will bring the subject matter up to date.

Black holes may obliterate most things that come near them, but they saved the theory of general relativity. Einstein's theory was quickly accepted as the true theory of gravity after its publication in 1915, but soon took a back seat in physics to quantum mechanics and languished for decades on the blackboards of mathematicians. Not until the

existence of black holes by Stephen Hawking and Roger Penrose in the 1960s, after Einstein's death, was the theory revived. Almost one hundred years after general relativity replaced Newton's theory of gravitation, *The Curious History of Relativity* tells the story of both events surrounding general relativity and the techniques employed by Einstein and the relativists to construct, develop, and understand his almost impenetrable theory. Jean Eisenstaedt, one of the world's leading experts on the subject, also discusses the theory's place in the evolution of twentieth-century physics. He describes the main stages in the development of general relativity: its beginnings, its strange crossing of the desert during Einstein's lifetime while under heated criticism, and its new life from the 1960s on, when it became vital to the understanding of black holes and the observation of exotic objects, and, eventually, to the discovery of the accelerating universe. We witness Einstein's construction of his theory, as well as the work of his fascinated, discouraged, and enthusiastic colleagues--physicists, mathematicians, and astronomers. Written with flair, *The Curious History of Relativity* poses--and answers--the difficult questions raised by Einstein's magnificent intellectual feat.

An ideal introduction to Einstein's general theory of relativity This unique textbook provides an accessible introduction to Einstein's general theory of relativity, a subject of breathtaking beauty and supreme importance in physics. With his trademark blend of wit and incisiveness, A. Zee guides readers from the fundamentals of Newtonian mechanics to the most exciting frontiers of research today, including de Sitter and anti-de Sitter spacetimes, Kaluza-Klein theory, and brane worlds. Unlike other books on Einstein gravity, this book emphasizes the action principle and group theory as guides in constructing physical theories. Zee treats various topics in a spiral style that is easy on beginners, and includes anecdotes from the history of physics that will appeal to students and experts alike. He takes a friendly approach to the required mathematics, yet does not shy away from more advanced mathematical topics such as differential forms. The extensive discussion of black holes includes rotating and extremal black holes and Hawking radiation. The ideal textbook for undergraduate and graduate students, *Einstein Gravity in a Nutshell* also provides an essential resource for professional physicists and is accessible to anyone familiar with classical mechanics and electromagnetism. It features numerous exercises as well as detailed appendices covering a multitude of topics not readily found elsewhere. Provides an accessible introduction to Einstein's general theory of relativity Guides readers from Newtonian mechanics to the frontiers of modern research Emphasizes symmetry and the Einstein-Hilbert action Covers topics not found in standard textbooks on Einstein gravity Includes interesting historical asides Features numerous exercises and detailed appendices Ideal for students, physicists, and scientifically minded lay readers Solutions manual (available only to teachers)

The General Theory of Relativity: A Mathematical Exposition will serve readers as a modern mathematical introduction to the general theory of relativity. Throughout the book, examples, worked-out problems, and exercises (with hints and

solutions) are furnished. Topics in this book include, but are not limited to: tensor analysis the special theory of relativity the general theory of relativity and Einstein's field equations spherically symmetric solutions and experimental confirmations static and stationary space-time domains black holes cosmological models algebraic classifications and the Newman-Penrose equations the coupled Einstein-Maxwell-Klein-Gordon equations appendices covering mathematical supplements and special topics Mathematical rigor, yet very clear presentation of the topics make this book a unique text for both university students and research scholars. Anadijiban Das has taught courses on Relativity Theory at The University College of Dublin, Ireland, Jadavpur University, India, Carnegie-Mellon University, USA, and Simon Fraser University, Canada. His major areas of research include, among diverse topics, the mathematical aspects of general relativity theory. Andrew DeBenedictis has taught courses in Theoretical Physics at Simon Fraser University, Canada, and is also a member of The Pacific Institute for the Mathematical Sciences. His research interests include quantum gravity, classical gravity, and semi-classical gravity.

Carefully documenting the different formulations of general relativity, the author reveals valuable insight into the nature of the gravitational force and its interaction with matter. This book will interest graduate students and researchers in the fields of general relativity, gravitational physics and differential geometry.

The captivating, all-but-forgotten story of Isaac Newton, Albert Einstein, and the search for a planet that never existed For more than fifty years, the world's top scientists searched for the "missing" planet Vulcan, whose existence was mandated by Isaac Newton's theories of gravity. Countless hours were spent on the hunt for the elusive orb, and some of the era's most skilled astronomers even claimed to have found it. There was just one problem: It was never there. In *The Hunt for Vulcan*, Thomas Levenson follows the visionary scientists who inhabit the story of the phantom planet, starting with Isaac Newton, who in 1687 provided an explanation for all matter in motion throughout the universe, leading to Urbain-Jean-Joseph Le Verrier, who almost two centuries later built on Newton's theories and discovered Neptune, becoming the most famous scientist in the world. Le Verrier attempted to surpass that triumph by predicting the existence of yet another planet in our solar system, Vulcan. It took Albert Einstein to discern that the mystery of the missing planet was a problem not of measurements or math but of Newton's theory of gravity itself. Einstein's general theory of relativity proved that Vulcan did not and could not exist, and that the search for it had merely been a quirk of operating under the wrong set of assumptions about the universe. Levenson tells the previously untold tale of how the "discovery" of Vulcan in the nineteenth century set the stage for Einstein's monumental breakthrough, the greatest individual intellectual achievement of the twentieth century. A dramatic human story of an epic quest, *The Hunt for Vulcan* offers insight into how science really advances (as opposed to the way we're taught about it in school) and how the best work of the greatest scientists reveals an artist's sensibility. Opening a new window onto our world, Levenson illuminates some of our most iconic ideas as he recounts one of the strangest episodes in the history of science. Praise for *The Hunt for Vulcan* "Delightful

. . . a charming tale about an all-but-forgotten episode in science history.”—The Wall Street Journal “Engaging . . . At heart, this is a story about how science advances, one insight at a time. But the immediacy, almost romance, of Levenson’s writing makes it almost novelistic.”—The Washington Post “A well-structured, fast-paced example of exemplary science writing.”—Kirkus Reviews (starred review)

Explore spectacular advances in contemporary physics with this unique celebration of the centennial of Einstein's discovery of general relativity.

This primer proposes a journey from Newton's dynamics to Einstein's relativity. It constitutes a pedagogical, rigorous, and self-contained introduction to the concepts and mathematical formulation of gravitational physics. In particular, much attention is devoted to exploring and applying the basic tools of differential geometry, that is the language of general relativity. Real-world manifestations of relativity, such as time dilation, gravitational waves, and black holes, are also discussed in detail. This book is designed for third-year bachelor or first-year master students in theoretical physics, who are already familiar with Newton's physics, possibly had an introductory course on special relativity, and who are seeking to learn general relativity on a firm basis. The revised and updated 2nd edition of this established textbook provides a self-contained introduction to the general theory of relativity, describing not only the physical principles and applications of the theory, but also the mathematics needed, in particular the calculus of differential forms. Updated throughout, the book contains more detailed explanations and extended discussions of several conceptual points, and strengthened mathematical deductions where required. It includes examples of work conducted in the ten years since the first edition of the book was published, for example the pedagogically helpful concept of a "river of space" and a more detailed discussion of how far the principle of relativity is contained in the general theory of relativity. Also presented is a discussion of the concept of the 'gravitational field' in Einstein's theory, and some new material concerning the 'twin paradox' in the theory of relativity. Finally, the book contains a new section about gravitational waves, exploring the dramatic progress in this field following the LIGO observations. Based on a long-established masters course, the book serves advanced undergraduate and graduate level students, and also provides a useful reference for researchers.

From Science News comes a captivating anthology of articles exploring the concept of gravity and Albert Einstein’s enduring influence on the way humans understand it. From the ancient Greeks to Galileo to Sir Isaac Newton, gravity has long fascinated scientists and laypeople alike. One of the most mysterious forces in the universe, gravity as a theory has developed and changed over the centuries, but no single person has had as much to do with its evolution, and our understanding, as Albert Einstein. This collection of articles from the Science News archive looks at Einstein’s development of the general theory of relativity and considers its impact. Thanks to his revisions of Newton's theories, we have come to predict and understand phenomena such as gravitational waves, black holes, and the expansion of the universe. But Einstein did not just provide explanations—his work has raised new questions that scientists continue to investigate today. Since 1921, Society for Science & the Public has facilitated global understanding of important scientific discoveries and issues. Since the first publication of the Science News-Letter in 1922,

they have grown their audience to millions of readers each year. Now, Science News exposes new readers to thrilling concepts and innovative theories in Einstein's Gravity.

After completing the final version of his general theory of relativity in November 1915, Albert Einstein wrote a book about relativity for a popular audience. His intention was 'to give an exact insight into the theory of relativity to those readers who, from a general scientific and philosophical point of view, are interested in the theory, but who are not conversant with the mathematical apparatus of theoretical physics.' The book remains one of the most lucid explanations of the special and general theories ever written. In the early 1920s alone, it was translated into ten languages, and fifteen editions in the original German appeared over the course of Einstein's lifetime. The theory of relativity enriched physics and astronomy during the 20th century.

Gravity causes an apple to fall to the ground and keeps the moon in orbit around Earth, but it can also trap light for infinity in a dying star and ripple across the cosmos carrying the news of a massive collision between two distant black holes. With accessible language and breathtaking NASA images, students will explore the theory of gravity, from Newton's law of universal gravitation to Einstein's general relativity and beyond. This book supports the Next Generation Science Standards' emphasis on scientific collection and analysis of data and evidence-based theories by discussing the theoretical models scientists devise to describe gravity and the real-world experiments they use to test them.

Best-selling, accessible physics-first introduction to GR uses minimal new mathematics and begins with the essential physical applications.

Fundamentals of Mechanics is Volume 1 of six-volume Calculus-based University Physics series, designed to meet the requirements of a two-semester course sequence of introductory physics for physics, chemistry, and engineering majors. The present volume focuses on building a good foundation in kinematics and dynamics. The emphasis is placed on understanding basic concepts of kinematics and equilibrium conditions of forces well before handling more difficult subject of dynamics. Concepts and ideas are developed starting from fundamental principles whenever possible and illustrated by numerical and symbolic problems. Detailed guided exercises and challenging problems help students develop their problem solving skills. The complete University Physics series (Volumes 1-6) covers topics in Mechanics, Gravitation, Waves, Sound, Fluids, Thermodynamics, Electricity, Magnetism, Optics, and Modern Physics. Appropriate volumes can be selected to provide students a solid foundation of introductory physics and make their transition into advanced courses easier. Volume 1: Fundamentals of Mechanics - Vectors, Kinematics, Newton's Laws of Motion, Impulse, Energy, Rotation, Physics in Non-inertial Frames. Volume 2: Applications of Mechanics - Newton's Law of Gravitation, Simple Harmonic Motion, Mechanical Waves, Sound, Stress and Strain in Materials, Fluid Pressure, Fluid Dynamics. Volume 3: Thermodynamics - Heat, Temperature, Specific Heat, Thermal Expansion, Ideal Gas Law, First Law of Thermodynamics, Work by Gas, Second Law of Thermodynamics, Heat Engine, Carnot Cycle, Entropy, Kinetic Theory, Maxwell's Velocity Distribution. Volume 4: Electricity and Magnetism - Static Electricity, Coulomb's Law, Electric Field, Gauss's Law, Electric Potential, Metals and Dielectrics, Magnets, Magnetic Force, Steady Current, Magnetic Field, Ampere's Law,

Kirchhoff's Rules, Electrodynamics, Faraday's Law, Maxwell's Equations, AC Circuits. Volume 5: Optics - Law of Reflection, Snell's Law of Refraction, Optical Elements, Optical Instruments, Wave Optics, Interference, Young's Double Slit, Michelson Interferometer, Fabry-Perot Interferometer, Huygens-Fresnel Principle, Diffraction. Volume 6: Modern Physics - Relativity, Quantum Mechanics, Material Science, Nuclear Physics, Fundamental Particles, Gravity, and Cosmology.

Gravity: An Introduction to Einstein's General Relativity
Cambridge University Press

This book provides an introduction to the theory of relativity and the mathematics used in its processes. Three elements of the book make it stand apart from previously published books on the theory of relativity. First, the book starts at a lower mathematical level than standard books with tensor calculus of sufficient maturity to make it possible to give detailed calculations of relativistic predictions of practical experiments. Self-contained introductions are given, for example vector calculus, differential calculus and integrations. Second, in-between calculations have been included, making it possible for the non-technical reader to follow step-by-step calculations. Thirdly, the conceptual development is gradual and rigorous in order to provide the inexperienced reader with a philosophically satisfying understanding of the theory. The goal of this book is to provide the reader with a sound conceptual understanding of both the special and general theories of relativity, and gain an insight into how the mathematics of the theory can be utilized to calculate relativistic effects.

William Shakespeare lived at a remarkable time—a period we now recognize as the first phase of the Scientific Revolution. New ideas were transforming Western thought, the medieval was giving way to the modern, and the work of a few key figures hinted at the brave new world to come: the methodical and rational Galileo, the skeptical Montaigne, and—as Falk convincingly argues—Shakespeare, who observed human nature just as intently as the astronomers who studied the night sky. In *The Science of Shakespeare*, we meet a colorful cast of Renaissance thinkers, including Thomas Digges, who published the first English account of the "new astronomy" and lived in the same neighborhood as Shakespeare; Thomas Harriot—"England's Galileo"—who aimed a telescope at the night sky months ahead of his Italian counterpart; and Danish astronomer Tycho Brahe, whose observatory-castle stood within sight of Elsinore, chosen by Shakespeare as the setting for *Hamlet*—and whose family crest happened to include the names "Rosencrans" and "Guildensteren." And then there's Galileo himself: As Falk shows, his telescopic observations may have influenced one of Shakespeare's final works. Dan Falk's *The Science of Shakespeare* explores the connections between the famous playwright and the beginnings of the Scientific Revolution—and how, together, they changed the world forever.

This book brings Einstein's general relativity into action in new ways at scales ranging from the tiny Planck scale to the scale of immense galactic clusters. It presents the case that Einstein's theory of gravity can describe the observed dynamics of galaxies without invoking the unknown dark matter required in models based on Newtonian gravity. Drawing on the author's experience as a lecturer and on his own research, the book covers the essentials of Einstein's special and general relativity at a level accessible to undergraduate students. The early chapters provide a compact introduction to relativity for readers who have

little or no background in the subject. Hermann Bondi's very transparent approach to special relativity is expanded to resolve the OC twin paradoxOCO using only elementary mathematics. In later chapters, general relativity is used to extend the concept of the Planck scale, to address the role of the cosmological term and to analyze the concept of OC time machinesOCO.

The extraordinary story of the scientific expeditions that ushered in the era of relativity In 1919, British scientists led expeditions to Brazil and Africa to test Albert Einstein's new theory of general relativity in what became the century's most celebrated scientific experiment. The result ushered in a new era and made Einstein a celebrity by confirming his prediction that the path of light rays would be bent by gravity. Yet the effort to "weigh light" during the May 29, 1919, solar eclipse has become clouded by myth and skepticism. Could Arthur Eddington and Frank Dyson have gotten the results they claimed? Did the pacifist Eddington falsify evidence to foster peace after a horrific war by validating the theory of a German antiwar campaigner? In No Shadow of a Doubt, Daniel Kennefick provides definitive answers by offering the most comprehensive and authoritative account of how expedition scientists overcame war, bad weather, and equipment problems to make the experiment a triumphant success.

Spacetime physics -- Physics in flat spacetime -- The mathematics of curved spacetime -- Einstein's geometric theory of gravity -- Relativistic stars -- The universe -- Gravitational collapse and black holes -- Gravitational waves -- Experimental tests of general relativity -- Frontiers

A clear, plain-English guide to this complex scientific theory String theory is the hottest topic in physics right now, with books on the subject (pro and con) flying out of the stores. String Theory For Dummies offers an accessible introduction to this highly mathematical "theory of everything," which posits ten or more dimensions in an attempt to explain the basic nature of matter and energy. Written for both students and people interested in science, this guide explains concepts, discusses the string theory's hypotheses and predictions, and presents the math in an approachable manner. It features in-depth examples and an easy-to-understand style so that readers can understand this controversial, cutting-edge theory.

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