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## General Relativity

*University of Chicago Press* "Wald's book is clearly the first textbook on general relativity with a totally modern point of view; and it succeeds very well where others are only partially successful. The book includes full discussions of many problems of current interest which are not treated in any extant book, and all these matters are considered with perception and understanding."—S. Chandrasekhar "A tour de force: lucid, straightforward, mathematically rigorous, exacting in the analysis of the theory in its physical aspect."—L. P. Hughston, *Times Higher Education Supplement* "Truly excellent. . . . A sophisticated text of manageable size that will probably be read by every student of relativity, astrophysics, and field theory for years to come."—James W. York, *Physics Today*

## Space, Time, and Gravity

## The Theory of the Big Bang and Black Holes

*University of Chicago Press* Writing for the general reader or student, Wald has completely revised and updated this highly regarded work to include recent developments in black hole physics and cosmology. Nature called the first edition "a very readable and accurate account of modern relativity physics for the layman within the unavoidable constraint of almost no mathematics. . . . A well written, entertaining and authoritative book."

## A First Course in General Relativity

*Cambridge University Press* Second edition of a widely-used textbook providing the first step into general relativity for undergraduate students with minimal mathematical background.

## Modern General Relativity

## Black Holes, Gravitational Waves, and Cosmology

*Cambridge University Press* 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.

## Spacetime and Geometry

*Cambridge University Press* Spacetime and Geometry is an introductory textbook on general relativity, specifically aimed at students. Using a lucid style, Carroll first covers the foundations of the theory and mathematical formalism, providing an approachable introduction to what can often be an intimidating subject. Three major applications of general relativity are then discussed: black holes, perturbation theory and gravitational waves, and cosmology. Students will learn the origin of how spacetime curves (the Einstein equation) and how matter moves through it (the geodesic equation). They will learn what black holes really are, how gravitational waves are generated and detected, and the modern view of the expansion of the universe. A brief introduction to quantum field theory in curved spacetime is also included. A student familiar with this book will be ready to tackle research-level problems in gravitational physics.

## Introduction to General Relativity

*World Scientific Publishing Company* A working knowledge of Einstein's theory of general relativity is an essential tool for every physicist today. This self-contained book is an introductory text on the subject aimed at first-year graduate students, or advanced undergraduates, in physics that assumes only a basic understanding of classical Lagrangian mechanics. The mechanics problem of a point mass constrained to move without friction on a two-dimensional surface of arbitrary shape serves as a paradigm for the development of the mathematics and physics of general relativity. After reviewing special relativity, the basic principles of general relativity are presented, and the most important applications are discussed. The final special topics section guides the reader through a few important areas of current research. This book will allow the reader to approach the more advanced texts and monographs, as well as the continual influx of fascinating new experimental results, with a deeper understanding and sense of appreciation.

## Advanced Classical Electromagnetism

*Princeton University Press* A modern approach to classical electromagnetism Electromagnetism is one of the pillars of modern physics. Robert Wald provides graduate students with a clear, concise, and mathematically precise introduction to the subject, covering all the core topics while bringing the teaching of electromagnetism up to date with our modern understanding of the subject. Electromagnetism is usually taught in a quasi-historical fashion, starting from concepts formulated in the eighteenth and nineteenth centuries, but this tends to promote outdated ways of thinking about the theory. Wald begins with Maxwell's equations—the foundation of electromagnetism—together with the formulas for the energy density, momentum density, and stress tensor of the electromagnetic field. He then proceeds through all the major topics in classical electromagnetism, such as electrostatics, dielectrics, magnetostatics, electrodynamics and radiation, diffraction, and special relativity. The last two chapters discuss electromagnetism as a gauge theory and the notion of a point charge—topics not normally treated in electromagnetism texts. Completely rethinks how to teach electromagnetism to first-year graduate students Presents electromagnetism from a modern, mathematically precise perspective, formulating key conceptual ideas and results clearly and concisely Written by a world-class physicist and proven in the classroom Covers all the subjects found in standard electromagnetism textbooks as well as additional topics such as the derivation of the initial value formulation for Maxwell's equations Also ideal as a supplementary text or for self-study

## A Student's Manual for A First Course in General Relativity

## Recent Developments in General Relativity

*Springer Science & Business Media* The 13th Italian Conference on General Relativity and Gravitational Physics was held in Cala Corvino-Monopoli (Bari) from September 21 to September 25, 1998. The Conference, which is held every other year in different Italian locations, has brought together, as in the earlier conferences in this series, those scientists who are interested and actively work in all aspects of general relativity, from both the mathematical and the physical points of view: from classical theories of gravitation to quantum gravity, from relativistic astrophysics and cosmology to experiments in gravitation. About 70 participants came from Departments of Astronomy and Astrophysics, Departments of Mathematics and Departments of Experimental and Theoretical Physics from all over the Country; in addition a few Italian scientists working abroad kindly accepted invitations from the Scientific Committee. The good wishes of the University and of the Politecnico di Bari were conveyed by the director of Dipartimento Interuniversitario di Matematica, Prof. Franco Altomare. These proceedings contain the contributions of the two winners of the SIGRAV prizes, the invited talks presented at the Conference and most of the contributed talks. We thank all of our colleagues, who did their best to prepare their manuscripts. The pleasant atmosphere induced by the beauty of the place was greatly enhanced not only by the participation of so many colleagues, who had lively discussions about science well beyond Conference hours, but also by the feeling of hospitality extended to the participants by the staff of the Cala Corvino Hotel, where the Conference was held.

## Problem Book in Relativity and Gravitation

*Princeton University Press* An essential resource for learning about general relativity and much more, from four leading experts Important and useful to every student of relativity, this book is a unique collection of some 475 problems--with solutions--in the fields of special and general relativity, gravitation, relativistic astrophysics, and cosmology. The problems are expressed in broad physical terms to enhance their pertinence to readers with diverse backgrounds. In their solutions, the authors have attempted to convey a mode of approach to these kinds of problems, revealing procedures that can reduce the labor of calculations while avoiding the pitfall of too much or too powerful formalism. Although well suited for individual use, the volume may also be used with one of the modern textbooks in general relativity.

## Gravity

## An Introduction to Einstein's General Relativity

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

## Problem Book in Relativity and Gravitation

An essential resource for learning about general relativity and much more, from four leading experts Important and useful to every student of relativity, this book is a unique collection of some 475 problems--with solutions--in the fields of special and general relativity, gravitation, relativistic astrophysics, and cosmology. The problems are expressed in broad physical terms to enhance their pertinence to readers with diverse backgrounds. In their solutions, the authors have attempted to convey a mode of approach to these kinds of problems, revealing procedures that can reduce the labor of calculations while avoiding the pitfall of too much or too powerful formalism. Although well suited for individual use, the volume may also be used with one of the modern textbooks in general relativity.

## A Relativist's Toolkit

## The Mathematics of Black-Hole Mechanics

*Cambridge University Press* 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.

## Shock Wave Interactions in General Relativity

## A Locally Inertial Glimm Scheme for Spherically Symmetric Spacetimes

*Springer Science & Business Media* This monograph presents a self contained mathematical treatment of the initial value problem for shock wave solutions of the Einstein equations in General Relativity. It has a clearly outlined goal: proving a certain local existence theorem. Concluding remarks are added and commentary is provided throughout. The author is a well regarded expert in this area.

## Advanced General Relativity

*Cambridge University Press* A self-contained introduction to advanced general relativity.

## Relativity, Gravitation and Cosmology

## A Basic Introduction

*Oxford University Press* This book provides an introduction to Einstein's general theory of relativity. A "physics-first" approach is adopted so that interesting applications come before the more difficult task of solving the Einstein equation. The book includes extensive coverage of cosmology, and is designed to allow readers to study the subject alone.

## Advanced Lectures on General Relativity

*Springer* These lecture notes are intended for starting PhD students in theoretical physics who have a working knowledge of General Relativity. The four topics covered are: Surface charges as conserved quantities in theories of gravity; Classical and holographic features of three-dimensional Einstein gravity; Asymptotically flat spacetimes in four dimensions: BMS group and memory effects; The Kerr black hole: properties at extremality and quasi-normal mode ringing. Each topic starts with historical foundations and points to a few modern research directions.

## Classical Analogies in the Solution of Quantum Many-Body Problems

*Springer* This book addresses problems in three main developments in modern condensed matter physics- namely topological superconductivity, many-body localization and strongly interacting condensates/superfluids-by employing fruitful analogies from classical mechanics. This strategy has led to tangible results, firstly in superconducting nanowires: the density of states, a smoking gun for the long sought Majorana zero mode is calculated effortlessly by mapping the problem to a textbook-level classical point particle problem. Secondly, in localization theory even the simplest toy models that exhibit many-body localization are mathematically cumbersome and results rely on simulations that are limited by computational power. In this book an alternative viewpoint is developed by describing many-body localization in terms of quantum rotors that have incommensurate rotation frequencies, an exactly solvable system. Finally, the fluctuations in a strongly interacting Bose condensate and superfluid, a notoriously difficult system to analyze from first principles, are shown to mimic stochastic fluctuations of space-time due to quantum fields. This analogy not only allows for the computation of physical properties of the fluctuations in an elegant way, it sheds light on the nature of space-time. The book will be a valuable contribution for its unifying style that illuminates conceptually challenging developments in condensed matter physics and its use of elegant mathematical models in addition to producing new and concrete results.

## Sixth Marcel Grossmann Meeting, The: On Recent Developments In Theoretical And Experimental General Relativity, Gravitation And Relativistic Field Theories (In 2 Volumes)

*World Scientific*

## The Evolution Problem in General Relativity

*Springer Science & Business Media* The main goal of this work is to revisit the proof of the global stability of Minkowski space by D. Christodoulou and S. Klainerman, [Ch-Kl]. We provide a new self-contained proof of the main part of that result, which concerns the full solution of the radiation problem in vacuum, for arbitrary asymptotically flat initial data sets. This can also be interpreted as a proof of the global stability of the external region of Schwarzschild spacetime. The proof, which is a significant modification of the arguments in [Ch-Kl], is based on a double null foliation of spacetime instead of the mixed null-maximal foliation used in [Ch-Kl]. This approach is more naturally adapted to the radiation features of the Einstein equations and leads to important technical simplifications. In the first chapter we review some basic notions of differential geometry that are systematically used in all the remaining chapters. We then introduce the Einstein equations and the initial data sets and discuss some of the basic features of the initial value problem in general relativity. We shall review, without proofs, well-established results concerning local and global existence and uniqueness and formulate our main result. The second chapter provides the technical motivation for the proof of our main theorem.

# Differential Geometry and Relativity Theory

## An Introduction

*Routledge* **Differential Geometry and Relativity Theory: An Introduction** approaches relativity as a geometric theory of space and time in which gravity is a manifestation of space-time curvature, rather than a force. Uniting differential geometry and both special and general relativity in a single source, this easy-to-understand text opens the general theory of relativity to mathematics majors having a background only in multivariable calculus and linear algebra. The book offers a broad overview of the physical foundations and mathematical details of relativity, and presents concrete physical interpretations of numerous abstract concepts in Riemannian geometry. The work is profusely illustrated with diagrams aiding in the understanding of proofs and explanations. Appendices feature important material on vector analysis and hyperbolic functions. **Differential Geometry and Relativity Theory: An Introduction** serves as the ideal text for high-level undergraduate courses in mathematics and physics, and includes a solutions manual augmenting classroom study. It is an invaluable reference for mathematicians interested in differential and Riemannian geometry, or the special and general theories of relativity.

## Recent Developments in General Relativity, Genoa 2000

*Springer Science & Business Media* A survey of the most recent developments in general relativity and in the theory of the unification of Fundamental Interactions is presented in this book. The theoretical results, the cosmological and astrophysical aspects, the experimental and observational programs are shown in 26 general talks by renowned scientists active in this field.

## The Large Scale Structure of Space-Time

*Cambridge University Press* Einstein's General Theory of Relativity leads to two remarkable predictions: first, that the ultimate destiny of many massive stars is to undergo gravitational collapse and to disappear from view, leaving behind a 'black hole' in space; and secondly, that there will exist singularities in space-time itself. These singularities are places where space-time begins or ends, and the presently known laws of physics break down. They will occur inside black holes, and in the past are what might be construed as the beginning of the universe. To show how these predictions arise, the authors discuss the General Theory of Relativity in the large. Starting with a precise formulation of the theory and an account of the necessary background of differential geometry, the significance of space-time curvature is discussed and the global properties of a number of exact solutions of Einstein's field equations are examined. The theory of the causal structure of a general space-time is developed, and is used to study black holes and to prove a number of theorems establishing the inevitability of singularities under certain conditions. A discussion of the Cauchy problem for General Relativity is also included in this 1973 book.

## Curvature of Space and Time, with an Introduction to Geometric Analysis

*American Mathematical Soc.* This book introduces advanced undergraduates to Riemannian geometry and mathematical general relativity. The overall strategy of the book is to explain the concept of curvature via the Jacobi equation which, through discussion of tidal forces, further helps motivate the Einstein field equations. After addressing concepts in geometry such as metrics, covariant differentiation, tensor calculus and curvature, the book explains the mathematical framework for both special and general relativity. Relativistic concepts discussed include (initial value formulation of) the Einstein equations, stress-energy tensor, Schwarzschild space-time, ADM mass and geodesic incompleteness. The concluding chapters of the book introduce the reader to geometric analysis: original results of the author and her undergraduate student collaborators illustrate how methods of analysis and differential equations are used in addressing questions from geometry and relativity. The book is mostly self-contained and the reader is only expected to have a solid foundation in multivariable and vector calculus and linear algebra. The material in this book was first developed for the 2013 summer program in geometric analysis at the Park City Math Institute, and was recently modified and expanded to reflect the author's experience of teaching mathematical general relativity to advanced undergraduates at Lewis & Clark College.

## General Relativity Without Calculus

## A Concise Introduction to the Geometry of Relativity

*Springer Science & Business Media* "General Relativity Without Calculus" offers a compact but mathematically correct introduction to the general theory of relativity, assuming only a basic knowledge of high school mathematics and physics. Targeted at first year undergraduates (and advanced high school students) who wish to learn Einstein's theory beyond popular science accounts, it covers the basics of special relativity, Minkowski space-time, non-Euclidean geometry, Newtonian gravity, the Schwarzschild solution, black holes and cosmology. The quick-paced style is balanced by over 75 exercises (including full solutions), allowing readers to test and consolidate their understanding.

## Numerical Relativity

## Solving Einstein's Equations on the Computer

*Cambridge University Press* Aimed at students and researchers entering the field, this pedagogical introduction to numerical relativity will also interest scientists seeking a broad survey of its challenges and achievements. Assuming only a basic knowledge of classical general relativity, the book develops the mathematical formalism from first principles, and then highlights some of the pioneering simulations involving black holes and neutron stars, gravitational collapse and gravitational waves. The book contains 300 exercises to help readers master new material as it is presented. Numerous illustrations, many in color, assist in visualizing new geometric concepts and highlighting the results of computer simulations. Summary boxes encapsulate some of the most important results for quick reference. Applications covered include calculations of coalescing binary black holes and binary neutron stars, rotating stars, colliding star clusters, gravitational and magnetorotational collapse, critical phenomena, the generation of gravitational waves, and other topics of current physical and astrophysical significance.

## Formulation and Numerical Solution of Quantum Control Problems

*SIAM* This book provides an introduction to representative nonrelativistic quantum control problems and their theoretical analysis and solution via modern computational techniques. The quantum theory framework is based on the Schrödinger picture, and the optimization theory, which focuses on functional spaces, is based on the Lagrange formalism. The computational techniques represent recent developments that have resulted from combining modern numerical techniques for quantum evolutionary equations with sophisticated optimization schemes. Both finite and infinite-dimensional models are discussed, including the three-level Lambda system arising in quantum optics, multi-spin systems in NMR, a charged particle in a well potential, Bose-Einstein condensates, multiparticle spin systems, and multiparticle models in the time-dependent density functional framework. This self-contained book covers the formulation, analysis, and numerical solution of quantum control problems and bridges scientific computing, optimal control and exact controllability, optimization with differential models, and the sciences and engineering that require quantum control methods.

## Advances in the Theory of Shock Waves

*Springer Science & Business Media* In the field known as "the mathematical theory of shock waves," very exciting and unexpected developments have occurred in the last few years. Joel Smoller and Blake Temple have established classes of shock wave solutions to the Einstein Euler equations of general relativity; indeed, the mathematical and physical consequences of these examples constitute a whole new area of research. The stability theory of "viscous" shock waves has received a new, geometric perspective due to the work of Kevin Zumbrun and collaborators, which offers a spectral approach to systems. Due to the intersection of point and essential spectrum, such an approach had for a long time seemed out of reach. The stability problem for "inviscid" shock waves has been given a novel, clear and concise treatment by Guy Metivier and coworkers through the use of paradiifferential calculus. The  $L^1$  semi group theory for systems of conservation laws, itself still a recent development, has been considerably condensed by the introduction of new distance functionals through Tai-Ping Liu and collaborators; these functionals compare solutions to different data by direct reference to their wave structure. The fundamental properties of systems with relaxation have found a systematic description through the papers of Wen-An Yong; for shock waves, this means a first general theorem on the existence of corresponding profiles. The five articles of this book reflect the above developments.

## Gravitation

*Princeton University Press* 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

## Einstein's Mistakes: The Human Failings of Genius

*W. W. Norton & Company* "A thought-provoking critique of Einstein's tantalizing combination of brilliance and blunder."—Andrew Robinson, *New Scientist* Never before translated into English, the *Manimekhalai* is one of the great classics of Indian culture.

## A General Relativity Workbook

## Principles of Quantum General Relativity

*World Scientific* This monograph explains and analyzes the principles of a quantum-geometric framework for the unification of general relativity and quantum theory. By taking advantage of recent advances in areas like fibre and superfibre bundle theory, Krein spaces, gauge fields and groups, coherent states, etc., these principles can be consistently incorporated into a framework that can justifiably be said to provide the foundations for a quantum extrapolation of general relativity. This volume aims to present this approach in a way which places as much emphasis on fundamental physical ideas as on their precise mathematical implementation. References are also made to the ideas of Einstein, Bohr, Born, Dirac, Heisenberg and others, in order to set the work presented here in an appropriate historical context.

## Modern Classical Physics

## Optics, Fluids, Plasmas, Elasticity, Relativity, and Statistical Physics

*Princeton University Press* A groundbreaking text and reference book on twenty-first-century classical physics and its applications This first-year graduate-level text and reference book covers the fundamental concepts and twenty-first-century applications of six major areas of classical physics that every masters- or PhD-level physicist should be exposed to, but often isn't: statistical physics, optics (waves of all sorts), elastodynamics, fluid mechanics, plasma physics, and special and general relativity and cosmology. Growing out of a full-year course that the eminent researchers Kip Thorne and Roger Blandford taught at Caltech for almost three decades, this book is designed to broaden the training of physicists. Its six main topical sections are also designed so they can be used in separate courses, and the book provides an invaluable reference for researchers. Presents all the major fields of classical physics except three prerequisites: classical mechanics, electromagnetism, and elementary thermodynamics Elucidates the interconnections between diverse fields and explains their shared concepts and tools Focuses on fundamental concepts and modern, real-world applications Takes applications from fundamental, experimental, and applied physics; astrophysics and cosmology; geophysics, oceanography, and meteorology; biophysics and chemical physics; engineering and optical science and technology; and information science and technology Emphasizes the quantum roots of classical physics and how to use quantum techniques to elucidate classical concepts or simplify classical calculations Features hundreds of color figures, some five hundred exercises, extensive cross-references, and a detailed index An online illustration package is available

## Lectures on General Relativity

- paperbound edition -

*BoD - Books on Demand* Do you know the basics of general relativity? Do you want to know something of what more there is? Do you wonder how the theory of relativity came into being? Then this book is for you! Partial contents: - Black holes and gravitational collapse - Cosmological solutions of Einstein's field equations - Gravitational waves - Space-time singularities - The problem of motion for massive particles - A collection of exact solutions of Einstein's field equations - A history of Einstein's creation of the theory of relativity in the years 1905-1915 - A short course for repetition of the basics of general relativity - Bibliography, references, and index The book, although not very advanced, covers a number of topics not often seen in text books. The selection, of course, reflects my own interests. The different chapters may to a large extent, though not completely, be read in any desired order. The author has a PhD in theoretical physics and is lecturer of mathematics. He has for many years taught physics and mathematics at senior high school as well as university level.

## Physics Of Reality, The: Space, Time, Matter, Cosmos - Proceedings Of The 8th Symposium Honoring Mathematical Physicist Jean-pierre Vigiér

*World Scientific* A truly Galilean-class volume, this book introduces a new method in theory formation, completing the tools of epistemology. It covers a broad spectrum of theoretical and mathematical physics by researchers from over 20 nations from four continents. Like Vigier himself, the Vigier symposia are noted for addressing avant-garde, cutting-edge topics in contemporary physics. Among the six proceedings honoring J.-P. Vigier, this is perhaps the most exciting one as several important breakthroughs are introduced for the first time. The most interesting breakthrough in view of the recent NIST experimental violations of QED is a continuation of the pioneering work by Vigier on tight bound states in hydrogen. The new experimental protocol described not only promises empirical proof of large-scale extra dimensions in conjunction with avenues for testing string theory, but also implies the birth of the field of unified field mechanics, ushering in a new age of discovery. Work on quantum computing redefines the qubit in a manner that the uncertainty principle may be routinely violated. Other breakthroughs occur in the utility of quaternion algebra in extending our understanding of the nature of the fermionic singularity or point particle. There are several other discoveries of equal magnitude, making this volume a must-have acquisition for the library of any serious forward-looking researchers.

## Selected Topics In Quantum Field Theory And Mathematical Physics

*World Scientific*

## Spinors in Four-Dimensional Spaces

*Springer Science & Business Media* Without using the customary Clifford algebras frequently studied in connection with the representations of orthogonal groups, this book gives an elementary introduction to the two-component spinor formalism for four-dimensional spaces with any signature. Some of the useful applications of four-dimensional spinors, such as Yang-Mills theory, are derived in detail using illustrative examples. Spinors in Four-Dimensional Spaces is aimed at graduate students and researchers in mathematical and theoretical physics interested in the applications of the two-component spinor formalism in any four-dimensional vector space or Riemannian manifold with a definite or indefinite metric tensor. This systematic and self-contained book is suitable as a seminar text, a reference book, and a self-study guide.

## Physics of Black Holes

## A Guided Tour

*Springer Science & Business Media* 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.

## Hyperbolic Problems: Theory, Numerics, Applications

## Seventh International Conference in Zürich, February 1998 Volume II

*Birkhäuser* [Infotext]((Kurztex))These are the proceedings of the 7th International Conference on Hyperbolic Problems, held in Zürich in February 1998. The speakers and contributors have been rigorously selected and present the state of the art in this field. The articles, both theoretical and numerical, encompass a wide range of applications, such as nonlinear waves in solids, various computational fluid dynamics from small-scale combustion to relativistic astrophysical problems, multiphase phenomena and geometrical optics. ((Volltext))These proceedings contain, in two volumes, approximately one hundred papers presented at the conference on hyperbolic problems, which has focused to a large extent on the laws of nonlinear hyperbolic conservation. Two-fifths of the papers are devoted to mathematical aspects such as global existence, uniqueness, asymptotic behavior such as large time stability, stability and instabilities of waves and structures, various limits of the solution, the Riemann problem and so on. Roughly the same number of articles are devoted to numerical analysis, for example stability and convergence of numerical schemes, as well as schemes with special desired properties such as shock capturing,

interface fitting and high-order approximations to multidimensional systems. The results in these contributions, both theoretical and numerical, encompass a wide range of applications such as nonlinear waves in solids, various computational fluid dynamics from small-scale combustion to relativistic astrophysical problems, multiphase phenomena and geometrical optics.

## An Introduction to General Relativity

*Cambridge University Press* More emphasis is placed on an intuitive grasp of the subject and calculational facility than on rigorous exposition in this introduction to general relativity for mathematics undergraduates or graduate physicists.