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Introduction to General Relativity Exact Solutions of Einstein's Field Equations 300 Problems in Special and General Relativity Special Relativity Problems And Solutions In Special Relativity And Electromagnetism An Introduction to General Relativity Introduction to General Relativity Problems and Solutions on Solid State Physics, Relativity and Miscellaneous Topics Macromolecules in Solution and Brownian Relativity Solutions of Exercises of General Relativity Simplified & Assessed FUNDAMENTALS OF SPECIAL AND GENERAL RELATIVITY, Revised Edition Exact Solutions of Einstein's Field Equations Pseudo-Complex General Relativity A Primer of Special Relativity Problems and Solutions in Differential Geometry, Lie Series, Differential Forms, Relativity and Applications An Introduction to Relativity Colliding Plane Waves in General Relativity General Relativity Without Calculus Cracking the Einstein Code Relativity Made Relatively Easy The Formative Years of Relativity General Relativity Relativity for Everyone Relativity Problem Book in Relativity and Gravitation Introduction to General Relativity, Black Holes, and Cosmology Numerical Relativity Relativity One Hundred Years Of General Relativity: From Genesis And Empirical Foundations To Gravitational Waves, Cosmology And Quantum Gravity - Volume 1 Frontiers in Numerical Relativity A Short Course in General Relativity Galaxies, Axisymmetric Systems and Relativity An Introduction to General Relativity and Cosmology Scalar Fields in Numerical General Relativity The General Theory of Relativity Time Travel Extensions of the Stability Theorem of the Minkowski Space in General Relativity General Relativity The Einstein-Klein-Gordon Coupled System Introduction to General Relativity

Introduction to General Relativity 2017-06-16 it is important for every physicist today to have a working knowledge of einstein s theory of general relativity introduction to general relativity published in 2007 was aimed at first year graduate students or advanced undergraduates in physics only a basic understanding of classical lagrangian mechanics is assumed beyond that the reader should find the material to be self contained 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 special relativity is reviewed the basic principles of general relativity are then presented and the most important applications are discussed the final special topics section takes the reader up to a few areas of current research an extensive set of accessible problems enhances and extends the coverage as a learning and teaching tool this current book provides solutions to those problems this text and solutions manual are meant to provide an introduction to the subject it is hoped that these books 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

Exact Solutions of Einstein's Field Equations 2009-09-24 a paperback edition of a classic text this book contains six new chapters covering generation methods and their application colliding waves classification of metrics by invariants and treatments of homothetic motions this book is an important resource for graduates and researchers in relativity theoretical physics astrophysics and mathematics

300 Problems in Special and General Relativity 2021-12-09 a textbook neutral problems and solutions book that complements any relativity textbook at advanced undergraduate or masters level

Special Relativity 2019-11-26 this textbook develops special relativity in a systematic way and offers problems with detailed solutions to empower students to gain a real understanding of this core subject in physics this new edition has been thoroughly updated and has new sections on relativistic fluids relativistic kinematics and on four acceleration the problems and solution section has been significantly expanded and short history sections have been included throughout the book the approach is structural in the sense that it develops special relativity in minkowski space following the parallel steps as the development of newtonian physics in euclidian space a second characteristic of the book is that it discusses the mathematics of the theory independently of the physical principles so that the reader will appreciate their role in the development of the physical theory the book is intended to be used both as a textbook for an advanced undergraduate teaching course in special relativity but also as a reference book for the future

Problems And Solutions In Special Relativity And Electromagnetism 2017-07-27 field theory is an important topic in theoretical physics which is studied in the physical and physico mathematical departments of universities therefore lecturers are faced with the urgent task of not only providing students with information about the subject but also to help them master the material at a deep qualitative level by presenting the specific features of general approaches to the statement and the solution of problems in theoretical physics one of the ways to study field theory is the practical one where the students can deepen their knowledge of the theoretical material and develop problem solving skills this book includes a concise theoretical summary of the main branches of field theory and electrodynamics worked examples and some problems for the student to solve the book is written for students of theoretical and applied physics and corresponds to the curricula of the theoretical courses field theory and electrodynamics for physics undergraduates it can also be useful for students of other disciplines in particular those in which physics is one of the base subjects

An Introduction to General Relativity 1990 this textbook provides an introduction to general relativity for mathematics undergraduates or graduate physicists after a review of cartesian tensor notation and special relativity the concepts of riemannian differential geometry are introducted more emphasis is placed on an intuitive grasp of the subject and a calculational facility than on a rigorous mathematical exposition general relativity is then presented as a relativistic theory of gravity reducing in the appropriate limits to newtonian gravity or special relativity the schwarzchild solution is derived and the gravitational red shift time dilation and classic tests of general relativity are discussed there is a brief account of gravitational collapse and black holes based on the extended schwarzchild solution other vacuum solutions are described motivated by their counterparts in linearised general relativity the book ends with chapters on cosmological solutions to the field equations there are exercises attached to each chapter some of which extend the development given in the text

Introduction to General Relativity 2020-01-16 a student friendly style over 100 illustrations and numerous exercises are brought together in this textbook for advanced undergraduate and beginning graduate students in physics and mathematics lewis ryder develops the theory of general relativity in detail covering the core topics of black holes gravitational radiation and cosmology he provides an overview of general relativity and its modern ramifications the book contains chapters on gravitational radiation cosmology and connections between general relativity and the fundamental physics of the microworld it explains the geometry of curved spaces and contains key solutions of einstein s equations the schwarzschild and kerr solutions mathematical calculations are worked out in detail so students can develop an intuitive understanding of the subject as well as learn how to perform calculations the book also includes topics concerned with the relation between general relativity and other areas of fundamental physics selected solutions for instructors are available under resources

Problems and Solutions on Solid State Physics, Relativity and Miscellaneous Topics 1995 crystal structures and properties 1001 1027 electron theory energy bands and semiconductors 1028 1051 electromagnetic properties optical properties and superconductivity 1052 1076 other topics 1077 1081 special relativity 2001 2007 general relativity 2008 2023 relativistic cosmology 2024 2028 history of physics and general questions 3001 3025 measurements estimations and errors 3026 3048 mathematical techniques 3049 3056

Macromolecules in Solution and Brownian Relativity 2008-07-22 macromolecules in solution and brownian relativity illustrates the recent picture of statistical physics of polymers and polymer solutions that emerges from some paradigms of contemporary science joint together among its principal aims are discussing the consequences of a novel self diffusion theory which benefits from an extension towards relativistic like principles and the generalization of usual concepts met in polymer science in terms of geometry alone the monograph gives the whole fundamentals necessary to handle the view proposed which is set in the final chapters all the formers see about to provide the reader with a comprehensive treatation of the necessary fundamentals of classical relativistic quantum and statistical mechanics among the most important mechanical theories ever developed a chapter on the brownian movement and another on macromolecules prepare the ground that is specific to face universality and scaling behaviors in polymer solutions the scope of the book is therefore two fold on the one hand it wishes to involve the readers and scholars into a new research on polymer physics and chemistry on the other to get close chemical physicists and physical chemists to disciplines which traditionally are far from their direct fields of interest cross disciplinarity novelty potentiality

Solutions of Exercises of General Relativity Simplified & Assessed 2003 this book contains detailed solutions of all the 606 exercises of my book general relativity simplified assessed these exercises represent an integral part of the original book as they fill many gaps and provide essential extensions and elaborations

FUNDAMENTALS OF SPECIAL AND GENERAL RELATIVITY, Revised Edition 2015-10-31 relativity apart from quantum mechanics is the greatest wonder in science unfolded single handedly in the 20th century by albert einstein the scientist developed general relativity as a logical sequel to special relativity this comprehensive book presents explication of the conceptual evolution and mathematical derivations of the theories of special and general relativity the book follows an einsteinian approach while explaining the concepts and the theories of relativity divided into 14 chapters the revised edition of the book covers elementary concepts of special relativity as well as the advanced studies on general relativity the recent theories like kerr geometry sagnac effect vaidya geometry raychaudhuri equation and gravitation physics vis à vis quantum physics are presented in easy to understand language and simple style in addition to it the book gives an in depth analysis on the applications of advanced theories like vaidya krori barua solution from author s own research works apart from that the book also discusses some of the isotropic and anisotropic cosmological models in detail the salient topics discussed in the revised edition of the book are extrinsic curvature detection of gravitational waves early universe evolution of a dead star into a white dwarf or a neutron star or a black hole dark matter and dark energy this book is intended for the undergraduate and postgraduate students of physics and mathematics key features step by step derivation of equations easy demagogic approach review questions to widen the analytical understanding of the students

Exact Solutions of Einstein's Field Equations 2004 a paperback edition of a classic text for graduates and researchers in relativity theoretical physics astrophysics and mathematics

Pseudo-Complex General Relativity 2017-10-20 this book explores the role of singularities in general relativity gr the theory predicts that when a sufficient large mass collapses no known force is able to stop it until all mass is concentrated at a point the question arises whether an acceptable physical theory should have a singularity not even a coordinate singularity the appearance of a singularity shows the limitations of the theory in gr this limitation is the strong gravitational force acting near and at a super massive concentration of a central mass first a historical overview is given on former attempts to extend gr which includes einstein himself all with distinct motivations it will be shown that the only possible algebraic extension is to introduce pseudo complex pc coordinates otherwise for weak gravitational fields non physical ghost solutions appear thus the need to use pc variables we will see that the theory contains a minimal length with important consequences after that the pc gr is formulated and compared to the former attempts a new variational principle is introduced which requires in the einstein equations an additional contribution alternatively the standard variational principle can be applied but one has to introduce a constraint with the same former results the additional contribution will be associated to vacuum fluctuation whose dependence on the radial distance can be approximately obtained using semi classical quantum mechanics the main point is that pc gr predicts that mass not only curves the space but also changes the vacuum structure of the space itself in the following chapters the minimal length will be set to zero due to its smallness nevertheless the pc gr will keep a remnant of the pc description namely that the appearance of a term which we may call dark energy is inevitable the first application will be discussed in chapter 3 namely solutions of central mass distributions for a non rotating massive object it is the pc schwarzschild solution for a rotating massive object the pc kerr solution and for a charged massive object it will be the reissner nordström solution this chapter serves to become familiar on how to resolve problems in pc gr and on how to interpret the results one of

the main consequences is that we can eliminate the event horizon and thus there will be no black holes the huge massive objects in the center of nearly any galaxy and the so called galactic black holes are within pc gr still there but with the absence of an event horizon chapter 4 gives another application of the theory namely the robertson walker solution which we use to model different outcomes of the evolution of the universe finally the capability of this theory to predict new phenomena is illustrated

A Primer of Special Relativity 2010-01-28 a primer of special relativity1 is an unusually lucid introduction to the subject specifically written for indian students it is intended to give the beginner a firm grounding for a more advanced course in relativity an entire chapter is devoted to applications of the theory to elucidate a large number of topics the students b sc physics come across in modern physics detailed and well selected examples are used to illuminate aspects of the theory as well as to show techniques of application a large number of illustrative examples enables the students to gain confidence to solve any problem in relativity normally expected of b sc students the book meets the complete requirements of a textbook for b sc general and honours courses in special theory of relativity recommended by the u g c existing syllabi in a number of our universities have been taken into account in planning the book the structure of the book permits a lot of flexibility the book can therefore be used as a text for a number of existing courses with different allotted periods presently prevalent in many indian universities

Problems and Solutions in Differential Geometry, Lie Series, Differential Forms, Relativity and Applications 2016-04-06 this volume presents a collection of problems and solutions in differential geometry with applications both introductory and advanced topics are introduced in an easy to digest manner with the materials of the volume being self contained in particular curves surfaces riemannian and pseudo riemannian manifolds hodge duality operator vector fields and lie series differential forms matrix valued differential forms maurer cartan form and the lie derivative are covered readers will find useful applications to special and general relativity yang mills theory hydrodynamics and field theory besides the solved problems each chapter contains stimulating supplementary problems and software implementations are also included the volume will not only benefit students in mathematics applied mathematics and theoretical physics but also researchers in the field of differential geometry request inspection copy

An Introduction to Relativity 2011-07-30 general relativity is now an essential part of undergraduate and graduate courses in physics astrophysics and applied mathematics this simple user friendly introduction to relativity is ideal for a first course in the subject beginning with a comprehensive but simple review of special relativity the book creates a framework from which to launch the ideas of general relativity after describing the basic theory it moves on to describe important applications to astrophysics black hole physics and cosmology several worked examples and numerous figures and images help students appreciate the underlying concepts there are also 180 exercises which test and develop students understanding of the subject the textbook presents all the necessary information and discussion for an elementary approach to relativity password protected solutions to the exercises are available to instructors at cambridge org 9780521735612

Colliding Plane Waves in General Relativity 2009-10-15 this monograph surveys recent research on the collision and interaction of gravitational and electromagnetic waves this is a particularly important topic in general relativity the author notes since the theory predicts that there will be a nonlinear interaction between such waves geared toward graduate students and researchers in general relativity the text offers a comprehensive and unified review of the vast literature on the subject the first eight chapters offer background presenting the field equations and discussing some qualitative aspects of their solution subsequent chapters explore further exact solutions for colliding plane gravitational waves and the collision and interaction of electromagnetic waves the final chapters summarize all related results for the collision of plane waves of different types

and in non flat backgrounds a new postscript updates developments since the book s initial 1991 publication

General Relativity Without Calculus 2012-10-05 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

Cracking the Einstein Code 2017-09-26 albert einstein s theory of general relativity describes the effect of gravitation on the shape of space and the flow of time but for more than four decades after its publication the theory remained largely a curiosity for scientists however accurate it seemed einstein s mathematical code represented by six interlocking equations was one of the most difficult to crack in all of science that is until a twenty nine year old cambridge graduate solved the great riddle in 1963 roy kerr s solution emerged coincidentally with the discovery of black holes that same year and provided fertile testing ground at long last for general relativity today scientists routinely cite the kerr solution but even among specialists few know the story of how kerr cracked einstein s code fulvio melia here offers an eyewitness account of the events leading up to kerr s great discovery cracking the einstein code vividly describes how luminaries such as karl schwarzschild david hilbert and emmy noether set the stage for the kerr solution how kerr came to make his breakthrough and how scientists such as roger penrose kip thorne and stephen hawking used the accomplishment to refine and expand modern astronomy and physics today more than 300 million supermassive black holes are suspected of anchoring their host galaxies across the cosmos and the kerr solution is what astronomers and astrophysicists use to describe much of their behavior by unmasking the history behind the search for a real world solution to einstein s field equations melia offers a first hand account of an important but untold story sometimes dramatic often exhilarating but always attuned to the human element cracking the einstein code is ultimately a showcase of how important science gets done

Relativity Made Relatively Easy 2013-11-11 relativity made relatively easy presents an extensive study of special relativity and a gentle but exact introduction to general relativity for undergraduate students of physics assuming almost no prior knowledge it allows the student to handle all the relativity needed for a university course with explanations as simple thorough and engaging as possible the aim is to make manageable what would otherwise be regarded as hard to make derivations as simple as possible and physical ideas as transparent as possible lorentz invariants and four vectors are introduced early on but tensor notation is postponed until needed in addition to the more basic ideas such as doppler effect and collisions the text introduces more advanced material such as radiation from accelerating charges lagrangian methods the stress energy tensor and introductory general relativity including gaussian curvature the schwarzschild solution gravitational lensing and black holes a second volume will extend the treatment of general relativity somewhat more thoroughly and also introduce cosmology spinors and some field theory

The Formative Years of Relativity 2013-07-05 first published in 1922 and based on lectures delivered in may 1921 albert einstein s the meaning of relativity offered an overview and explanation of the then new and controversial theory of relativity the work would go on to become a monumental classic printed in numerous editions and translations worldwide now the formative years of relativity introduces einstein s masterpiece to new audiences this beautiful volume contains einstein s insightful text accompanied by important historical materials and commentary looking at the origins and development of general relativity hanoch gutfreund and jürgen renn provide fresh

original perspectives placing einstein s achievements into a broader context for all readers in this book gutfreund and renn tell the rich story behind the early reception spread and consequences of einstein s ideas during the formative years of general relativity in the late 1910s and 1920s they show that relativity s meaning changed radically throughout the nascent years of its development and they describe in detail the transformation of einstein s work from the esoteric pursuit of one individual communicating with a handful of colleagues into the preoccupation of a growing community of physicists astronomers mathematicians and philosophers this handsome edition quotes extensively from einstein s correspondence and reproduces historical documents such as newspaper articles and letters inserts are featured in the main text giving concise explanations of basic concepts and short biographical notes and photographs of some of einstein s contemporaries are included the first ever english translations of two of einstein s popular princeton lectures are featured at the book s end

General Relativity 2004-02-12 the foundations are thoroughly developed together with the required mathematical background from differential geometry developed in part iii the author also discusses the tests of general relativity in detail including binary pulsars with much space is devoted to the study of compact objects especially to neutron stars and to the basic laws of black hole physics this well structured text and reference enables readers to easily navigate through the various sections as best matches their backgrounds and perspectives whether mathematical physical or astronomical very applications oriented the text includes very recent results such as the supermassive black hole in our galaxy and first double pulsar system

Relativity for Everyone 1975-12-21 this book explains the theory of special and general relativity in detail without digressions such as information on einstein s life or the historical background however complicated calculations are replaced with figures and thought experiments the text being formulated in such a way that the reader will be able to understand the gist intuitively the first part of the book focuses on the essentials of special relativity explanations are provided of the famous equivalence between mass and energy and of why einstein was able to use the theory of electrodynamics as a template for his electrodynamics of moving bodies simply because besides the speed of light the electric charge itself is also absolute leading to the relativity of other physical quantities general relativity is then introduced mainly with the help of thought experiments reference is made to the previously introduced special relativity and the equivalence principle and using many figures it is explained how space time is bending under gravity the climax of the book comes with the einstein equations of gravity that describe the way in which matter bends space time the reader is shown how to obtain the famous schwarzschild solution there follows a numerically correct and yet intuitive explanation of the classic effects such as light bending or the movement of the perihelion the book concludes by explaining the friedmann model of the big bang and why the theory of gravity does not fit with quantum theory

Relativity 2015 publisher description

Problem Book in Relativity and Gravitation 2015-11-05 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

Introduction to General Relativity, Black Holes, and Cosmology 2008 a precise yet simple introduction to the foundations and main consequences of general relativity the first five chapters from choquet bruhat s general relativity and the einstein equations 2008 have been updated with new sections and chapters on black holes gravitational waves singularities and more to form this textbook

Numerical Relativity 2017-05-26 this book is composed of two parts first part describes basics in numerical relativity that is the formulations and methods for a solution of einstein s equation and general relativistic matter field equations this part will be helpful for beginners of numerical relativity who would like to understand the content of numerical relativity and its background the second part focuses on the application of numerical relativity a wide variety of scientific numerical results are introduced focusing in particular on the merger of binary neutron stars and black holes contents preliminaries for numerical relativitymethodology formulation for initial value problems of general relativitynumerical methods for a solution of einstein s evolution equationmatter equations in general relativityformulations for initial data equilibrium and quasi equilibriumextracting gravitational wavesfinding black holesapplications coalescence of binary compact objectsgravitational collapse to a black holenon radial instability and magnetohydrodynamics instabilityhigher dimensional simulationsconclusionappendices killing vector and frobenius theoremnumerical relativity in spherical symmetrydecomposition by spherical harmonicslagrangian and hamiltonian formulations of general relativitysolutions of riemann problems in special relativistic hydrodynamicslandau lifshitz pseudo tensorlaws of black hole and apparent horizonpost newtonian results for coalescing compact binaries readership this book is suitable for advanced ungraduate students postgraduate students and researchers who are interested in numerical relativity keywords numerical relativity black hole neutron star gravitational waves

Relativity 1989-04-13 this book describes carmeli s cosmological general and special relativity theory along with einstein s general and special relativity these theories are discussed in the context of moshe carmeli s original research in which velocity is introduced as an additional independent dimension four and five dimensional spaces are considered and the five dimensional braneworld theory is presented the tully fisher law is obtained directly from the theory and thus it is found that there is no necessity to assume the existence of dark matter in the halo of galaxies nor in galaxy clusters the book gives the derivation of the lorentz transformation which is used in both einstein s special relativity and carmeli s cosmological special relativity theory the text also provides the mathematical theory of curved space time geometry which is necessary to describe both einstein s general relativity and carmeli s cosmological general relativity a comparison between the dynamical and kinematic aspects of the expansion of the universe is made comparison is also made between the friedmann robertson walker theory and the carmeli theory and neither is it necessary to assume the existence of dark matter to correctly describe the expansion of the cosmos

One Hundred Years Of General Relativity: From Genesis And Empirical Foundations To Gravitational Waves, Cosmology And Quantum Gravity - Volume 1 2010-04-30 the aim of this two volume title is to give a comprehensive review of one hundred years of development of general relativity and its scientific influences this unique title provides a broad introduction and review to the fascinating and profound subject of general relativity its historical development its important theoretical consequences gravitational wave detection and applications to astrophysics and cosmology the series focuses on five aspects of the theory the first three topics are covered in volume 1 and the remaining two are covered in volume 2 while this is a two volume title it is designed so that each volume can be a standalone reference volume for the related topic

Frontiers in Numerical Relativity 1985-11-07 this 1989 text will be of value to those who wish to understand developments in computer studies of general relativity at the time of publication

A Short Course in General Relativity 2024-05-31 suitable for a one semester course in general relativity for senior undergraduates or beginning graduate students this text

clarifies the mathematical aspects of einstein s theory of relativity without sacrificing physical understanding

Galaxies, Axisymmetric Systems and Relativity 2018-06-16 this 1985 book comprises essays reviewing areas of the applications of gravity theory to which professor bonnor had contributed the influence of his work in two important fields of interest to astonomers physicists and mathematicians galaxy formation and the study of axisymmetric solutions in general relativity is well recognised

An Introduction to General Relativity and Cosmology 2012-06-26 experts pleba□ski and krasi□ski provide a thorough introduction to the tools of general relativity and relativistic cosmology assuming familiarity with advanced calculus classical mechanics electrodynamics and special relativity the text begins with a short course on differential geometry taking a unique top down approach starting with general manifolds on which only tensors are defined the covariant derivative and affine connection are introduced before moving on to geodesics and curvature only then is the metric tensor and the pseudo riemannian geometry introduced specialising the general results to this case the main text describes relativity as a physical theory with applications to astrophysics and cosmology it takes the reader beyond traditional courses on relativity through in depth descriptions of inhomogeneous cosmological models and the kerr metric emphasis is given to complete and clear derivations of the results enabling readers to access research articles published in relativity journals

Scalar Fields in Numerical General Relativity 2009-06-30 this book explores the use of numerical relativity nr methods to solve cosmological problems and describes one of the first uses of nr to study inflationary physics nr consists in the solution of einstein s equation of general relativity which governs the evolution of matter and energy on cosmological scales and in systems where there are strong gravitational effects such as around black holes to date nr has mainly been used for simulating binary black hole and neutron star mergers like those detected recently by ligo its use as a tool in fundamental problems of gravity and cosmology is novel but rapidly gaining interest in this thesis the author investigates the initial condition problem in early universe cosmology whether an inflationary expansion period could have got going from initially inhomogeneous conditions and identifies criteria for predicting the robustness of particular models state of the art numerical relativity tools are developed in order to address this question which are now publicly available

The General Theory of Relativity 2012-10-08 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

Time Travel 2022-03-15 this short technical note describes an approximate mathematical solution for time travel involving relativity and very brief time intervals limitations of the solution are discussed including possible error sources assumptions are made for small changes in the speed of light and for the lighthouse frequency which has been described in previous papers this paper will only be meaningful to those with a background in calculus physics and or engineering each reader must comprehend that our universe blinks off and on more than 1 trillion times every second

Extensions of the Stability Theorem of the Minkowski Space in General Relativity 2013-10-22 a famous result of christodoulou and klainerman is the global nonlinear stability of minkowski spacetime in this book bieri and zipser provide two extensions to this result in the first part bieri solves the cauchy problem for the einstein vacuum equations with more general asymptotically flat initial data and describes precisely the asymptotic behavior in particular she assumes less decay in the power of r and one less derivative than in the christodoulou klainerman result she proves that in this case too the initial data being globally close to the trivial data yields a solution which is a complete spacetime tending to the minkowski spacetime at infinity along any geodesic in contrast to the original situation certain estimates in this proof are borderline in view of decay indicating that the conditions in the main theorem on the decay at infinity on the initial data are sharp in the second part zipser proves the existence of smooth global solutions to the einstein maxwell equations a nontrivial solution of these equations is a curved spacetime with an electromagnetic field to prove the existence of solutions to the einstein maxwell equations zipser follows the argument and methodology introduced by christodoulou and klainerman to generalize the original results she needs to contend with the additional curvature terms that arise due to the presence of the electromagnetic field f in her case the ricci curvature of the spacetime is not identically zero but rather represented by a quadratic in the components of f in particular the ricci curvature is a constant multiple of the stress energy tensor for f furthermore the traceless part of the riemann curvature tensor no longer satisfies the homogeneous bianchi equations but rather inhomogeneous equations including components of the spacetime ricci curvature therefore the second part of this book focuses primarily on the derivation of estimates for the new terms that arise due to the presence of the electromagnetic field

General Relativity this book provides a completely revised and expanded version of the previous classic edition general relativity and relativistic astrophysics in part i the foundations of general relativity are thoroughly developed while part ii is devoted to tests of general relativity and many of its applications binary pulsars our best laboratories for general relativity are studied in considerable detail an introduction to gravitational lensing theory is included as well so as to make the current literature on the subject accessible to readers considerable attention is devoted to the study of compact objects especially to black holes this includes a detailed derivation of the kerr solution israel s proof of his uniqueness theorem and a derivation of the basic laws of black hole physics part ii ends with witten s proof of the positive energy theorem which is presented in detail together with the required tools on spin structures and spinor analysis in part iii all of the differential geometric tools required are developed in detail a great deal of effort went into refining and improving the text for the new edition new material has been added including a chapter on cosmology the book addresses undergraduate and graduate students in physics astrophysics and mathematics it utilizes a very well structured approach which should help it continue to be a standard work for a modern treatment of gravitational physics the clear presentation of differential geometry also makes it useful for work on string theory and other fields of physics classical as well as quantum

The Einstein-Klein-Gordon Coupled System a definitive proof of global nonlinear stability of minkowski space time as a solution of the einstein klein gordon equations this

book provides a definitive proof of global nonlinear stability of minkowski space time as a solution of the einstein klein gordon equations of general relativity along the way a novel robust analytical framework is developed which extends to more general matter models alexandru ionescu and benoît pausader prove global regularity at an appropriate level of generality of the initial data and then prove several important asymptotic properties of the resulting space time such as future geodesic completeness peeling estimates of the riemann curvature tensor conservation laws for the adm tensor and bondi energy identities and inequalities the book is self contained providing complete proofs and precise statements which develop a refined theory for solutions of quasilinear klein gordon and wave equations including novel linear and bilinear estimates only mild decay assumptions are made on the scalar field and the initial metric is allowed to have nonisotropic decay consistent with the positive mass theorem the framework incorporates analysis both in physical and fourier space and is compatible with previous results on other physical models such as water waves and plasma physics

Introduction to General Relativity introduction to general relativity is an introductory text on the concepts and modes of calculation used in general relativity topics covered range from newton s laws of motion and the galilean transformation to tensor analysis equations of motion of free particles electromagnetism and gravitational fields and waves solutions of the field equations are also given the emphasis is on the actual performance of relativistic calculations rather than on mathematical rigor or exhaustive completeness this volume is comprised of nine chapters and begins with an overview of the theory of relativity which includes special relativity and general relativity the discussion then turns to newton s laws of motion and the galilean transformation electromagnetism and the galilean transformation and the lorentz transformation subsequent chapters explore tensor analysis equations of motion of free particles gravitational fields and waves relativity in cosmology and unified theories and quantized theories of general relativity the final chapter is devoted to minkowski s coordinates and orthogonal transformations this book will be a valuable resource for students of physics

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