



Special Relativity

Galina Weinstein



Special Relativity:

Very Special Relativity Sander Bais, 2007 Einstein's Special Theory of Relativity first published in 1905 radically changed our understanding of the world. Familiar notions of space and time and energy were turned on their head and our struggle with Einstein's counterintuitive explanation of these concepts was under way. The task is no easier today than it was a hundred years ago but in this book Sander Bais has found an original and uniquely effective way to convey the fundamental ideas of Einstein's Special Theory. Bais's previous book *The Equations* was widely read and roundly praised for its clear and commonsense explanation of the math in physics. *Very Special Relativity* brings the same accessible approach to Einstein's theory. Using a series of easy to follow diagrams and employing only elementary high school geometry Bais conducts readers through the quirks and quandaries of such fundamental concepts as simultaneity, causality and time dilation. The diagrams also illustrate the difference between the Newtonian view in which time was universal and the Einsteinian in which the speed of light is universal. Following Bais's straightforward sequence of simple commonsense arguments readers can tinker with the theory and its great paradoxes and finally arrive at a truly deep understanding of Einstein's interpretation of space and time. An intellectual journey into the heart of the Special Theory, the book offers an intimate look at the terms and ideas that define our reality.

Special Relativity for the Enthusiast Thomas Strohm, 2023-04-17 This textbook introduces special relativity with a focus on a profound understanding of the physics behind the theory. The main part of the book is targeted to undergraduates for physics education for undergraduate students in natural sciences in general and even to interested laypersons. To serve these target groups the book uses only basic mathematics and in contrast to many other introductions to special relativity the book is based on a pedagogical approach that relies on geometry and space time diagrams to make the surprising predictions of the theory particularly clear. Special relativity is a geometric theory and space time diagrams are an efficient and easily understandable way to comprehend its implications. The textbook however is also suitable for advanced students and enthusiasts that already learned the basics of the special theory of relativity and want to know more. Special digression sections provide plenty of interesting material. Carefully selected problems with solutions and in depth explanations for all key experiments help deepen the knowledge.

Modern Special Relativity Johann Rafelski, 2022-03-07 This book presents Special Relativity in a language accessible to students while avoiding the burdens of geometry, tensor calculus, space time symmetries and the introduction of four vectors. The search for clarity in the fundamental questions about Relativity, the discussion of historical developments before and after 1905, the strong connection to current research topics, many solved examples and problems and illustrations of the material in colloquial discussions are the most significant and original assets of this book. Importantly for first time students Special Relativity is presented such that nothing needs to be called paradoxical or apparent, everything is explained. The content of this volume develops and builds on the book *Relativity Matters* Springer 2017. However this presentation of Special Relativity does not require 4 vector tools. The relevant

material has been extended and reformulated with additional examples and clarifications This introduction of Special Relativity offers conceptual insights reaching well beyond the usual method of teaching relativity It considers relevant developments after the discovery of General Relativity which itself is not presented and advances the reader into contemporary research fields This presentation of Special Relativity is connected to present day research topics in particle nuclear and high intensity pulsed laser physics and is complemented by the current cosmological perspective The conceptual reach of Special Relativity today extends significantly further compared even to a few decades ago As the book progresses the qualitative and historical introduction turns into a textbook style presentation with many detailed results derived in an explicit manner The reader reaching the end of this text needs knowledge of classical mechanics a good command of elementary algebra basic knowledge of calculus and introductory know how of electromagnetism

Special Relativity for Physicists G. Stephenson, C. W. Kilmister, 2019-10-16 Even in the most technical sections the authors writing is delightfully lucid and they give many applications to classical and modern physics Undergraduates and those who require some understanding of special relativity for their work in other fields will find this elegant work a pleasure to read Technology This concise account of special relativity is geared toward nonspecialists and belongs in the library of anyone interested in the subject and its applications to both classical and modern physics The treatment takes a historical point of view without making heavy demands on readers mathematical abilities in fact the theory is developed without the use of tensor calculus requiring only a working knowledge of three dimensional vector analysis Topics include detailed coverage of the Lorentz transformation including optical and dynamical applications and applications to modern physics An excellent bibliography completes this compact accessible presentation

Special Relativity N.M.J. Woodhouse, 2012-12-06 This book provides readers with the tools needed to understand the physical basis of special relativity and will enable a confident mathematical understanding of Minkowski's picture of space time It features a large number of examples and exercises ranging from the rather simple through to the more involved and challenging Coverage includes acceleration and tensors and has an emphasis on space time diagrams

Special Relativity for Beginners Jürgen Freund, 2008 This book first appearing in German in 2004 under the title *Spezielle Relativitätstheorie für Studienanfänger* offers access to the special theory of relativity for readers with a background in mathematics and physics comparable to a high school honors degree All mathematical and physical competence required beyond that level is gradually developed through the book as more advanced topics are introduced The full tensor formalism however is dispensed with as it would only be a burden for the problems to be dealt with Eventually a substantial and comprehensive treatise on special relativity emerges which with its gray shaded formulary is an invaluable reference manual for students and scientists alike Some crucial results are derived more than once with different approaches the Lorentz transformation in one spatial direction three times the Doppler formula four times the Lorentz transformation in two directions twice also twice the unification of electric and magnetic forces the velocity addition

formula as well as the aberration formula Beginners will be grateful to find several routes to the goal moreover for a theory like relativity it is of fundamental importance to demonstrate that it is self contained and without contradictions Author s website www.relativity.ch *Special Relativity* Domenico Giulini,2005 Provides the foundations of our understanding of space and time This book gives a self contained and modern introduction to the subject and covers several experimental developments **Special Relativity** Michael Tsamparlis,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

A Student's Guide to Special Relativity Norman Gray,2022-02-03 This compact yet informative Guide presents an accessible route through Special Relativity taking a modern axiomatic and geometrical approach It begins by explaining key concepts and introducing Einstein s postulates The consequences of the postulates length contraction and time dilation are unravelled qualitatively and then quantitatively These strands are then tied together using the mathematical framework of the Lorentz transformation before applying these ideas to kinematics and dynamics This volume demonstrates the essential simplicity of the core ideas of Special Relativity while acknowledging the challenges of developing new intuitions and dealing with the apparent paradoxes that arise A valuable supplementary resource for intermediate undergraduates as well as independent learners with some technical background the Guide includes numerous exercises with hints and notes provided online It lays the foundations for further study in General Relativity which is introduced briefly in an appendix **Einstein's Pathway to the Special Theory of Relativity** Galina Weinstein,2015-06-18 This book pieces together the jigsaw puzzle of Einstein s journey to discovering the special theory of relativity Between 1902 and 1905 Einstein sat in the Patent Office and may have made calculations on old pieces of paper that were once patent drafts One can imagine Einstein trying to hide from his boss writing notes on small sheets of paper and according to reports seeing to it that the small sheets of paper on which he was writing would vanish into his desk drawer as soon as he heard footsteps approaching his door He probably discarded many pieces of papers and calculations and flung them in the waste paper basket in the Patent Office The end result was that Einstein published nothing regarding the special theory of relativity prior to 1905 For many years before 1905 he had been intensely concerned with the topic in fact he was busily working on the problem for seven or eight years prior to 1905

Unfortunately there are no surviving notebooks and manuscripts no notes and papers or other primary sources from this critical period to provide any information about the crucial steps that led Einstein to his great discovery In May 1905 Henri Poincar sent three letters to Hendrik Lorentz at the same time that Einstein wrote his famous May 1905 letter to Conrad Habicht promising him four works of which the fourth one Relativity was a rough draft at that point In the May 1905 letters to Lorentz Poincar presented the basic equations of his 1905 Dynamics of the Electron meaning that at this point Poincar and Einstein both had drafts of papers relating to the principle of relativity The book discusses Einstein s and Poincar s creativity and the process by which their ideas developed The book also explores the misunderstandings and paradoxes apparent in the theory of relativity and unravels the subtleties and creativity of Einstein *Special Relativity* , Special Relativity Sadri Hassani,2017-05-09 *Special Relativity A Heuristic Approach* provides a qualitative exposition of relativity theory on the basis of the constancy of the speed of light Using Einstein s signal velocity as the defining idea for the notion of simultaneity and the fact that the speed of light is independent of the motion of its source chapters delve into a qualitative exposition of the relativity of time and length discuss the time dilation formula using the standard light clock explore the Minkowski four dimensional space time distance based on how the time dilation formula is derived and define the components of the two dimensional space time velocity amongst other topics Provides a heuristic derivation of the Minkowski distance formula Uses relativistic photography to see Lorentz transformation and vector algebra manipulation in action Includes worked examples to elucidate and complement the topic being discussed Written in a very accessible style Special Relativity Yury Deshko,2022-02-18 This textbook introduces the special theory of relativity at a level which is accessible to undergraduate students and even high school students with a strong foundation in algebra The presentation emphasizes clean algebraic and geometrical methods visualized with plenty of illustrations resulting in a textbook that is modern and serious yet accessible Replete with many solved exercises and copious spacetime diagrams this book will help students develop relativistic intuition when encountering the subject for the first time The emphasis on geometric methods combined with the pedagogically appealing k calculus approach makes this book ideal for a self contained course on special relativity or as supplementary reading for modern physics courses It will also appeal to high schoolers with a strong math background who want to get ahead **Special Theory of Relativity** S. P. Puri,2013 *Special Theory of Relativity* is primarily intended as a textbook for the students of physics at the undergraduate level Examining developments in the field as well as the predictions of special relativity that have taken place since 1959 its comprehensive coverage includes engaging explanations of the mathematical treatment as well as the applications of the special theory of relativity **Special Relativity, Electrodynamics, and General Relativity** John B. Kogut,2018-01-09 *Special Relativity Electrodynamics and General Relativity From Newton to Einstein* is intended to teach students of physics astrophysics astronomy and cosmology how to think about special and general relativity in a fundamental but accessible way Designed to render any reader a master of relativity all material on the

subject is comprehensible and derivable from first principles The book emphasizes problem solving contains abundant problem sets and is conveniently organized to meet the needs of both student and instructor Fully revised and expanded second edition with improved figures Enlarged discussion of dynamics and the relativistic version of Newton's second law Resolves the twin paradox from the principles of special and general relativity Includes new chapters which derive magnetism from relativity and electrostatics Derives Maxwell's equations from Gauss law and the principles of special relativity Includes new chapters on differential geometry space time curvature and the field equations of general relativity Introduces black holes and gravitational waves as illustrations of the principles of general relativity and relates them to the 2015 and 2017 observational discoveries of LIGO

Special Relativity in General Frames Éricourgoulhon, 2013-08-20

Special relativity is the basis of many fields in modern physics particle physics quantum field theory high energy astrophysics etc This theory is presented here by adopting a four dimensional point of view from the start An outstanding feature of the book is that it doesn't restrict itself to inertial frames but considers accelerated and rotating observers It is thus possible to treat physical effects such as the Thomas precession or the Sagnac effect in a simple yet precise manner In the final chapters more advanced topics like tensorial fields in spacetime exterior calculus and relativistic hydrodynamics are addressed In the last brief chapter the author gives a preview of gravity and shows where it becomes incompatible with Minkowsky spacetime Well illustrated and enriched by many historical notes this book also presents many applications of special relativity ranging from particle physics accelerators particle collisions quark gluon plasma to astrophysics relativistic jets active galactic nuclei and including practical applications Sagnac gyrometers synchrotron radiation GPS In addition the book provides some mathematical developments such as the detailed analysis of the Lorentz group and its Lie algebra The book is suitable for students in the third year of a physics degree or on a masters course as well as researchers and any reader interested in relativity Thanks to the geometric approach adopted this book should also be beneficial for the study of general relativity A modern presentation of special relativity must put forward its essential structures before illustrating them using concrete applications to specific dynamical problems Such is the challenge so successfully met of the beautiful book by Ericourgoulhon excerpt from the Foreword by Thibault Damour

Physical Relativity: Space-time structure from a dynamical perspective Harvey R. Brown, 2005-11-24 Physical Relativity explores the nature of the distinction at the heart of Einstein's 1905 formulation of his special theory of relativity that between kinematics and dynamics Einstein himself became increasingly uncomfortable with this distinction and with the limitations of what he called the principle theory approach inspired by the logic of thermodynamics A handful of physicists and philosophers have over the last century likewise expressed doubts about Einstein's treatment of the relativistic behaviour of rigid bodies and clocks in motion in the kinematical part of his great paper and suggested that the dynamical understanding of length contraction and time dilation intimated by the immediate precursors of Einstein is more fundamental Harvey Brown both examines and extends these

arguments which support a more constructive approach to relativistic effects in Einstein's terminology after giving a careful analysis of key features of the pre history of relativity theory He argues furthermore that the geometrization of the theory by Minkowski in 1908 brought illumination but not a causal explanation of relativistic effects Finally Brown tries to show that the dynamical interpretation of special relativity defended in the book is consistent with the role this theory must play as a limiting case of Einstein's 1915 theory of gravity the general theory of relativity Appearing in the centennial year of Einstein's celebrated paper on special relativity *Physical Relativity* is an unusual critical examination of the way Einstein formulated his theory It also examines in detail certain specific historical and conceptual issues that have long given rise to debate in both special and general relativity theory such as the conventionality of simultaneity the principle of general covariance and the consistency or otherwise of the special theory with quantum mechanics Harvey Brown's new interpretation of relativity theory will interest anyone working on these central topics in modern physics **Special Relativity** Patricia M.

Schwarz, John H. Schwarz, 2004-03-25 This book provides a thorough introduction to Einstein's special theory of relativity suitable for anyone with a minimum of one year's university physics with calculus It is divided into fundamental and advanced topics The first section starts by recalling the Pythagorean rule and its relation to the geometry of space then covers every aspect of special relativity including the history The second section covers the impact of relativity in quantum theory with an introduction to relativistic quantum mechanics and quantum field theory It also goes over the group theory of the Lorentz group a simple introduction to supersymmetry and ends with cutting edge topics such as general relativity the standard model of elementary particles and its extensions superstring theory and a survey of important unsolved problems Each chapter comes with a set of exercises The book is accompanied by a CD ROM illustrating through interactive animation classic problems in relativity involving motion *Cosmological Special Relativity* Moshe Carmeli, 2002 This book presents Einstein's theory of space and time in detail and describes the large scale structure of space time and velocity as a new cosmological special relativity A cosmological Lorentz like transformation which relates events at different cosmic times is derived and applied A new law of addition of cosmic times is obtained and the inflation of the space at the early universe is derived both from the cosmological transformation The relationship between cosmic velocity acceleration and distances is given In the appendices gravitation is added in the form of a cosmological general relativity theory and a five dimensional unified theory of space time and velocity This book is of interest to cosmologists astrophysicists theoretical physicists mathematical physicists and mathematicians *Space and Time in Special Relativity* N. David Mermin, 1968

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