

# Access Free Special Relativity From Einstein To Strings

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 Relativity and Common Sense

## CAYDEN MELANY

### Relativity - the Special and General Theory/ Sidelights on Relativity

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Relativity - The Special and General Theory/ Sidelights on Relativity is a compilation of two classic Albert Einstein physics papers. Special relativity is a theory of the structure of spacetime. It was introduced in Einstein's 1905 paper "On the Electrodynamics of Moving Bodies" (for the contributions of many other physicists see History of special relativity). Special relativity is based on two postulates which are contradictory in classical mechanics: The laws of physics are the same for all observers in uniform motion relative to one another (principle of relativity). The speed of light in a vacuum

is the same for all observers, regardless of their relative motion or of the motion of the light source. The resultant theory copes with experiment better than classical mechanics. For instance, postulate 2 explains the results of the Michelson-Morley experiment. Moreover, the theory has many surprising and counterintuitive consequences. Some of these are: Relativity of simultaneity: Two events, simultaneous for one observer, may not be simultaneous for another observer if the observers are in relative motion. Time dilation: Moving clocks are measured to tick more slowly than an observer's "stationary" clock. Length contraction: Objects are measured to be shortened in the direction that they are moving with respect to the observer. Maximum speed is finite: No physical object, message or field line can travel

faster than the speed of light in a vacuum. The effect of Gravity can only travel through space at the speed of light, not faster or instantaneously. Mass-energy equivalence:  $E = mc^2$ , energy and mass are equivalent and transmutable. Relativistic mass, idea used by some researchers. The defining feature of special relativity is the replacement of the Galilean transformations of classical mechanics by the Lorentz transformations. General relativity is a theory of gravitation developed by Einstein in the years 1907-1915. The development of general relativity began with the equivalence principle, under which the states of accelerated motion and being at rest in a gravitational field (for example, when standing on the surface of the Earth) are physically identical. The upshot of this is that free fall is inertial motion: an object in

free fall is falling because that is how objects move when there is no force being exerted on them, instead of this being due to the force of gravity as is the case in classical mechanics. This is incompatible with classical mechanics and special relativity because in those theories inertially moving objects cannot accelerate with respect to each other, but objects in free fall do so. To resolve this difficulty Einstein first proposed that spacetime is curved. In 1915, he devised the Einstein field equations which relate the curvature of spacetime with the mass, energy, and any momentum within it. Some of the consequences of general relativity are: Clocks run slower in deeper gravitational wells. This is called gravitational time dilation. Orbits precess in a way unexpected in Newton's theory of gravity. (This has been observed in the orbit of Mercury and in binary pulsars). Rays of light bend in the presence of a gravitational field. Rotating masses "drag along" the spacetime around them; a phenomenon termed "frame-dragging". The universe is expanding, and the far parts of it are moving away from us faster than the speed of light. Technically, general relativity is a theory of gravitation whose defining feature is its use of the Einstein field equations. The solutions of the field equations are metric tensors which define the topology of the spacetime and how objects move inertially.

From Einstein to Strings Sheba Blake Publishing

This unique book presents a particularly beautiful way of looking at special relativity. The author encourages students to see beyond the formulas to the deeper structure. The unification of space and time introduced by Einstein's special theory of relativity is one of the cornerstones of the modern scientific description of the universe. Yet the unification is counterintuitive because we perceive time very differently from space. Even in relativity, time is not just another dimension, it is one with different properties. The book treats the geometry of hyperbolas as the key to understanding special relativity. The author simplifies the formulas and emphasizes their geometric content. Many important relations, including the famous relativistic addition formula for velocities, then follow directly from the appropriate (hyperbolic) trigonometric addition formulas. Prior mastery of (ordinary) trigonometry is sufficient for most of the material presented, although occasional use is made of elementary differential calculus, and the chapter on electromagnetism

assumes some more advanced knowledge. Changes to the Second Edition The treatment of Minkowski space and spacetime diagrams has been expanded.

Several new topics have been added, including a geometric derivation of Lorentz transformations, a discussion of three-dimensional spacetime diagrams, and a brief geometric description of "area" and how it can be used to measure time and distance. Minor notational changes were made to avoid conflict with existing usage in the literature. Table of Contents Preface

1. Introduction. 2. The Physics of Special Relativity. 3. Circle Geometry. 4. Hyperbola Geometry. 5. The Geometry of Special Relativity. 6. Applications. 7. Problems III. 8. Paradoxes. 9. Relativistic Mechanics. 10. Problems II. 11. Relativistic Electromagnetism. 12. Problems III. 13. Beyond Special Relativity. 14. Three-Dimensional Spacetime Diagrams. 15. Minkowski Area via Light Boxes. 16. Hyperbolic Geometry. 17. Calculus. Bibliography. Author Biography Tevian Dray is a Professor of Mathematics at Oregon State University. His research lies at the interface between mathematics and physics, involving differential geometry and general relativity, as well as nonassociative algebra and particle physics; he also studies student understanding of "middle-division" mathematics and physics content. Educated at MIT and Berkeley, he held postdoctoral positions in both mathematics and physics in several countries prior to coming to OSU in 1988. Professor Dray is a Fellow of the American Physical Society for his work in relativity, and an award-winning teacher. *Very Special Relativity* Cambridge University Press Einstein's only autobiography outlining the development of his scientific and philosophical ideas. Parallel English and German texts.

*The Einstein Theory of Relativity* Springer By the year 1900, most of physics seemed to be encompassed in the two great theories of Newtonian mechanics and Maxwell's theory of electromagnetism. Unfortunately, there were inconsistencies between the two theories that seemed irreconcilable. Although many physicists struggled with the problem, it took the genius of Einstein to see that the inconsistencies were concerned not merely with mechanics and electromagnetism, but with our most elementary ideas of space and time. In the special theory of relativity, Einstein resolved these difficulties and profoundly altered our conception of the physical universe. Readers looking for a concise,

well-written explanation of one of the most important theories in modern physics need search no further than this lucid undergraduate-level text. Replete with examples that make it especially suitable for self-study, the book assumes only a knowledge of algebra. Topics include classical relativity and the relativity postulate, time dilation, the twin paradox, momentum and energy, particles of zero mass, electric and magnetic fields and forces, and more.

Emergence (1905) and Early Interpretation (1905-1911) W. W. Norton

Here are the 11 papers that forged the general and special theories of relativity: seven papers by Einstein, plus two papers by Lorentz and one each by Minkowski and Weyl. "A thrill to read again the original papers by these giants." — School Science and Mathematics. 1923 edition.

*Introduction to Special Relativity* Morgan & Claypool Publishers

This book discusses in detail the special theory of relativity without including all the instruments of theoretical physics, enabling readers who are not budding theoretical physicists to develop competence in the field. An arbitrary but fixed inertial system is chosen, where the known velocity of light is measured. With respect to this system a moving clock loses time and a moving length contracts. The book then presents a definition of simultaneity for the other inertial frames without using the velocity of light. To do so it employs the known reciprocity principle, which in this context serves to provide a definition of simultaneity in the other inertial frames. As a consequence, the Lorentz transformation is deduced and the universal constancy of light is established. With the help of a lattice model of the special theory of relativity the book provides a deeper understanding of the relativistic effects. Further, it discusses the key STR experiments and formulates and solves 54 problems in detail.

*Including the Relativistic Theory of the Non-Symmetric Field - Fifth Edition* Basic Books

An analysis of one of the three great papers Einstein published in 1905, each of which was to alter forever the field it dealt with. The second of these papers, "On the Electrodynamics of Moving Bodies", established what Einstein sometimes referred to as the "so-called Theory of Relativity". Miller uses the paper to provide a window on the intense intellectual struggles of physicists in the first decade of the 20th century: the interplay between physical theory and empirical data; the fiercely held notions that could not be articulated clearly or

verified experimentally; the great intellectual investment in existing theories, data, and interpretations - and associated intellectual inertia - and the drive to the long-sought-for unification of the sciences. Since its original publication, this book has become a standard reference and sourcebook for the history and philosophy of science; however, it can equally well serve as a text on twentieth-century philosophy.

[A First Encounter, 100 Years Since Einstein](#) Academic Press

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 Poincaré 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, Poincaré presented the basic equations of his 1905 "Dynamics of the Electron", meaning that, at this point, Poincaré and Einstein both had drafts of papers relating to the principle of relativity. The book discusses Einstein's and Poincaré'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.

**Relativity: The Special and General Theory** Columbia University Press

Among the considerations of the two dozen papers are the reception and development of Einstein's theory of

general relativity in various institutions around the world; conceptual issues of the theory, especially themes, concepts, and principles associated with his theory of gravity; a number of tech

**Special Relativity** Springer Science & Business Media

Albert Einstein, a Nobel laureate, has changed the world with his research and theories. He is regarded as the founder of modern physics. Besides 'Relativity', he worked on Photoelectric effect, Brownian motion, Special relativity, and Mass-Energy equivalence ( $E=mc^2$ ). They reformed the views on time, space and matter. Albert Einstein developed the general theory of 'Relativity'. He published 'Relativity: The Special and the General Theory' in German. Its first English translation was published in 1920. The book deals with the special theory of relativity, the general theory of relativity, and the considerations on the universe as a whole. The book gives an exact insight into the theory of Relativity. It covers, the system of Co-ordinates; The Lorentz Transformation; The experiment of Fizeau; Minkowski's four dimensional space; The Gravitational Field; Gaussian Co-ordinates; The structure of space, and lot many other scientific concepts thus will be highly beneficial to the Readers. A must have book for everyone related to modern physics.

*The Meaning of Relativity* Courier Corporation

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*The Einstein Theory of Relativity* Courier Corporation

The Einstein Theory of Relativity usually encompasses two interrelated theories by Albert Einstein: special relativity and general relativity. Special relativity applies to elementary particles and their interactions, describing all their physical

phenomena except gravity. General relativity explains the law of gravitation and its relation to other forces of nature. It applies to the cosmological and astrophysical realm, including astronomy. The theory transformed theoretical physics and astronomy during the 20th century, superseding a 200-year-old theory of mechanics created primarily by Isaac Newton. It introduced concepts including spacetime as a unified entity of space and time, relativity of simultaneity, kinematic and gravitational time dilation, and length contraction. In the field of physics, relativity improved the science of elementary particles and their fundamental interactions, along with ushering in the nuclear age. With relativity, cosmology and astrophysics predicted extraordinary astronomical phenomena such as neutron stars, black holes, and gravitational waves.

[Meson Theory Of Nuclear Forces](#) Princeton University Press

The book presents the theory of relativity as a unified whole. By showing that the concepts of this theory are interrelated to form a unified totality David Bohm supplements some of the more specialist courses which have tended to give students a fragmentary impression of the logical and conceptual nature of physics as a whole.

[Einstein's World in New Axiomatics](#) Psychology Press

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

**Studies in the History of General Relativity** Courier Corporation

A funny, insightful, and self-contained guide to Einstein's relativity theory and classical field theories--including electromagnetism Physicist Leonard Susskind and data engineer Art Friedman are back. This time, they introduce readers to Einstein's special relativity and Maxwell's classical field theory. Using their typical brand of real math, enlightening drawings, and humor, Susskind and Friedman walk us through the complexities of waves, forces, and particles by exploring special relativity and electromagnetism. It's a must-read for both devotees of the series and any armchair physicist who wants to improve their knowledge of physics' deepest truths.

**From Newton's Laws to Einstein's Theory of Relativity** Mercury Learning and Information

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.

**With Modern Applications in**

**Cosmology** Harvard University Press

Relativity: The Special and General

Theory Diamond Pocket Books Pvt Ltd

Autobiographical Notes Cambridge

University Press

This book aims to introduce to the reader the main thread of development from Newton's laws to Einstein's theory of relativity. Limited by its scope and avoiding as much as possible the use of mathematical apparatus, the authors try to clarify the most fundamental ideas and concepts. Both authors hold a deep reverence for Galileo and Einstein, and this book is dedicated to these two great scientists.

*Special Relativity* Springer Nature

In 1921, five years after the appearance of his comprehensive paper on general relativity and twelve years before he left

Europe permanently to join the Institute for Advanced Study, Albert Einstein visited Princeton University, where he delivered the Stafford Little Lectures for that year. These four lectures constituted an overview of his then-controversial theory of relativity. Princeton University Press made the lectures available under the title *The Meaning of Relativity*, the first book by Einstein to be produced by an American publisher. As subsequent editions were brought out by the Press, Einstein included new material amplifying the theory. A revised version of the appendix "Relativistic Theory of the Non-Symmetric Field," added to the posthumous edition of 1956, was Einstein's last scientific paper.

How Einstein's Theory of Gravity Was Lost and Found Again Oxford University Press

"This volume presents one of the most influential scientific documents of the twentieth century: Albert Einstein's (1879-1955) exposition of the theory of relativity. Each of the seventy-two handwritten pages of Einstein's seminal work are faithfully reproduced here and

are accompanied on their facing pages by an English translation of the original German text." "A tribute to Einstein's genius, Einstein's 1912 Manuscript on the Special Theory of Relativity opens with a brief essay by Hanoch Gutfreund, a chronology of Einstein's life, and, to introduce the manuscript, a detailed description of the manuscript, its contents, publication history, and provenance. The manuscript pages themselves then follow, reproduced in full color, with the English translation facing each page." "Subtle variations in paper and ink are clearly visible in the excellent reproductions, indicating where and when Einstein drafted certain parts of this scientific masterpiece. Because the manuscript shows extensive reworking, it reveals Einstein's thought processes more than any other of his handwritten works, inviting the reader to either imaginatively or actually toil alongside Einstein toward the completion of this elegant proof."--

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