Preamble

This book presents Special Relativity (SR) in language accessible to students while avoiding the burden of geometry, tensor calculus, and space-time symmetries, yet advancing in highly contemporary context all the way to research frontiers. I further take into consideration the way Einstein saw SR after 1915 as a part of the more general scientific context, with the newly formulated General Relativity (GR) influencing the way SR was understood. This is complemented by the current cosmological perspective and connected to present day research topics. SR is presented such that nothing remains a paradox or just apparent, but rather everything is explained.

We first develop the basic principles of SR, and explore and discuss alternatives. Much of the first half of the book has the format of a discussion in which the teacher, and in particular his graduate student, will be challenged by a brilliant but web-self-taught student called ‘Simplicius’.¹

These conversations are representative of both the foundational concepts in SR and how students have challenged this author over the years. These conversations present the opportunity to explore what often remains unsaid when teaching SR and often explain how one should think about SR. They are also in response to the realization that many ‘Modern Physics’ texts contain serious misunderstandings of the principles of SR. These find their way into web-based, and even some classroom teaching.

As the book progresses, the qualitative and historical discussion turns into textbook-style presentation, and at the end evolves into the concise and precise format of a physics research book. The final 100 pages reveal research topics and unresolved questions related to relativistic charged particle dynamics. The reader reaching the middle of this book

¹Simplicio appears in Galileo Galilei’s Dialogue Concerning the Two Chief World Systems (1632) comparing the Copernican with the Ptolemaic paradigm. The book is presented as a series of discussions among two philosophers and Simplicio, layman defender of the Aristotelian geocentric view on astronomy. Simplicius of Cilicia, c.490–c.560, was a Greco-Roman mathematician and philosopher who wrote extensively on the works of Aristotle.
needs a good command of elementary algebra and the basic knowledge of calculus along 
with introductory knowledge of classical mechanics and, ultimately, electrodynamics at 
the level of Maxwell’s equations.

A text of similar character, content, scope, has not been presented before. The search for 
clarity in the fundamental questions about SR, the developments after 1905, and the strong 
connection to current research topics are, in my view, the most important and original as-
sets of this book. Readers should keep in mind that I do not invent relativity, but report 
and interpret the development and the progress of the theoretical framework, with many 
conceptual developments reaching far beyond the initial ideas. Those who cherish Special 
Relativity of 1905 vintage should remember that in 1918–1922 Einstein disavowed publi-
cation of his 1912 Special Relativity review, which had been delayed by the outbreak of 
WWI. Looking at this manuscript\(^2\) after reading this book, the answer to ‘why’ should be 
clear: by 1920 the scientific context had evolved. Today, of course, it has evolved further.

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**Background remarks**

In the early 1980s when teaching at University of Frankfurt I wrote my first book on SR.\(^3\) 
Published in Walter Greiner’s “Theoretical Physics” series, this volume was well received 
in three editions. Walter knew there were significant problems in many texts explaining SR; 
thus he encouraged and supported this project. Looking today at this 1980–1990 effort, it 
was good but not complete. The current volume is very different, but has its basis in that 
first experience.

A few years later I asked John S. Bell, a friend and mentor, which English language 
book to use to teach relativity. I reproduce his letter and some key words are here: John 
said “…recommend …my own paper …Einstein approach is …pedagogically danger-
ous…” . Between the lines John argues that the book I was seeking needed to be written. 
I of course agreed as my German language relativity book aligned well with Bell’s think-
ing. In the past 25+ years I was on-off in respect to writing a new text, and I made sure to 
take John’s advice to follow the historical approach, clarifying why Einstein’s relativisti-
ally invariant æther is different from the Lorentz and Larmor points of view.

\(^2\)The manuscript is published as a facsimile of the original hand written document, with English 
translation and historical introduction: A. Einstein and H. Gutfreund, *Einstein’s 1912 

\(^3\)Spezielle Relativitätsstheorie, Verlag Harri Deutsch, Frankfurt (1984, ISBN3-87144-711-0; 1989, 
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I benefited greatly from a long list of critical comments prepared in 2010 “all summer long” by Iwo Bialynicki-Birula, of the Centrum Fizyki Teoretycznej, Polish Academy of Sciences in Warsaw. Iwo’s crisp and critical mind was an invaluable help for me in
realizing why the 2010 version of this book could be considerably improved. Iwo took deep interest in this manuscript; his criticism, comments, and questions influenced the precise final format of this volume.

I thank all those involved for their kind help and interest. I am alone responsible for any errors, omissions, and personal historical remarks and anecdotes in the contents presented here.

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