



A Most Incomprehensible Thing: Notes Towards a Very Gentle Introduction to the Mathematics of Relativity

Peter Collier

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Synopsis

Based on the concept of four-dimensional spacetime - curved in the vicinity of mass-energy, flat in its absence - Einstein's theories of special and general relativity together form a cornerstone of modern physics. Special relativity has some strangely counter-intuitive consequences, including time dilation, length contraction, the relativity of simultaneity and mass-energy equivalence, whilst general relativity is at the heart of our understanding of black holes and the evolution of the universe.

Using straightforward, accessible language, with numerous fully solved problems and clear derivations and explanations, this book is aimed at the enthusiastic general reader who wants to move beyond maths-lite popularisations and tackle the essential mathematics of this fascinating theory. (To paraphrase Euclid, there is no royal road to relativity - you have to do the mathematics.) For those with minimal mathematical background, the first chapter provides a crash course in foundation mathematics. The reader is then taken gently by the hand and guided through a wide range of fundamental topics, including Newtonian mechanics; the Lorentz transformations; tensor calculus; the Einstein field equations; the Schwarzschild solution; the four classical tests of general relativity; simple black holes; the mysteries of dark energy and the cosmological constant; and the Friedmann equations and Friedmann-Robertson-Walker cosmological models.

Understand even the basics of Einstein's amazing theory and the world will never seem the same again.

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