

Instead of a preface

Before we begin, some words are in order on the purpose and the limits of these notes, on the notation used, and on some of the many people I am indebted to.

Each of the chapters of these notes is meant for a week of two lectures of two hours each. Much more could be said about all of their topics in all directions, in terms of mathematics, physics, and experimental tests of general relativity. These notes are meant as an introduction which can in no way be considered complete. They may serve as a first guide through the subject, not a comprehensive one. These lectures are part of a curriculum in which cosmology, gravitational lensing, and theoretical astrophysics are regularly taught separately. In these areas, they are thus only meant to lay the foundation.

We use index-free notation where possible and convenient. Then, the curvature, the curvature tensor, the Ricci tensor and the Ricci scalar, often denoted with an R with different numbers of indices, need different symbols. We denote the curvature and the curvature tensor, closely related as they are, with \bar{R} , the Ricci tensor with R and the Ricci scalar with \mathcal{R} . Since the symbol G is then reserved for the Einstein tensor, we write Newton's gravitational constant as \mathcal{G} .

Indices referring to coordinates on general, d -dimensional manifolds are written as Latin characters. On 4-dimensional, spacetime manifolds, Greek indices run from 0 to 3, while Latin indices refer to spatial coordinates and run from 1 to 3.

These lecture notes grew over several years. Many students were exposed to this lecture and contributed corrections and suggestions that greatly helped improving it. In particular, Dr. Christian Angrick and Dr. Francesco Pace were kind and patient enough to meticulously work through the entire notes and point out many mistakes. Thank you all very much!

Particular thanks are due to the wonderful and inspiring teachers I myself had on general relativity. Jürgen Ehlers always impressed me with his depth and clarity of thinking, and Norbert Straumann introduced me to the elegance and beauty of the theory.