Wald, Robert M.
General relativity. (English) Zbl 0549.53001
Chicago-London: The University of Chicago Press. XIII, 491 p. $ 34.50 (1984).

In twenty five years of studying mathematical and physical monographs on general relativity, the reviewer has not previously encountered a single book which can compare with the present one either in the breadth and scope of its content, or in the wealth and elegance of its ideas. Quite simply, this book is a masterpiece which offers the reader an unparalleled introduction to the problems which challenge today's research workers in general relativity. The author's viewpoint is thoroughly modern and non-traditional (less than 15 of his three hundred or so references pre-date 1960).

The text is divided into two parts: fundamentals (approximately a third of the book) with chapters devoted to manifolds and tensor fields, curvature, Einstein's equation, homogeneous isotropic cosmology, and the Schwarzschild solution; and advanced topics: methods for solving Einstein's equation, causal structure, singularities, the initial value formulation, asymptotic flatness, black holes, spinors, and quantum effects in strong gravitational fields. The book concludes with six appendices (approximately fifty pages) dealing with various mathematical and physical topics. While one might occasionally wish for additional information, or a missing derivation, the fundamental ideas are always given in the text. The explanations are lucid, sometimes exciting, and the author's style is informal and persuasive. For example, who could resist his characterization of gravitational radiation as ripples in the curvature of space-time (page 78), or his intuitive description of the nature of singularities (pages 212–216)?

As suggested above, the principal virtue of this monograph is that it presents a very slick exposition of the physical aspects of general relativity using contemporary mathematics, and paradoxically its principal defect arises from precisely the same virtue. For a physicist the mathematical prerequisites are non-trivial. For example, despite the author's best efforts, it is difficult to believe that Appendix A on topological spaces, which leads the reader from open sets to partitions of unity on a paracompact space (in less than five pages) will be sufficient for a mathematical tyro. Likewise, for a mathematician wishing to learn something about relativity, the astrophysics of white dwarfs, or particle creation near black holes, presume a non-trivial acquaintance with modern physics. Indeed one can almost imagine an unprepared reader experiencing the same fate as an observer who ventures too near a black hole !

However, for a reader with the required background, and a sense of adventure, the monograph offers a superb intellectual experience. It not only offers a comprehensive view of the state of general relativity as it exists now, but barring unexpected breakthroughs, it charts the course the theory will probably follow in the next decade. It is clearly required reading for anyone wishing to participate in the future exploration of Einstein's ideas.

Reviewer: J.D.Zund

MSC:

53-02	Research exposition (monographs, survey articles) pertaining to differential geometry
83-02	Research exposition (monographs, survey articles) pertaining to relativity and gravitational theory
53B50	Applications of local differential geometry to the sciences
53C80	Applications of global differential geometry to the sciences

Cited in **5** Reviews
Cited in **1198** Documents

Keywords:

curvature; Einstein's equation; homogeneous isotropic cosmology; Schwarzschild solution; causal structure; singularities; asymptotic flatness; black holes; spinors; quantum effects; strong gravitational fields

Full Text: DOI