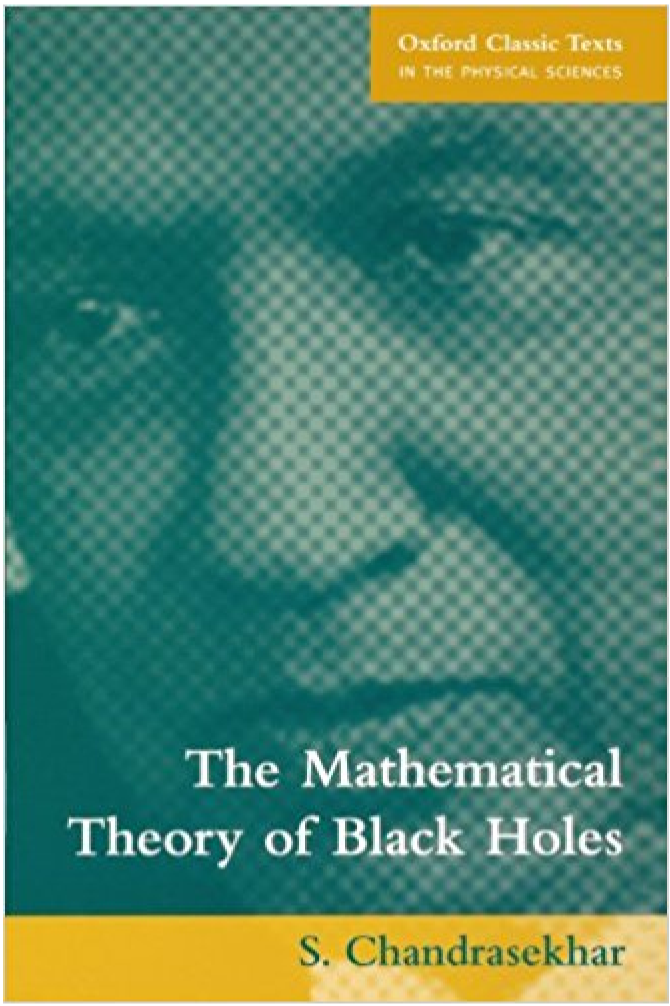
The Mathematical Theory Of Black Holes (Oxford Classic Texts In The Physical Sciences)



Synopsis

This volume has become one of the modern classics of relativity theory. When it was written in 1983 there was little physical evidence for the existence of black holes. Recent discoveries have only served to underscore the elegant theory developed here, and the book remains one of the clearest statements of the relevant mathematics.

Book Information

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Customer Reviews

"There is no doubt in my mind that this book is a masterpiece. . .beautifully written and well-presented." --Roger Penrose in Nature

S. Chandrasekhar is at University of Chicago.

Chandrasekhar begins this work ex initio, which is Latin for, from the beginning. It is assumed however you have some working knowledge of Differential geometry and relativity. Nevertheless, he is set out to derive the theory from the ground-up. For those looking on how relationships occur with these equations rather than being forced to solve exercises to dig out the meaning assumed in the problem, this is an Oasis where the author is not afraid to tell you what can be done. Now this is a compendium of knowledge and the entire purpose is to provide a jumping point that you can develop from. Of course, given its publication in the 80s, it does not contain any hoo ha on multiple dimensions or branes, or even the ER bridge. This is to derive the mathematical theory of black holes, which is succeeds to do and explores several frontiers.The general mathematical introduction is rigorous but you can follow along if you are exposed to the notation of general relativity. There are occurrences when the author does show you the equations in all their unholy glory, in the sense of computing all the elements of a Riemann or Ricci tensor, the usage of the Penrose-Newman formalism components, and other things taken to be trivial but forced upon students to "verify" as many other authors would do. It provides a scope that showcases the fear and trembling to experience when using Tensors (to think we have functors nowadays that supersede these now considered "classical" structures). In the end however, he begins generally with differential geometry, derives the equations and metrics to be used, to which he further specifies the metric of our universe, and from then on explores the different instances of spacetime singularities which manifest physically as black holes.Cases considered are the Schwarzschild, Reissner-Nordstrom, and Kerr black hole solutions. With all these are included the various events and situations that are important when evaluating the dynamics of these constructs, such as perturbations, geodesics, influence on particles, and possible other solutions to the problem, as with using variational methods. As another reviewer wrote, it is a hypersonic suppository of knowledge. This is to mean all the possible information, up to ’83 at least, is presented in a fashion that is guided and informative. Compared to his earlier books, especially, Hydrodynamic and Hydromagnetic Stability, he has improved the clarity and justification between arguments and transitions in the subject. If only more people wrote books like this great man, where the reader is expected to understand the mechanisms of the logic and is not forced to read hundreds and hundreds of referenced articles, which "On the Emergence Theme of Physics" by Carroll is notorious (nearly 20 immediate references just to get a feel for the Gutzwiller trace formula, among others).To wrap up, this work is extremely beneficial to anyone with some exposure to general relativity and differential geometry. It is extremely dense, kinda like Landau’s works, where one sentence is a shard of truth to be verified. But it is the intention of the author to derive these things from the beginning. From this you should be able to explore other implications of the equations, to go beyond the work itself. I do not claim to understand it perfectly, but it is, if given necessary study and understanding, the relativist’s bible, a classic work that should lead to new possibilities. My main interest is numerical relativity and simulation of space-times, and the book provides the initial computational grounding for such an excursion.

The author largely uses the tetrad or vierbein approach in general relativity so familiarity with the basic theory is assumed (Weinberg's text is a good introduction here) as is knowledge of differential forms. As other reviewers have noted the presentation is mathematically deep and rigorous, not a casual dabbling. This text contains the only mathematically rigorous derivation of the Kerr metric. Until Chandrasekhar's work this was assumed via intuitive or plausibility arguments. Even derivations on the web use simplifying assumptions. This text is worth having for this reason alone (historical). It remains unparalleled in depth and breadth.

For anybody who is studying general relativity at a graduate level or higher, this is a fantastic book. Explains very clearly the mathematics behind the theory and its prediction of the very exotic black holes.

Excellent monograph - it must be read book by allresearchers working on physics of black holes.

A classic in the field (not an easy reading...)

I cannot give this book 5 stars because it is written in such a dry fashion that it is terrible reading, certain to put you to sleep. Nonetheless, I recommend it if you are a serious student of relativity because it contains everything you need to know about black holes and the mathematical formalism of relativity in general (i.e. good for study of gravity waves etc). While to read it from cover to cover would be an exercise in torture, it makes an excellent reference book.

"The black holes of nature are the most perfect macroscopic objects there are in the universe: the only elements in their construction are our concepts of space and time. And since the general theory of relativity provides only a single unique family of solutions for their descriptions, they are the simplest objects as well." Well, yes, but somehow these simple object have given rise here to over 3500 numbered equations, one of which occupies nearly two pages. Deriving the unique family of equations for the rotating black hole is not easy, and then there are the questions of the scattering of electromagnetic waves, particles, or gravitational waves by black holes. At the end of a hundred-page chapter on the gravitational perterbations of a Kerr black hole, with 533 numbered equations, we find the note, "Every effort has been taken to present the mathematical developments in this chapter in a comprehensible logical sequence. But the nature of the developments simply does not allow a presentation that can be followed in detail with modest effort: the reductions that are necessary to go from one step to another are often very elaborate and, on occasion, may require as many as ten, twenty, or even fifty pages. . . . The author's derivations (in some 600 legal-size pages and six additional notebooks), have been deposited . . . ." Not for the faint-hearted.

First of all let me say that this book is a member of the hypersonic suppository school of presentation. I wish those that attempt to learn the tetrad and Newman-Penrose methods from this book only good luck. That said, this book contains the most extensive treatment of black holes I have seen anywhere. Period. The section in this book on Kerr black holes inspired me to seek and find a physically meaningful interior solution for the Kerr black hole. I have to admit it: the tetrad and Newman-Penrose treatments inspired me to master these techniques. In the long run that is what this book has done - inspired me. Anything by S. Chandrasekhar does that to me.

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