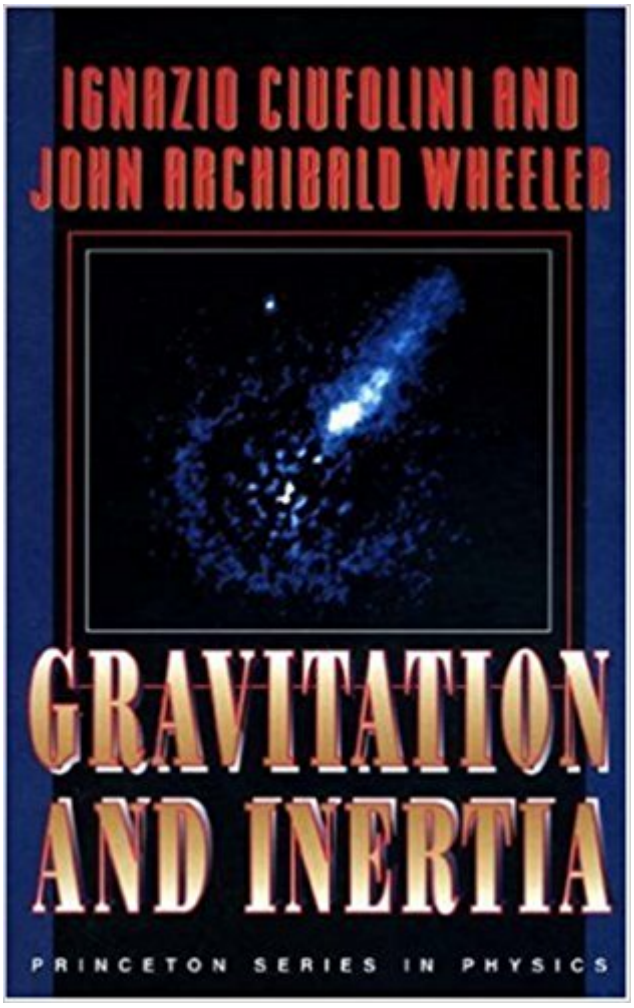
Gravitation And Inertia



Synopsis

Einstein’s standard and battle-tested geometric theory of gravity--spacetime tells mass how to move and mass tells spacetime how to curve--is expounded in this book by Ignazio Ciufolini and John Wheeler. They give special attention to the theory’s observational checks and to two of its consequences: the predicted existence of gravitomagnetism and the origin of inertia (local inertial frames) in Einstein’s general relativity: inertia here arises from mass there. The authors explain the modern understanding of the link between gravitation and inertia in Einstein’s theory, from the origin of inertia in some cosmological models of the universe, to the interpretation of the initial value formulation of Einstein’s standard geometrodynamics; and from the devices and the methods used to determine the local inertial frames of reference, to the experiments used to detect and measure the "dragging of inertial frames of reference." In this book, Ciufolini and Wheeler emphasize present, past, and proposed tests of gravitational interaction, metric theories, and general relativity. They describe the numerous confirmations of the foundations of geometrodynamics and some proposed experiments, including space missions, to test some of its fundamental predictions--in particular gravitomagnetic field or "dragging of inertial frames" and gravitational waves.

Book Information

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Customer Reviews

Winner of the 1996 Award for Best Professional/Scholarly Book in Physics and Astronomy, Association of American Publishers"[An] admirably comprehensive guide. . . .The approach is

leavened with historical perspectives and almost poetic insights. Particularly valuable [are] the up to date accounts of experimental tests of general relativity."--Robert Matthews, New Scientist". . . it has plenty of useful resources and ideas and it is enjoyable. It covers, sometimes with distinctive originality, topics not easily found in other textbooks. Its charm lies in the interweaving of Wheeler's speculative quest for the physical origin of inertia with Ciufolini's experimental craft. In such interweaving lies the magic of an extraordinarily beautiful science: the science of the shape of space-time."--Carlo Rovelli, Science"In this important work, Ciufolini and Wheeler provide extensive coverage of current gravitation theory, current problems of interest to the physics community, and recent and proposed experiments based upon Einstein's theory of general relativity."--Choice"This is an excellent book that will be of interest to anyone seriously interested in general relativity. It is clearly written with a very well connected development of many topics which are not covered in the other books on the subject."--Classical and Quantum Gravity"Gravitation and Inertia has plenty of useful resources and ideas and it is enjoyable. It covers, sometimes with distinctive originality, topics not easily found in other textbooks. Its charm lies in the interweaving of Wheeler's speculative quest for the physical origin of inertia with Ciufolini's experimental craft. In such interweaving lies the magic of an extraordinarily beautiful science: the science of the shape of space-time."--Science

"This book is an ambitious walking tour through a host of topics in general relativity. It includes a treasure chest of useful references."--Robert Geroch, University of Chicago "Bringing together both the philosophy and the application in one place produces a synergy that vastly increases the value of the work."--Richard Matzner, Director of the Center for Relativity at the University of Texas, Austin

John Archibald Wheeler does not need any introduction,neither by me, nor by anybody else:he is simply the greatest living authority on General Relativity!This book, written together with Ignazio Ciufolini,is as interesting as all his other books,and is well worth the price,despite what our friend Johngorno says!!However,Johngorno is right in one respect:when the authors say ,in the Preface(page ix),that the "book may be used as an introduction to general relativity..." ,they are misleading the prospective reader!As a matter of fact ,if you have not had at least an introductory course in GR ,such as "A first course in General Relativity" by B.F. Schutz,don't even think about reading this book.Even the Mathematical Appendix at the end is not enough for someone not familiar with tensor calculus.The unaware reader who reaches page 21 ,for example,is hit on the head with the expression giving the Christoffel symbols as a function of the metric components: how is he or she supposed to guess that the comma represents a partial derivative,that sigma is a

dummy index ,and therefore that there is a sum involved in this expression?He or she might turn to the mathematical index ,which will direct him or her to the Appendix,page 427,but this won't help much:the summation convention is not explained there,but at page 425,and in a very inconspicuous fashion!So,albeit a great book on gravitation theory and experiment, this is definitely not an introduction to Einstein's theory of gravitation.It is rather aimed at the real "cognoscenti" in the field.But if the book's contents are outstanding, the same cannot be said with regards the form:the pictures are quite poor for a book priced at more than $90, and the paper is not that good either.Too bad!

6/10/2013 In light of quite constructive criticisms, I am elaborating on, and moderating, my original, quick review (archived below).Summary:Reading the preview of the cover flaps and Chapter One, one might expect the book to be a mathematically-approachable exploration of geometro-dynamics -- the identity of space-time geometry, Gravity, and Inertia, as I did (much more on this later); reading the preview of the Mathematical Appendix, one might expect a hard-core mathematical exploration of the same. Neither would be correct, although the second chapter is a painfully concise mathematical summary of the theory. "'This book is an ambitious walking tour through a host of topics in general relativity...' -- Robert Geroch, University of Chicago" And so it is. Presuming an understanding of the theory and its essential mathematics, it examines numerous familiar questions and unusual twists in various domains of General Relativity. Included are chapters on cosmology, the initial value problem, the gravimagnetic field, and tests of the theory. While quite varied and interesting, these do not add up to a book that should be titled "Gravitation and Inertia." The inclusion of the aforementioned Chapter Two and Appendix is puzzling, as their largely coordinate-independent approach, while "elegant," is not employed in the remainder, and their impenetrability renders them useless and off-putting to a reader who has not already mastered them; the only justification I can imagine for them is as a reference summary, rather than an exposition. Overall, the book is a grab-bag of diverse topics in gravitation, with a mix of intermediate and more advanced approaches, and while few will find every section to be of value to them (or worth the $80 list price!), there is something to interest every student and scholar of General Relativity, if you can get it at a price that suits you.Background:I came to buy this book as a reasonably prepared physics B.S., having already read and understood the "old-school," coordinate-based approach (as well presented on many web sites and in Dirac's excellent (albeit, illustration-free) bookletÃ Â General Theory of Relativity) and comfortable (if not confident!) with Tensor Calculus and the associated mathematics. I then broke down and purchased Wheeler, et

al’s definitive and pricey tome,Ã Â Gravitation (Physics Series)Ã Â (the nerd’s "Godel, Escher, Bach," i.e., something everyone has but no one gets far in!) and like so many others, found myself unable to penetrate the new-style math of coordinate-independent tensors, one-forms, fiber-bundles, the "star dual," etc.. In this text, Cartan/Wheeler’s nifty insights about geometro-dynamics (the identity of Gravitation and Inertia, the Boundary-of-a-Boundary Principle, Sum of the bounding curvatures = 8 Pi x Momentum-energy enclosed) are explored at length, but the treatment has so far resisted my understanding.I then read Wheeler’s intriguing "coffee-table" bookÃ Â A Journey into Gravity and Spacetime ("Scientific American" Library)-- (now available for a penny through marketplace!), where he attempts (and very nearly succeeds) to explain these concepts in terms of curvatures and geometry alone. The book is blessed with numerous helpful diagrams, a few more of which would have carried the ball over the finish line to allow almost anyone with a modest understanding of spatial relations to determine the qualitative structure of space-time in and around a mass. I found that some of the statements about curvature didn’t jibe with the calculations they inspired me to make (it seems that Wheeler is defining his curvatures from covariant vectors, which changes the sign of either the space-time or space-space planes, so his sum is my difference).Eager to resolve the discrepancy and get a more formal mathematical treatment, I searched here to see if Wheeler had written a book intermediate between "Journey..." and "Gravitation." I was delighted when I read the listing for "Gravitation and Inertia," which seemed to be that very book, an entire text fleshing out the identity of the two concepts. The cover flaps proclaim, "Einstein’s standard and battle-tested geometric theory of gravity--spacetime tells mass how to move and mass tells spacetime how to curve--is expounded in this book by Ignazio Ciufolini and John Wheeler." The sample text consists of the brief first chapter and the Mathematical Appendix, and while the latter is quite advanced, the former is exactly what I was seeking, the continuation of the intuitive geometrodynamics of "Journey..." for physicists.Alas, when I received my purchase, I discovered that Chapter One belongs in a different book. So does Chapter Two, wherein geometrodynamics is presented as a concise mathematical summary of the treatment in "Gravitation," with little attempt at teaching or approachability. I find it hard to believe that anyone who had not already been taught the very formal, abstract, mathematical approach of Chapter Two and the Mathematical Appendix could make much use of them, and they seem irrelevant to the later chapters, which employ the more-familiar coordinate-dependent notation. If their inclusion in the volume can be justified, it would be only as a summary review or a teaser for "Gravitation." While Chapter Five takes another stab at *summarizing* geometrodynamics, it is only a summary.My personal interest in General Relativity at present lies in the realm of intuitive understanding between

deep theory and experimental results, and while there is much to be learned from this book, it doesn't grab my interest. Perhaps this is due to my limited grasp of the mathematics, perhaps I'm looking for an unreasonable level of approachability, "hand-holding" or intuitive/diagrammatic explanation that is possible, and hinted at in "Journey...," but I cannot open this book without being deeply disappointed at what it is not.My original review:Don't Waste Your Money, April 3, 2002I purchased my copy used (20$) and (after my initial delight at the bargain) was disappointed. I had hoped for a more technical intermediate-level expansion of Wheeler's intriguing but vague "Journey into Gravity and Spacetime." This book is instead largely a hodge-podge of specialty articles of interest only to advanced professionals in the field. Unless you have money to burn, invest it in another text, like "Gravitation," by Thorne, Wheeler, etc., which isn't great but is useful.

This book tought me a lot about the physics of gravitation and inerti

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