from the sea. He returns frequently to the theme that nuclear energy is a proven, safe performer that does not emit greenhouse gases such as CO_2. In his review of renewable energy sources, including wind, solar, and biomass, he provides some hard data about their physical limitations to become significant contributors to the world s energy needs. He attempts to base his findings on science, although his foray into the California deregulation debacle is a departure whose purpose is to warn us about how policy made in the absence of knowledge and understanding can lead to costly failures.

White hopes that nuclear energy will be the transitional energy source, but he does not appear to be optimistic: In his opinion the natural advocates, environmental organizations and industry, are conflicted for different reasons: The former has a history of aversion to nuclear energy; the latter, a heavy reliance on burning coal and other fossil fuels.

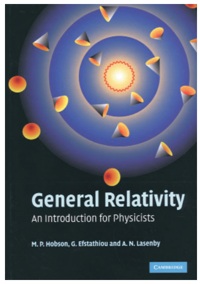
Compared with *Energy for the Public*, Sweet s book is more worrisome. After reading *Kicking the Carbon Habit*, you may become frightened, angry, or simply depressed because the problem seems so personally overwhelming, with global warming and climate change being inevitable. The only question for the world might be what form climate change will take. Will Earth get hotter or colder, wetter or drier? Or will all those possibilities occur, depending on where you live? The bottom line conclusion is that we do not know whether cataclysmic climate change is going to happen or when.

Overall, both books offer a sobering, timely message. The global environmental impact of a business as usual energy strategy is clearly unacceptable. The good news may be that we run out of fossil fuels before we do irreparable damage to the environment. Some argue that we are very close to that irreparable point now.

General Relativity
An Introduction for Physicists

M. P. Hobson, G. Efstathiou, and A. N. Lasenby
Cambridge U. Press, New York, 2006. $75.00 (572 pp.). ISBN 978-0-521-82951-9

In recent decades, general relativity theory underwent a renaissance from an obscure and rarely taught subject to a standard component of the graduate physics curriculum. The renaissance was fueled by advances in black hole astrophysics, cosmology, and the search for gravity waves, and by theoretical developments at the interface of relativity and quantum theory, in particular black hole evaporation and information loss puzzles. These trends moved general relativity from the periphery of mid 20th century physics to the center of early 21st century physics.



Along with increased research activity, many excellent textbooks at various levels have become available. Despite the existence of several excellent graduate level general relativity texts, *General Relativity: An Introduction for Physicists*, written by University of Cambridge astrophysicists Michael Hobson, George Efstathiou, and Anthony Lasenby, is a useful addition to the literature on the subject.

The book s subtitle might lead some to expect a monograph aimed at research physicists rather than an approachable text suitable for advanced undergraduate and beginning graduate students. In British parlance, an introductory book for physicists apparently means one that is aimed at students specializing in physics. In any case, *General Relativity* is written clearly, with most of the arguments worked out in sufficient detail for students to follow. Numerous exercises are at the end of each chapter, and unlike most recent texts, the factors of Newton s constant G and the speed of light c are written out explicitly. That approach has the downside of leading to more cluttered expressions, but it may be helpful to students who are sometimes confused by the $G = c = 1$ units in which masses and times have dimensions of length. The issue of sign conventions in relativity is often a contentious one, with no generally accepted convention for the metric signature and the Riemann tensor. The authors adopt the time like metric convention. I found only a handful of misprints, which is better than average for a book of this nature.

Compared with other noteworthy recent textbooks on the subject, *General Relativity* is on a somewhat higher level than James Hartle s *Gravity: An Introduction to Einstein s General Relativity* (Addison Wesley, 2003), which is aimed primarily at undergraduates. The book is more similar in level to Sean Carroll s *Spacetime and Geometry: An Introduction to General Relativity* (Addison Wesley, 2004). Carroll s book has a greater emphasis on the geometrical and quantum aspects of gravity than *General Relativity*, which concentrates more on astrophysical and cosmological applications. (For a review of the books by Hartle and Carroll, see PHYSICS TODAY, January 2005, page 52.)

Chapter 1 begins with a brief review of special relativity, including a discussion of accelerated observers. The next three chapters develop the necessary mathematical formalism of tensor calculus and Riemannian geometry needed for a self contained exposition of general relativity. It is at this point that many authors succumb to the temptation to add digressions that contribute little to the subsequent discussion. To their credit, the authors keep the mathematical formalism to the minimum needed to understand the theory and its applications.

Chapters 5 and 6 return to special relativity, in four vector notation, and to the covariant formulation of electrodynamics in flat spacetime. The authors cover the equivalence principle the motivation for a geometrical theory of gravity and the properties of the curvature tensor in chapter 7. The Einstein equations and their weak field limit are introduced in chapter 8, which also contains a notable discussion of the relationship between the Einstein and the geodesic equations. In electromagnetism, the Lorentz force law must be postulated separately from the Maxwell equations. In general relativity, the equations of motion for test particles the geodesic equations are implicit in the Einstein equations, as was first realized in a long, complex 1938 paper by Albert Einstein, Leopold Infeld, and Banesh Hoffmann published in *The Annals of Mathematics*. *General Relativity* gives a very simple argument deriving the geodesic equations from stress tensor conservation, a key ingredient in the Einstein equations.

The Schwarzschild solution and experimental tests of general relativity are discussed in chapters 9 and 10. The authors then cover Schwarzschild black holes, relativistic stellar structure, and the Reissner Nordstrom solution in chapters 11 and 12. Chapter 13 contains an especially detailed treatment of the Kerr geometry including its geodesics, and the astrophysics of rotating black holes. Among the points worthy of special mention is the clear discussion of frame dragging.

In chapters 14, 15, and 16, the authors offer extended discussions on cosmology, which is not surprising given that the subject is one of their research specialties. Chapter 16 in particular has a detailed discussion of inflationary cosmology, including perturbations from inflation. The final chapters, 17, 18, and 19, cover, respectively, linearized theory, gravity waves, and variational principles for deriving the Einstein equations.

Of course no textbook of reasonable size can cover all aspects of general relativity. Nonetheless, it is worth noting some of the topics that have been omitted, such as singularity theorems, focusing, the Raychaudhuri equation, and Penrose diagrams all of which have adequate coverage elsewhere. Overall, *General Relativity* gives a good, readable introduction to the foundations and applications of general relativity theory, and it is a good choice for a general relativity course emphasizing astrophysical and cosmological applications.

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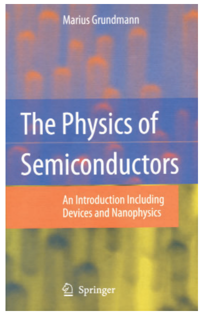
The Physics of Semiconductors
An Introduction Including Devices and Nanophysics

Marius Grundmann
Springer, New York, 2006. $89.95 (689 pp.). ISBN 978-3-540-25370-9

Marius Grundmann undertook a sweeping project when he set out to write a book that would include all of the physics of semiconductors and semiconductor devices and briefly cover nanostructures. He begins *The Physics of Semiconductors: An Introduction Including Devices and Nanophysics* at a very basic level with bonds and moves on to discuss crystals, defects, phonons, and band structure. He then deals with doping, transport, optical properties, and recombination, heterostructures, dielectric structures, diodes, the conversion of light to electricity and electricity to light, and ends with transistors. The task was monumental, and culminated with 21 chapters, 587 figures, 36 tables, and 734 references.

The strength of *The Physics of Semiconductors* may be its breadth, but that is also its greatest weakness. A single book, even one that is nearly 700 pages long, cannot possibly cover such a broad set of topics with sufficient depth to satisfy a reader who is interested in learning. For instance, chapter 16 on organic semiconductors has facts and 10 figures but not much of a story that would make it accessible or worth returning to.

In his classic *Physics of Semiconductor Devices* (Wiley Interscience, 1969), Simon M. Sze aptly began at a higher level. He assumed that the reader would have a working knowledge of solid state physics, and he produced a book that should always be close at hand. But who is the intended reader for Grundmann's book? That question could have been answered in a foreword. The title and discussions on elementary bonds and crystal lattices suggest that Grundmann intends the book to be accessible and instructional for beginners. Unfortunately, the bare bones presented in the various chapters make the text difficult to read for one who does not have a suitable background.



For example, consider chapter 6 on band structure, which begins with an introductory paragraph lacking a coherent theme. Next are sections on Bloch's theorem, free electron dispersion, and vector **G**s of the reciprocal lattice. After a very brief detour through the Kronig Penney model and electrons in a periodic potential, the reader reaches a section on band structures of selected semiconductors.