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

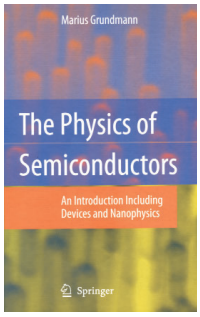
An Introduction Including Devices and Nanophysics

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.

What follows are 18 band structures for semiconductors from silicon and germa nium through the lead salts, and for the chalcopyrites, the delafossites, and the perovskites. Each structure is accompa nied by a figure caption and brief text. For example, we read that GaP is an in direct compound semiconductor. The conduction band minima are along the $\langle 100 \rangle$ directions. A student who had read the chapter from the beginning would not have been prepared to make sense of or benefit from the linguini diagrams in that section.

I read chapter 9 on optical properties of semiconductors with interest because the early part of my career focused on such properties. It was fun to be reac quainted with Fermi s golden rule and with dipole transition matrix elements. Yet I was annoyed trying to sort out fig ure 9.4 for the matrix elements formed along the high symmetry directions of wurtzite gallium nitride because of the confusing caption: The transitions are A: $\Gamma_9(A)-\Gamma_{7c}$, B: $\Gamma_7(B)-\Gamma_{7c}$, C: $\Gamma_7(C)-\Gamma_{7c}$ (cf. Fig. 6.27). First, GaN bands were pre sented in figure 6.7, not 6.27; to choose the figure presenting the wurtzite structure, readers would need to note that the pho tons were polarized relative to the *c* axis. Second, no such symmetry labels are given for the states at Γ in figure 6.7 one would have to take a quick look at refer ence 276 to realize that relativistic effects had been taken into account and thus changed the symmetry designations. Third, the meanings of (A), (B), and (C) are not made clear. The reader again has to turn to the indicated reference, which explains that the letters correspond to the first three valence bands. But no band structures are included in that reference, so one cannot see the valence bands. At that point, I gave up.

Other aspects of style get in the way of the presentation. Grundmann s con stant use of i.e. and parenthetical clauses breaks the flow of the text. Also, many of the reproduced figures are im possible to read without a magnifying glass. The author does not develop many of the ideas and discussions, and the typesetting, figures, and equations contain more errors than one would hope to find.

On a positive note, the book s many references are helpful. However, *The Physics of Semiconductors* would have profited from a better story line. In its current form, it is not particularly reader friendly. Sadly, the book suffers from trying to be both an introductory text and a compilation of advanced in formation that relies on figures from the current literature.

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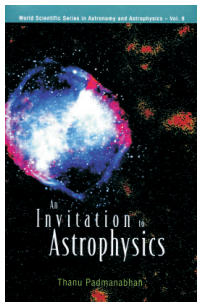
An Invitation to Astrophysics

Thanu Padmanabhan
World Scientific, Hackensack, NJ, 2006. $66.00, $36.00 paper (362 pp.). ISBN 978-981-256-638-6, ISBN 978-981-256-687-4 paper

No field of physics is more vibrant today than astronomy. And the power of astronomy to excite students and draw them into physics is universally recognized. As a result, some physicists who never took a course in astronomy probably wish that they had. Now they have a chance to catch up.

An Invitation to Astrophysics by Thanu Padmanabhan is targeted at physicists interested in taking a tutorial in astronomy. In just 362 pages, Pad manabhan, a respected cosmologist at the Inter University Centre for Astron omy and Astrophysics in Pune, India, aims to bring readers from square one to a position from which they can un derstand current research across almost the whole field of astronomy from normal and degenerate stars to the dynamics and evolution of normal and active galaxies, and from the Big Bang to the formation of stars and galaxies. The ex position is quantita tive throughout and firmly based on basic physical principles.



To benefit from the book, readers need to have a good knowledge of undergraduate physics, including electromagnetism, special relativity, and quantum mechanics. They also need a sophistication in the handling of physical concepts that few undergraduates possess. Readers hav ing those prerequisites will be able to grasp the basic principles of such di verse areas as gravitational lensing, ac cretion onto degenerate stars and black holes, the workings of astrophysical plasmas in interstellar space and rela tivistic jets, cosmic nucleosynthesis, the use of the cosmic background radiation as a cosmic probe, and the dynamics of dark matter.

The reader, however, will have to work hard: A serious session with Pad manabhan s book does for the mind what a vigorous workout in the gym does for the body. Each of the nine chap ters has about 80 equations and finishes with about 15 exercises, so ideally one would work through the book with pen and paper at hand. I m not sure how many of my colleagues have the time for such an exercise, but most would benefit from it. I would warmly recom mend the book to a good graduate stu dent of astronomy who is preparing for general exams, or to a graduate student working in particle physics who is shift ing to the astroparticle side. The text could also serve as a focus for an inspi rational graduate seminar that would broaden and deepen students under standing of physics and the way it en ables us to understand environments wildly unlike our own.