done, and I recommend it for anyone trying to get physics across to nonspecialist audiences.

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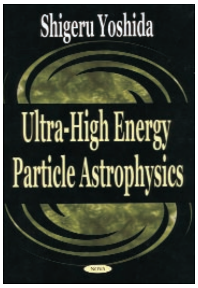
Ultra-High Energy Particle Astrophysics

Shigeru Yoshida
Nova Science, Hauppauge, NY, 2003. $89.00 (163 pp.). ISBN 1-59033-593-7

Cosmic rays with energies greater than 10^{18} eV are the highest-energy particles in the known universe; where and how they are accelerated to such extraordinary energies is one of the most pressing problems in astrophysics. Although the current observational status looks like a bit of a mess, the study of ultrahigh-energy particles is coming of age, and astrophysicists have seen a constant improvement in the quality of experimental data. The Pierre Auger Observatory in Argentina's Pampa Amarilla has started to dramatically increase the number of recorded cosmic rays, and it promises to settle decisively some important observational issues. One example is the ongoing controversy concerning cosmic rays observed to have energies above a theoretical limit—the so-called GKZ cutoff—predicted by Kenneth Greisen, Vadem Kuzmin, and Georgi Zatsepin.



I was therefore rather excited to see a new textbook on cosmic-ray physics on the market. And the timing for *Ultra-High Energy Particle Astrophysics* by Shigeru Yoshida could hardly be better. However, the bar is high. A variety of books on astroparticle physics, even at the undergraduate level, now include well-written chapters on cosmic-ray physics. Simply being the newest book does not justify publication.

Yoshida has a long and distinguished track record in cosmic-ray research. He has worked on the Akeno Giant Air Shower Array (AGASA) cosmic-ray experiment in Japan and the High Resolution Fly's Eye (HiRes) Experiment in Utah; both have contributed significantly—and still do contribute—to the advance of ultrahigh-energy cosmic-ray physics. Yoshida's knowledge of the field shows, and he manages to squeeze a large number of relevant topics into a small volume of little more than 150 pages. In the first part of the book, he describes cosmic-ray acceleration and propagation in an expanding universe. After that rather theoretical section, he summarizes the observational status and some experimental aspects of the field. The last chapters offer several interesting special topics—for example, the possible connection between ultrahigh-energy cosmic rays and gamma-ray bursts or neutrino physics.

Those last chapters have the most to offer. They contain the outlines of a number of interesting calculations that one cannot easily find elsewhere in such a compact form. Readers with a healthy mathematical constitution will find a lot to enjoy.

Unfortunately, the book is, for the most part, disappointing. In the theoretical section, Yoshida tries to accomplish too much in too few pages. He describes his book as an "introductory textbook rather than a review for experts," but large stretches of the text amount to little more than collections of formulas. In a section billed as a brief introduction to general relativity and cosmology, Yoshida merely confronts the reader with a lot of math; there's almost no physics insight. His use of four-vector notation is often sloppy, and he takes it for granted that his nonexpert audience knows the comma derivative.

The chapters on experimental methods and observations suffer from a similar overabundance of formulas and dearth of explanation. Additionally, in my opinion, too much room is given to statistically unsound experimental results. That said, I find it laudable that Yoshida puts such a strong emphasis on observation.

Potential readers should be warned that the book is largely unedited and contains numerous errors, misleading expressions, and misspelled names of major scientists in the field. It appears that very little or no proofreading has gone into the book; that lack of care will, unfortunately, challenge the patience of even the most enthusiastic reader. One wonders how much more than the already steep price for this small volume one has to pay before Nova Science Publishers runs at least a spell check. The publisher also has to be blamed for the poor quality of many figures. Particularly bad are the black and white reprints of color plots, such as the figure-1.2 sky map of AGASA cosmic-ray arrival directions. Axis labels are often hard to read or, as in figure 5.13, misleading.

In summary, *Ultra-High Energy Particle Astrophysics* can serve as a useful collection of relevant formulas for scientists in the field. It is not a good book for nonexperts to read first, and it's certainly not an introductory textbook. Students are better off reading older books like Thomas Gaisser's *Cosmic Rays and Particle Physics* (Cambridge U. Press, 1990), supplemented with some recent journal papers and reviews, or opting for the carefully crafted and well-written *High Energy Cosmic Rays* by Todor Stanev, published this year by Springer.

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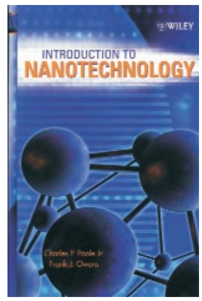
Introduction to Nanotechnology

Charles P. Poole Jr and
Frank J. Owens
Wiley, Hoboken, NJ, 2003. $79.95 (388 pp.). ISBN 0-471-07935-9

Rarely has a scientific field created so much enthusiasm and expectation as has nanotechnology. Much of the hype is certainly the stuff of science fiction, but the exuberance, irrational or not, has quickly spread from the laboratory to Madison Avenue, Wall Street, and Washington, DC.



Nanotechnology is not a new field but rather a confluence of many fields—physics, chemical and electrical engineering, mechanics, materials science, chemistry, and biology—coming together at the nanometer scale. Much hope exists for vast improvements in each of these areas through developments in such fields as nanoelectronics, information technology, nanomachines, molecular electronics, nanotubes, microelectromechanical systems (MEMS), and microfluidity. The real excitement for nanotechnology, however, is driven by the integration of nanodevices and sensors into biological systems for diagnostics, drug delivery, and homeland security. Nanotechnology has thus evolved into a particularly interdisciplinary science.

In *Introduction to Nanotechnology*, Charles Poole Jr and Frank Owens set out to provide the background for specialists working in one area of nanotechnology to understand and contribute to advances made in other areas. This is a formidable challenge.

Having developed an introductory course on nanoscience for beginning graduate students in materials science, I was very interested whether such a broad topic could be reasonably represented in a single volume written by just two authors.

The approach adopted in this book assumes the reader is only slightly acquainted with the technical subject matter and thus provides a background for each topic. The text begins with two introductory chapters on the physics of the solid state and methods for characterizing the structure and properties of materials. Each subsequent chapter is more or less self-contained and includes introductory material, methods of synthesis, structure, properties, and in some cases, applications. Although the authors note that they cannot possibly cover every important topic in nanotechnology, they do cover most of the more important topics that would be expected—quantum dots, nanotubes, magnetoresistance, catalysis, DNA, and MEMS.

The two authors working together have maintained a consistent perspective and level throughout the book. As can be expected, however, subjects most familiar to the authors, such as ferrofluidics, are well covered while those less familiar, such as mechanical properties, lack some of the key ideas. The primary benefit from the authors' approach is that the reader can quickly locate specific subjects and, with very little previous knowledge, obtain a brief description of them. Most topics are covered in a few paragraphs. Read in its entirety, the book provides a good appreciation of the diversity and possibilities of the field.

Although the encyclopedic style of *Introduction to Nanotechnology* offers quick access to information, it is not conducive to developing the underlying principles of the field. Subjects such as the thermodynamics, kinetics, lithography, and magnetic behavior of small particles are covered ad hoc as they appear in specific discussions. For example, in describing the synthesis of nanoparticles, the authors provide a few chemical equations for the overall reaction in specific examples, but they do not describe the kinetics that controls the size of the particles. Similarly, the book mentions that, compared with their bulk forms, small particles can have lowered melting temperatures, different structures, and other modified properties, but the underlying thermodynamics principles that link these behaviors are not developed. The book, therefore, would not serve well as a textbook, but that was not the authors' main goal.

Finally, one wonders how quickly the book will become dated. Poole and Owens have attempted to choose subjects partly on the basis of maturity of the field, but clearly, some of the subjects have already moved far beyond the author's treatment of them. The good news is that *Introduction to Nanotechnology* is short and can be easily revised from time to time.

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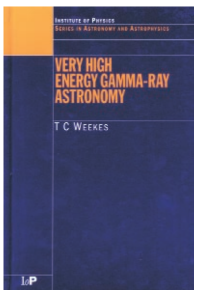
Very High Energy Gamma-Ray Astronomy

T. C. Weekes
IOP, Philadelphia, 2003. $135.00 (221 pp.). ISBN 0-7503-0658-0

Astronomy experienced unprecedented growth in the latter half of the 20th century and has transformed into a vibrant, dynamic discipline within the physical sciences. The evolutionary path expanded the field from optical astronomy (the historical parent of modern astronomy); to radio and IR-band astronomy; and then, with technological developments in space, to ultraviolet, x-ray, and gamma-ray astronomy. The latest pivotal development in this sequence concerns the field of high-energy gamma-ray astrophysics, which is the subject of Trevor C. Weekes's *Very High Energy Gamma-Ray Astronomy*.



This subfield of astronomy is emerging from its fledgling status to become an integral contributor to our understanding of the most energetic phenomena in the post-recombination universe. The principal experimental techniques divide the gamma-ray energy range naturally: Photons below 50 GeV are best detected by space missions, while those of much higher energy, generally up to 10 TeV, are observed with ground-based telescopes that measure Čerenkov radiation. Such radiation comes from atmospheric showers initiated by incident energetic cosmic rays and photons.

Weekes is the foremost pioneer in the atmospheric Čerenkov experimental discipline. His efforts with the