

rather than allowing a broader research program defined by the observers themselves. According to Giacconi, “the slow pace of discovery” associated with investigations of galactic clusters “came about because theorists . . . had struck again and convinced themselves . . . that there were no clusters to be found. . . . Once again the theorists were wrong.”

As those concerns will, if anything, play more prominent roles in the building of large 21st-century astronomy instruments, Giacconi’s account is an important one.

Introduction to Modern Physics

Theoretical Foundations

John Dirk Walecka
World Scientific, Hackensack, NJ,
2008. \$88.00, \$65.00 paper
(477 pp.). ISBN 978-981-281-224-7,
ISBN 978-981-281-225-4 paper

Introduction to Modern Physics: Theoretical Foundations, by John D. Walecka, introduces a wide range of subjects commonly taught in advanced undergraduate or beginning graduate courses. The book begins with a straightforward review of classical mechanics, followed by a chapter that

discusses the standard deficiencies of classical physics. The next chapter, the basis for the rest of the book, offers a succinct introduction to quantum mechanics. The remaining chapters provide elementary

introductions to relativistic quantum mechanics; special and general relativity; atomic, nuclear, and particle physics; quantum fluids; and quantum field theory.

The author is obviously well versed in both teaching and writing about the topics covered, and the presentation is mostly clear and concise. Perhaps because of its ambitious breadth, the book does not provide much depth in any of its subjects. It does, however, cover the basic features, and the text is complemented and expanded by numerous well-chosen exercises. In some cases the exercises are essential for a proper understanding of the material, but the text seldom refers to them; the reader must review all the exercises in each chapter to determine whether there is one essential to the material being studied.

The no-frills approach is punctuated with nice derivations and arguments concerning, for example, the absence of Lorentz contraction perpendicular to the direction of motion, the formation of Cooper pairs, Landau’s derivation of the condition for superfluidity, and the Dirac equation. Unfortunately, other parts of the text suffer from ill-chosen notation, careless editing, and poor wording. The list of such deficiencies is not unacceptably long, but it is too lengthy to be itemized here, and so I provide but three examples: quantization of angular momentum in equation 4.135 is associated with periodic boundary conditions instead of with the requirement that the wavefunction be single valued; equation 6.3 suggests that protons are not stable and might also be confusing to students because the reaction is kinematically forbidden in vacuum; and in equation 7.32 Walecka writes that lepton-family number is conserved but then negates the remark in the very next equation.

Though the author writes that with few exceptions the text is self contained, I found that the “few exceptions” sometimes include formulas or concepts that are repeatedly used throughout the text, or are central to a proper understanding of the subject matter. Examples include the Fermi–Dirac and Bose–Einstein distributions, the addition of angular momentum, the evaluation of Feynman graphs, and the idea of a virtual particle. In other sections, formulas are presented without their symbols being properly defined; such is the case for the Einstein equations of general relativity. In my opinion many students will be frustrated and confused by the sudden appearance of such concepts and formulas.

The text suffers from other deficiencies; here I mention just a few. The chapter on quantum mechanics does cover the basic material, but several omissions make the presentation less than compelling. For example, the author does not mention the probabilistic interpretation of the wavefunction, nor does he provide motivation for the quantization procedure of replacing the classical momentum with a derivative, though the substitution is mentioned several times. The chapter on special relativity presents a derivation of the standard results, but the author opts for anachronistic complex coordinates, something he has to change in the chapter on the general theory. The choice of complex coordinates also prevents the author from discussing the light cone, which, as far as I could see, is not mentioned in the text.

In his preface Walecka mentions that his book is intended as the text for a one-semester advanced undergraduate course, but I believe such a course would most likely consist of a selection of topics from the book. The presentation of the material is amenable to such treatment, as the chapters following the introduction to quantum mechanics are largely independent from one another.

Overall, *Introduction to Modern Physics* left a mixed impression. It includes sections of brilliance and insight but is marred by poor notation and lack of coherence in other places. Careful preparation of lectures, inclusion of ancillary material, and thorough discussion of the incompletely treated concepts would patch up most of those deficiencies. But an unguided reader, or one who has a less than very conscientious instructor, would face difficulties learning modern physics with only this text.

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The Crime of Reason

and the Closing of the Scientific Mind

Robert B. Laughlin
Basic Books, New York, 2008.
\$25.95 (186 pp.).
ISBN 978-0-465-00507-9

Robert Laughlin, author of *The Crime of Reason*, and *the Closing of the Scientific Mind*, has won many physics prizes and awards, including a share of the 1998 Nobel Prize in Physics for his work on the fractional quantum Hall effect. His first book, *A Different Universe: Reinventing Physics from the Bottom Down* (Basic Books, 2005), is a popularization aimed at a broad readership that lacks specialized scientific or technical training (see the review by Anthony Leggett in *PHYSICS TODAY*, October 2005, page 77). His second book, *Looking for a Hero* (privately published in 2006), describes his experiences as the first foreign president of the Korea Advanced Institute of Science and Technology. With this, his third effort—a mere 30 000 words, and not graced by a single equation—Laughlin again addresses a general audience, but he now treats a topic that

