

misses the grandeur of Lorentz invariance, embedded in electrodynamics from its inception but hidden from full view until Albert Einstein recognized its implications and replaced Newton's concepts of space and time with spacetime. Zangwill's choice of Minkowski's imaginary component in four-vectors is strange; given the straightforward mathematics of special relativity, that choice adds unnecessary complexity and heightens the potential for confusion. Also, numerical methods are not addressed in this book.

I sometimes advise advanced undergraduates to begin building their own physics libraries with classic advanced textbooks, even before the books are assigned in class. Such texts can broaden perspectives on core subjects and would be readily accessible as the student advances in his or her studies and work. Where shall I put *Modern Electrodynamics* on such a reading list? It has a lot to offer, so I think it should be somewhere pretty high up, but after John David Jackson's *Classical Electrodynamics* (3rd edition, Wiley, 1998), David Morin's update of Edward Purcell's *Electricity and Magnetism* (3rd edition, Cambridge University Press, 2013; reviewed in PHYSICS TODAY, August 2013, page 48), and the timeless classic, Lev Landau and Evgeny Lifshitz's *Classical Theory of Fields* (Addison-Wesley Press, 1951).

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The Universe in the Rearview Mirror

How Hidden Symmetries Shape Reality

Dave Goldberg
Dutton, 2013. \$27.95 (352 pp.).
ISBN 978-0-525-95366-1

In *The Universe in the Rearview Mirror: How Hidden Symmetries Shape Reality*, Dave Goldberg expounds on the important role of symmetries in the fundamental laws of physics. He starts with the discrete operations of charge conjugation, parity, and time inversion—and their combinations. Then, after introducing readers to mathematician Emmy Noether and her work connecting symmetries with conservation laws, Goldberg discusses continuous symmetries, homogeneity and isotropy, and Lorentz in-

variance. Later chapters deal with gravity, gauge symmetries, and symmetry breaking; the book's finale considers proposals beyond the standard model of particle physics, grand unification, supersymmetry, and the missing theory of quantum gravity.

Goldberg does a remarkably good job of conveying technical topics in non-technical terms and with only a handful of equations (yes, $E = mc^2$ is among them). He works mostly with analogies and writes in an engagingly colloquial way. The bibliography and the guide to further reading provide helpful references for readers who want more details. The book also has a brief glossary.

Symmetries that “shape reality,” as mentioned in the subtitle, cover a vast subject area, of course. Except for offering one brief analogy, Goldberg does not touch on the broad topic of emergent symmetry and order in condensed-matter, biological, and other systems. His focus on fundamentals has the benefit of keeping the book relatively lean and maintaining its momentum, but the description on the cover could have been more explicit.

Unfortunately, *The Universe in the Rearview Mirror* is somewhat confusingly organized, and readers who do not possess sufficient prior knowledge might become frustrated. In several instances, Goldberg refers to concepts that he has not previously discussed; he gives other explanations repeatedly. For example, he introduces “the elusive dark matter particle” in chapter 9 without so much as mentioning what dark matter is or what evidence we have for it. He uses the Planck length in chapter 6, but he doesn't explain what it is until chapter 10. The graphics that have been produced specifically to accompany the text are well done and helpful, but the book also contains a number of images that are only loosely connected to the text and come without caption or explanation.

Parts of the book are just too superficial to be of much use. For example, Goldberg mentions that cosmic inflation was proposed “to get around the horizon problem,” but readers are not actually told how inflation solves the problem. The evidence he provides for inflation amounts to “we're reasonably certain that it is [correct].” He elaborates on the multiverse and later on the compactified dimensions of M-theory, but he does not connect the two topics. The *Wilkinson Microwave Anisotropy Probe* mission and the cosmic microwave background are mentioned twice before the actual explanation and the

relevant image of the CMB temperature anisotropies appear. Those are just some places that might trip up readers who have little prior knowledge of the subject.

For the most part, Goldberg is to be credited for making his text timely by referring to recent research; in particular, he includes a good summary of the discovery of the Higgs particle and the relevance of that finding (see also page 10 and the article by Joseph Lykken and Maria Spiropulu, page 28, in this issue). He mentions Erik Verlinde's contribution to entropic gravity. That reference—the only one on the topic—appears in a section on the arrow of time, though for all I can tell, the only connection is that both have something to do with entropy. Goldberg presents Max Tegmark's proposed “level” structure of the multiverse. And in the last chapter on physics beyond the standard model we meet Garrett Lisi, the surfer without university affiliation who stunned everybody by proposing a unified theory of matter and gravity—it somehow goes unmentioned in the book that Lisi has a PhD in physics.

The Universe in the Rearview Mirror is valuable for its selection of topics and for inspiring a sense of awe for the relevance and power of symmetries in the laws of nature. But the execution leaves one wanting. Readers who do not have a background in modern physics will learn a great deal more from the didactic approach of Sean Carroll in his books *From Eternity to Here: The Quest for the Ultimate Theory of Time* (Dutton, 2010; reviewed in PHYSICS TODAY, April 2010, page 54) and *The Particle at the End of the Universe: How the Hunt for the Higgs Boson Leads Us to the Edge of a New World* (Dutton, 2012; reviewed in PHYSICS TODAY, July 2013, page 50). Together, those books cover a substantial part of the physics shaped by hidden symmetries.

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What Editors Want

An Author's Guide to Scientific Journal Publishing

Philippa J. Benson and Susan C. Silver
U. Chicago Press, 2013. \$55.00
(192 pp.). ISBN 978-0-226-04313-5

The long-term future of scientific journal publishing is unclear. The rise of mobile devices, the decrease in personal and institutional subscriptions to

journals, the move to open access, funding pressures, and the creation of alternative online methods of disseminating new results are all threatening to undermine the traditional mode of communicating research results through journal articles. And yet the number of submissions and published articles is rising exponentially, mostly because of the growth of science in countries such as China, India, and Brazil. Thus, at least in the near future, the tradition of publishing scientific articles via the peer-review process is likely to continue.

In *What Editors Want: An Author's Guide to Scientific Journal Publishing*, Philippa Benson and Susan Silver acknowledge the rapid changes that are occurring, but they focus on what new authors need to know about the traditional scientific publishing enterprise. The book's greatest impact is likely to be on authors in countries that are just beginning to publish in English-language scientific journals. Indeed, the book is the outgrowth of workshops that Benson and Silver conducted in China.

Because almost all scientific articles are multiauthored, most scientists in countries with a long-standing culture

of scientific research learn much of the information provided in this book from their more senior coauthors. One particular issue that Benson and Silver discuss at length is how to choose the appropriate journal for submission, but that's not as difficult an issue for most physicists as it might be for those, like the authors, in the biological sciences.

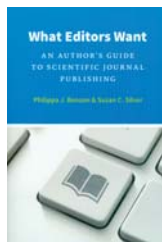
What Editors Want is really two books: The first is advice for new authors; the second is an assortment of opinions—in sidebars throughout the book—by Benson, Silver, and others on issues such as impact factors, open access, the value of peer review, scientific ethics, and the future of journal publishing. The opinions reflect the consensus among most scientists, and they provide some context that would be useful for those just beginning to publish. The authors' advice is all solid, but it is sometimes too general because of the variety of procedures and policies found in different journals.

As Benson and Silver acknowledge, much of what authors need to know can be found from carefully reading the "Information for Authors" section on a journal's website; a substantial part of

What Editors Want is a summary of that kind of information. Also, much of Benson and Silver's advice is on the edge of importance in the sense that editors prefer that article authors follow the journal's instructions. But from my experience as a journal editor, failing to do so usually does not determine whether or not the article will be accepted.

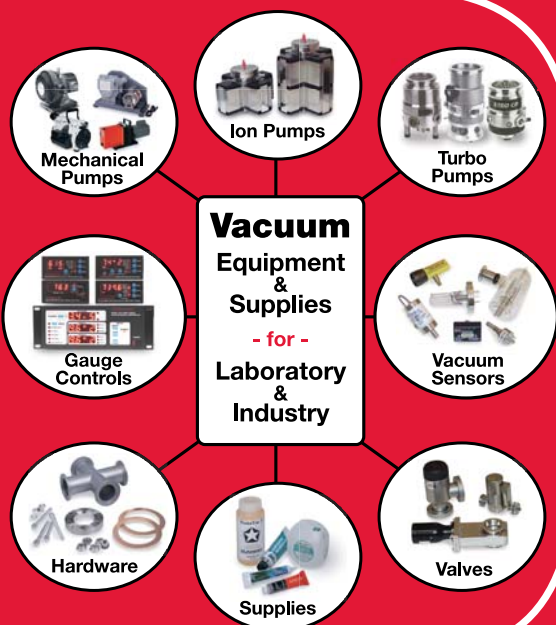
The book would be more useful if it discussed in greater depth how to handle the typical concerns raised by reviewers. Editors rarely make decisions that are inconsistent with those of the reviewers, and thus a more important book would be entitled *What Reviewers Want*. For example, although Benson and Silver discuss what to do when reviewers disagree, they assume that editors will provide some guidance. But my experience is that many editors do not provide much independent judgment. One particular problem not discussed in detail is the tendency of some reviewers to ask authors for further experiments, calculations, or literature reviews, even though such additions are not necessary and sometimes not even relevant. I have been dismayed at how little some editors do to prevent that problem in the review process.

The book's best advice is for article



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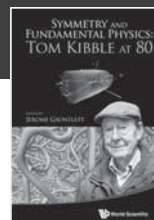


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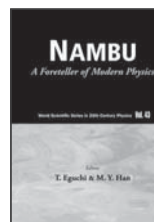
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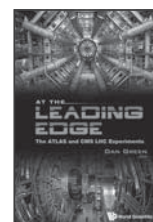
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authors to write professional, objective, and constructive responses to reviewer concerns. Too many authors waste their responses by attacking the reviewers. A piece of advice that I would offer is not in the book: Authors should not try to buttress their claim for correctness or importance by invoking the name of a prestigious scientist who, they say, thinks their work is wonderful. Whenever I saw such a statement, I suspected that an author was arguing from a position of weakness. Sometimes I even checked with the scientist in question and found that the author's claim was exaggerated or not true.

Each chapter of *What Editors Want* ends with a section entitled "The Bottom Line." For me, the bottom line is that the information and advice in this book are good, not surprising, and not difficult to find elsewhere. But for a new author, it will be convenient to have all that information in one place.

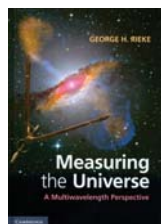
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Measuring the Universe

A Multiwavelength Perspective

George H. Rieke
Cambridge U. Press, 2012. \$75.00
(343 pp.). ISBN 978-0-521-76229-8

Anyone who has tried to design a course to cover the gamut of experimental astronomy comes to a realization: The subject is vast. A complete text would include methods to observe the entire electromagnetic spectrum from



radio waves to gamma rays, not to mention cosmic rays, neutrinos, gravity waves, and the dark sector. The technologies involved are radically different depending on whether your instrument is in orbit above Earth, on a high-altitude site, or deep below Earth's ice, ocean, or land. Entire textbooks are devoted to each of those observational perspectives, and even then they only scratch the surface. Yet there is a clear need for texts that introduce experimental astronomy to students and no shortage of books that claim to do the job.

George Rieke's *Measuring the Universe: A Multiwavelength Perspective* joins those attempts, and in only 340 pages it largely succeeds in providing a

solid introduction to the field. Rieke, deputy director of the Steward Observatory at the University of Arizona, has had a long and distinguished career working with IR instrumentation and telescopes and is well qualified to tackle the subject. Like other introductory texts—for example, C. R. Kitchin's *Astrophysical Techniques* (5th edition, CRC Press, 2008)—most of the book is devoted to fundamental principles in the optical-to-radio domain, with only brief mentions of high-energy astrophysics (20 pages), and cosmic rays, neutrinos, and gravity waves (5 pages total). That imbalance reflects the fact that most astronomers work with data obtained from optical, IR, and radio telescopes.

The chapter on detectors is excellent and its coverage is more detailed than for most other topics in the book; it even includes electrical diagrams to illustrate how charge is detected and recorded. I found the high level of detail appropriate because astronomical instruments are designed backwards from the detector. For that reason, I would have appreciated even more expert insight, such as on how small pixels can be made, how the dynamical range and noise limit are set for a given detector technology, and how detectors are likely to evolve in the future.

An introductory text such as this cannot provide students with the ability to start designing instruments or telescopes. That would require a more extensive introduction to optical and mechanical design. But *Measuring the Universe* missed opportunities to engage readers with important questions: What are the fundamental differences between forming an image—optical or radio—with focal-plane optics and with interferometry? Is it sufficient to have intensity information without phase information? Why are radio images never as good as optical images?

In certain respects, the book looks forward to a future era of observational astronomy. The most up-to-the-minute topics are arguably adaptive optics and high-contrast imaging, which Rieke largely succeeds at discussing in chapter 7. He also spends a few pages on the convoluted subject of multi-object integral field spectroscopy, a major topic in modern astronomical instrumentation.

But given that 10 pages are devoted to polarimetry, a niche topic in astronomy, one feels shortchanged that more space was not devoted to new enabling technologies. There is no mention of space-based instruments, such as the *Hubble Space Telescope's* Cosmic Origins

Spectrograph; of ultrahigh stability spectrographs for exoplanet searches; or of noise mitigation technology to suppress, for example, spectral lines of hydroxide. Nor does the book discuss the revolutionary developments in interferometry made possible by photonics. (See the article on astrophotonics that I coauthored with Pierre Kern, *PHYSICS TODAY*, May 2012, page 31.) I was impressed that Rieke mentions the optical vortex chronograph, but he missed an opportunity to discuss how photons have orbital angular momentum in addition to spin angular momentum.

Measuring the Universe could have made more use of supplementary material and appendices. For example, chapter 5 introduces the optical photometric system but does not define wavebands across the full spectrum. They could have been listed in like manner as in Martin V. Zombeck's *Handbook of Space Astronomy and Astrophysics* (3rd edition, Cambridge University Press, 2006). *Measuring the Universe* also does not include a lot of Web resources. Many optical and radio simulators are available online that could educate interested students, and several other websites are devoted to introductory data analysis.

Overall, *Measuring the Universe* provides a backbone of understanding to build on. Among its major strengths are its spare and uncluttered style, its good use of equations and figures, and its problem sets. I would almost certainly use it as the basis of a course for final-year undergraduates or for graduate students, but with extensive supplementary material for some of the chapters.

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