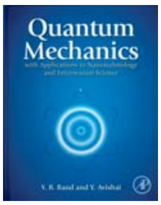
they are presenting. Face to face, Moffat must have made them very uncomfortable, but in the book, he portrays them warmly. Those often invisible analysts shine in his narration.

It is a thrill to see the Higgs data come into focus. It is now clear that the new particle is a scalar (spinless) boson and, at the very least, an important part of the mystery of elementary particle masses. Both books state clearly many questions that remain open. Future detailed measurements of the Higgs boson's properties will give us new information to address those questions. The saga of the Higgs boson is just beginning.

Quantum Mechanics with Applications to Nanotechnology and Information Science

Yehuda B. Band and Yshai Avishai
Academic Press, 2013. $126.00
(971 pp.). ISBN 978-0-444-53786-7

As we get better at controlling materials and fabricating devices on the atomic scale, we'll need more "quantum engineers" to tackle the inherent challenges of technologies that exploit quantum effects. Although many modern devices rely on quantum mechanics in one way or another—for example, on population inversion in lasers or electron tunneling in transistors—most of those quantum effects can be described semiclassically and are accessible to engineers who have taken the standard courses on solid-state devices.



The next few decades, however, will see the emergence of new technologies—quantum communication links, quantum computers, and quantum sensors, for instance—that are based on the fundamentally quantum properties of coherence and correlations. Developing those technologies will require a deep understanding of quantum physics, which is typically lacking in engineering curricula. Moreover, the subject's standard presentation is not well suited to engineering students, who typically prefer to learn fundamentals through application examples rather than in mathematical abstraction.

Based on its title, *Quantum Mechanics with Applications to Nanotechnology and Information Science* seems to address a timely need. And since I am planning a new course in quantum engineering, I jumped at the opportunity to review Yehuda Band and Yshai Avishai's new book. I was shocked by its scope. In more than 950 pages, it develops nonrelativistic quantum mechanics from first principles and provides an overview of condensed-matter physics, atomic and molecular physics, quantum chemistry, and several modern topics such as low-dimensional materials, spintronics, quantum dynamics and dissipation, and quantum information science. The authors suggest that the book can serve as the text for at least seven different courses, including undergraduate or graduate quantum mechanics, solid-state physics, quantum chemistry, and quantum information. Indeed, if one is looking for a single textbook to provide a solid foundation in quantum theory and an overview of modern research topics, Band and Avishai's tome is an excellent choice.

In covering so much material, however, the authors have sacrificed a sense of direction and purpose. Especially for undergraduate courses, I prefer texts that stress intuitive understanding, even at the expense of completeness. A clear gem in that regard is David Griffiths's *Introduction to Quantum Mechanics* (2nd ed., Pearson Prentice Hall, 2004), which carefully guides students new to the subject through many of its conceptual and mathematical roadblocks. A decade after learning undergraduate quantum mechanics via Griffiths, I still return to the book for a reminder of those intuitive points. Although undergraduates using Band and Avishai's text will encounter a good presentation of the typical course material, they will probably be overwhelmed by the book's scope.

But such a comprehensive reference is desirable for a graduate course, even if the course won't cover all of its material. Students embarking on a research career need an early encounter with a broad range of related topics so they can teach themselves more when needed. So I can see the potential of this text for graduate quantum mechanics courses with a bent toward solid-state physics and quantum information processing. Due to the book's overall lean toward breadth over depth, however, some topics may need to be supplemented by additional sources. Where that's needed, Band and Avishai provide many good suggestions for further reading.

Unfortunately, I think that contrary to the title's suggestion, the text is unlikely to be embraced by students in engineering and computer science. It is highly physics oriented with a decidedly theoretical bent. For example, although it discusses semiconductor materials and briefly overviews p–n junctions, it barely mentions optoelectronics, even though the theoretical framework for understanding such devices is covered in detail. And the discussion on applications of quantum information theory and quantum dynamics—for example, quantum computer architectures and techniques to extend quantum coherence—feels scanty in comparison to the more thorough presentation on the theory itself. Also, the problems are too few, just one or two for each section, and do not cater well to an engineering audience, since they are mostly of the "verify that . . ." or "derive . . ." nature.

On the whole, I think *Quantum Mechanics with Applications to Nanotechnology and Information Science* will be of greatest interest to physics students who already have some exposure to quantum mechanics. It would work well as the textbook for a more specialized survey of topics in modern quantum physics alongside established texts dedicated to the fundamentals. Through its sheer scope, it will be a useful one-stop reference for quantum researchers, particularly in condensed-matter physics and quantum information science. I will buy a copy for my lab and point students to it when they have questions—on just about anything.

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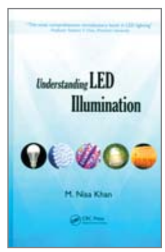
Understanding LED Illumination

M. Nisa Khan
CRC Press/Taylor & Francis, 2013.
$69.95 (272 pp.).
ISBN 978-1-4665-0772-2

Many publications about LED lighting are highly focused on the physics of the light source, but precious few actually take a laboratory-to-marketplace perspective and examine how scientific innovations in LED technology relate to the engineering world and the practice of lighting. *Understanding LED Illumination* is one of those rare resources that address the engineering of LED light-



ing as well as the challenges and opportunities faced by lighting designers working in a rapidly evolving marketplace. Author Nisa Khan's concise and unique perspective brings together key issues related to both the evolution and practice of next-generation lighting.

Khan, an independent R&D consultant, has an extensive background in solid-state lighting technology. She also has a profound understanding of the SSL industry and the technology's commercial applications. Her impressive research experience includes work at Bell Labs followed by a career that focused on solid-state technology development.

Understanding LED Illumination begins with a concise introduction to lighting metrics and design. It quickly introduces the technologies involved and the basic science behind LED lighting, and it offers a brief analysis of the current and future prospects of the LED industry. After that, it progresses nicely into devices and the materials and production issues associated with them. Khan then weaves that information into applications, introducing lighting design and the process of moving from conventional or "legacy" lighting to SSL.

Lighting designers and engineers will find the significant amount of material on measurements and related processes quite useful. The author includes a detailed discussion of LED photometrics, including the color rendering index (CRI) and other established standards for measuring color characteristics; with the advent of SSL, that topic is one of current industry debate. I was particularly impressed with the author's ability to explain some of the nuances of LED technology in a straightforward manner that will be easily understood by those newly acquainted with the industry.

Understanding LED Illumination would make an excellent textbook for teaching illumination engineering, architectural engineering, and other subjects related to next-generation lighting. The monograph is extremely well organized and its tables, charts, diagrams, and photographs effectively reinforce the concepts described by the text. It can also serve as a ready reference for those involved in the design, engineering, and marketing of SSL. I recommend it to anyone interested in SSL lighting, including, in particular, my lighting design students and the industry partners I work with as director of the California Lighting Technology Center at the University of California, Davis. I also commend the book to the fast-growing cadre of technicians and engineers entering the SSL marketplace. Many of them are coming from peripheral or distant fields and could use this type of concise yet technically rich material.

I have only a couple of criticisms for Khan's otherwise excellent work. I would have liked to see the illustrations complemented by case studies of actual lighting retrofits or installations for various applications. I also would have liked to see more of the photos and diagrams enhanced with color, particularly given the subject material. The investment in more colorful graphics would be returned with an even more broadly appealing book.

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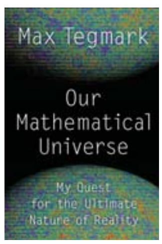
Our Mathematical Universe

My Quest for the Ultimate Nature of Reality

Max Tegmark
Knopf, 2014. $30.00 (432 pp.).
ISBN 978-0-307-59980-3

Theoretical physicist Max Tegmark's *Our Mathematical Universe: My Quest for the Ultimate Nature of Reality* is sometimes delightful but often annoying, sometimes fascinating but other times frustrating.

The author does present an engaging and informative overview of some profound aspects of cosmology—in particular, as they pertain to the origin and evolution of the universe. The figures are extremely well done and informative. I don't think I have seen inflation explained more clearly for a general audience.



The presentation is informal and sometimes charming. But Tegmark, a professor at MIT, can be a little overdramatic, and he takes many side trips to relate stories of his life and career. It's a matter of taste, of course, but after a while I found those two features distracting. A shorter, more straightforward book might not have been a bad thing.

Tegmark writes that the purpose of his book is to convince readers that the universe is a mathematical construct. To be clear, he is not merely discussing the use of mathematics in modeling physical phenomena, nor is he speculating about the "unreasonable effectiveness"