

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
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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 non-relativistic 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 un-

likely 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.

Lee Bassett

University of Pennsylvania
Philadelphia

Understanding LED Illumination

M. Nisa Khan
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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-

