

medium practically opaque at distances beyond a few hundred light years, about 1/100 of the way to the center of our galaxy.

As Martin Barstow and Jay Holberg explain in the introductory chapters of *Extreme Ultraviolet Astronomy*, the pioneers of EUV astronomy challenged the accepted wisdom that EUV radiation was really unobservable and went on to open yet another window for astronomical discovery. Peering through the window, they discovered that local interstellar space is more transparent than previously thought. Their observations of active stars and nearby white dwarfs have provided new insights into stellar evolution and the ultimate fate of stars like our Sun. Both Barstow and Holberg played key roles in the development of EUV astronomy through their involvement with the wide field camera (WFC) on the *ROSAT* satellite and the UV spectrometer on the *Voyager* spacecraft.

With a readable blend of history, experimental technique, and observational results in chapters 1 and 2, the authors provide an in-depth introduction to the field, suitable for an advanced graduate student or professional astronomer. Chapters 3 and 4 cover major results from the *ROSAT*/WFC and *Extreme Ultraviolet Explorer (EUVE)* all-sky surveys, and subsequent chapters are devoted to *EUVE* spectroscopic observations of stellar winds, stellar coronae, white dwarfs, cataclysmic variables, active galactic nuclei, and the local interstellar medium. The book's final chapter gives Barstow and Holberg's vision of the future of EUV astronomy. The authors highlight—unintentionally—the youth and difficulty of EUV astronomy by including a slim appendix that contains all 1100 sources of EUV radiation so far cataloged.

Most EUV radiation sources detected with *ROSAT* and *EUVE* lie within the irregularly shaped, highly ionized “local bubble” that surrounds our solar system. Perhaps the major accomplishment of EUV astronomy has been to discern the structure of that bubble, understand the processes by which the gas within it is ionized, and by extension, improve our understanding of the rest of the interstellar medium in the Milky Way. *EUVE* observations of objects inside the bubble enabled astronomers to measure the surface composition of white dwarfs and provided the first accurate temperature measurements of the hottest of them. In chapters 4–10, Barstow and Holberg provide a wealth of illustrations, tables, and references covering all facets of those *EUVE* results. A

major shortcoming in the presentation, however, is the authors' narrow and nearly exclusive focus on observational details. None of the chapters makes more than a perfunctory attempt to establish the larger meaning of the results in the wider astronomical arena. For example, the temperatures of white dwarfs and the composition of their atmospheres provide a key link in our understanding of the late stages of stellar evolution, but little more than a few pages is devoted to discussing that link. Broader views would make the volume more interesting and attractive to new students and nonspecialists.

In 2001, *EUVE* ended its operations, and a space observatory dedicated to EUV observations no longer exists. However, important portions of the EUV band can be accessed with the *Far Ultraviolet Spectroscopic Explorer* and the *Chandra X-ray Observatory*. The authors mention neither, although both were launched in 1999 and the current capabilities of those satellites enable many of the same studies of white dwarfs, stellar coronae, cataclysmic variables, and active galactic nuclei as were done with *EUVE*.

When the authors consider the future of EUV astronomy, their vision suffers from the same narrow focus as their discussion of the past. Rather than describing a broad-based scientific case for a future EUV observatory, they emphasize the usual technical requirements of greater sensitivity and higher spectral resolution. Nevertheless, I recommend *Extreme Ultraviolet Astronomy* as a solid introduction to the history and practice of the field.

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Atomic and Electronic Structure of Solids

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Quantum Theory of Solids

Eoin O'Reilly

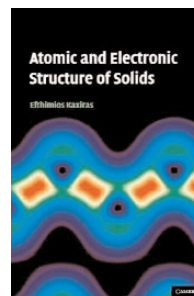
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Writing a textbook on modern solid-state physics is akin to writing a travel

guide for a vast country with a rich landscape, diverse peoples, and long history. Although it is impossible to be comprehensive, much less definitive, a good book can introduce the subject, give a sound grounding in fundamentals, open a window to current research and, most important, stimulate the interest of the reader toward further study. *Quantum Theory of Solids* by Eoin O'Reilly and *Atomic and Electronic Structure of Solids* by Efthimios Kaxiras achieve these goals in two very different ways.

O'Reilly's book purposefully guides the reader along a carefully chosen itinerary based on the physics of a quantum mechanical “particle-in-a-box.” The author cleverly casts progressively complex topics in this form, starting with bonding in simple molecules and semiconductors, going on to band structure of solids via the one-dimensional Kronig–Penney model, and ending in quantum wells, wires, and dots. This organizing principle makes the book easy to use for a course or for self-study. The problems that O'Reilly provides are sound pedagogical exercises directly tied to the text. The review and reinforcement of basic quantum mechanical results and their relation to the properties of real systems are undoubtedly valuable for advanced undergraduate students and beginning graduate students.

Kaxiras chooses a quite different approach in *Atomic and Electronic Structure of Solids*. The book begins with an overview of crystal structures of the elements, which introduces many physical concepts that are explained and more fully discussed later. Succeeding chapters systematically develop the single-particle approximation in periodic potentials, the band structure of representative solids and related topics, and lattice dynamics.



The emphasis of Kaxiras's book is more on concepts and their mathematical expression than on the application to individual materials. With a few exceptions, the figures are based on data from three elements (aluminum, silver, and silicon)

or show general behavior rather than data for a particular system. The measured, elegant prose is reminiscent of classic texts such as John M. Ziman's *Principles of the Theory of*

Solids (Cambridge U. Press, 1964) and Joseph Callaway's *Quantum Theory of the Solid State* (Academic Press, 1974).

In Kaxiras's book, exercises, some quite nontrivial, are included at the end of each chapter. Extensive appendixes review the prerequisite quantum mechanics, statistical mechanics, and electromagnetic and elasticity theory and make the book relatively self-contained. However, this book demands a much higher-level sophistication and attention on the part of the reader. While it is thus suitable as a text for a graduate-level lecture course, it is also valuable as a reference book.

O'Reilly's presentation in *Quantum Theory of Solids* is more elementary, which is appropriate for an intended

audience that includes advanced undergraduates. The book greatly relies on one-dimensional and classical analogs. In a few cases, the author oversimplifies. This makes, for example, the

discussion of the effective mass approximation and envelope function rather confusing. The simple pictures, however, generally work well. O'Reilly includes information only as necessary to the subject under discussion. For example, the only Bravais lattices he describes are face-centered cubic and body-centered cubic, he states Bloch's theorem without proof, and he does not cover lattice dynamics.

In Kaxiras's book, however, one can find at least some information on nearly any topic, sometimes in a refreshingly unusual place. For instance, most of semiconductor physics is presented in the chapter on point defects, whereas cohesion of solids and optical and transport properties are combined in a chapter on applications of band theory.

Both books have rather standard sections on magnetism and superconductivity, apparently included for completeness rather than for their pertinence to the individual vision of each book. Each book also offers direct access to selected topics of current research interest. O'Reilly includes, as the natural culmination of the development of the particle-in-a-box principle, an interesting and informative chapter on selected topics in low-dimensional semiconductor structures. Kaxiras devotes the en-

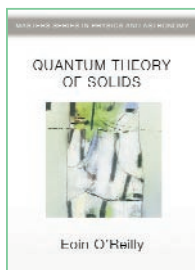
tire second half of his book to the physics of defects. Building on the foundation laid in part 1, it is an elementary, systematic presentation of the physics of point defects, dislocations and other line defects, and surfaces and heterostructures. Essentially a "book within a book," part 2 also includes an introduction to non-periodic solids, quasicrystals, clusters, and macromolecules. It is an invaluable background resource for students and researchers who want to study the recent literature.

Atomic and Electronic Structure of

Solids and Quantum Theory of Solids each have a unique vision and voice; the two books highlight the diversity of possible approaches to presenting the subject and further broaden the options available in solid-state physics textbooks. One can hope that, with the appropriate book, the experiences of each new visitor to the land of solid-state physics will be such as to encourage a deep and lasting interest in this subject.

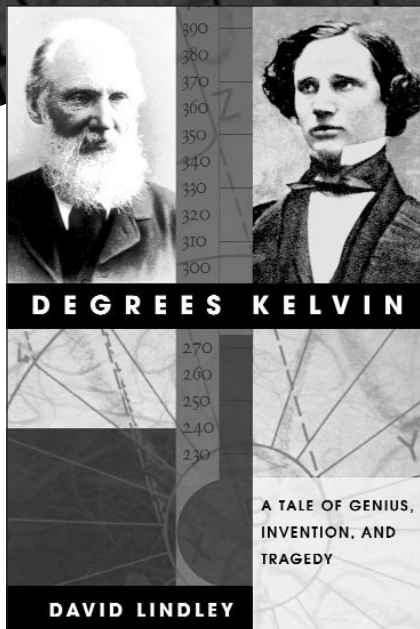
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