in other areas are quite valuable, helping to set the research problems related to AGN in a broader context. For example, in chapter 8, section 6.1, the heating of the solar corona is compared to the heating of plasma in the vicinity of an accretion disk. Detail about the precise way in which heating occurs is lacking in both cases, serving as an important reminder that it is not surprising if all is not clear about processes occurring in the vicinity of a massive, spinning, accreting, and possibly magnetized black hole.

The book will be particularly useful in educating young researchers, because of the style of presentation Krolik has adopted: a style illustrative of the general approaches and techniques used by astrophysicists. Observations are presented; a model is then constructed to explain the observations and is tested with additional observations. The limitations of the model and observations are often discussed. Also discussed is the fact that there may be a broad range of processes and observational consequences. The timescales over which different processes operate are often compared, which is always an important point when dealing with astrophysical processes. The book gives a sense of how complex and interrelated many processes can be.

Overall, Krolik's book provides a broad and thorough review of the standard model for AGN, including observational information and theoretical modeling. It will provide graduate and advanced undergraduate students with an excellent introduction to the field.

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Properties of Materials

Mary Anne White
Oxford U. P., New York, 1999.
334 pp. $45.00 pb
ISBN 0-19-511331-4

Materials science fuels the latest technology, from the "Intel inside" to the flat panel display outside. Recent Nobel prizes in physics—for high-T_c superconductivity, for the integer and fractional quantum Hall effects—stand on the shoulders of materials advances. Yet, the physics curriculum, for majors and nonmajors alike, usually pays little heed to the principles and practices of materials science.

In the last several years, a spate of materials science books has appeared, offering alternatives or supplements to such mainline engineering texts as William D. Callister Jr's *Materials Science and Engineering, An Introduction* (Wiley, 4th ed., 1997). The newer texts include Stephen Sass's *The Substance of Civilization* (Arcade, 1998), Ivan Amato's *Stuff* (Harper Collins, 1997), B. S. Chandrasekhar's *Why Things Are the Way They Are* (Cambridge U. P, 1998), and, now, Mary Anne White's *Properties of Materials*. White's book lies the closest to a traditional text; it assumes a technical orientation on the part of the student and includes mathematics at the level of early calculus. It does not match the intimacy and eloquence of Sass's work or the eclectic portraiture of Amato's, but it does provide a solid introduction to materials science.

White, a professor of chemistry, physics, and materials science at Canada's Dalhousie University, has employed an unorthodox organizing principle for her material. She orders sections in the book by the physical properties of matter: optical, thermal, electrical, magnetic, mechanical. This scheme permits the student to jump right into a healthy mix of science and phenomenology, with a sprinkling of intriguing technological applications. The text is enlivened by vignettes on familiar technologies—lasers, xerography, space-shuttle tiles, carbon-monoxide detectors—and by tutorials that guide students to explore the underpinnings of materials design and application. White's prose is clear and straightforward and is aided by well-chosen line drawings. Photographs are few but fine, including a memorable series of a shape-memory alloy sculpture at different temperatures. Notable as well are the useful compilations of "further reading" at the end of each chapter, including pertinent magazine articles from such popular publications as *Scientific American* and *New Scientist*.

White's unusual format has some disadvantages. For one, it leads to artificial designations, such as the characterization of phase equilibria as a "thermal property." More serious is the short shrift given to the central paradigm of materials science: the interrelationship between processing, structure, and properties. Industries rise and fall on the ability of materials scientists and engineers to translate insights about microstructural variations, which arise from different processing techniques, into tailored materials having specific properties and performance. Steel wires with elongated grains make fine clothes hangers, but equiaxed grains lead to crumpled pants!

As a physicist, I miss the first-principles approach to the subject, more in tune with a book like Chandrasekhar's, which uses the rules of quantum mechanics to show how to build atoms from electrons, organize them into the periodic table and form solids from the elements. My engineering colleagues probably would decry the lack in White of a detailed discussion of the different types of steel or of the myriad strategies for creating composites—topics found in the 800 pages of Callister. Yet, I think White has struck an effective compromise in *Properties of Materials*, combining, in an approachable text of 300 pages, accurate science, a flavor of engineering, and the excitement of a burgeoning field.

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Accelerator Physics

S. Y. Lee
World Scientific, River Edge, N.J., 1999. 491 pp. $64.00 hc ($32.00 pb) ISBN 981-02-3709-X hc (981-02-3710-3 pb)

Shyh Yuan Lee's *Accelerator Physics* textbook is based on an accelerator physics graduate course that Lee teaches at Indiana University and two courses he taught at the US Particle Accelerator School. It is intended as an introductory text for students planning to do thesis research in accelerator physics; as such it covers a wide range of topics that Lee divides into four chapters.

A short introductory chapter provides a good history of the field, along with typical layouts of accelerators and some of their applications. In the second chapter, the author provides a thorough treatment of the transverse motion of particles in an accelerator, using a Hamiltonian approach. While this appears at first sight to be more formal than necessary, it does create a good basis for the later discussion of the stability of particle motion in accelerators. Basic collective effects and nonlinear resonances are discussed at the end of the second chapter. The third chapter applies the same Hamiltonian approach to synchrotron motion. The interaction of the radio-frequency accelerating systems with the particle beam, and the major longitudinal collective instabilities, are treated in detail. The last section of this chapter provides a good overview of particle motion in linear accelerators.

The physics of electron storage rings is the topic of the fourth chapter, which emphasizes storage rings used to provide synchrotron radiation. For modern sources, the experiments that use such radiation often require very high-brightness x-ray beams from insertion devices placed in the storage ring lattice. After introducing the radiation physics of electrons moving in magnetic fields, Lee discusses the damping of the synchrotron motion and betatron motion—along with radiation excitation of this motion due to quantum effects. The last section in this chapter discusses lattices that provide very low emittance electron beams, which are essential to the generation of high-brightness x-ray beams. Missing from this chapter is a detailed discussion of beam–beam effects in e^+e^- colliders.

The exercises distributed throughout the book are an important supplement to the reading and serve to reinforce the material being covered. The description of experimental measurements on beams in operating accelerators, especially the transition to chaotic behavior, provides an important confirmation of the sometimes tedious equations describing the phenomena. On the negative side, there is little discussion of the parameters of accelerators that are driven by the needs of nuclear and particle physicists—higher energy, luminosity, and beam intensity, to name a few.

I would recommend this text to a graduate student wishing to do thesis research in accelerator physics. The large number of formulas and the excellent table of contents and index make the book a very useful addition to the library of a scientist or engineer already in the field.

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X-Ray Scattering from Soft-Matter Thin Films: Materials Science and Basic Research

Metin Tolan
Springer-Verlag, New York, 1999. 197 pp. $129.00 hc
ISBN 3-540-65182-9

The importance of x-ray scattering techniques for elucidating the structure of condensed matter is evident from their ubiquitous application to a diverse variety of materials. Technical and theoretical advances in x-ray scattering in recent years have been particularly noteworthy in the arena of so-called soft materials, which include polymers, molecular crystals, and liquid crystals. Considerable improvements in x-ray sources, optics, and detectors are making x-ray scattering methods more readily available, while improved understanding of scattering principles is helping to reveal the rather complex architectures characteristic of soft materials. The impact of these advances has been particularly significant for soft-matter thin films, the subject of Metin Tolan's *X-Ray Scattering from Soft-Matter Thin Films*.

Tolan's book primarily addresses the techniques of x-ray reflectivity and off-specular and coherent x-ray scattering. Grazing-incidence diffraction is not described, although Tolan does refer the reader to several key reviews on the topic. (Inclusion of this technique, which is increasingly being used to measure Bragg scattering from ordered Langmuir monolayers, would have made the book more comprehensive.)

Tolan's overall presentation is exceptionally well organized, with experimental methods and examples discussed following a description of the underlying theory. The book's six principal chapters cover three topics: reflectivity of x rays from surfaces, reflectivity experiments, and advanced analysis techniques; statistical description of interfaces and off-specular scattering; and x-ray scattering with coherent radiation (this last topic is treated rather briefly since it has been limited by the requirement for high-brilliance synchrotron sources). Tolan appropriately reserves a description of the Hilbert phase and its relationship to the phase of the structure factor for an appendix.

The strength of this book is the coupling of expert descriptions of scattering principles with carefully chosen examples of thin films, with clear comparisons of theory and experimental data. The examples will make the text accessible and more manageable for beginning practitioners, although the book will best serve readers who are already comfortable with the basic principles of scattering theory. (The introductory material in chapter 2 is beyond the level of those new to x-ray scattering.)

Tolan systematically provides brief explanations of the technological and fundamental issues pertaining to each example, weaving together theories that describe the structure and properties of soft-matter thin films and the scattering methods that provide experimental verification of these theories. Particularly well described are the application of reflectivity and off-specular reflectance to the characterization of capillary waves in liquid and polymer films, the influence of experimental parameters such as film thickness and substrate, and the correspondence of these factors to theory. Several illustrative examples of block copolymer films demonstrate the utility of reflectivity and nonspecular scattering in characterizing surface structure, both lateral and vertical, with respect to conformal and anticonformal polymer film structures on patterned substrates, phase segregation, and island formation at film surfaces.

Throughout the text, Tolan points out the advantages and disadvantages inherent in scattering methods. For example, the phase problem is addressed in detail, accompanied by an excellent description of the limits this problem imposes on the structure of solutions. An equally good description of the experimental parameters and sample characteristics that enable users to circumvent this problem is included. Tolan also pays considerable attention, in a chapter dedicated to the statistical description of interfaces, to the influence of roughness on scattering, providing a thorough explanation of the correlation functions for describing roughness. The book is well referenced and clearly conveys materials systems and behavior that are amenable to characterization by thin-film scattering techniques. It should be an asset to any research group beginning, or currently involved in, the characterization of thin films by x-ray diffraction.

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Annual Review of Earth and Planetary Sciences, Vol. 27. R. Jeanloz, A. L. Albee, K. C. Burke, eds. Annual Reviews,