1960), Ugo Fano and Guilio Racah (*Irreducible Tensorial Sets*, Academic, 1959), Brian R. Judd (*Operator Techniques in Atomic Spectroscopy*, McGraw-Hill, 1963) and, more recently Richard N. Zare (*Angular Momentum*, Wiley, 1988). These have served to educate several generations of physicists and chemists.

The basic goal of these books is threefold: 1) to establish the nature of the operators and wavefunctions as necessitated by rotational invariance; 2) to introduce the Clebsch–Gordan machinery of angular momentum coupling, the algebra of angular momentum "recouplings" associated with the names of Eugene Wigner and Racah; and finally, 3) to define (spherical) tensor operators and to then prove the justly celebrated Wigner–Eckart theorem allowing expression of the matrix elements of spherical tensors in terms of an irreducible tensorial part and a Clebsch–Gordan coefficient.

These form the canon of angular momentum theory. These texts not only introduce the canonical materials but also carry out detailed analysis of elementary applications, so that the novice learns the fundamentals and the beginnings of applications as well. Later developments, in particular the introduction of diagrammatic techniques and the recognition of the isomorphism of Feynman and angular-momentum diagrams, have also resulted in excellent and comprehensive texts. These are texts that highlight the work of A. P. Yutsis, J. B. Levinson and V. V. Vanagas (*Mathematical Apparatus of the Theory of Angular Momentum*, Israel Program for Scientific Translation, 1962) and Judd (*Second Quantization and Atomic Spectroscopy*, Johns Hopkins U. P., 1967).

Symmetries in Quantum Physics, by the distinguished University of Chicago emeritus professor of physics and Enrico Fermi protégé, Ugo Fano, and one of his own highly successful students, Ravi Rau, of Louisiana State University, clearly comes out of the traditions set by these earlier texts. But it attempts to fill a rather different and timely need: to embed the above canon into a rather broader and more general framework of continuous symmetry and representations of tensorial operators. Thus, representations of the special unitary group SU(2) are introduced early on and are consistently used and developed as "being central to the study of all symmetries under rotations and reflections."

Rather than being simply an abstract development of Lie groups, *Symmetries in Quantum Physics* is also an introduction to the angular-momentum canon itself. As this is done at a rather higher level than is the case in the more traditional texts, and with many fewer detailed physical examples, my suspicion is that it will appeal most to students who have at least seen, albeit briefly, the basic elements of the canon in a first-year graduate course in quantum mechanics. The advantage of this high road is that, by the end of the text, not only are applications of representations of the group SO(4) to the hydrogen atom placed in a familiar framework, but modern uses of noncompact and noninvariance groups are also introduced as an outgrowth of the canonical concepts. Applications of the latter have allowed development of novel classification schemes for strongly coupled states of two-electron systems.

The broader view taken by this clearly written and well-organized book is a welcome development, but one which, perhaps necessarily, still falls short of being an introduction to "symmetries in quantum physics." Thus, for example, the general idea that invariances always imply conservation laws (Noether's theorem) is not made explicit in the text. Nor is there discussion of gauge and broken symmetries, or even of modern applications of symmetry to polyatomic molecular rotational spectra. Thus, atomic theorists and experimenters, who will probably form the major audience for the book, will still need to look to the condensed matter physics literature to find discussions of symmetry issues essential to understanding of the newly exhibited gaseous Bose condensate.

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Principles of Lightwave Communications

Göran Einarsson
Wiley, New York, 1996. 355 pp.
$79.65 hc ($39.95 pb)
ISBN 0-471-95297-4
(0-471-95298-2 pb)

The principles of optical fiber transmission are so well established and books on lightwave communications are so abundant that there seems little room for further texts. *Principles of Lightwave Communications*, however, adds value by its focus on analysis and theory relevant to an area of continuing research interest, namely system optimization. It is particularly interesting for its use of a modern communication-theory approach in its coverage of optical fiber communications. It is thus appropriate for its intended audience of postgraduates and practicing engineers. Göran Einarsson's book is a timely addition to the literature, providing a reference for those working on the modeling of lightwave systems, particularly in the areas of detector and receiver analysis.

Einarsson's first chapter is an interesting and readable review of fiber development. Paradoxically, it seems out of place when seen within the book as a whole, and I cannot help but feel that it will be little read by the intended audience. Chapters two and three touch briefly on the propagation of light within fibers, and are presumably included for completeness, to set the scene or to remind readers of areas with which they should already be familiar.

The fourth chapter marks the beginning of the major focus of the book. It addresses lucidly the area of dispersion, which is key to future high-speed, long-distance communications. There is a brief mention of solitons and fiber attenuation, but it is to be assumed that fuller coverage would have made the book too long.

The next three chapters take the reader into the author's areas of expertise: optical detection, optical receivers and optical amplifiers. These presentations soon surpass the standard levels of background information concerning, for example, quantum limits, and deal with such key topics as intersymbol interference and mean-square error receivers. It is within this section's many pages, packed with useful techniques not often found in one place, that this book comes into its own. The introduction to methods such as the saddlepoint approximation for moment-generating functions, and the use of numerous examples backed up by a good selection of references, make an excellent starting point for those interested in the analysis of optical receivers and amplifiers. There is also specific coverage of the limits to the gaussian approximation, in particular for the setting of optimum decision levels.

Although the framework of these chapters is intensity modulation direct detection, as befits this major area of application consideration is also given to other specialized or up-and-coming areas. These include analog communications and subjects linked to optical preamplification, such as pulse position modulation and shift keying techniques, which have been the focus of concentrated activity in recent years. Coherent communication merits—and gets—a chapter of its own, covering heterodyne systems and providing a balanced view of the field at present.

Overall, I would recommend this

book as a specialized text for those working on the receiver or amplifier side of system design and analysis.

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Quantum Theory of Matter: A Novel Introduction

Antonis Modinos
Wiley, New York, 1996.
356 pp. $79.95 hc ($32.95 pb)
ISBN 0-471-96363-1 hc
(0-471-96364-X pb)

Many of us, myself included, have taught one-semester physics courses for engineers (subsequent to the introductory sequence) in which we have tried to cover all of "modern physics." Typically, one spends a substantial part of the course on basics of quantum mechanics, then applies it to atomic, nuclear and elementary-particle topics, leaving little time for condensed matter physics, which is arguably of greatest interest to these students. The novelty of the approach taken by Antonis Modinos in *Quantum Theory of Matter* is to bury most of the formal development of quantum theory in his appendix B, thereby allowing him to reach chapter 2, "Atoms," after just 45 pages. Chapter 3, "Molecules," serves as a modest bridge to chapter 4, "Solids," which contains nearly half the body of the text. He mentions neither nuclei nor quarks.

The unusual flavor of the text stems from the author's experiences teaching related courses at the University of Salford in the UK and the National Technical University of Athens, Greece. Modinos comments with pride, in the preface, that the book's four chapters contain no differential equations and can be read with just "rudiments of calculus." Appendix B, which supplies the "mathematical backbone of the theory," is longer than chapter 1! We are left, then, with a spineless treatment of quantum physics in which important ideas and solutions to standard potentials are dished up to the reader one after the other. While the preface suggests that readers will thus gain a better overall view of the quantum world, their understanding of these ideas will be superficial and ill-grounded if they have failed to master appendix B. In fact, over half of the dozen-plus problems at the end of chapter 1 require appendix B (though in subsequent chapters, this fraction decreases).

Some ideas that might have been exciting when the author was developing his course now seem rather dated. An example is John Slater's Xα method for computing the electronic structure of atoms or clusters. While Modinos mentions different ways to pick α, he does not explore the physics behind the various choices. Band structure and self-consistency are described in nice detail (although—not surprisingly by now—Bloch's theorem is just handed to the reader); however, there is no mention of current total-energy calculations. To suggest an up-to-date outlook, Modinos includes sections on surfaces, amorphous materials and superconductors, but he does not mention such Nobel Prize-winning topics as the quantum Hall effect or scanning tunneling microscopy, both of which relate readily to elementary quantum mechanics. The grudgingly short paragraph on high-temperature superconductors is strikingly unstimulating.

A book of this sort should provide a good qualitative discussion of fundamental ideas, but Modinos often glosses over them. Holes in semiconductors are simply defined in passing as empty states in the valence band. There is a nice discussion of vibrations and phonons, but zero-point motion is never mentioned. Modinos poses the intriguing question of why 4s states fill before the 3d band is completely occupied, then answers, basically, that this is what emerges from the full calculation.

The book's physical layout is pleasant enough, with few typos and ample, helpful figures. (However, the figure on bonding and antibonding states in dimers misses the point that their normalization factors are different.) The text notes appear at the end of the chapters rather than at the bottom of the pages; some are worthwhile, some minor, and it soon becomes annoying to hunt for them. The energy unit changes from eV to Hartree to Rydberg with no explanation of why one might favor a particular choice.

In conclusion, a more accurate title would be "Quantum Description of Non-Subatomic Matter." The back cover (presumably penned by Wiley's marketing arm) preposterously boasts that this text is "essential for all undergraduate physics courses" and "a most valuable supplementary text for postgraduate courses on quantum mechanics." In the preface, the author himself is appropriately modest: He hopes the book can serve as a complement in a beginning course on quantum mechanics and as part of a subsequent course on atomic, molecular and solid-state physics, and he describes it as suitable as a textbook only for "students of applied physics"; having no experience with such students, I cannot fairly judge the benefits they would derive from this book. As for graduate students, some might gain from skimming this book before a qualifying exam; for those interested in condensed matter, their time and money would much better be spent on Neil Ashcroft and N. David Mermin's admittedly more advanced *Solid State Physics* (Holt, Rinehart and Winston, 1976).

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New Books

Acoustics

Advances in Acoustic Microscopy, Vol. 2. A. Briggs, W. Arnold, eds. Plenum, New York, 1996. 264 pp. $75.00 *hc* ISBN 0-306-45344-4

Progress in Speech Synthesis. J. P. H. van Santen, R. W. Sproat, J. P. Olive, J. Hirschberg, eds. Springer-Verlag, New York, 1997. 598 pp. $89.00 *hc* ISBN 0-387-94701-9, *CD-ROM*

Signals, Sound, and Sensation. W. M. Hartmann. AIP, Woodbury, N.Y., 1997. 647 pp. $80.00 *hc* ISBN 1-56396-283-7

Spatial Hearing: The Psychophysics of Human Sound Localization. Revised edition. J. Blauert. MIT Press, Cambridge, Mass., 1997 [1983]. 494 pp. $35.00 *hc* ISBN 0-262-02413-6

Astronomy and Astrophysics

The Art and Science of CCD Astronomy. *Practical Astronomy.* D. Ratledge, ed. Springer-Verlag, New York, 1997. 162 pp. $39.95 *pb* ISBN 3-540-76103-9

Completing the Inventory of the Solar System. *Astronomical Society of the Pacific Conference Series 107.* Proc. Symp., Flagstaff, Ariz., Jun. 1994. T. W. Rettig, J. M. Hahn, eds. Astronomical Society of the Pacific, San Francisco, Calif., 1996. 395 pp. $44.00 *hc* ISBN 1-886733-27-9

Gamma-Ray Bursts, Part 1 and Part 2. *AIP Conference Proceedings 384.* Proc. Symp., Huntsville, Ala., Oct. 1995. C. Kouveliotou, M. F. Briggs, G. J. Fishman, eds. AIP, Woodbury, N.Y., 1996. 1008 pp. $270.00 set *hc* ISBN 1-56396-685-9

An Introduction to Radio Astronomy. B. F. Burke, F. Graham-Smith. Cambridge U. P., New York, 1997. 297 pp. $69.95 *hc* ($29.95 *pb*) ISBN 0-521-55454-3 *hc* (0-521-55604-X *pb*)

M. A. S. S.: Model Atmospheres and Stellar Spectra. *Astronomical Society of the Pacific Conference Series 108.* Proc. Wksp., Vienna, Austria, Jul. 1995. S. J. Adelman, F. Kupka, W. W. Weiss, eds. Astronomical Society of the Pacific, San Francisco, Calif., 1996. 313 pp. $44.00 *hc* ISBN 1-886733-28-7

The Minnesota Lectures on Extragalactic Neutral Hydrogen. *Astronomical Society of the Pacific Conference Series 106.* Proc. Conf., Minneapolis, Minn., Mar.–Jun. 1994. E. D. Skillman, ed. Astronomical Society of the Pacific, San Francisco, Calif., 1996. 414 pp. $44.00 *hc* ISBN 1-886733-26-0