

rate contributions. He deserves commendation for his success in achieving uniformly high standards of presentation, thorough coverage and minimum overlap.

## Lie Algebras in Particle Physics

Howard Georgi

255 pp. Benjamin/Cummings, Reading, Mass., 1982. \$19.95

The most useful techniques for classifying elementary particles and their interactions require a knowledge of Lie algebras and their representations. Howard Georgi's new textbook is an introduction to these techniques. Although the book is written at an elementary level and does not require quantum field theory, it describes many applications of group theory to particle physics in a compelling manner. It also describes the root and Dynkin diagrams of the simple Lie algebras and a little about their representations.

The range of application of group theory in particle physics is now so broad that it is important to become familiar with it as early as possible. This textbook is written for (very motivated) advanced undergraduates and beginning graduate students interested in particle physics. It is no trivial matter to write an introductory book on this subject, because developing the mathematics fully requires long algebraic proofs and abstract arguments, and covering the many facets of the physics is complicated. Although fully qualified to do both, Georgi is careful to do only a little of each, but enough so that by the end of the book (and the semester), the student will have both a clear physical understanding of why this mathematics is relevant and a feeling for the structure of modern particle theory. As students learn more particle theory, they will become grateful to learn just how useful Georgi's book is. It provides physical insight with mathematically simple examples. Georgi does not fall into the trap of showing off his expertise with lengthy calculations (which are easy enough to find). Instead he selects examples of the mathematics and physics that are conceptually significant but require little paper to work out. Only rarely does he stray from the most important topics. Essentially everything in the book is indispensable to the practicing particle physicist. Naturally, in paring down this gigantic field to an introductory course, he has had to leave out many important details, but much of that material can be left to a more advanced course.

I found the book delightful to read; many other physicists should enjoy it,

too. Instead of completing group theory with abstract or lengthy proofs, Georgi uses examples, especially SU(2) and SU(3), to make the results believable. The examples are well chosen; the beginner will be astounded by the power and simplicity of the arguments. (However, Georgi is very careful to warn the reader not to become too enamored of the mathematics alone.) Although the price of its simplicity is occasional glibness, the book makes the most of informality without sacrificing too much rigor.

The book contains roughly equal parts of group-theoretic fundamentals, physical applications (isospin, eightfold way, SU(6), electroweak theory, QCD, and unified theories) and taxonomy of simple Lie algebras. Roots systems and Dynkin diagrams are emphasized. Although much of this material has been predigested for physicists in a wonderful book by Brian Wybourne (*Classical Groups for Physicists*, 1974), I believe that aspiring particle physicists will find that the narrower focus of Georgi's book makes it easier to follow.

The book is brilliant in conception and always competent in execution. It is an excellent addition to the all-too-small library of contemporary elementary-particle textbooks.

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## Introduction to Nonlinear Laser Spectroscopy

M. D. Levenson

256 pp. Academic, New York, 1982. \$29.50

The advent of tunable lasers has revolutionized optical spectroscopy. The immense research activity in this area is manifested by the ever-increasing number of publications during the past 15 years. This prolific phase of optical spectroscopy stems from the development of new spectroscopic techniques using the high intensity, narrow collimation and extreme monochromaticity of laser sources. These techniques have opened up possibilities of probing atomic and molecular structure in incredibly fine detail. They have also found applications in many other disciplines of science and technology, ranging from physics, chemistry, biology and medical science to isotope separation, combustion and air pollution studies. In a field of rapid growth, it is generally difficult for beginners to learn the essence of the field out of the scattered materials in the literature. Books that can summarize the basic important aspects of the field in a coherent fashion are always most welcome. Marc Levenson's *Introduction to Nonlinear Laser Spectroscopy* is written to fulfill such a need.

The book gives a good survey of

various nonlinear optical spectroscopic techniques. In this relatively short monograph, Levenson has succeeded in providing a rather thorough description of a most complete list of techniques: saturation spectroscopy, coherent Raman spectroscopy, multiphoton transitions, optical coherent transients and nonlinear optical sources. (A few interesting areas, such as quantum beats, polarization CARS, Rydberg spectrometry, detection of rare molecules, and multi-level echoes, unfortunately are neglected.) In an attempt to unify the presentation of the various techniques, Levenson uses the two-level Bloch vector model in the description. This choice may indeed help illustrate and connect the principles behind the various techniques, but one should realize that the model is not applicable to all spectroscopic cases. Being an experimentalist, the author puts emphasis on the experimental methods. The book is exceptionally clear and thorough in its presentation of the experimental details. Thus, it should be most useful as a reference for researchers who are interested in adopting some of the techniques in their laboratories.

The main weakness of this book is in the theoretical exposition and physical explanation. They appear to be sketchy and confusing. The basic theory sections in Chapter 2, for example, include hardly any derivations of the equations. Levenson does not explicitly state assumptions and quotes results directly out of the references. He does not emphasize physical pictures alongside the mathematical derivations. He has apparently misjudged the level of an ordinary reader. A beginner would find it difficult to learn about the detailed principles of laser spectroscopy from the book without consulting the extensive lists of references given in the book.

This monograph provides a good introduction to laser spectroscopy to those who have had some familiarity with the field. It should also serve as a useful handbook to experimentalists already working in the field.

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## The Logic of Quantum Mechanics

E. G. Beltrametti, G. Cassinelli

305 pp. Addison-Wesley, Reading, Mass., 1981. \$31.50

The "logic of quantum mechanics," as understood in this book, is the study of the mathematical structures that are implicit in standard quantum mechanics or that have been investigated to deepen our comprehension of that theory. The authors largely abstain from

questions of the logic of language or of the rules of reasoning, although the one chapter which they devote to these questions, chapter 20, is an excellent introduction. They also abstain from the "algebraic approach to quantum mechanics" (as treated, for example, in the book of Gerard Emch), because while its intricate mathematics is useful for systems with infinitely many degrees of freedom, it is not particularly illuminating in elementary quantum mechanics. Within the domain the authors have chosen for themselves, their treatment is remarkable. It is wide-ranging in its survey of various formulations, efficient in summarizing them, judicious in stating what has motivated them and what they have achieved, efficient and sometimes elegant in mathematical reasoning, and sensitive to physical issues. It is also pedagogically sensible: It avoids both long-winded and cryptic expositions, offers a fine set of problems for classroom use or self-study and omits what is pedagogically inappropriate. The authors merely sketch certain classical but long and difficult results—notably Gleason's theorem, Constantine Piron's recovery of the Hilbert space structure from quantum-logical axioms, and George Mackey's theorems on induced representations—and give references to fuller presentations. I suspect that this book would be a more successful text in a second-year graduate course on the foundations of quantum mechanics than the books (of Josef Jauch, Mackey, V. S. Varadarajan, and Piron) that I have used in the past.

Part I ("Hilbert-Space Quantum Mechanics") contains mainly standard material but includes some sophisticated exposition that would be difficult to find elsewhere: for example, a summary of experimental evidence on polarization that supports the quantum mechanical thesis of the nonunique decomposability of a mixture. Part II ("Basic Structures in the Description of Quantum Systems") studies choices of primitive concepts and proposals for axiomatization. The authors prefer to take propositions as primitive and to define states as probability measures on the set of propositions. However, they assess the alternatives: Piron's nonprobabilistic characterization of states, the convex-set approach of Bogdan Mielnick and of Gunther Ludwig and his school, and transition-probability spaces. Chapter 16 contains some original work about the derivations of structural features of the propositions from considerations of ideal measurement. It is outstanding. Part III ("Reconstruction of Hilbert-Space Quantum Mechanics") returns to the standard formulation of the theory, but uses the mathematical results of Part II to exhibit its coherence and (given

certain premises about the propositions) its inevitability. Chapter 24 on the composition of physical systems and Chapter 26 on a quantum theory of conditional probabilities (based largely on Stanley Gudder's work) present important results that are not widely known.

The few slips or misprints that occur do not generally prevent a reader from understanding the material. The only serious conceptual error I detected was the claim that Einstein-Podolsky-Ro-

sen correlations are as innocuous as familiar classical correlations (page 72), which disregards the import of Bell's theorem. A proof of Bell's theorem in Chapter 25 is literally correct, but the presentation could easily lead an unwary reader to the incorrect belief that no inequality of Bell's type can be derived without some quantum-mechanical assumptions. Although there are a subject index and bibliographical references at the end of each chapter, there is no author index

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and there is no compilation of symbols. Some technical terms are missing in the subject index. Because the book is intended not only as a textbook but also as a reference work, these omissions are serious and should be corrected in subsequent volumes of the *Encyclopedia of Mathematics and Its Applications*, to which series this volume belongs.

In sum, Beltrametti and Cassinelli have written a guide to quantum logic that maintains high standards mathematically and physically. It may even help readers to descend without drowning into "the abyss of philosophical interpretations" (a phrase in the Foreword by Peter Carruthers).

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## book notes

### Japanese Electronics: A Worm's-Eye View of Its Evolution

M. Kikuchi. 208 pp. Simul Press, Tokyo (US dist. Kinokuniya Bookstores, New York). \$17.50

Readers who enjoyed the PHYSICS TODAY article "Creativity and ways of thinking: the Japanese style" by Makoto Kikuchi (September 1981, page 42) will find this little book very familiar. Kikuchi has taken his favorite theme—the process by which Japan set about "catching up" to the West in electronics—and has woven it into an autobiography describing his progress from student at the University of Tokyo during World War II to his present position as director of the Sony Research Center in Yokohama.

The style is the same as in his 1981 article, conversational and highly anecdotal. There is very little physics in this book, but Kikuchi, who has worked and traveled extensively in the US, appears to have met virtually all the solid-state physicists of note and tells many charming stories of his associations with them.

JOHN T. SCOTT  
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## new books

### Particles, Nuclei and High-Energy Physics

**Particles and Fields 2.** Proc. Banff Summer Institute, Alberta, Canada, August 1981. A. Z. Capri, A. N. Kamal, eds. 706 pp. Plenum, New York, 1983. \$97.50

**Structural Elements in Particle Physics and Statistical Mechanics.** Proc. NATO Advanced Summer Institute on Theoretical Physics, August-September 1981, Freiburg. J. Honerkamp, K. Pohlmeier, H. Römer, eds. 378 pp. Plenum, New York, 1983. \$65.00

**Gauge Symmetries and Fibre Bundles: Applications to Particle Dynamics.** A. P. Balachandran, G. Marmo, B.-S. Skagerstam, A. Stern. 140 pp. Springer-Verlag, New York, 1983. \$7.00. *text*

**Electroweak Interactions at High Energies.** Proc. DESY Workshop, September 1982. R. Kogerler, D. Schildknecht, eds. 383 pp. World (US dist. Heyden, Philadelphia), 1983. \$44.00

**Advances in Nuclear Science and Technology. Vol. 15.** J. Lewins, M. Becker, eds. 406 pp. Plenum, New York, 1983. \$57.50. *compendium*

**Progress in Particle and Nuclear Physics. Vol. 10.** D. Wilkinson, ed. 323 pp. Pergamon, New York, 1983. \$102.00

### Astronomy, Cosmology and Space Physics

**Catalog of Cometary Orbits.** B. G. Marsden. 96 pp. Enslow, Hillside, N.J., 1983. \$10.00

**Galaxies.** Reprint. T. Ferris. 191 pp. Stewart, Tabori, & Chang, New York, 1982. \$27.50. *general readership*

**Teacher's Guide to Astronomy: From the Earth to the Universe.** J. M. Pasachoff. 236 pp. Saunders, New York, 1983. *no price stated*

**Astronomy and Astrophysics Abstracts. Astronomisches Rechen-Institut Heidelberg. Vol. 32, Literature 1982, Part 2.** S. Bohme, W. Fricke, H. Hefele, I. Heinrich, W. Hofmann, D. Krahn, V. R. Matas, L. D. Schmadel, G. Zech, eds. 848 pp. Springer-Verlag, New York, 1983. \$66.00

**The Realm of the Nebulae.** Reprint. E. Hubble. 207 pp. Yale U.P., New Haven, Conn., 1982. \$30.00 cloth, \$8.95 paper

**Astrophysical Jets.** Proc. International Workshop, Torino, Italy, October 1982. A. Ferrari, A. G. Pacholczyk, eds. 327 pp. Reidel (US dist. Kluwer, Boston, Mass.), 1983. \$48.00

**Evolution of the Universe.** I. D. Novikov. 176 pp. Cambridge U.P., New York, 1983. \$14.95. *general readership*

**Activity in Red-Dwarf Stars.** Proc. 71st Colloquium of the International Astronomical Union, Catania, Italy, August 1982. P. B. Byrne, M. Rodono, eds. 669 pp. Reidel (US dist. Kluwer, Boston, Mass.), 1983. \$85.00

**100 Billion Suns: The Birth, Life, and Death of the Stars.** R. Kippenhahn. 264 pp. Basic Books, New York, 1983. \$25.00. *general readership*

**Vectorial Astrometry.** C. A. Murray. 353 pp. Hilger (US dist. Heyden, Philadelphia), 1983. \$49.00. *text and reference*

**Mindsteps to the Cosmos.** G. S. Hawkins. 340 pp. Harper & Row, New York, 1983. \$19.95. *general readership*

**The Left Hand of Creation: The Origin and Evolution of the Expanding Universe.** J. B. Barrow, J. Silk. 256 pp. Basic Books, New York, 1983. \$17.95. *general readership*

**The Radio Universe.** Third Edition. J. S. Hey. 246 pp. Pergamon, New York, 1983. \$13.50. *general readership*

**Astronomy from Space: Sputnik to Space Telescope.** J. Cornell, P. Gorenstein,

eds. 248 pp. MIT Press, Cambridge, Mass., 1983. \$17.50. *general readership*

**The Adjustment and Testing of Telescope Objectives.** H. D. Taylor. 112 pp. Hilger (US dist. Heyden, Philadelphia), 1983. \$13.50

**Atlas of Deep-Sky Splendors.** Fourth Edition. H. Vehrenberg. 242 pp. Sky, Cambridge, Mass., 1983. \$39.95

**Solar and Stellar Magnetic Fields: Origins and Coronal Effects.** Symposium No. 102, Zurich, August 1982. J. O. Stenflo, ed. 564 pp. Reidel (US dist. Kluwer, Boston), 1983. \$67.50 cloth, \$32.50 paper

**Solar-Terrestrial Physics: Principles and Theoretical Foundations.** Based upon Proc., Theory Institute, Boston College, August 1982. R. L. Carovillano, J. M. Forbes, eds. 859 pp. Reidel (US dist. Kluwer, Boston), 1983. \$115.00

**Spacewarps.** J. Gribbin. 211 pp. Delacorte, New York, 1983. \$16.95. *general readership*

**Diffuse Matter in Galaxies.** Cargèse 1982. Proc. NATO Advanced Study Institute, September 1982. J. Audouze, J. Lequeux, M. Levy, A. Vidal-Madjar, eds. 262 pp. Reidel (US dist. Kluwer, Boston, Mass.), 1983. \$39.50

### Atomic, Molecular and Chemical Physics

**Problems in Molecular Structure.** G. J. Bullen, D. J. Greenslade, eds. 466 pp. Pion (US dist. Methuen, New York), 1983. \$32.00. *intermediate text*

**Advances in Chemical Physics. Vol. 53.** I. Prigogine, S. A. Rice, eds. 402 pp. Wiley, New York, 1983. \$55.00. *compendium*

**Energy Storage and Redistribution in Molecules.** Proc. June 1980, Center for Interdisciplinary Studies, Bielefeld. J. Hinze, ed. 615 pp. Plenum, New York, 1983. \$85.00

**Physics of Atoms and Molecules.** B. H. Bransden, C. J. Joachain. 686 pp. Longman, New York, 1983. \$26.00. *undergraduate text*

### Optics and Acoustics

**Quantum Optics, Experimental Gravity, and Measurement Theory.** Proc. NATO Advanced Study Institute August 1981, Bad Windsheim, FRG. P. Meystre, M. O. Scully, eds. 701 pp. Plenum, New York, 1983. \$95.00

**Colour Science in Television and Display Systems.** W. N. Sproson. 221 pp. Hilger (US dist. Heyden, Philadelphia), 1983. \$36.00

**Applied Charged Particle Optics. Part C. Very-High-Density Beams.** A. Septier, ed. 545 pp. Academic, New York, 1983. \$74.50. *compendium*

**Waves and Photons: An Introduction to Quantum Optics.** E. Goldin. 211 pp. Wiley, New York, 1983. \$25.95

**Speech of the Hearing Impaired: Research, Training, and Personnel Preparation.** I. Hochberg, H. Levitt, M. J. Osberger, eds. 427 pp. University Park, Baltimore, 1983. \$39.95. *compendium*