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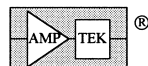
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techniques used in the various topical areas. This both makes it easier to approach a new topic and encourages the reader to consider a modular approach when writing programs.

Thijssen has targeted *Computational Physics* at graduate students and researchers interested in learning about newer computational techniques. If the instructor uses some care in selecting topics, the book may also be useful in a course for advanced undergraduates, although the reader is generally assumed to have a background in quantum mechanics, statistical mechanics, computer programming, and numerical analysis. Chapters that may be skipped in the first reading have been clearly marked, and the problems provided at the end of each chapter cover a mixture of derivation, programming, and computation.

Thijssen encourages the reader to write programs, and he gives helpful hints on ways to ensure that these programs are giving correct answers. He also maintains a Web site at <http://ectm.et.tudelft.nl> through which the reader can download a file containing computer programs discussed in the book. These programs are currently implemented only in FORTRAN 77, but Thijssen notes that he is working on versions in C and FORTRAN 90.

Thijssen's book is well suited for a graduate-level course in computational condensed matter physics, filling the gap between elementary texts such as Giordano's *Computational Physics* (Prentice Hall, 1997) and review articles on specialized topics while it provides students with an up-to-date look at computational methods used in physics research.

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Statistical Methods in Quantum Optics 1: Master Equations and Fokker-Planck Equations

Howard J. Carmichael
Springer-Verlag, New York, 1999.
361 pp. \$64.95 hc
ISBN 3-540-54882-3

Quantum optics, the union of quantum field theory and physical optics, is in one way new and another way old. In one sense, all of quantum mechanics (and indeed most of modern physics) springs from the study of black-body radiation. Planck was

arguably the first quantum optical scientist. On the other hand, quantum optics promises to be a mainstay in the 21st century, emphasizing, for example, squeezed light ("darker than dark"), cavity QED (quantum electrodynamics), quantum noise quenching through atomic coherence, and quantum decoherence. Quantum "noise" is at the cutting edge of the field, and the new book by Howard J. Carmichael, *Statistical Methods in Quantum Optics 1: Master Equations and Fokker-Planck Equations*, is a valuable addition to the literature.

If asked to describe the key events that ushered in the modern era of quantum optics, one would, of course, point to the laser. But the advent of high-efficiency photodetectors was also a key development. In the early 1960s, experiments by H. Hanbury-Brown and R. Twiss, and measurements of the laser photon statistics, stimulated Roy Glauber to develop the theory of multiphoton correlation spectroscopy and quantum coherence in pretty much the form we use today. But to get where we are today still required the clarification of many subtle issues, such as the clear distinction between quantum and classical noise. Glauber stated this well in his classic 1964 Les Houches lectures, "Quantum Optics and Electronics:"

"It has recently been claimed that the class of states of the field for which the simple statistical description we have mentioned is available includes all states of the field, and that consequently the quantum theory and the 'classical' theory will always yield equivalent results. . . . [T]his claim seems to be based more upon wishful thinking than upon accurate mathematics. The quantum theory still offers the only complete and logically consistent basis for discussing field phenomena."

Today, with the benefit of a quarter-century of experience, we recognize how deep and insightful Glauber's statement is. In fact, a hallmark of nonclassical squeezed light is the appearance of the negative diffusion coefficient in the Fokker-Planck equation. Thus, quantum noise is seen to be profoundly different from classical noise, and this is one reason Carmichael's book is so useful.

The book is divided into two volumes. For such modern topics as squeezing, the positive P representation, cavity QED, and quantum trajectories, we must wait for the second volume. The first volume concentrates on the fundamentals, the ideas developed in the first two decades of

research in quantum optics (the 1960s and 1970s). Two principal themes are followed in Volume 1: (1) the development of the fundamental formalism based on master equations, and the quantum regression theory of Melvin Lax for treating open systems in quantum optics; and (2) the development of the phase-space methods (quantum classical correspondence) used to express this formalism in a language reminiscent of classical statistical physics (Fokker–Planck equations and diffusion processes). The two themes are developed in parallel.

There are many novel and useful aspects to the book. The contents of Volume 1 are largely standard, but the development is particularly detailed and self-contained. For the most part, calculations can be followed step by step and often fill in detail that is difficult or even impossible to recover from the literature. The evaluation of multitime averages in the phase-space representation (P , Q , and Wigner representations) provide a case in point. Also, explicit examples of singular P distributions (P distributions as generalized functions) are constructed where usually little more than the existence of such things is mentioned. A particularly helpful feature for the student is the systematic way in which N. G. van Kampen's system size expansion is applied to such things as the derivation of the laser Fokker–Planck equation. The logic of the scaling of variables, which uncovers the small-noise basis of the diffusion approximation in laser theory, is presented very clearly in this approach.

In the absence of such a systematic and careful treatment, the passage from the laser master equation to a Fokker–Planck equation often has the appearance of something rather too close to 'black magic.' It is also helpful to see the Scully–Lamb density matrix version of laser theory discussed in parallel to the phase-space theory.

Volume 1 also includes a discussion of the relationship between intracavity and radiated field correlations for cavity radiators like the laser. This topic took on considerable importance when squeezed-light sources arrived on the quantum optics scene in the 1980s. Squeezed light itself is scheduled to be treated in Volume 2, but it is good to see this relationship established in the first volume, because it is a general one, not one relevant only to the squeezed-light situation.

This book is not a general textbook in quantum optics. While it is self-con-

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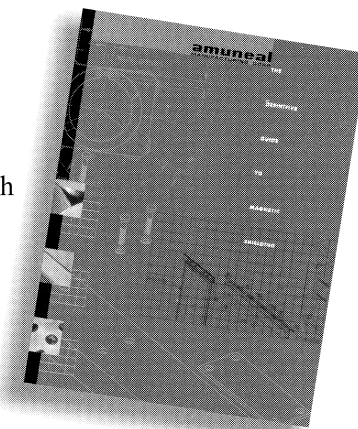
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tained with respect to the topics it treats, these are specialized and fairly advanced by the standards of a first course in quantum optics. The focus is on the treatment of photoemissive sources in the language of open quantum systems. Core topics like the quantization of the electromagnetic field are not touched, and some familiarity with quantum mechanics and the basic notions of statistical physics is presumed. The book targets methodology at the expense of phenomenology. Thus, it aims to cover a few central problems in quantum optics thoroughly, with an emphasis on the

way calculations are done and the physics interpreted without worrying about the fact that many phenomena of interest to modern quantum optics are not mentioned at all.

The book thus really targets beginning researchers. It could nevertheless serve as a text for any course in quantum optics that lays its emphasis on the open quantum system approach. Some sections (for example, on master equations, resonance fluorescence, coherent states, the Fokker-Planck equation, and laser theory) would also be excellent as supplements to a quantum optics course at a lower

level. There are many exercises distributed through the book, although, for a lower-level course, these would need to be screened for difficulty by an instructor.

It is often the case that a book's greatest strength is also its greatest weakness. In the case of this book, the detailed calculations may go too far for some readers who would prefer a book of greater breadth and less depth. But I am strongly in favor of presenting detailed calculations.

To sum up: *Statistical Methods in Quantum Optics 1* is an excellent book. Try it, you'll like it!

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NEW BOOKS

Acoustics

Fluid-Structure Interactions in Acoustics. *International Centre for Mechanical Sciences (CISM) Courses and Lectures 396.* D. Habault, ed. Springer-Verlag, New York, 1999. 304 pp. \$65.00 pb ISBN 3-211-83147-9

Astronomy and Astrophysics

Astronomical Data Analysis Software and Systems VIII. *Astronomical Society of the Pacific Conference Series 172.* Proc. Mtg., Urbana, Ill., Nov. 1998. D. M. Mehringer, R. L. Plante, D. A. Roberts, eds. Astronomical Society of the Pacific, San Francisco, Calif., 1999. 519 pp. \$52.00 hc ISBN 1-886-733-94-5

Astrophysics with Infrared Surveys: A Prelude to SIRT. *Astronomical Society of the Pacific Conference Series 177.* Proc. Conf., Pasadena, Calif., Jun. 1998. M. D. Bica, C. A. Beichman, R. M. Cutri, B. F. Madore, eds. Astronomical Society of the Pacific, San Francisco, Calif., 1999. 483 pp. \$52.00 hc ISBN 1-58381-001-3

Catching the Perfect Wave: Adaptive Optics and Interferometry in the 21st Century. *Astronomical Society of the Pacific Conference Series 174.* Proc. Symp., Albuquerque, N. M., Jun.-Jul. 1998. S. R. Restaino, W. Junor, N. Duric, eds. Astronomical Society of the Pacific, San Francisco, Calif., 1999. 256 pp. \$52.00 hc ISBN 1-886733-96-1

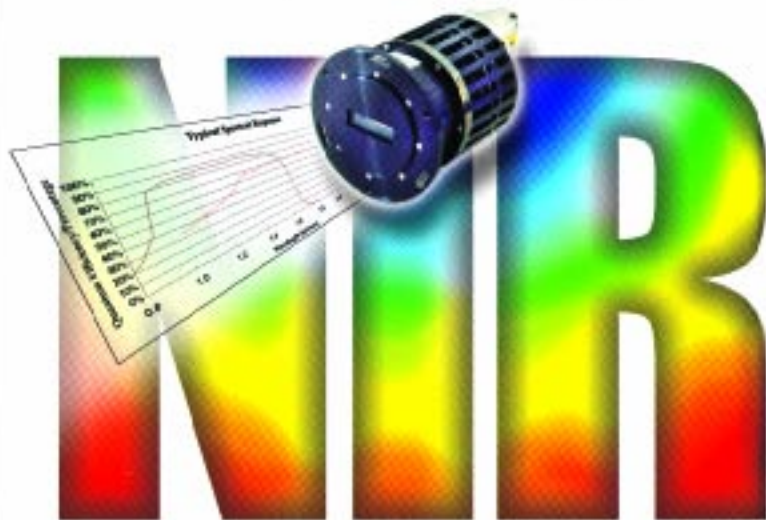
Celestial Dynamics at High Eccentricities. *Advances in Astronomy and Astrophysics 3.* V. A. Brumberg, E. V. Brumberg, Gordon and Breach, Amsterdam, 1999. 210 pp. \$95.00 hc ISBN 90-5699-212-0

The Cosmological Background Radiation: Echo of the Early Universe. M. Lachièze-Rey, E. Gunzig. Cambridge U. P., New York, 1999. 247 pp. \$80.00 hc (\$34.95 pb) ISBN 0-521-57398-X hc (0-521-57437-4 pb)

Eta Carinae at the Millennium. *Astronomical Society of the Pacific Conference Series 179.* Proc. Wksp., Gallatin Gateway, Mont., Jul.

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