

evidence of perfunctory editing and proofreading. For example, in some of the figures, labels for the x -axis and y -axis are missing, and in a number of places in the text, equations are incorrectly cited. For instance, on page 96, equation 4.24 is given as the scattering cross section; however, equation 4.26 is the one that should have been cited. The last chapter seems to have missing or mislabeled figures.

Despite such minor blemishes, *Atmospheric Acoustic Remote Sensing* is a welcome contribution to the field of acoustic remote sensing. Moreover, it will be most useful for nonexpert scientists and engineers who wish to increase their knowledge of sodar and RASS—without muddling through the sometimes cursory treatment of the subject by manufacturers and without blindly diving into a huge body of literature.

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Introduction to the Theory of Coherence and Polarization of Light

Emil Wolf
Cambridge U. Press, New York,
2007. \$45.00 (222 pp.).
ISBN 978-0-521-82211-4

The science of light has fascinated and occupied humankind since the dawn of civilization, perhaps because its impact is so great in every aspect of life. Fast forward past remarkable historical developments, and one sees how scientists' understanding of light in terms of electromagnetic waves has produced considerable sophistication in the description of its propagation, manipulation, and detection. Quantum mechanics has further refined and deepened that understanding and has led, in particular, to the invention of the laser, followed by the development of nonlinear optics and, more recently, the generation of nonclassical light sources.

Those developments continue to stimulate extraordinary technological advances in optical communications and have resulted in revolutionary medical procedures, clocks of astonishing accuracy, and "flashlights" that permit researchers to investigate atomic and molecular processes at time scales of a few attoseconds, characteristic of the motion of electrons around nuclei. Just around the corner one can expect

the emergence of quantum-based information technologies such as quantum cryptography and, perhaps in the more distant future, quantum computers. Other remarkable, recent scientific developments enabled by optical tools include laser cooling, which has led to quantum-degenerate atomic and molecular systems including the Bose-Einstein condensate, and the study of ultra-intense phenomena—for example, with petawatt lasers. Optics also remains a central tool in refining our understanding of the origin of the universe, as famously evidenced by exquisite measurements of the cosmic microwave background.

In light of those developments, Emil Wolf's *Introduction to the Theory of Coherence and Polarization of Light* might appear somewhat quaint, as it concentrates squarely on the coherence and polarization properties of stationary, classical optical fields—an aspect of optics that is not the subject of many headlines these days. Wolf, who is currently the Wilson Professor of Optical Physics at the University of Rochester in New York, coauthored with Max Born the classic text *Principles of Optics: Electromagnetic Theory of Propagation, Interference and Diffraction of Light* (Pergamon Press, 1959), now in its 7th edition (Cambridge University Press, 1999). Every serious student of optics has a copy of that book on his or her bookshelf. It has long been and still remains the bible of physical optics; it covers much more broadly and rigorously the subjects treated in Wolf's current book. A second text, *Optical Coherence and Quantum Optics* (Cambridge University Press, 1995), which Wolf coauthored with Leonard Mandel, also covers physical optics in greater depth and includes quantum optics in addition.

Why, then, did Wolf choose to write another book on classical coherence theory? I can only guess that his goal must have been to produce a light version of the Born-Wolf text, one aimed at a readership less inclined to go through the detailed, rigorous, and occasionally lengthy treatments of the original. In that respect, Wolf succeeds quite well; he has produced a text that should be at about the right level for motivated advanced undergraduates or beginning graduate students in physics, electrical and computer engineering, or optics. The coverage is usually distilled to the most important elements, and the mathematics is succinct and clear. The problems are well chosen and help amplify the text. One chapter presents a unified treatment of the polarization

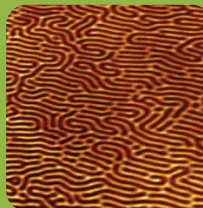
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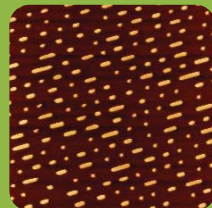
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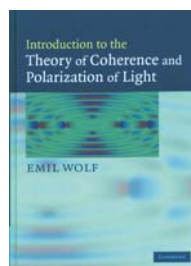
and coherence of classical light, a topic that has recently received much attention by the author and his students and had not appeared in book form until now. So, as would be expected from the undisputed master of the field, what is covered in Wolf's text is typically covered beautifully.

Despite all the book's positives, I am a bit troubled by the absence of any indication that optical coherence theory actually goes far beyond what is treated in the text. Perhaps adding "classical" before "coherence" in the title would have helped focus my expectations. Much of optics R&D these days involves the region where the light fields are not adequately described as stationary and classical. From a pedagogical point of view, it would have been useful for the author to give readers at least some indication of that state of affairs, particularly for the Hanbury Brown and Twiss effect. (For more information about its historical and conceptual importance, see "Hanbury Brown's Steamroller" by Daniel Kleppner, *PHYSICS TODAY*, August 2008, page 8.)

Although it is true that the clever intensity correlation effect was first proposed in the context of astronomical applications—and, hence, of classical stationary fields—that is not where the concept has shined. Instead, the effect's greatest impact has been in the development of a new subfield of optics—quantum optics—and the quantum theory of optical coherence. That theory, for which Roy Glauber shared the 2005 Nobel Prize in Physics, is essential to understand the statistical properties of laser light and the nonclassical electromagnetic and matter-wave fields that are increasingly important in applications ranging from gravitational wave antennas to sub-shot noise detectors to quantum information science.

Wolf's new text would have benefited greatly from having a window opened to such remarkable developments. For example, it would have been appropriate to mention the seminal experiments of H. Jeffrey Kimble and Mandel that unambiguously demonstrated the nonclassical nature of light and prompted many modern developments in optics. It also would have been useful to read some comments about the difficulties in properly characterizing the coherence properties—for example, the spectrum—of the violently nonstationary fields encountered in much of ultrafast science.

With such limitations in mind, however, Wolf's *Introduction to the Theory of*



Coherence and Polarization of Light will serve as a useful text on classical coherence theory for students specializing in optics, since they will be introduced to complementary aspects of the field in other classes. But as a standalone text for an advanced undergraduate optics course typical

of many physics or electrical and computer engineering curricula, it presents a picture of optical coherence that is, in my view, overly narrow. It would need to be supplemented with a book that covers other topics in optics—for instance, Christopher Gerry and Peter Knight's *Introductory Quantum Optics* (Cambridge University Press, 2004) or Rodney Loudon's classic *The Quantum Theory of Light* (3rd edition; Oxford University Press, 2000). Paired with a suitable complement, Wolf's book could form the basis of a strong course.

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Stellar Systems, and the Sun. G. van Belle, ed. *Astronomical Society of the Pacific Conference Series 384*. Proc. wksp., Pasadena, CA, Nov. 2006. Astronomical Society of the Pacific, San Francisco, 2008. \$77.00 (441 pp.). ISBN 978-1-58381-331-7, CD-ROM

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Clusters of Galaxies: Beyond the Thermal View. J. Kaastra, ed. Springer, New York, 2008. \$179.00 (418 pp.). ISBN 978-0-387-78874-6

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