As someone who has conducted research related to optical physics, I foresee that *Mathematical Methods for Optical Physics and Engineering* will be an indispensable reference tool on my bookshelf. Given the approachable nature of the writing style as well as the clarity with which the material is presented, I view it as an insightful, contemporary book which would serve as a great text for an introductory course in mathematical physics.

Lance Parsons
Physics and Physical Oceanography
Memorial University

Optical Physics, A. Lipson, S.G. Lipson, H. Lipson, Cambridge University Press, 2011, pp. 572, ISBN: 978-0-521-49345-1; Price US $75.

What is it about optics and families? For many years at Simon Fraser University, our fourth-year course on Optics used the text *Introduction to Optics*, whose third edition was written by three Pedrotti brothers. More recently, we have switched to *Optical Physics,* which boasts three generations of Lipsons and now has been updated to a fourth edition. (Henry Lipson, *pater familia* and co-author of the first two editions, passed away in 1991.) The defining feature of this book is that it treats optics as a branch of physics, not a subject unto itself for "optical engineers." It is the book you should consider for a course taught to physicists. At SFU, the course is taught concurrently with one on electrodynamics, which handles the background on waves and Maxwell's equations, Fresnel coefficients, and treatments of optical properties of matter, leaving time to focus on applications such as a treatment of lasers and, occasionally, semi-classical nonlinear optics.

The outstanding example of the Lipson approach lies in the book's treatment of Fraunhofer diffraction, whose treatment goes back to the original 1969 edition of the book, which integrated discussions of optics to X-ray crystallography, neutron diffraction, and other wave probes of structure. Thus, there are threads throughout the book that address common issues, including reciprocal lattice vectors, fluctuations (Debye-Waller factors, speckle, etc.), and the inference of structure from intensity measurements (phase retrieval). The Lipson book shows that learning optics can not only open the door to applications but also provide alternate intuitions about solid state physics, etc. The discussion of laboratory demonstrations in technology, while dated, remains valuable conceptually and can inspire course demonstrations.

Another strength of the book is the quality of its problems, which are often creative, difficult, and reinforce physical intuition. Indeed, what first seduced me about this book was a problem matching 20 diffraction masks with 20 patterns. The masks are well chosen, with obvious inspiration for variations. Although some problems need hints, they are better than the routine, uninspired exercises that many books offer.

Relative to earlier editions, the authors (including newcomer Ariel Lipson) have modernized notation (sorely needed), added many new modern topics and applications, and updated the format, with introductions, summaries, and notes in the margins. Many of the new topics, such as non-imaging optics, negative-index materials, super-resolution microscopy, and optical tweezers, were ones that I had added informally on my own. Now it's all there! (And there are many topics I was unfamiliar with or did not see how to present: surface plasmon resonance, omnidirectional reflectors, photonic crystals, and more.) Though old, optics remains vital: not a year goes without some new application or fundamental insight appearing in top journals (sometimes, as with cloaking, in the popular press), explainable to undergraduate students. Few other fields of physics can make a similar claim.

Weaknesses? The book is sometimes too qualitative. Building physical intuition is a worthy goal, but sometimes students need a step-by-step derivation. Also, some of the qualitative explanations make sense to someone who already knows the material but will be mysterious to one encountering it for the first time. Areas that would have benefited from a more explicit treatment include

- Fermat's principle: there should be links to the calculus of variations, the ray equations, a real calculation of mirages, etc.
- Group velocity: The method of stationary phase should be presented, not talked around.
- Wave propagation in anisotropic media: optics is a good place to learn about tensors, and there is no need to finesse explicit calculations, such as the velocities of waves in different directions.
- Diffraction: the treatment of a Gaussian beam is better done using Fourier transforms, starting from the paraxial approximation to the Helmholtz equation.
- Fourier methods: the treatment is frustratingly vague in places. For example, the transform of the comb function has one prefactor in Chapter 4 and another in Chapter 9. These are small issues, but students get hung up on them.

Still, such quibbles are small blemishes in the overall appeal of a book that remains the best treatment I know of optics as a branch of physics. Its reasonable price is all the more reason to give it a try.

John Bechhoefer
Simon Fraser University

Particle Detectors, Second Edition, Claus Grupen and Boris Shwartz, Cambridge University Press, 2008; pp. 651, ISBN: 978-0-521-84006-4 (hardback); Price: $156.18.

This book offers a thorough course in the physics of subatomic particle detection, at a level suitable for advanced graduate students or researchers in the field. While the emphasis is on detectors for high-energy physics, the principles are equally applicable to particle detection in nuclear, medical, astro- and condensed matter physics. Indeed, chapter 16 is devoted to applications in imaging of blood vessels, cancer therapy, tribology, and gamma-ray astronomy.

The first chapter deals with interactions of particles and radiation with matter. Important results, such as the Bethe-Bloch equation for ionization energy loss, are carefully documented but not derived, and references to the primary literature are given. Following this are short chapters discussing detector resolution and counting statistics, radiation dose measurement, and accelerators. The latter only briefly describes linacs and synchrotrons, to the exclusion of other types.

The real meat of the book starts in chapter 5, which discusses ionization counters (gaseous, liquid and solid state), scintillation counters and their adjunct photon detectors, Cerenkov counters, and transition radiation detectors. Chapter 6 covers historical track detectors (cloud and bubble chambers, streamer chambers, emulsions, plastic foil detectors) which are infrequently used in modern research. Chapter 7 discusses tracking detectors (multi-wire and micropattern gas detectors, silicon strips, and scintillating fibre arrays. Chapter 8 discusses calorimetry, including electromagnetic and hadronic calorimeters in detail, as well as a discussion of cryogenic calorimeters used for Dark Matter searches. Following this are chapters on particle identification and neutron detection, and neutrino detection. Chapter 11 deals with momentum measurement in magnetic spectrometers, with careful discussion of the effects of track resolution and multiple scattering on momentum resolution. Only the non-focusing magnetic spectrometers normally used in high-energy physics are considered, not the high-resolution focusing magnetic spectrometers frequently used in nuclear physics. Chapter 12 discusses ageing effects in gaseous detectors and radiation effects in scintillation, Cerenkov, and silicon detectors. Chapter 13 is a detailed look at the Belle detector, as a case study of how the various components discussed in previous chapters is integrated into one detector system. Chapters 14 and 15 cover electronics and data analysis.

Chapter 16 was discussed earlier. Chapter 17 is a valuable "Glossary" which summarizes the important results from the entire book; reading the 21 pages of this chapter alone would be a good introduction to the salient points for those who don't have time to read the whole book! At the end of each chapter, there is a set of typically 3 to 6 problems for the student to solve, with solutions given at the end of the book, and a set of references to the primary literature. The book concludes with a set of Appendices containing a table of