

ASTRONOMICAL INSTRUMENTATION ACQUIRES PEDAGOGICAL TOOLS

Astronomical Observations: An Optical Perspective

Gordon Walker
Cambridge U. P.,
New York, 1987. 347 pp.
\$79.50 hc ISBN 0-521-32587-0;
\$29.95 pb ISBN 0-521-33907-3

Observational Astrophysics

Pierre Léna
Springer-Verlag,
New York, 1988 [1986]. 328 pp.
\$54.00 hc ISBN 0-387-18433-3

Astronomical Optics

Daniel J. Schroeder
Academic, San Diego,
Calif., 1987. 352 pp.
\$45.00 hc ISBN 0-12-629805-X

Reviewed by Joseph S. Miller

Astronomy is largely an observational science rather than an experimental one. An enormous diversity of observational techniques play major roles in modern astronomy, including observations from both space and the ground and detection of photons covering the entire electromagnetic spectrum. There are even small but very important efforts concerned with neutrino and gravitational-wave detection. An instructor planning to teach a course on astronomical instrumentation is faced with the challenge of choosing a subset from the wide range of potential topics. Too, there have been no general textbooks available on the subject. It was this lack of a suitable book for his undergraduate course on instrumentation that led

Gordon Walker to write his book *Astronomical Observations*. The other two books reviewed here also derive from their authors' classroom experience, but, not surprisingly, the resulting three works differ considerably.

The title of Walker's book would imply that observations themselves, especially optical observations, provide the main focus of the book. In fact the book gives very little detail on observational activities. Rather, it contains an extremely wide selection of material, incorporating discussions of diverse techniques and instruments, as well as of observations at all wavelengths. It is this very diversity that is the book's major drawback, as each topic receives rather limited discussion.

The first two chapters provide a general overview of radiation from astronomical objects and a discussion of the many factors that contribute to the constraints on astronomical observations. Material is in general not developed from first principles, but the well-prepared student will still find it useful; for example, the discussion of detection limits for telescopes is handled quite well.

Walker's discussion of telescopes in chapter 3 illustrates his general approach. Half the chapter is devoted to gamma-ray telescopes, x-ray telescopes, radio interferometers, radio-telescopes and infrared telescopes; the other half discusses optical ones. But very little of it is treated in detail. Similarly, chapter 6, on dilute apertures, covers a very diverse set of subjects ranging over gamma-ray detector networks, optical interferometry, radio interferometry and occultations.

Chapter 5, on spectrographs, particularly disappointed me. Spectrographs play a dominant role in the use of large optical telescopes. While Walker's introduction to the basic theory of spectrograph design is good, the discussion is otherwise too limited to give the reader a detailed understanding. For example, Walker gives

an expression for the anamorphic magnification of a grating, but no explanation for the effect.

Chapter 8 treats charge-coupled-device detectors rather briefly in comparison with other detectors such as photographic plates, television tubes and image tubes. CCDs have become the detectors of choice for much optical observing, and I would have liked to have seen a more extensive discussion of their properties and use. However, the treatment of single-channel detectors in chapter 7 is quite good. I also liked the discussion of astronomical seeing in chapter 4.

Overall I found few outright errors in the book. A particularly surprising one was the statement that the human eye has an angular resolution of one-tenth of a degree under normal daylight conditions and one degree when dark adapted. If this statement were true, the Pleiades star cluster would look like a blur in the sky to the unaided eye. The actual resolution is a few minutes of arc.

Pierre Léna's book is even more encyclopedic than Walker's. The original title, *Astrophysique: Méthodes Physiques de l'Observation*, conveys the book's content much more accurately than the English title; the book has very little about astrophysics. But virtually any kind of observation that could be considered astronomical is discussed in the book—not only the traditional wave bands (x-ray, optical, infrared and radio) and their detectors, but also gravitational-wave, neutrino and muon detectors. The approach taken is highly mathematical, with a strong emphasis on theory rather than practice. A good example is a treatment of the mathematics of Fourier transforms in chapter 4, which is on the measurement and processing of signals. Some will find the discussion quite straightforward, but others with no prior exposure to Fourier transforms will find the chapter tough going; the treatment is not designed to educate the novice. Of

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