BOOK REVIEW

Selection of books for review is based on the editor's opinions regarding possible reader interest and on the availability of the book to the editor. Occasional selections may include books on topics somewhat peripheral to the subject matter ordinarily considered acceptable.

Principles of Plasma Diagnostics

Author	I. H. Hutchinson
Publisher	Cambridge University Press, New York (1987)
Pages	364
Price	$65.00
Reviewer	S. J. Zweben

This book is excellent. It presents, in a very clear and authoritative way, the physical principles of nearly all common plasma diagnostics, such as Langmuir probes, diamagnetic loops, electron cyclotron emission, atomic spectroscopy, and nuclear techniques. The level is appropriate to an intermediate graduate-level course or for a researcher who might want to find out how, for example, a heavy ion beam probe works without working back through the journal articles.

The organization is interesting and appropriate. The chapter titles are magnetic diagnostics, plasma particle flux, refractive-index measurements, electromagnetic emission by free electrons, electromagnetic emission from bound electrons, scattering of electromagnetic radiation, and ion processes. Each chapter starts out with the basic equations and then branches out into various applications. Nearly all applications are illustrated with a drawing of the typical experimental setup or geometry, and nearly all give good examples of real data from the literature, although engineering-oriented technological details such as detector design and optimization are intentionally left out (except for a brief appendix on radiation technology).

The discussion of incoherent Thomson scattering, for example, begins with the relativistic equation of motion for an electron in an electromagnetic field, derives the general formula for the scattered electric field in two pages (a formidable vector equation with ~7 terms!), simplifies this for nonrelativistic scattering in the dipole approximation (one term left!), describes the conditions needed in order to assume incoherent scattering ($k\lambda_D \gg 1$), calculates the differential cross section for incoherent scattering for a relativistic Maxwellian distribution, shows a typical configuration for a Thomson scattering experiment (3 figures), and finally shows an example of a temperature and density profile diagnosed in this way from the Princeton Large Torus. The subject is presented quite neatly and carefully over ~20 pages, in a way that should satisfy everyone from a nonplasma theorist to a tokamak diagnostician.

Several topics receive particularly detailed coverage, such as Langmuir probes, magnetic measurements, and electron cyclotron emission. These correspond to former research interests of the author, who is a well-known tokamak physicist and currently an associate professor of nuclear engineering at the Plasma Fusion Center at Massachusetts Institute of Technology.

The book has a few shortcomings as well, the main one being the relatively few references to work after 1985. Thus, a researcher planning to build a plasma diagnostic would need supplementary information to get started, such as from the High-Temperature Plasma Diagnostics Conference proceedings published biannually in *Reviews of Scientific Instruments*. Another shortcoming is the almost complete absence of diagnostic examples from astrophysical or low-temperature plasma research, although, as the author emphasizes, the general principles should be applicable.

The book is beautifully printed, carefully proofread, and perfect for a graduate textbook. There has been no comparable book on plasma diagnostics for at least 10 years, and none has woven together theory and experiment so well.

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