



Plasma Physics and Controlled Fusion

Principles of Plasma Diagnostics: Second Edition

I H Hutchinson

[Plasma Physics and Controlled Fusion, Volume 44, Number 12](#)

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2002 Cambridge University Press

ISBN: 0-521-80389-6 £75.00

Citation

I H Hutchinson 2002 *Plasma Phys. Control. Fusion* **44** 2603

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DOI

<https://doi.org/10.1088/0741-3335/44/12/701>

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Abstract

Although diagnostics are the essential tools of the experimental plasma physicist, there are surprisingly few up-to-date books in this field. Several excellent volumes appeared in the early days of fusion research but these, though containing much material that is still relevant, are now seriously out of date with respect to the substantial advances that have taken place in this field over the past decades. There is of course a vast amount of information in journal articles, conference papers and reviews, but these generally are aimed at the experienced specialist and consequently usually omit, or at most give a quick overview of, the basic principles. Moreover most research papers are concerned either with recent developments or with specific applications of existing techniques making it difficult for a newcomer to the field to find a good introduction to the basic principles. So when the first edition of Ian Hutchinson's book entitled *Principles of Plasma Diagnostics* appeared some 15 years ago it filled an important niche and quickly established a high reputation.

This book deals with the fundamental physics of plasma diagnostics and develops an understanding of the methods from first principles. Instrumentation and experimental techniques are not discussed in great detail-as the author explains, to do so would have resulted in an unwieldy volume and moreover some of the technology is developing so rapidly that it would soon become outdated-but there is sufficient discussion of the applications to guide the reader towards more specialist literature. So this is not a book that will give a step-by-step account of how to build or operate a diagnostic-but it is the place to turn to in order to learn about the physics underlying the measurement method.

After a brief introduction, the book deals comprehensively with the broad range of diagnostic methods, categorising them according to the physical process or property of the plasma that is used in the measurement. Successive chapters deal with magnetic measurements; plasma particle flux measurements-essentially probe techniques; refractive index methods, including interferometry, polarimetry and reflectometry; emission from free electrons-cyclotron emission, bremsstrahlung etc.; emission from bound electrons-the classic emission spectroscopy; scattering of

electromagnetic radiation, incoherent and coherent Thomson scattering; neutral atom diagnostics; and finally a chapter on fast ions and fusion products. There are appendices dealing with various mathematical tools and some special issues, a glossary of symbols and a list of references. And as well as these specific references, the author gives suggestions for further reading and exercises for the student at the end of each chapter. With over 25 years experience in experimental plasma physics, Ian Hutchinson has made significant contributions to the development of the physics of many of the measurement methods that are described here, so this is book of considerable authority and insight. It is well written and will provide much interesting reading for the experienced physicist as well as the student.

The material has been thoroughly revised and updated for this second edition, with new sections and chapters covering recent developments in the field. A small amount of outdated material has been removed, but some additional hundred pages compared to the first edition have extended the work quite considerably. Although the book is based quite firmly on diagnostics for magnetic confinement fusion plasmas, the author's own field of research, the basic principles of these methods are sufficiently general and they are so well explained here that this book will serve as a valuable asset also for physicists working in other areas of plasma research-in particular astrophysical and processing plasmas. The treatment is generally at graduate student level; knowledge of basic plasma physics is useful but not essential to work through the book. But this is much more than a book for the student-it is a valuable work of reference that merits a place on every diagnostician's desk.

Peter Stott

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