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.

Plasma Physics for Nuclear Fusion

Author Kenro Miyamoto

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Reviewer Keith R. Symon

This book was written as a textbook on plasma physics intended for students who plan to work on applications to fusion energy production. It covers all aspects of plasma physics relevant to nuclear fusion applications and therefore essentially covers all of plasma physics except for relativistic and quantum plasmas.

The author states in his preface that the book is intended for students at the senior undergraduate level. It is my opinion that the treatment is somewhat advanced for an undergraduate course, at least at an American university. The scope and level of treatment are quite suitable for a graduate course.

There is a need for a suitable text for a thorough course in basic plasma physics at the graduate level. I know of none that is entirely satisfactory. There are a few excellent texts on particular branches of plasmas physics. There are also a few that cover everything one might want to treat in such a course, but that are written in such a way as to be more suitable as a reference than as a text. *Plasma Physics for Nuclear Fusion* does cover the field and is as good as any other single text now available. I found it still not entirely satisfactory, however. The treatment is somewhat uneven. At times, it is difficult to follow, particularly if, like me, you are unable to keep in mind everything that has gone before. I would have liked references by number to needed equations, especially, for example, when the relevant equations are more than several pages back. There are no suggested problems. A list of references to material covered is provided at the end of each chapter.

The book is divided into four main sections: Fundamentals; The Magnetohydrodynamic Description of a Plasma; Kinetic Descriptions of Waves and Instabilities; and Heating, Diagnostics, and Confinement. It begins with a brief chapter on nuclear fusion and closes with a chapter on plasma confinement, which includes individual treatment of nearly all the major proposed confinement schemes, including inertial confinement. The 14 chapters between treat the physical principles needed to understand the behavior of confinement devices. Examples and applications to plasma confinement devices are worked into the treatment.

The outline of topics is logical, although occasionally a little surprising. The chapter on diffusion, for example, is in the section on magnetohydrodynamics. The subject of radiation processes in plasmas is worked into the chapter on plasma diagnostics, making up about half the chapter. (There are also three chapters on waves in plasmas in the kinetic theory section.) "Radiation" is not in the index, although if one knows what to look for, one can find special topics (e.g., bremsstrahlung).

The book contains a substantial number of typographical errors, but very few in formulas and equations. Some of the material is obscurely presented. I found the section on quasi-linear theory almost impossible to follow. There are a few errors or omissions in the presentation. For example, in the derivation of the Lawson criterion, the energy confinement time is defined, but is called simply the "confinement time," and it is asserted that it is the plasma confinement time. Magnetic surfaces are defined and methods for finding them are discussed, but it is not pointed out that they do not always exist.

In summary, this book covers the material promised in its title. It is as suitable as any single text I know of for a course giving a complete basic coverage of plasma physics. I am still hoping to see an even better one.

Keith R. Symon is a professor of physics at the University of Wisconsin-Madison. He is author of a well-known undergraduate textbook on mechanics. After making a number of contributions to particle accelerator theory, including orbit theory, beam stacking, and colliding beams, he has been interested in plasma physics since about 1968. He is currently working on the theory of plasma stability. He has taught courses and seminars in plasma physics, both at the introductory and graduate levels.