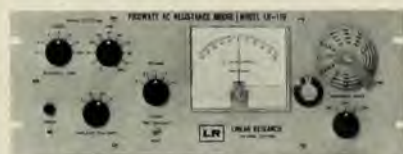
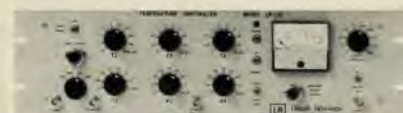


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and polarization maps of radio galaxies obtained by the technique of aperture synthesis. It seems to me that observations of the morphology of radio galaxies are central to any discussion of them.

Pacholczyk's treatment of the theory of incoherent synchrotron spectra is a concise summary of the long derivations presented in *Radio Astrophysics*. The present volume is not self-contained on this subject, since the reader must make repeated reference to the earlier book for the basic equations. The important subject of circular polarization has been significantly expanded over the earlier volume. The graphical examples of the different absorption and evolutionary features that can be expected in both the flux density and polarization spectra of radio sources are especially helpful, although no observational examples are given. The book contains appendices of constants that will be valuable to those interested in doing quantitative calculations of source spectra. Pacholczyk also presents an extensive and very useful set of bibliographical notes at the end of each chapter. One thing I found particularly annoying, however, was the complete absence of references in the text; it was frequently not obvious on which paper in the bibliography the author was basing his statements.

The transfer of polarized radiation in a magnetoactive plasma, a field in which Pacholczyk has written several papers, is presented in an entirely mathematical fashion with little physical insight. His derivations of the hydromagnetic equations and the conditions of hydromagnetic stability are very brief.

Probably the essence of the book is its treatment of the fundamental question concerning the confinement and structure of the ejected radio-emitting plasmoids. The author presents a pedagogical derivation of the popular dynamical (ram) pressure confinement model for different equations of state and including the expansion of the plasmoid itself. The alternative beamed model of radio galaxies that is currently receiving a great amount of attention receives an inadequate one-page discussion.

I was rather surprised to see the final chapter devoted to compact radio sources and models to explain their flux-density variations. I would have thought this to be the major topic of the promised third book in the series that is to be devoted to quasi-stellar sources and the evolution of their radio emission. Pacholczyk's treatment of this topic is greatly slanted to his own published model, which involves betatron and Fermi acceleration of the relativistic electron. Here, for the only time in the book, he compares a theory with actual observations but unjustifiably concludes that the data verifies his model. The radio outbursts in all sources known to me either reach a maximum simultaneously at adjacent radio

frequencies or reach their maxima at later times at progressively lower frequencies. Pacholczyk's model predicts that some outbursts will peak first at the lower frequency and shows the example of the quasar CTA 26. It is evident from the large scatter in the data that simultaneous maxima are also consistent with the observations, a conclusion supported by my own observations of this source.

*Radio Galaxies* is more suitable for specialists already familiar with the subject, rather than for people desiring a text to introduce them to the field. The price of \$27.50 is far too excessive, especially since the book has a typewritten format rather than being typeset. This high price combined with its specialized usefulness will prevent *Radio Galaxies* from populating the bookshelves of many graduate students and professional astronomers.

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## An Introduction to Controlled Thermonuclear Fusion

M. O. Hagler, M. Kristiansen

188 pp. Lexington (Heath), Lexington, Mass., 1977. \$17.00

During the last decade of successful fusion research, as often happens in rapidly developing research areas, a bewilderingly large amount of new knowledge has accumulated in many specialized journal and review publications. At the same time, however, a serious dearth has developed of introductory books summarizing and evaluating this knowledge for non-specialized newcomers or for people working in a special area of fusion research but interested in gaining a wider perspective of the problems and present status of the entire fusion effort. It is this void that the above booklet tries to fill.

In a first approximation, the book can be considered an abbreviated update of Samuel Glasstone and Ralph Lovberg's classic introductory book *Controlled Thermonuclear Reactions* (1960) (although with a strongly reduced emphasis on general plasma physics). Compared with Terry Kammash's recent *Fusion Reactor Physics: Principles and Technology* (Ann Arbor Science, 1975), the much smaller new book puts more emphasis on giving a good overview of the present status of the various concepts rather than to treat scientific details.

Corresponding with this aim, Marion O. Hagler and Magne Kristiansen first briefly describe the basic facts and requirements relating to thermonuclear-energy generation and to the confinement of plasmas in magnetic fields, and review the major engineering problems and pa-

parameters governing the design of a fusion reactor. They then devote the main part of the book entirely to explaining and evaluating the basic principles, physics, problems and present status of development of various reactor concepts presently under investigation. In this part, a large section, leading up to a very useful comprehensive list of parameters for the large experimental and reactor designs presently envisioned or in construction, is devoted to tokamaks—the system that is clearly the most successful so far. Other major concepts—like the magnetic mirrors and pinches, and also an interesting variety of ten exploratory concepts, ranging from Bumpy Torus and Astron to the laser-heated solenoid—are given space roughly according to the size of the respective present research effort. Unfortunately, however, the important area of inertial fusion (laser or charged-particle beams) is treated only very briefly. Also, the potentially important area of fusion-fission hybrid systems is essentially omitted.

Throughout the book, the authors make their explanations and evaluations by briefly developing a semiquantitative description of the physical processes involved rather than by exhibiting the more customary formalistic derivations. This procedure, though obviously not very rigorous scientifically, permits the attentive reader—even if he is uninitiated at the beginning—to acquire quite quickly a useful, although of course still quite basic, understanding of a surprisingly wide range of modern concepts and results, and of their importance for the prospects of thermonuclear fusion. Hagler and Kristiansen present additional useful facets for a next-deeper level of understanding in a well developed system of footnotes. A fluid, often even colloquial writing style helps to increase the attention span of the reader.

A certain drawback of the book, I feel, lies in its not so well developed organization. In particular, it appears that some of the basic plasma physics that is used at more than one place would better be collected in the respective introductory chapter. Also, most of the appendices following the various chapters appear out of place: Some of this material could easily be incorporated in the main text, while other parts do not add much to the overall understanding at this level. In addition, specialists in various areas may find some distraction in a somewhat larger-than-usual number of incidents of clear sloppiness or outright mistakes in the details of some explanations. (The description of our own effort happens to be one example.)

Overall, I feel that the book—although not spotless—clearly is a valuable addition to the otherwise rather sparse book market on fusion. I expect that it will prove really useful for the intended audience, and also for a significant number

of more advanced readers. In addition, it appears that the book would be an excellent choice as a complementary text for many college courses on plasma physics that tend to focus on the mathematically formalistic base and to show too much benign academic neglect for many of the important physics and engineering aspects presented in this book.

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## book notes

**Handbook of Optics.** W. G. Driscoll, ed. 1172 pp. McGraw-Hill, New York, 1978. \$55.00

*Handbook of Optics*, prepared specifically for optical systems designers, is a one-volume source of technical data in the field of optics. Sponsored by the Optical Society of America, the book covers, among other things, topics such as lens design, optical materials, light detectors, thin films, electronic detectors, photographic materials, image tubes, optical fibers, light measurement systems, eyes and vision, optical instruments for metrology, optical modulators, colorimetry, polarization and spectroscopy.

**Handbook of X-Ray and Ultraviolet Photoelectron Spectroscopy.** D. Briggs, ed. 398 pp. Heyden, Philadelphia, 1977. \$60.00

The contributors to this volume have attempted to provide the essential principles of x-ray and ultraviolet photoelectron spectroscopy, particularly for newcomers to these fields. Topics covered include spectrometer design, calibration and performance, sample preparation and handling in the major fields of investigation, interpretation of spectra and the kinds of information that can be obtained with these techniques. Those investigators already established in these fields may find the comprehensive reference lists and appendices useful.

**The Chamber of Physics.** G. Pipping. 250 pp. Almqvist and Wiksell, Stockholm, 1977. \$13.00

This volume contains a catalogue of instruments in the History of Science Collections of the Royal Swedish Academy of Sciences in Stockholm. Gunnar Pipping, deputy keeper of the Swedish National Museum of Science and Technology, has preceded the catalogue with chapters on two of the sources of the Collections: the Stockholm Observatory and its instruments and the *Apparatus Physicus*, or Chamber of Physics, of Johan Carl Wilcke (1732–96), the Academy's Thamian Lecturer in Experimental



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69