lisionless, plasmas and of enhanced nonclassical transport of plasmas across magnetic field lines. The first volume deals with velocity-space instabilities of a non-Maxwellian, spatially uniform plasma, and could broadly be said to address itself to the former type of anomaly. The second volume deals with instabilities of a Maxwellian, but spatially nonuniform, plasma and is thus addressed to the latter type of anomaly. In both volumes, all the important original material up to 1970 is covered. Thus, for example, the second volume ends with a discussion of trapped-particle effects, which are currently a subject of active research in connection with the Tokamak program.

The most valuable feature of these volumes is their completeness. Essentially all significant known plasma modes are derived and discussed, with all destabilizing mechanisms exhaustively cataloged. Although the books contain no index, the material is sufficiently well organized and the notation sufficiently transparent that they are easy to use for reference purposes. Each chapter ends with an annotated bibliography of original papers. This reviewer has been told that the books are very popular in the Soviet Union, especially among experimental plasma physicists, who use them as source books of plasma theory. They should prove equally valuable in the United States.

PAUL H. RUTHERFORD
Plasma Physics Laboratory,
Princeton University,
Princeton, New Jersey

Planetary Atmospheres

Aeronomy. P. M. BANKS and G. KOCKARTS. Academic Press, New York, 1973. Two volumes, illus. Part A, xiv, 430 pp. $28. Part B, xvi, 356 pp. $24.

In the preface to this book, the authors define aeronomy as the study of the composition, movement, and thermal balance of planetary atmospheres. The book discusses the physics and chemistry of the earth's atmosphere in the height interval from about 50 to several thousand kilometers, with references to other regions in space when appropriate. It is neither a collection of empirical facts and observations nor a historical survey of the field, but rather an attempt to develop a mathematical description of the physical and chemical processes responsible for observed atmospheric behavior. More precisely, it provides adequate tools for simple as well as sophisticated modeling studies of the atmosphere. In fact, I think the underlying theme of this book is the evolution and current status of upper atmospheric modeling.

It is impractical to develop the subject of aeronomy in a logical, sequential fashion from first principles because this approach would require solution of the coupled equations for conservation of mass, momentum, and energy for all constituents of the atmosphere, both neutral and ionized. A substantial portion of the book is devoted to a detailed explanation and interpretation of models that provide a reasonable description of selected regions of the atmosphere, for example, the thermosphere or the exosphere, or of certain selected parameters that characterize the atmosphere, for example, the neutral temperature or the electron and ion temperatures. The assumptions adopted in each model are discussed, and the parameters included in the various terms are described in detail. The book achieves a satisfying blend of physical description, mathematical development, and numerical results of model computations, in which observations serve as starting points as well as tests for the models. The emphasis on the comparison of modeling results with observations is illustrated by the presentation of not just one set of altitude profiles of neutral constituents, but a series of results indicating the effects of a range of exospheric temperatures on these profiles. Through this approach, the reader gains some feeling for the sensitivity of the results to various input parameters in the model, leading to an insight into the mechanisms found in the real world.

The major topics covered include solar radiation, photon absorption by the atmosphere and photoionization, all relevant atomic, molecular, and ionic collision processes, chemical reactions of aeronomic importance, transport processes in the neutral and ionized atmospheres, and thermal processes. Discussion of the airglow, the optical radiations resulting from aeronomic processes, is woven into several chapters. Since the book does not treat effects of energetic particle bombardment on the atmosphere, there is only passing reference to the aurora.

At the end of each chapter is a good list of references. This is an important part of the book because it was impossible for the authors to provide the complete background for each concept and each equation introduced. The reference lists draw attention to the diversity of disciplines in aeronomy.

The last six chapters, 208 pages, are devoted to the ionized portion of the atmosphere, the formation of the ionosphere and the physical processes associated with it. These chapters were the most satisfying to read, in part because the discussion could draw on all the preceding material, thus achieving a level of authoritative completeness that the early chapters could not claim.

This book is the most ambitious and comprehensive work on aeronomy to date, and it will probably be unequaled for some years.

M. H. REES
Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder

Laser Advances

Dye Lasers. F. P. SCHÄFER, Ed. Springer-Verlag, New York, 1973. xii, 286 pp., illus. $25.10. Topics in Applied Physics, vol. 1.

Dye lasers provide the capability of generating continuously tunable coherent radiation across the 330- to 1000-nanometer spectral range. Their impact is yet to be fully appreciated, but it is fair to say that tunable dye lasers are leading to a revolution in spectroscopy and laser chemistry. The enormous power and spectral brightness of dye lasers compared to previously available incoherent sources have led to measurements on the time scale of picoseconds and to spectral resolution of better than 1 megahertz. Chemists have learned to establish nonequilibrium population levels by optical pumping, to selectively enhance chemical reaction rates, and recently to effect laser isotope enrichment with a photon utilization that approaches unity. The economic implications of these research advances are already apparent. The advances in linear and nonlinear spectroscopy are equally impressive. This book provides an overdue review of all these developments.

The book consists of five chapters, each written by one (or two) authors. An introductory chapter by Schäfer precedes the more specific chapters. The use of a common reference list and a subject index make this volume much easier to read and use than a mere collection of separate chapters.

Schäfer's introduction is a very clearly

written review of dye lasers and their properties. In chapter 2, B. B. Snavely discusses continuous-wave dye lasers. The descriptions of tuning range, power, and experimental systems are still up to date in this rapidly developing area of dye laser technology.

An important application of dye lasers is the generation of tunable picosecond pulses. In chapter 3, C. V. Shank and E. P. Ippen describe the formation of ultrashort optical pulses and their measurement and applications.

The heart of the dye laser is the dye molecule itself. In chapter 4, K. H. Drexhage, the father of a number of laser dyes, discusses the structure and properties of laser dyes and outlines the future possibilities for new, more efficient, and longer-lived dyes with extended ultraviolet and infrared wavelengths.

The final chapter, by T. W. Hänsch, encompasses the wide applications of dye lasers. The topics considered include pollution detection, selective excitation spectroscopy, nonlinear spectroscopy, quantum-beat spectroscopy, and ultrahigh-resolution spectroscopy. Extension of the dye laser frequency range by nonlinear optical methods to the infrared and the ultraviolet is also discussed. Finally, a topic of recent intense interest, photochemistry and isotope separation, is considered.

I have found the book very useful as a reference and as an up-to-date summary of dye lasers. The only disappointment is the lack of discussion of high-energy flash-lamp dye lasers and their special engineering and design requirements. The book is well written and reasonably priced. It is an excellent introduction into the technology and applications of dye lasers.

ROBERT L. BYER
Microwave Laboratory,
Stanford University,
Stanford, California

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