several meV. It follows that a wide variety of sensors and sensing techniques must be called upon to handle the problems of detection over such a broad range. No matter where within that range one's interest is focused, it is necessary to understand the basic physical principles that underlie successful detector designs. I believe Rieke makes that understanding possible by providing a consistently lucid exposition of those principles for each of the many devices and techniques that are covered—an approach that contributes an overall unity to the book's contents. Nonetheless, each topic covered is sufficiently self-contained to allow a reader to dip into any chapter without having to search for prerequisite information elsewhere in the book.

After the introduction, which contains a discussion of radiometry and some background solid-state physics, there is a chapter on photography. (I was reminded that the classic silver-halide photographic process does have certain limitations, but it is far and away the leader when it comes to packing in the pixels: 10^9 potential picture elements are provided on an 8×10-inch plate.) Semiconductor physics is in the spotlight in the four chapters dealing with intrinsic photoconductors and extrinsic photoconductors, photodiodes, charge-coupled devices and other arrays. Photomultipliers are discussed in the chapter on photoemissive detectors.

Thermal detectors, although slow in frequency response, have always been valuable because of their wide wavelength range. They are covered in a chapter titled "Bolometers." Since the latter are really a subclass of thermal detectors, I thought this organization a bit odd. In that same subject area, I would have preferred a more extensive treatment of pyroelectric detectors; a single page seems insufficient.

I was pleased that the author did not neglect electronics and circuitry. He has a chapter on amplifiers and readouts in which he discusses the importance of, for example, proper transimpedence amplifier design to photodiode operation and similarly for integrating amplifiers *vis-à-vis* CCD arrays. There is an obvious electronics connection to the coherent receiver, defined by Rieke as a "device that measures the field strength of the incoming photon—that is, that has the potential to measure and preserve phase information." Within that category is the heterodyne receiver, familiar to many from its use in microwaves and radar; perhaps not as well known is its role at shorter wavelengths. There is a chapter devoted to submillimeter- and millimeter-wave heterodyne receivers and another on visible and infrared applications. In both cases, important receiver components, such as the mixer, local oscillator and intermediate-frequency amplifier are analyzed and evaluated. Superconductors make their first appearance in the book in the discussion of SIS (superconductor–insulator–superconductor) mixers.

As might be expected, the literature on the extensive subject of low-light-level detectors is voluminous, but it is widely diffused in space and time. Rieke has addressed that problem by providing in a single source a comprehensive, up-to-date overview of the field. Whether used as a text or a reference, his book would be an invaluable addition to the professional's bookshelf.

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Space Plasmas: Coupling Between Small and Medium Scale Processes

Edited by Maha Ashour-Abdalla, Tom Chang and Paul Dusenbery
American Geophysical Union, Washington, D.C., 1995.
Geophysical Monograph 86
390 pp. $80.00 hc
ISBN 0-87590-043-7

A space plasma potpourri! Maha Ashour-Abdalla, Tom Chang and Paul Dusenbery have wrapped 40 papers into seven categories, maintaining a focus on the coupling between small- and medium-scale processes. *Space Plasmas: Coupling Between Small and Medium Scale Processes* complements another recent American Geophysical Union monograph released in 1994, *Solar System Plasmas in Space and Time*, edited by James Burch and J. Hunter Waite Jr, which focused on highly structured and dynamic phenomena.

Many of the phenomena considered in the papers collected by Ashour-Abdalla, Chang and Dusenbery are characterized by them as "fluctuating, nonequilibrium or turbulent," and the relevant physical processes in determining such behavior are "stochastic, quasi-linear, nonlinear, inhomogeneous or nonlocal." Together, they demonstrate the way the field of space plasma physics has significantly matured over the past 10 to 20 years. Although the number of unsolved problems is quite literally astronomical (space plasmas and space physics being part of modern astronomy along with planetary science and astrophysics), observations and phenomenology have been replaced by an effective synergism of theory and simulation, modeling, experiment and observation. Among the many gems that exhibit such synergism in this collection, the paper by the late Oscar Buneman and his colleagues is especially noteworthy. They carried out simulations of solar wind–magnetosphere interactions using a three-dimensional, electromagnetic particle code. This kinetic model captures some of the basic physics, and yet it clearly shows the problem of scaling that limits most kinetic simulations to the realms of micro- or mesoscale processes. Buneman's outstanding contributions to plasma physics and computational modeling are evident throughout this volume, and his impact on this field will be felt indefinitely.

A short version of James Chen's seminal paper on nonlinear dynamics in the magnetotail ("Nonlinear Particle Dynamics in the Magnetotail," *J. Geophys. Res.* **97**, 15 011, 1992) is included. Such nonlinear dynamical effects can be both instructive and fascinating in man-made laboratories. However, their implications become astonishing when considered over the enormous scale of the highly coupled space plasmas of Earth's magnetosphere. As noted by Chen and coauthor Daniel Holland, "The magnetosphere is made up of many distinct regions but exhibits globally coherent behavior governed by large-scale fields and collisionless charged particles." Indeed, recent observations indicate that the magnetosphere acts as a self-organized critical system that, for certain key parameters, exhibits low-dimensional behavior. The prospect of near-term predictability suggested by such results has given new momentum to the vision of real-time "space weather" predictions.

Space plasma physics is a vast, open field in which research is just beginning to tackle such key problems as reconnection and nonlinear turbulence, yet clear progress is being made, as shown by the excellent set of papers on compressible as well as incompressible magnetohydrodynamic simulations that begins this volume. The multifarious threads by which kinetic and mesoscale processes in a space plasma contribute to the dramatic macroscopic effects evident in solar-wind turbulence, reconnection and magnetospheric transport and convection are effectively illustrated by the papers in this volume. Because of this sustained focus on micro-

and mesoscale plasma processes, this monograph may be more useful than most to researchers in other fields. For example, one new and novel algorithm for the numerical simulation of hot, collisionless plasmas is presented by David Nunn of the University of Southampton. This efficient, low-noise and simple algorithm is very general and is applicable to many plasma systems in which collisions can be neglected.

Any edited collection of this type can suffer from a lack of focus when covering such a complex, multidisciplinary field. This monograph would have benefitted by inclusion of a unifying paper to bring all the threads together, yet the tapestry has unity, and a careful reading is well rewarded.

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