

with cross references to the subject index. Given the audience Mills is attempting to address, these additions would add greatly to its usefulness.

I recommend this book to any first-year graduate student who may wish to learn about the opportunities of this exciting field. But to really learn what is going on, or what is involved in the subject, the student will need to be guided by a book that goes into greater details.

RICHARD R. FREEMAN
University of California, Davis

Galaxy Formation

▶ Malcolm S. Longair
Springer-Verlag, New York, 1998.
536 pp. \$64.95 hc
ISBN 3-540-63785-0

The discipline of cosmology—extragalactic astronomy is one of the most rapidly evolving fields in astronomical research. During the last three decades it evolved from the search for three numbers—the Hubble constant (H_0), the density parameter (Ω_0), and the deceleration parameter (q_0)—to a full-fledged quantitative science with considerable predictive power and substantial impact on such other topics in physics as particle physics.

Of these three decades, the most recent one has probably been the most fruitful, mainly because of the breathtaking images captured by the Hubble Space Telescope, but also because of the advent of other superb research facilities during that time. Those facilities include the Keck 10 m telescopes and space probes such as ROSAT (Roentgen (x-ray) Satellite) and COBE (Cosmic Background Explorer) to name only a few. Actually, one could argue that a similar if not even larger boost still lies ahead, triggered by the large number of 8 m telescopes that are going to be dedicated in the next few years and such new satellites as SIRTf (Space Infrared Telescope Facility) and MAP (Microwave Anisotropy Probe), and, in the somewhat more distant future, the Planck and the NGST (Next Generation Space Telescope).

To write a textbook at the graduate level on such a rapidly evolving subject is a formidable challenge. This challenge has been met by about a half-dozen textbooks, all of them excellent and none older than about five or six years. Some appeared as recently as 1998.

Malcolm Longair's *Galaxy Formation* is a very nice addition to that pool of textbooks. Despite its title, the book actually covers pretty much all of extragalactic astronomy and cosmology. Among the smallest textbooks by mass

(it's still suitable for your carry-on luggage), it nonetheless offers one of the most comprehensive descriptions of the topic, in particular where observational data are concerned. For example, it gives a 20-page crash course on general relativity, but one also finds the Hubble Galaxy classification scheme, mass estimates of galaxy clusters using lensing and x-ray data, linear and nonlinear theory of structure formation, and the physics of the cosmic microwave background.

Although many topics are covered, Longair never fails to place the results within the big picture. Of course, one cannot expect every topic to be derived with the depth and rigor of a theoretical physics textbook, but Longair knows how to use physical intuition to comfort the reader who is stepping into unfamiliar terrain.

Besides completeness, it is also the most up-to-date textbook. Even very recent developments are included, such as supernova projects to measure cosmological parameters, the Hubble Deep Field, the clustering of the so-called Lyman-break galaxies (a galaxy population at redshift 3), and the paradigm shift in explaining the Lyman-alpha forest based on the outcome of large hydrodynamical simulations.

The only weakness I could identify is, ironically, in the topic of galaxy formation itself, which is discussed somewhat too briefly. Some recent developments that involve numerical simulations using N-body and gas dynamical techniques, as well as the so-called semianalytical or phenomenological galaxy formation models, are hardly mentioned, even though these topics have made up a fair share of the literature of the last couple of years.

I very much enjoyed reading this book, and I am sure I will make use of it the next time I teach a cosmology graduate course, as both a textbook for the students and a guide in preparing my lectures.

MATTHIAS STEINMETZ
University of Arizona
Tucson, Arizona

Physics of the Space Environment

▶ Tamas I. Gombosi
Cambridge U. P., New York, 1998.
339 pp. \$74.95 hc
ISBN 0-521-59264-X

Space physics, narrowly defined as the study of Earth's plasma environment, has had an identity crisis throughout its relatively brief existence as a discipline: ▶ The limited and often serendipitous nature of the data requires the re-

search style of an astrophysicist.

▶ However, the *in situ* observations and instrumentation that are central to the field are quite different from the remote observations and instrumentation of astronomers.

▶ Compared to neutral gases, the wealth of additional phenomena and the complexity associated with magnetized plasmas and their interaction leave the space physicist little in common with the atmospheric scientist.

▶ Although the phenomena studied in space physics are ultimately important to astrophysics, the intimate measurements of plasma properties provide a greater commonality with the methods of the plasma physicist.

Tamas I. Gombosi's *Physics of the Space Environment* cuts through this diversity to deal with the interpretation of space physics observations. The book is intended for well-motivated graduate students and research scientists and engineers. It is based upon graduate-level courses taught by the author in the College of Engineering at the University of Michigan. Although the book does not delve into numerical modeling, the author's interest in this area is evident throughout.

The book emphasizes physical processes rather than phenomenology. In particular, it stresses the application of transport theory to the space environment. The reader is assumed to be proficient in undergraduate physics and mathematics through tensor algebra, complex variables, statistics, and the solution of basic ordinary and partial differential equations. Knowledge of elementary chemistry and astronomy is also helpful. Terms that are not part of the standard physics curriculum, such as "spectral type G2V" and "type IV radio emission," are sometimes used without explanation.

The text is divided into three parts. There is no overview or historical introduction. (A reader will have to look elsewhere for historical perspective.) Part I presents the theory of gases and plasmas. This includes single-particle orbit theory, the Boltzmann equation and collision terms, the fluid and magnetohydrodynamic equations, basic MHD and plasma waves, shock waves and discontinuities, and energetic particle transport. Part II is devoted to aeronomy, the physics and chemistry of Earth's upper atmosphere. The neutral atmosphere, the ionosphere, the aurora, and airglow are covered. Part III addresses the Sun, the solar wind, cosmic rays and energetic particles, and Earth's magnetosphere. Four appendices contain physical constants and summaries of vector and tensor identities and some special functions.

Each of the 14 chapters concludes