## BOOK REVIEWS

**Annual Review of Astronomy and Astrophysics. Vol. 42.** Geoffrey Burbidge *et al.* (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, CA 94303-0139, USA. 2004. 763 pp. Price not mentioned.

This volume begins with a prefatory account by A. Blaauw of his cruise through the world of astronomy. Blaauw is well known for his pioneering contributions in the field of galactic structure and star formation with emphasis on stellar associations. The other 15 articles cover a variety of subjects such as solar system astrophysics (Astrophysics with presolar stardust by Clayton and Nittler; Dynamics of lunar formation by Canup), solar physics (Impulsive magnetic reconnection in the earth's magnetotail and the solar corona by Bhattacharjee), stellar physics (The first stars by Bromm and Larson; Neutron star cooling by Yakovlev and Pethick; Abundance variations within globular clusters by Gratton, Sneden and Carretta; Fine structure in sunspots by Thomas and Weiss, Young stars near the Sun by Zuckerman and Song), dynamical astronomy (Interstellar turbulence I: observations and processes by Elmegreen and Scalo; Interstellar turbulence II: implications and effects by Scalo and Elmegreen; Planet formation by coagulation: a focus on Uranus and Neptune by Goldreich, Lithwick and Sari), interstellar medium (ISO spectroscopy of gas and dust: from molecular clouds to protoplanetary disks by van Dishoeck), extragalactic astronomy and cosmology (GRS 1915 + 105 and the disk–jet coupling in accreting black-hole systems by Fender and Belloni; EROs and faint red galaxies by McCarthy; Secular evolution and formation of pseudobulges in disk galaxies by Kormendy and Kennicutt). This compilation of review articles by eminent workers in their respective fields presents a rich account of these topics, suitable for the broad-based audience working in different areas of astronomy and astrophysics. A brief highlight of these articles is, therefore, in order to better appreciate these reviews.

Solar system astrophysics: Presolar stardust has emerged as a new area of astronomy. Meteorites and interplanetary dust particles contain presolar stardust grains which are solid samples of stars that can be studied in terrestrial laboratories. The stellar origin of the grains is indicated by enormous isotopic ratio variations compared with solar system materials, explainable only by nuclear reactions occurring in stars. Presolar grains include diamond, SiC, graphite, $Si_3N_4$, $Al_2O_3$, $MgAl_2O_4$, $CaAl_{12}O_{19}$, $TiO_2$, Mg $(Cr, Al)_2O_4$, and most recently, silicates. Subgrains of refractory carbides (TiC) and Fe–Ni metal have also been observed. The article on Astrophysics with presolar stardust is an overview of the field from the points of view of both a theorist and an observer, and to indicate the types of arguments and conclusions that presolar grains have uniquely brought to astrophysics. Astrophysical implications of these grains are reviewed for the sciences of nucleosynthesis, stellar evolution, grain-condensation, and the chemical and dynamic evolution of galaxy.

The giant impact theory is the leading hypothesis for the origin of the moon. The article on Dynamics of lunar formation focuses on dynamical aspects of an impact-induced lunar formation, in particular those areas that have advanced considerably in the past decade, including late-stage terrestrial accretion, giant impact simulations, protolunar disk evolution and lunar accretion, and the origin of the initial lunar inclination. Recent developments provide a reasonably consistent dynamical account of the origin of the moon through a late giant impact with the earth, and suggest that the impact-generation of satellites is likely to be a common process in late-stage solid planet formation.

Solar physics: The article on Impulsive magnetic reconnection in the earth's magnetotail and the solar corona reviews recent developments in the theory and simulation of forced impulsive reconnection based on the equations of resistive and Hall magnetohydrodynamics. The main emphasis is on impulsive reconnection dynamics, which involves not only a fast timescale but also a trigger.

Stellar physics: The first stars to form out of unenriched H/He gas marked the crucial transition from a homogeneous, simple universe to a highly structured, complex one at the end of cosmic dark ages. Extending the familiar scheme of classifying stellar populations in the local universe to the extreme case of zero metallicity, the first stars constitute the so-called Population III. The quest for Population III stars has fascinated astronomers for many decades. Recently, the subject has attracted increased interest, both from a theoretical and an observational perspective. New empirical probes of the high-redshift universe have become available, and our ability to carry out sophisticated numerical simulations has improved dramatically. The article on The first stars summarizes the current state of this rapidly evolving field.

Neutron stars are the most compact stars in the universe. They have masses $M \sim 1.4\ M_\odot$ and radii $R \sim 10$ km, and contain matter at supernuclear densities in their cores. Our knowledge of neutron star interiors is still uncertain, and the composition and equation of state of matter at supernuclear densities in neutron star cores cannot be predicted with confidence. The article on Neutron star cooling gives an overview of the current state of the cooling theory and compares it with observations of thermal radiation from isolated neutron stars.

Abundance variations within globular clusters (GCs) and of GC stars with respect to field stars, are important diagnostics of a variety of physical phenomena, related to the evolution of individual stars, mass transfer in binary systems, and chemical evolution in high-density environments. The broad astrophysical implications of GCs as building blocks of our knowledge of the universe make a full understanding of their history and evolution basic in a variety of astrophysical fields. The article on Abundance variations within globular clusters reviews the current status of research in this field, comparing the abundances in GCs with those obtained for field stars, discussing the evidence for H-burning at high temperatures in GC stars, describing the process of self-enrichment in GCs with particular reference to the case of the most massive galactic GC, and discussing various classes of cluster stars with abundance anomalies. In this way, exciting new scenarios are opening where the interplay between GC dynamical and chemical properties is closely linked with each other.

Important physical processes on the sun, and especially in sunspots, occur on spatial scales at or below the limiting resolution of current solar telescopes. Over the past decade, using a number of new techniques, high-resolution observations have begun to reveal the complex thermal and magnetic structure of a sunspot, along with associated flows and oscillations. During this time, remarkable advances in computing power have allowed significant progress in our theoretical understanding of the dynamical processes, such as magnetoconvection, taking place within a sunspot. The review on Fine structure in sunspots summarizes the latest observational results and theoretical interpretations of the fine structure in sunspots.

Until the late 1990s, the rich Hyades and the sparse UMa clusters were the only coeval, comoving concentrations of stars known within ~60 pc of the earth. Both are hundreds of millions of years old. Then beginning in the late 1990s, the TW Hydrae Association, the Tucana/Horologium Association, the beta Pictoris Moving Group, and the AB Doradus Moving Group were identified within ~60 pc of the earth, and the eta Chamaeleontis cluster was found at 97 pc. These young groups (ages 8–50 m.y.), along with other nearby young stars, will enable imaging and spectroscopic studies of the origin and early evolution of the planetary system. The article on Young stars near the sun tells the story.

Dynamical astronomy: Turbulence affects the structure and motions of nearly all temperature and density regimes in the interstellar gas. Interstellar turbulence has implications for the dispersal and mixing of the elements, cloud chemistry, cosmic-ray scattering, and radio-wave propagation through the ionized medium. The two-part review on Interstellar turbulence summarizes the observations, theory, and simulations of interstellar turbulence and its applications in many fields of astrophysics. The first part discusses the dense cool phases of interstellar matter, energy sources, turbulence theory and simulations. The second part considers the effects of turbulence on element mixing, chemistry, cosmic-ray scattering and radio scintillation.

Planets form in the circumstellar disks of young stars. The article on Planet formation by coagulation: a focus on Uranus and Neptune reviews the basic physical processes by which the solid bodies accrete each other and alter each others' random velocities, and provide order-of-magnitude derivations for the rates of these processes. The first half of the review deals with the basic physical processes responsible for the evolution of the masses and velocity dispersions of bodies in a protoplanetary disk. The second half is concerned with the growth of planets starting from a disk of planetesimals.

Interstellar medium: A study of the characteristics of the circumstellar gas and dust is key to understanding the origin of stars. Part of this gas and dust ends up in the rotating disk surrounding young stars, and forms the basic material from which icy planetesimals, and ultimately rocky and gaseous planets, are formed. Spectroscopic surveys of star-forming regions at different evolutionary stages, therefore, provide quantitative information on the building blocks available during planet formation. The Infrared Space Observatory (ISO) has provided the first opportunity to obtain complete infrared (IR) spectra 2.4 to 200 μm unhindered by the earth's atmosphere. The article on ISO spectroscopy of gas and dust: from molecular clouds to protoplanetary disks gives an overview of the subject.

Extragalactic astronomy and cosmology: Jets are highly relativistic, collimated, powerful outflows, and seem to be an ubiquitous feature of accreting black holes, and yet remain poorly understood. GRS 1915 + 105 is the first stellar-scale, highly relativisitic jet source identified, which is a key system for our understanding of the disc–jet coupling in accreting black-hole systems. Comprehending the coupling between inflow and outflow in this source is not only important for X-ray binary systems, but also has a broader relevance for studies of active galactic nuclei and gamma-ray bursts. The article on GRS 1915 + 105 and the disk-jet coupling in accreting black-hole systems reviews the observational properties of the system, and places it in context by detailed comparison with other sources. It constructs a simple model for the disc–jet coupling, which may be more widely applicable to accreting black-hole systems.

The chapter on EROs and faint red galaxies reviews the properties of faint IR-selected field galaxies and the extremely red colour-selected populations in particular. These populations are a mix of passively evolving stellar systems and heavily obscured star-forming galaxies. The star-forming component appears to constitute 20–50% of the population depending on the magnitude and colour cuts employed. The remaining objects are a mix of passively evolving ellipticals and early-type disk galaxies. The passively evolving red galaxies are strongly clustered in space and are likely the high-mass, high-luminosity end of the elliptical galaxy progenitor population at redshifts between one and two. These galaxies have masses and space densities that appear to be in conflict with late-forming hierarchical galaxy-formation models. The red galaxies appear to be a population that is distinct from the moderately star-forming Lyman–Break galaxies, but may be related to the star burst population at $z > 2$ seen in deep submillimetre surveys. The article on Secular evolution and formation of pseudobulges in disk galaxies reviews internal processes of secular evolution in disk galaxies.

All the articles in this volume present an up-to-date account of a variety of topics and list extensive references for further reading, which make this issue broad-based for one and all working in astronomy and astrophysics.

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**Multiscale Methods in Quantum Mechanics: Theory and Experiment.** Philippe Blanchard and Gian Dell'Antonio (eds). Birkhäuser, Boston, USA, 2004. 220 pp. Price not mentioned.

The book under review is a collection of papers presented at a meeting on 'Multiscale Methods in Quantum Mechanics: Theory and Experiment' held at the Academia dei Lincei in Rome during 16–20 December 2002. The theme of the meeting was to discuss the mathematical physics techniques of studying quantum mechanics of slow and fast degrees of freedom and other multi-scale phenomena. Discussion of the relevant experiments formed an integral part of the meeting. The quantum phenomena discussed ranged from the ones of interest in the foundations of quantum mechanics to those in the condensed matter physics and the quantum theory of structure of pyramidal molecules. The issues discussed included the questions of stability of three- and four-body Coulomb systems (by Martin), the quantum Boltzmann equation (by Pulvirenti), time evolution of bound states of classically non-integrable systems (by Robert), scattering of many non-interacting particles accounting for the exchange symmetry (by Dürr and Teufel), Schrödinger equation for double-well potential with a nonlinear perturbation (by Sacchetti) and asymptotic wave function of two particles interacting by δ-function potential (by Teta). The open problems associated with coloured