Book Reviews

Galactic Supernova Remnants

The Crab Nebula and Related Supernova Remnants. MINAS C. KAFATOS and RICHARD B. C. HENRY, Eds. Cambridge University Press, New York, 1985. xvi, 285 pp., illus. $39.50. From a workshop, Fairfax, VA, Oct. 1984.

It was certainly time (when the workshop that led to this volume was held) for another major conference on the Crab Nebula, that most famous and still easily the most important of all galactic supernova remnants. Since the previous symposium on the subject in 1970 the object had aged by a substantial 1.5 percent; this long baseline alone facilitated a direct measurement of the rate of decline of the radio luminosity—an important evolutionary parameter (which turns out to be within theoretical predictions, though just barely). Of considerably greater importance, of course, are the wealth of observational data that has been accumulated and the attendant theoretical advances that have occurred on the subject during the last decade and a half. These include some spectacular new images of the Crab jet (discovered in 1970) in a variety of wavelength bands, observational studies of the composition of the nebula, theoretical studies of the progenitor star, the emergence of a broad class of supernova remnants that (largely on the basis of radio and x-ray morphology) appear "Crab-like," and finally the discovery (only several months before the conference) of the remarkable remnant 0540-69 in the Large Magellanic Cloud, which bears such a close relationship to the prototype that one of the conferees can refer to it, with some justification, as being "more Crab-like than the Crab."

Overall this collection of papers is quite successful and (owing in part to its favorable timing) will be greatly appreciated as a reference by workers in the field and other interested astrophysicists. The most valuable contributions are the reviews, two good examples being "The composition of the Crab" by K. Davidson and "Evolution of the Crab Nebula" by R. Chevalier. (The latter review is related to a significant nonresult of the conference: the purported "shell" around the nebula—which would have fit well with our expectations for a type II supernova explosion—has apparently disappeared.) A nice discussion by F. Coroniti and C. Kennel of their magnetohydrodynamic model should prove helpful to anyone trying to understand their rather daunting formal papers on the subject. A few observational papers that merely duplicate material available in journals are less important but still have some convenience value. There is a useful appendix (by K. Weiler) cataloging the related objects of the title.

A minor annoyance is that the volume has the full complement of typographical and related errors that one has come to expect in photo-offset conference proceedings. (In the most embarrassing of these, at the end of one paper someone has apparently transcribed instructions for typing the references—which were then not followed.) The choice of the Vela pulsar field—not labeled as such—for the cover design seems curious (even if it is somewhat Crab-like), particularly in view of the striking photographs of the Crab jet reproduced within the volume, and will likely confuse a lot of people.

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Astrophysics

Relativistic Astrophysics. MAREK DEMIAŃSKI. Pergamon, New York, and PWN–Polish Scientific Publishers, Warsaw, 1985. xii, 341 pp., illus. $45. International Series in Natural Philosophy, vol. 110. Translated from the Polish edition by Antoni Fol.

Major astronomical discoveries in the 1960's—the cosmic background radiation, the quasars, the pulsars, and the cosmic x-ray sources—heralded the application of general relativity theory to astrophysics, and there has been vigorous development of relativistic astrophysics ever since. General relativistic effects are significant only in certain problems in astrophysics, but these tend to be ones of great fundamental interest: the end states of stellar evolution and the structure of the universe. When a theoretical astrophysicist does need general relativity, he or she is likely to find it in this book.

The main theme is the application of gravitational physics, particularly general relativity theory, to astrophysics. There are short side trips into other areas of physics in order to develop necessary topics, such as properties of matter in neutron stars or in the early universe, but gravity is the main subject. The principal applications are to stellar equilibrium and collapse, neutron stars, black holes, gravitational waves, and cosmology.

The pedagogical style is that of the famous course on theoretical physics by L. D. Landau and E. M. Lifshitz. The author moves quickly and does not pause for long derivations or explanations; he depends on a certain sophistication on the part of the reader. There are a lot of equations (but, alas, no exercises). Many physicists and astrophysicists will like this style, but it can be hard on the student or the specialist from another field. There is a quick introduction to general relativity, but most readers will find it necessary to learn relativity elsewhere before tackling this book. As for the main applications, this or that subject is covered in greater detail in other books, monographs, and review articles, to which the author frequently refers. However, no one book has the same coverage as this one, and the book serves a useful purpose in bringing together a coherent set of topics.

The book is up to date as of its original publication date of 1978, but inevitably it is now out of date in significant respects. Theoretical cosmology—and the overlap between cosmology and theoretical elementary particle physics—have seen enormous developments over the last decade. However, most of the author's material is of permanent significance and needs only to be added to, not supplanted, in light of recent developments in the field.

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Mathematical Physics

Gravitational Physics of Stellar and Galactic Systems. WILLIAM C. SASLAW. Cambridge University Press, New York, 1985. xviii, 491 pp., illus. $90. Cambridge Monographs on Mathematical Physics.

In the last 20 years there has been a revival in the application of the Newtonian theory of gravitation to a variety of astronomical phenomena. This was motivated on the one hand by observations of globular clusters, of spiral density waves in galaxies, of the violent events that take place in galactic nuclei, and of the large-scale structure of the universe as it is delineated by the clustering of galaxies and on the other hand by the ability to simulate these systems efficiently on computers, by integration of the equations of motion for many thousands of particles.

Saslaw's book addresses the whole of Newtonian gravitational physics. It is the first treatise on the subject to appear in a long time. Although astronomical applications and computer simulations of N-body systems are discussed, the main emphasis is on the physics of gravitation and not on the modeling of particular astronomical objects. The book is written in a pleasant and informal style and contains many apt quotations. Most derivations are preceded by an introduction to the underlying physical ideas, and the derivations are usually transparent.