BOOK REVIEWS

Gamma Ray Theory

Cosmic Gamma Rays. By Floyd William Stecker. Pp. xi+246. (Mono: Baltimore, Maryland, 1971.) \$12.50.

In the past few years a new type of astronomy has been born which could shed new light on many of the astrophysical processes taking place in our galaxy and beyond. This is gamma ray astronomy and its significance lies in the information which it might give about the processes in which gamma rays originate and the fact that this radiation provides direct links between the sources and the observer. Indeed, gamma rays might ultimately provide new ways of studying the nature and origin of cosmic rays and the distribution of antimatter in the universe.

It would seem then that the time might be ripe for a good general book on this subject to bring to the scientifically trained reader the purpose, methods and results of the new astronomy and to indicate its astrophysical potential. The book under review does not measure up to these requirements and in fact is rather dull and does little to excite the imagination of the reader. The reason is that it is a collection of research papers on some problems in theoretical gamma ray astronomy and not a general treatment of the subject. Viewed from the point of view of an attempt to develop the theoretical foundation for gamma ray astronomy this is a good book and as such will be most useful to the advanced research worker. Processes which lead to the production of gamma rays are examined from first principles and are developed theoretically in considerable detail. The main emphasis is placed on the most important processes, that is, the decay of the secondary particles (mainly π^0 -mesons) produced in cosmic ray interactions, electron-positron annihilation and proton-antiproton annihilation. Other processes dealt with are Compton and bremsstrahlung interactions, synchrotron radiation and photomeson production. Experimental results obtained so far, for example, the anisotropic distribution of high energy gamma rays in our own galaxy and the

continuous spectrum at energies around 1 MeV, are examined against the theoretical background. It is shown that gamma rays from the galactic disk come from the decay of neutral pions from cosmic ray interactions whilst the extra emission from the galactic centre is an additional source of gamma rays perhaps due to Compton interactions of cosmic ray electrons with the intense infrared radiation field.

Detailed consideration is also given to extragalactic gamma rays and the particular role this radiation could play in the fascinating problem of the existence of antimatter in the universe. Production spectra for various processes are again derived and the results are compared with experimental data where they exist. It is found that extragalactic bremsstrahlung and Compton interactions could provide an explanation of the observed continuous spectrum below 1 MeV. Results for the isotropic radiation between 1 MeV and 6 MeV seem to indicate an extra component which is thought might be gamma radiation from cosmic ray inelastic processes involving extragalactic cosmic ray protons and gas. Such data could lead to information about the state of the universe at an earlier epoch.

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Turbulent Phenomena

A First Course in Turbulence. By H. Tennekes and J. L. Lumley. Pp. xii+300. (MIT: Cambridge, Massachusetts, and London, March 1972.) \$12.50.

Tennekes and Lumley's book is based on material taught to postgraduate students at the Massachusetts Institute of Technology. We can therefore expect a scholarly work in which the title *A First Course in Turbulence* is not synonymous with a very elementary presentation. The title is an accurate description of the contents. If this were our first study of turbulent phenomena we would obtain from this book a breadth of understanding from the outset and appreciate how specific flow behaviour fits into a much wider context.

Following an invaluable introductory chapter on length scales in turbulent flows the authors consider the relevance and failings of eddy viscosity and mixing length models of turbulence. The means of production and sustaining the turbulence are then reviewed in the light of the turbulent energy and vorticity equations, then follow considerations of wakes, jets and boundary layers. The latter part of the book introduces relevant statistical theory and in this context studies turbulent diffusion and mixing. Different readers will have their own preferences but I particularly appreciated the careful discussion on length scales in the introduction. I also found the statistical theory began at an elementary level and was surprisingly readable.

The style of the book is good and is pleasing to present-day British readers in that metric units are used throughout. Each chapter begins with an excellent summary and concludes with an interesting set of examples. Although it is possible to read straight through, it is a book which will be kept for reference purposes on our shelves alongside Townsend and Hinze whose works it complements admirably. A notable feature is in the relationships which are developed in which different symbols are adopted to describe equality, approximate equality, crude approximation and order of magnitude.

The authors have deliberately omitted any discussion of experimental methods of turbulence measurement. Nor are specific methods of turbulent boundary layer prediction included. Neither of these omissions detracts from the book because they are well covered elsewhere. There are a few errors in the text but these are trivial. The authors decided to conclude the book with a short bibliography rather than make specific references. Although this decision is understandable it is rather disappointing. I feel that a much fuller treatment of the physical nature of transition to turbulence would have been in keeping with the rest of this book but perhaps for this I must wait for the authors' second course in turbulence.

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