Astrophysics for Physicists, *Arnab Rai Choudhuri*. Cambridge University Press, 2010, pp. 471 (hc), Price: $60.

The author of this book is a professor of physics at the reputed Indian Institue Science in Bangalore, and is well-known for his work in solar magneto-hydrodynamics. The author feels that astrophysics should be a core course for physicists at a senior undergraduate or beginning graduate level (like condensed matter physics and particle physics), and this book is an attempt to fill this gap. A special attraction of the book is a set of well-designed problems at the end of each chapter that enlarge the scope and usefulness of the book.

Not being an astrophysicist, I shall review this book as someone who teaches statistical mechanics to advanced physics honours undergraduates, with applications to astrophysics. After discussing the different distance scales for interstellar, intergalactic and the visible universe, the introductory chapter gives an account of the experiments that heralded modern astrophysics. Chapter 2 is on the interaction of radiation with matter in relation to astrophysical measurements (analysis of spectral lines, calculation of opacity , radiative transfer through stellar atmosphere, etc). Chapter 3 deals with the basic equations of stellar structure, the energy transport inside a star, and the mass luminosity relation. Chapter 4 starts with nuclear burning (fusion) in stars, and their deaths by supernovae. There is a very readable section on the calculation of the nuclear reaction rates. The crucial role of nuclear resonance in Carbon 12 for its formation through the triple-alpha reaction is discussed.

The next chapter is on the end states of the stellar collapse : white dwarfs and neutron stars. Binary pulsars are discussed at some length. There is a very nice section on X-ray emission from the Accretion disks. The example of Cygnus X-1 is given as an evidence for the black hole. Chapter 6 is on galaxies, interstellar matter and molecular clouds. The latter, the nursery of star formation, are found in the cool dense regions of interstellar matter. The detection of CO through radio signals, and other molecules is a fascinating subject. On the theoretical side, the dynamics of how an initial (almost) uniform distribution of gas may break into fragments is discussed later in chapter 8. Chapter 7 is on stellar dynamics and the Boltzmann equation. It is somewhat specialized, and may not form a part of the core course. The next chapter is on plasma astrophysics, where the basic equations of fluid mechanics are developed to discuss Jean’s instability. The major emphasis, however, is on the exposition of magnetohydrodynamics, and its application to sunspots. This chapter is very well-written, and deserves careful study. Chapter 9 is on Extra-galactic astronomy. The active galactic nucleus, producing a huge amount of energy in a very small volume may be due to a central black hole of 108 solar mass. The implications of this are discussed. The space-time dynamics of the universe (cosmology) is discussed next in chapter 10. No knowledge of General Relativity is needed to follow this chapter, which is based on the Robertson-Walker metric. The next chapter is on the Early universe, covering Primordial nucleosynthesis, cosmic neutrino background, and dark matter. The horizon problem and the inflation theory are discussed briefly. Chapters 12-14 cover general relativity and relativistic cosmology.

I have only a few minor criticisms of the text. On page 32, Eq.(2.29) for the Saha equation is written in an unneccessarily complicated manner, and the symbol P in the denominator

is not defined. The solar neutrino problem is discussed in sect. 4.4.2, but the SNO experiment at Sudbury is only mentioned in passing. A description of the experiment, together with a problem on neutrino oscillations would have clarified the statements in the last paragraph of sect. 4.4. Finally, rather than deriving the standard general relativistic relation for perihelic shift on pages 396-398, perhaps more should have been said about black holes on page 392 in sect. 13.3. There is no mention of the work of Bekenstein, or Hawking radiation in this book. Such criticisms apart, I should make it clear that this book is a major contribution, and largely succeeds in its objective of synthesizing the diverse topics of astrophysics for a core course for physics students. However, in the Canadian setting of an undergraduate semester, the instructor will have to make judicious selections from chapters 1-11, omitting substantial parts.

Rajat K. Bhaduri,
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