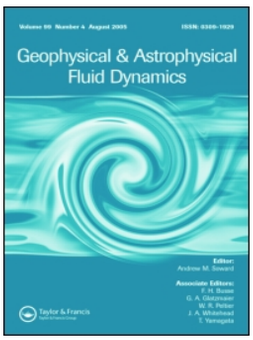

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Magnetohydrodynamics of the Sun

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Book Review

Magnetohydrodynamics of the Sun, by EricPriest, Cambridge, Cambridge University Press, 2014, 576pp., £55.00 hardback, (ISBN 978-0-52-185471-9).

For decades, Priest's book of 1982 on Solar Magnetohydrodynamics has served as an excellent reference to learn about solar MHD. The new book with a slight variant on the title can hardly be though of as an update of that book. Indeed, as the preface already says, it is a complete rewrite. On the observational side, many crucial discoveries have been made that warrant a new general textbook about solar MHD. On the theoretical side, our understanding of the many solar magnetohydrodynamic phenomena has significantly increased, as is reflected in the range and volume of the material presented.

The book conveniently covers many general aspects of astrophysical fluid dynamics that should be taught in any course on solar physics and MHD. Examples include the physics of shocks, waves, instabilities, the solar wind, and of course reconnection, which is a recurrent theme in several chapters. Indeed, not only in the chapter on reconnection itself are spines and separatrices prominent keywords, but also in most of the following chapters on coronal heating, prominences, flares, and even the solar wind, these words belong to the regular vocabulary.

Of course, there are many more topics in solar physics that are not covered or only touched upon, for example helioseismology, MHD turbulence, or polarimetric techniques of magnetic field measurements. Helioseismology is mentioned in passing, but there are now many new developments in spot seismology that could have been useful to include. A presentation of MHD turbulence would have significantly enhanced the chapters on dynamos and coronal heating, both of which were advertised in the preface as major unsolved topics deserving special attention. Furthermore, students in solar MHD should hear at least something about radiative transport and especially polarized emission. After all, this is the most important tool of quantitative magnetic field detection in the Sun.

I quite enjoyed reading the brief history of solar research accomplishments in tabular form. It contains lots of information, some of which I have never seen elsewhere. It focuses mainly on observational discoveries, but it does mention some theoretical advances as well, for example those in helioseismology, sunspots, and dynamo theory, but not, for example, Larmor's early ideas of 1919 that led to Cowling's antidynamo theorem, the alpha effect that is now at the heart of dynamo theory, and mixing length theory, without which we would have no idea about the nature of the convection zone and thus about the ultimate motor of all of solar activity. Indeed, the theoretical discovery of the convection zone starting with early work since the 1930s is not listed either, although some basic aspects are discussed early in the book on page 12. Incidently, the list does mention Stenflo's discovery of kilogauss magnetic fields in the intergranular network, but for the reader to appreciate this fully, some exposure to polarized emission might be a useful suggestion for the next edition of this book.

In various places I would have welcome more detailed derivations that I feel would be useful to present during a lecture. One such example was the section on convective

collapse, where a derivation of the eigenvalue problem and the reduction to the local dispersion relation would have been useful to the student. Another example is the statement that the umbra radiates only about 20–30%, making it 1,000–1,900 K cooler. Of course, this calculation can be done on the back of an envelope, or better with a calculator, but not really in one's head, and so an extra line of maths might be appealing to some of the readers.

The reference to exercises is somewhat misleading, because the link brings one to the page advertising the purchase of the book. However, clicking then on "resources" brings one to the page where one can download not only the sets of problems, but also model solutions. Exercises and especially their solutions are always a nice treat for the students who might otherwise not easily find whether they got it right.

The St Andrews school of solar MHD is world famous and a large number of solar physicists have worked with Eric and have spent time at St Andrews. This book presents an excellent account of the many accomplishments that have either emerged from this school or have been promoted by it. The book will therefore serve as a basic reference of all aspects connected with this large body of work and will provide a valuable reference for many years to come!

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