Magnetohydrodynamics and Turbulence
Alexander Schekochihin, Part III (CASM) Lent Term 2005

SUGGESTED READING

As we move along, I will give you more references to articles, reviews etc. These, as well as specific reading suggestions for individual lectures will be posted in the Course Blog: see http://www.damtp.cam.ac.uk/user/as629/course.html.

I. Magnetohydrodynamics

   — A (mostly) sensible introduction to plasma physics. MHD is covered in Chapters 11-17.

   — A brand new and very thorough and meticulous presentation of the subject. Also written by plasma physicists with applications to astrophysics and to fusion devices in mind.

3. P. A. Davidson, An Introduction to Magnetohydrodynamics (CUP 2001)
   — A very good text written from a non-plasma perspective. A lot of fun to read. The second half of the book is an extensive introduction to engineering/metallurgical applications.

   — A new book (about to come out) by a renowned plasma astrophysicist. I learned MHD from his lectures, so I expect you will find some similarities between my presentation and his.

Here are a few other titles on MHD and plasma physics. You might find it interesting to page through some of these if you want to go beyond (in some cases far beyond) the course material.

1. T. G. Cowling, Magnetohydrodynamics (Adam Hilger Ltd 1976)

   — The bible of MHD instabilities.

   — A classic account of the mean-field dynamo theory. Out of print.

4. E. N. Parker, Cosmical Magnetic Fields: Their Origin and Activity (Clarendon 1979)
   — A monograph by one of the founders of the subject. Out of print.

5. D. Biskamp, Nonlinear Magnetohydrodynamics (CUP 1997)
   — An oft-cited monograph by one of the gurus of the numerical simulations of MHD.

   — A spin-off of the above. A standard monograph on magnetic reconnection.

7. L. Spitzer, Physics of Fully Ionized Gases (Wiley 1962)
   — A classic of plasma physics by the founder of the US fusion program.

   — The bible of laboratory plasma physics. Review articles by the leading scientists. Quality varies, but the book as a whole is a good resource.

II. Turbulence

   — A lucid account of Kolmogorov’s theory is given in §§33-34.

   — A recent book that quickly became a classic reference. It presents Kolmogorov’s theory very
   thoroughly (if in a somewhat formalistic way). Also contains a long chapter reviewing the literature
   and the modern (as of 1995) state of the subject.

   — A compendium of knowledge on turbulence. Everything you ever wanted to know about it but were
   afraid to ask. Very well written.

   — A classic essay on turbulence.


   — An engineering-style monograph.

   — A good monograph on closure schemes, if you must know about them.


III. MHD Turbulence

We do not know very much about MHD turbulence. Close examination shows that we know even less than
we think we do. Consequently there is no standard textbook account of the subject. Here are some books
that more or less pertain to what I will talk about.

   — A review of (the author’s understanding of) the present state of the subject.


   — A somewhat loosely assembled book, which, nevertheless, is worth reading for the wealth of physical
   insights it contains. It is a book on the physics of randomness rather than exclusively on MHD
   turbulence. Small-scale dynamo is treated in Chapter 9.

   — A book on stochastic methods, not on MHD. However, these are very useful things to know for
   someone interested in the subject. A very thorough and systematic treatment. This is for further
   reading, not for the course material.

There are also sections on MHD turbulence in both P. A. Davidson’s books listed above.

If you wish to investigate the origins of my views on MHD turbulence, see links to my papers on
http://www.damtp.cam.ac.uk/user/as629/publist.html.