MAGNETIC FIELDS IN STARS

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Eight one-hour lectures supplemented by approximately eight hours of supplementary reading and eight hours of short problems and exercises. The lectures will be very informal, punctuated by exchanges with the students.

Lecture 1

An overview of the place of magnetic fields in stellar evolution, from star formation to final collapse -- where fields are found, what phenomena they are associated with, what importance they may have.

Lecture 2

Review of the atomic Zeeman effect in atoms, and how this effect may be used to detect and measure a stellar magnetic field.

Lecture 3

Measurements of magnetic fields in the Sun and stars. Review of "polarising optics", including waveplates and polarisers, and how these are used to create polarimeters which may be used to detect magnetic fields. Introduction of the Stokes parameters.

Lecture 4

A review of the magnetic fields found in the Sun, cool main sequence stars, and upper main sequence stars, and of the accompanying phenomena (stellar activity in low-mass stars, unusual atmospheric chemistry and inhomogeneity in more massive stars)

Lecture 5

A review of the basic ideas of radiative transfer. Discussion of the simplest problem of LTE spectral line radiative transfer, the Milne-Eddington model, as a paradigm.

Lecture 6

The equations of transfer for polarised light, using the Stokes parameters. Simple solutions of the equations, and their use for creating LTE model spectra appropriate to spectra of magnetic stars by "spectrum synthesis". The use of synthetic spectra to model the fields of main sequence stars in detail.

Lecture 7

The special case of continuum polarisation produced by really large (megaGauss) fields, and measurement and modelling of fields of white dwarf stars. Brief introduction to the fields of pulsars (magnetised neutron stars).

Lecture 8

Overview of the occurrence and importance of magnetic fields during stellar evolution, from collapse of clouds in the interstellar medium to collapse to final states, and a discussion of the nature of the two main classes of fields (dynamo and fossil) found in stars. Final review of the course.

Assigned reading

Three chapters (by me) from a forthcoming book of lectures ("Stellar Magnetism", eds. C. Neiner & J-P Zahn, EAS Publications), the result of an autumn school at La Rochelle, France in 2007 (about 55 pages). A pdf file will be provided at the beginning of the course.

I will also provide an annotated bibliography of potentially useful and/or interesting articles and reviews, going well beyond the assigned reading.

Assigned problems

It is very important for students to do small conceptual and numerical exercises to make the material of the reading and lectures concrete, and to strengthen and cement understanding of concepts. Some tens of such problems will be given out (but not marked). Solutions for each problem set will be discussed during or after the class following that in which problems are handed out, as desired by the students.

There will not be any required examinations. I may hand out an "exam" for self-evaluation at the end of the course if clamoured for by popular demand.