High Energy Astrophysics: Course Outline

1 Some useful information

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Course Webpage:
http://www.mso.anu.edu.au/~geoff/HEA/HEA.htm

2 What is High Energy Astrophysics?

High energy astrophysics (HEA) is the study of astrophysical phenomena that involve particles of "high energy". Often this refers to photons so that X-ray and gamma-ray astronomy are considered parts of high energy astrophysics, for example.

However, high energy, relativistic electrons are also responsible for low energy emission in the form of radio waves so that parts of radio, infrared and optical astronomy are also considered to be part of High Energy Astrophysics.

High Energy Astrophysics had its origins in the study of cosmic rays and then studies of the energetic component of the interstellar medium of the Galaxy. Now the range of subject matter is very broad and includes supernova remnants, the hot atmospheres of elliptical galaxies, radio galaxies, quasars, jets, black holes and gamma-ray bursters. We shall study various aspects of these phenomena using as a diagnostic base the theory of emission processes such as blackbody emission, synchrotron emission, inverse Compton emission and thermal Comptonisation. This course complements the course on the Interstellar Medium, which primarily involves a study of line emission processes in thermal gas; this course concentrates on continuum processes in non-thermal plasma.

3 Course content, philosophy & administration

- Check out the above link to the course web-page for the lectures which give you a good idea of the course content.
- The lectures will provide a comprehensive introduction to various aspects of High Energy Astrophysics. The notes contain a lot of detail and you will find that they are quite self-contained.
- Lectures on the web page will have a posting date attached so that you can see whether the lecture has been revised.
- The emphasis in this course is on doing problems. You may need to consult the notes for material that is not covered in detail in lectures.
- Tutorials are very important in view of the problem-oriented nature of this course.

- All lecture notes and the problem set will be available via my web page.
- Solutions will be posted when all assignments have been handed in.
- This course is worth 6 units.

4 Prerequisites and/or assumed knowledge

- Cartesian tensors (Comprehensive notes on my web page.)
- A course in electrodynamics at 3rd or 4th year level (Some notes on my web page.)
- Special relativity at 3rd or 4th year level (some acquaintance with the concepts of general relativity would be useful).
- A basic acquaintance with fluid dynamics (See notes on web-page.)

5 Assessment

Assessment is based entirely on the assignments entailing a total of about 40 questions. In order to facilitate feedback I will ask you to hand in about 3-5 questions each week. I will endeavour to hand the marked questions back during the following week.

6 References

The following books complement this course and all make good additions to a graduate student's library.

High Energy Astrophysics, Malcolm S. Longair, Cambridge University Press, ebook

Radiative Processes in Astrophysics, George B. Rybicki and Alan P. Lightman, Wiley

High-Energy Astrophysics, Fulvio Melia, Princeton University Press.