29:235 Final Project

A brief description of your final project topic is due at the beginning of class, Tuesday, April 10, 2012.

Your final project is due at the beginning of class, Thursday, May 3, 2012.

The final project for 29:235 Space and Astrophysical Plasmas is your opportunity to extend your knowledge of the plasma physics for one particular topic of relevance to space and astrophysical plasmas.

Format In order to allow you significant latitude to pursue the topic your greatest interest, the final project may take one of three possible formats:

1. A "course lecture" on a new topic, or extension of a topic we have covered, consisting of a set of lecture notes similar to those that I hand out at the beginning of each lecture. (Note that you do not have to give the lecture.)
2. A detailed calculation of a particular mathematical problem arising from the study of space and astrophysical plasmas. For example, Lecture #18 (The Parker Solar Wind Solution), Lecture #21 (The Magnetorotational Instability), or Lecture #22 (The Parker Magnetic Buoyancy Instability).
3. A literature review of the present state of knowledge on a particular topic, for example what is presently known about structure of quasiparallel and quasiperpendicular collisionless shocks.

For any of these project formats, the length of the final project should be approximately 5 to 10 pages. The project may be handwritten or typed. If it is handwritten, please be sure that the presentation is sufficiently polished and that the writing is legible.

Potential Topics A list of possible topics for a final project is below, but please feel free to devise a topic of your own interest that does not appear on this list.

1. Linear resistive tearing instability (related to magnetic reconnection)
2. Collisionless magnetic reconnection
3. A single-particle-motion description of reconnection
4. The structure of quasiparallel and quasiperpendicular collisionless shocks
5. The Kelvin-Helmhotz Instability
6. Faraday rotation of electromagnetic radiation
7. MHD plasma waves in an inhomogeneous plasma
8. Quantitative treatment of ionization balance in the ionosphere
9. Detailed discussion of magnetic substorm models
10. Magneto-Thermal Instability
11. Heat Flux Buoyancy Instability
12. Plasma Turbulence
13. Models of Accretion Flows: Advection Dominated Accretion Flows (ADAF), Convection Dominated Accretion Flows (CDAF), Radiatively Inefficient Accretion Flows (RIAF)
14. Effects of Geomagnetic Storms on the Electrical Power Grid and Long distance pipelines

15. Radiation belt physics relevant to the upcoming Radiation Belt Storm Probe (RBSP) mission
16. Ionospheric Sounding at Mars (MARSIS)
17. Saturnian Kilometric Radiation
18. Origin of the Whistler Chorus emission
19. The physics of the auroral electrojet
20. Models for Solar Flares
21. Models of Solar Prominences
22. Models for Coronal Mass Ejections
23. Solar wind interactions with unmagnetized planets
24. Global MHD pulsations in dipolar magnetospheres

References In addition to our recommended textbooks (Kivelson & Russell 1995 and Shu 1992) here are some useful general references for identifying interesting final project topics:

1. Tajima & Shibata, *Plasma Astrophysics*, Perseus: Cambridge, Massachusetts, 2002.
2. Gombosi, *Physics of the Space Environment*, Cambridge University Press: Cambridge, 1998.
3. Baumjohann & Treumann, *Basic Space Plasma Physics*, Imperial College Press: London, 1997.
4. Treumann & Baumjohann, *Advanced Space Plasma Physics*, Imperial College Press: London, 1997.
5. Kulsrud, *Plasma Physics for Astrophysics*, Princeton University Press: Princeton, 2005.
6. Schrijver & Siscoe, *Heliophysics: Plasma Physics of the Local Cosmos*, Cambridge University Press: Cambridge, 2009.
7. Schrijver & Siscoe, *Heliophysics: Space Storms and Radiation: Causes and Effects*, Cambridge University Press: Cambridge, 2009.
8. Schrijver & Siscoe, *Heliophysics: Evolving Solar Activity and the Climate of Space and Earth*, Cambridge University Press: Cambridge, 2009.

A longer list of references is available on the course website:
`http://www.physics.uiowa.edu/~ghowes/teach/phys235/index.html`

Deadlines

1. Tuesday, April 10, 2012: Please turn in a sheet stating the topic you have chosen for your project, with a few sentences of describing your intended treatment of the topic, and your choice of format (lecture, calculation, or review).
2. Thursday, May 3, 2012: Your completed final project, approximately 5 to 10 pages, must be turned in before the beginning of our final class meeting.