Astronomy 680: High Energy Astrophysics

Instructor:

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Class web page: http://www.astro.umd.edu/∼miller/teaching/astr680

Schedule:

Lectures on Tuesdays and Thursdays from 12:30 to 1:45, CSS 0201.

Textbooks:

Recommended: *Accretion Power in Astrophysics* by Frank, King, and Raine.

Other references:

No perfect reference exists for the whole list of topics we cover. Notes from the last time I taught this class are at http://www.astro.umd.edu/∼miller/teaching/astr688m. That page has all the previous lectures (I'll be following this reasonably closely this semester, with some modifications), as well as the old problem sets. Not linked, but present in the directory, are the old solution sets: for example,

www.astro.umd.edu/∼miller/teaching/astr688m/solution1.pdf

is the first solution set. I'll set different problems this time, of course, but I hope this gives you some practice if you want it.

The syllabus and problem sets from when Chris Reynolds taught the class are at www.astro.umd.edu/∼chris/Teaching/ASTR688M_Fall_2003/astr688m_fall_2003.html

Gravitation, by Misner, Thorne, and Wheeler, is a good overview of the fundamentals of general relativity, and *Black Holes, White Dwarfs, and Neutron Stars* by Shapiro and Teukolsky is a fine introduction to the astrophysics of compact objects. Both are in the astronomy library.

Course Grading

Homework	25%
Midterm Exam	25%
Final Exam	35%
Individual Project	10%
Class Participation	5%

Feel free to discuss homework with other students, but you must work out and write up the solutions yourself. Web research is also okay (it's part of the learning process), but I do recommend that you work on the problems yourself first, and please indicate in your answer if some substantial component came from a webpage or other resource. I will grade each problem (in the homework and in the exams) on a four-point scale. One point is awarded if you demonstrate understanding of the physical issues associated with the problem. One point is awarded if you use the correct equations (assuming equations are needed). Two points are awarded for correct solution of the equations. If you come up with an answer that is obviously incorrect (e.g., a velocity 1000 times the speed of light!), but correctly say why it is incorrect and approximately what the right answer is, you will get one of those possible two points. The midterm and final will both be in-class, and we can negotiate whether they are open-book or closed-book.

Homework sets will be available on the class webpage, at least two weeks before the due date. Due dates will be Thursdays, typically two weeks apart (except for spring break week and the week of the midterm). Homework will be due right at the beginning of class, because I want it to be possible for you absorb the content of that lecture instead of worrying about the problems! I will therefore enforce this policy strictly, and will take off points for, e.g., homework turned in at the end of class. I will do my best to return graded homeworks to you, with a solution set, by the next Tuesday.

The individual project will be a report on one current topic in high energy astrophysics. This will typically be represented by a single short paper in the literature, but it can be more extensive if you want. I'll want you to have selected the topic you'll discuss by the week after the midterm, so that we can talk about it and make sure it's a good project. The report will be both a written report (4-5 pages in double-spaced 12pt format) and an oral report, which will be given in class at the end of the semester. For this project you will be graded on both content and presentation in the oral and written reports. Class participation will be determined by attendance and by participation during classes; I will ask many questions during class, and while I don't expect you to get the "right" answer every time I do want you to try.

Letter Grades

I will guarantee that you will receive no worse than the following letter grades for a given percentage of the total available points:

85%–100%	A
70%–85%	B
55%–70%	C
40%–55%	D

There will not be any extra credit in the class. I may grade on a curve if the class average is significantly lower than suggested by the table.

Late Policy and Make-Up Policy

Partial credit for late homework assignments may be given if you give me a valid reason by the Tuesday before the assignment is due. No credit will be given for homework turned in after the beginning of class that Tuesday, because I will hand out solution sets then. If you cannot make the midterm or the final exam, then we can arrange a different time if you tell me at least a week before the exam (to be fair to other students, the alternate time should be before the scheduled time).

Tentative Course Outline

January 25: Overview and administrative matters.
January 30–February 6: Particles, their interaction, and detection.
February 8: First homework due.
February 8–20: General relativity.
February 22: Second homework due.
February 22–March 6: Black holes.
March 8: Third homework due.
March 8: Frontiers: observational signatures of strong gravity.
March 13: Midterm.
March 15: Structure of neutron stars.
March 19-23 Spring break.
March 27–April 3: More on neutron stars.
April 5: Fourth homework due.
April 5: Frontiers: magnetars.
April 10–12: Clusters of galaxies.
April 17: Frontiers: the Sunyaev-Zeldovich effect.
April 19: Fifth homework due.
April 19: Cosmic rays.
April 24: Fontiers: ultra-high energy cosmic rays.
April 26: Frontiers: gamma-ray bursts.
May 1-3: Presentation of projects.
May 8: Frontiers: intermediate-mass black holes.
May 10: Recap and discussion of unclear issues.
May 17: Final exam.