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:

None. We will use my online notes on the website.

Other references:

No perfect reference exists for the whole list of topics we cover. Notes from the most recent time I taught this class are at http://www.astro.umd.edu/∼miller/teaching/astr680s09. That page has all the previous lectures (I'll be following this reasonably closely this semester, with some modifications).

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	30%
Midterm Exam	25%
Final Exam	30%
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 unless specified otherwise in the problem (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. 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 significant partial credit. If your answer is incorrect and this can be shown by simple units, limits, or symmetry arguments and you do *not* note this, more points might be taken off. You do need to take a stand: saying "I think this might be wrong" with no details won't help you, and might hurt you if your answer is actually right. The midterm and final will both be in-class, closed-book and closed-notes.

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 special cases

such as the week of the midterm). Homework will be due right at the beginning of class, because I want it to be possible for you to 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.

I will typically ask you to write computer codes as part of your homework. In addition to giving me the output of your code (in graph form, usually), I will require that before the due date, you send me a copy of your code. This can be in any language that you want *provided* that the code compiles and runs on my departmental computer without my having to do anything but compile and run it (you can send me instructions about the compilation). Thus I will not install libraries or download anything to make your code run!

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 spring break, 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; the presentation in the oral report will be judged based on the criteria in the guides to talks that I give on the webpage. The "class participation" portion involves both your questions to me and answers to my questions during class; I don't expect you to get the "right" answer every time but I do want you to try. **An additional component of the class participation grade is that by the night before a given class I want you to e-mail me (1) a short statement about an aspect of my notes for the class that you want elaborated or that you didn't understand, and (2) a short statement about something you *did* understand well.**

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 and documented reason by the Tuesday before the assignment is due. No credit will be given for homework turned in after the beginning of class the Tuesday after the due date, 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 26: Overview and administrative matters.
January 31–February 7: The interactions and detection of photons, particles, and gravitational waves
February 9–21: General relativity.
February 9: First homework due.
February 23–March 7: Black holes.
February 23: Second homework due.
March 9: Third homework due.
March 9: Gravitational lensing
March 14: Frontiers: observational signatures of strong gravity.
March 16: Midterm.
March 20-24 Spring break.
March 28–30: Clusters of galaxies.
April 4: Frontiers: the Sunyaev-Zeldovich effect.
April 6: Fourth homework due.
April 6–18: Neutron stars.
April 20: Fifth homework due.
April 20: Frontiers: measurement of neutron star masses and radii.
April 25: Frontiers: ultra-high energy cosmic rays.
April 27: Frontiers: gamma-ray bursts.
May 2-4: Frontiers: sources of gravitational radiation.
May 4: Sixth homework due.
May 9-11: Presentation of projects.
May 18: Final exam, 1:30-3:30 PM