

SYLLABUS: ASTRONOMY 8900

GRADUATE SEMINAR IN ASTRONOMY

FALL 2004

Coordinator: **Prof. Paul J. Wiita**

Timings: Wednesday, 3:00–3:50

Location: Room 732, One Park Place (note change from course list location)

Office hours: MTW 9:30–11 AM, and by appointment

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The first class will be an organizational meeting involving only students formally enrolled in the class. Presentations will be assigned for the first half of the semester at that time. The second and subsequent seminars will be open to all astronomy students, faculty and staff. The main subject for the seminars this fall will be:

APPLICATIONS OF GENERAL RELATIVITY

Since some of you will be taking Astronomy 8700, Relativistic Astrophysics and Cosmology this term, and some of you won't be taking it, but should be doing so, it makes a lot of sense (at least to me) for us to discuss a few important topics that are relevant to that immense subject. While some aspects of these topics will be discussed in that course, and those of you not taking it now should take it the next time it is offered, many of the applied aspects will have to be treated in too cursory a fashion (thanks to the great extent of the field and the mere four hours a week we will have to cover it in Astr 8700); therefore, these seminars should provide everyone the opportunity to learn a little bit about general relativity (GR) and its importance.

Each enrolled student can anticipate giving two 45–50 minute presentations during the course of the semester; when preparing them, actually aim to be able to cover the material in 40 minutes, as there will invariably be questions and other interruptions. (As of the time I'm writing this syllabus only 5 students are enrolled; if the number swells to 8 or more then the requirement will drop to one full 45 minute talk per student plus one 20 minute presentation on a day when two will be given.)

Depending on the number of students finally enrolled (i.e., if it stays at 5 or 6), some faculty or staff members may also give presentations on aspects of their current research.

Do not fear: no one will be expected to use (or even understand) the relatively difficult mathematics of general relativity in these seminars. However, it is imperative that all students of astronomy are cognizant of the many important roles that GR plays in a wide range of astrophysical problems today.

SOME SPECIFIC TOPICS

GPS systems: How the Global Positioning Satellite systems work in theory and in practice; why general relativity is actually relevant if you want to drive to an unfamiliar location or direct a missile to an extremely annoying one.

Black holes: What is the evidence for their existence in binary systems and in the cores of galaxies? Do intermediate mass black holes exist? Can we detect the spin of a BH? What current and planned instruments are best for these tasks? Each of these questions are worth a separate seminar.

Gravitational radiation: Several presentations will be needed to discuss the astrophysical sources expected to produce gravitational waves and the indirect detection thereof through binary pulsars. Details of current and planned gravity wave experiments such as *LIGO*, *TAMA*, *LISA*, *VIRGO*.

Gravitational lensing: (Very) Basic theory; strong lensing and multiple images of quasars; weak lensing and mass estimates for clusters of galaxies; searches for dark matter and planets using gravitational lensing (e.g., *OGLE*).

Relativistic jets: observations of “superluminal motion” in quasars and relativistic motion in microquasars; launching and collimation of relativistic jets.

Other topics: Students should feel free to suggest any topic in which they have an interest and which can be somehow construed to be relevant to the theme for the semester.

GRADING

Grades will be predominantly (80%) based upon the presentations given by individual students. Accuracy and logical organization of the scientific content will be the most important aspects of the talks which will be evaluated; however, clarity, animation, flashes of humor, and overall professionalism of the presentation will all be considered in assigning a grade. I will critique each student’s presentation immediately after it is over.

The remaining 20% of the grade will be based upon the student’s participation in the seminars led by their peers (and, perhaps, professors). Attendance, questions asked of presenters, and thoroughness of written evaluations of peer presentations will be the factors which will determine this portion of the grade.

There is a long-standing tradition that the speaker(s) bring snacks (most typically donuts, brownies or cookies) for the audience. If you would like a more positive reception from Prof. Miller, chocolate should be an important ingredient in (at least) a subset of those sweets.