SYLLABUS: ASTRONOMY 8700

RELATIVISTIC ASTROPHYSICS and COSMOLOGY

FALL SEMESTER 2004

Instructor: Prof. Paul J. Wiita

Timings: MONDAYS and WEDNESDAYS, 1:00 PM – 2:50 PM (incorporating a 10 minute break) – NOTE CHANGE IN DAYS!

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

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

Primary Contacts: 715 1PP wiita@chara.gsu.edu (404)651-1367

Other Contacts: home in Atlanta, (609) 273-7177 – cell, so try to call between 9 and 11 PM; home, (609) 683-3834 – most weekends; office in Princeton, (609) 258-1164 most Fridays

Prerequisite: Physics 8100 with a grade of C or higher or equivalent; Astronomy 6000 and/or 8100 are helpful but by no means necessary.

This revised and expanded course is for 4 Semester Hours of credit and meets for two, "2 hour" lectures per week.

COURSE OBJECTIVES: This course will provide a high level introduction to some of the most exciting and important aspects of astrophysics today. We will review and expand upon our knowledge of special relativity, using the K-calculus as a preparation for a study of General Relativity (GR). For the sake of simplicity, we will use tensor analysis instead of differential geometry in studying Einstein's equations. While the fundamental theory will be briefly (but, I hope, adequately) covered, the emphasis of this course will be on applications of GR to astrophysics. Therefore the study of relativistic stars (neutron stars and black holes) will take center stage. We will then turn to a discussion of the important prediction of gravitational radiation and the exciting prospects for its direct detection with new instrumentation. The final portion of the course will be devoted to cosmology, including discussions of both the geometrical and physical aspects. Our current understanding of the Big Bang, the "consensus cosmology", and the subsequent origin of galaxies and large-scale structure in the universe will be discussed. If there is time, some non-standard cosmological models will be touched upon.

Required texts:

1) Ray D'Inverno, **Introducing Einstein's Relativity**, (Oxford U.P.) (paperback).

2) John A. Peacock, **Cosmological Physics**, (Cambridge U.P.) (paperback)

Recommended text:

3) Stuart L. Shapiro & Saul A. Teukolsky, **Black Holes, White Dwarfs & Neutron Stars** (Wiley Interscience)

Other books you might wish to look at to get alternative presentations of some of the material include Hans Stephani, "General Relativity", Steven Weinberg, "Gravitation and Cosmology", Hans Ohanian and Remo Ruffini "Gravitation and Spacetime", and Jim Peebles "Physical Cosmology".

COURSE SCHEDULE

TOPIC	NUMBER OF LECTURES
Review of Special Relativity	2
Tensor Formalism for General Relativity	3
Einstein's Equations	3
Schwarzschild Metric and Classical Tests of GR	3
Neutron Stars and Pulsars	3
Midterm Exam	1
Black Holes and the Kerr Metric	4
Gravitational Radiation	2
Introduction to Relativistic Cosmology	2
The Very Early Universe	3
Physical Cosmology and Structure Formation	4

SOME USEFUL INFO: This syllabus and all assignments will be posted on my web-site: www.chara.gsu.edu/~wiita/teaching.html It is highly probable that the notes will also be posted to that site, most likely shortly after the lecture in which they are presented. Thus, if you have too much difficulty in simultaneously taking notes and understanding the material being presented, you should concentrate on the latter and then download the notes later to go over them at your leisure. But you will be wise to take notes on material that is not presented on overheads, since that stuff is unlikely to be posted on the web-site. (Of course you can always make friends with a good note taker and copy her notes.)

GRADES: will be based $\approx 40\%$ on assignments, $\approx 30\%$ on an in-class mid-term (closed book) and $\approx 30\%$ on a take-home final. You can expect one assignment to be due roughly every two or 2.5 weeks.

All students are expected to understand and abide by the University Policy on Academic Honesty. In particular, no collaboration on any assignment is permissible unless I explicitly say otherwise in a particular case, though of course you are free to ask your colleagues to share notes they have taken but not calculations they have made. All questions concerning assignments are to be directed to me, unless I let you know that working together is acceptable on a particular assignment or part thereof.

This syllabus may be revised if necessary, and given that it is the first time that this expanded course has been taught, such revisions are to be expected.