Physics 541
Compact Objects
Spring Semester 2005

144 Loomis Lab TuTh 10:30–11:50

Course web page URL

`http://rainman.astro.uiuc.edu/compact/`

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Course Goals

Welcome to Physics 541/Astronomy 541, Compact Objects.

This is the last paper handout you will be receiving. All problem sets and other materials will be handled through the course web page, above. Problem sets will be available only in PDF format.

The study of compact objects is at the forefront of several aspects of modern astrophysics. It draws on a broad range of physical principles, including the dynamics of dilute plasmas, the behavior of matter at nuclear densities, and relativistic gravity. Most high energy photons (X-ray and γ-ray) in the universe are produced in regions that are somehow connected with compact objects.

This course is a rigorous review of the physics of compact objects. The course will be largely based around the excellent textbook, *Black Holes, White Dwarfs, and Neutron Stars,* by Shapiro & Teukolsky. (The bookstore tells me that the book is on back order; you may want to go online to get the book, if you have not purchased it already. It is essential for the course.) The textbook was written in the early 1980s, but has held up extremely well because of its physical focus. I will update some of the material, especially observational material, and introduce some new topics such as gamma-ray bursts. I will also spend more time on accretion physics than does the book.

The prerequisites for the course are a solid preparation in advanced undergraduate physics, including electromagnetism, statistical mechanics and thermodynamics, classical and quantum mechanics, and special relativity. No background in astronomy or general relativity is assumed (the necessary concepts and mathematical tools will be developed as necessary).

Course Requirements

You are expected to attend lecture and participate actively.

Course grades will be based on problem sets (2/3), two midterm exams (1/12 each) and a final (1/6).

Useful Resources

For non-astronomers: the astronomical literature can be accessed through `http://adsabs.harvard.edu`.

Academic Integrity and Collaborative Work

Academic honesty is essential to this course and the University. Any instance of academic dishonesty (including but not limited to cheating, plagiarism, falsification of data, and alteration of grade) will be documented in the student's academic file. In addition, the particular problem set or exam will be given a zero.

Guidelines for collaborative work: Discussing course material with your classmates is in general a good idea, but each student is expected to do his or her own work. On problem sets, you may discuss the questions and issues behind them, but you are responsible for your own answers.

Accessibility Statement

To insure that disability-related concerns are properly addressed from the beginning, students with disabilities who require reasonable accommodations to participate in this class are asked to see the instructor as soon as possible.

Topics and Important Dates

This is a brief list of important dates and the likely subject of each problem set. Topics may change depending on the interests and abilities of the class.

18 Jan.: Instruction Begins; First Class

27 Jan.: PS 1 due (Basic Estimates)

3 Feb.: PS 2 due (Equations of State I)

10 Feb.: PS 3 due (White Dwarfs)

17 Feb.: PS 4 due (General Relativity)

24 Feb.: PS 5 due (Equations of State II)

3 Mar.: Midterm exam 1 (no problem sets)

10 Mar.: PS 6 due (Neutron Stars)

17 Mar.: PS 7 due (Black Holes)

19 Mar.–28 Mar.: Spring Break

31 Mar.: PS 8 due (Pulsars)

1 Apr.: Gammie to KITP

7 Apr.: Midterm exam 2 (no problem sets)

14 Apr.: PS 9 due (Accretion)

21 Apr.: PS 10 due (Gravitational Radiation)

28 Apr.: PS 11 due (Supernovae/GRBs)

4 May: Instruction Ends

10 May, 8am: Final exam