Physics 718: High Energy Astrophysics

Spring 2019, David Kaplan & John Friedman

Syllabus

Course Description: This is a graduate-level class in high energy astrophysics, concentrating on compact objects (white dwarfs, black holes, and neutron stars).

Prerequisites: Students are assumed to be familiar with special relativity, and to have encountered the Einstein field equations.

Lectures: Monday/Wednesday 12:30pm-1:45pm (KIRC 1180)

Instructors:

- David Kaplan
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  - Office hours: by request
- John Friedman
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  - Phone: 414-229-4476
  - Office hours: T Th 11-12 and by request

Course Website: http://www.gravity.phys.uwm.edu/~kaplan/phys718/
Lecture notes, reading assignments, and problem sets will be posted there.

Course Textbook:
Black Holes, White Dwarfs, and Neutron Stars: The Physics of Compact Objects
by Shapiro & Teukolsky
ISBN: 978-0471873167 ($68)

We will also use a set of class notes and *The Physics of Stars*, by A. C. Phillips.

Additional books that might be useful:

- *Accretion Power in Astrophysics*, by Frank, King, & Raine
- *High Energy Astrophysics*, by Malcolm S. Longair
- *An Introduction to Modern Astrophysics* by Carroll & Ostlie
- *Rotating Relativistic Stars* by Friedman & Stergioulas
- *Gravitation* (Misner, Thorne & Wheeler), General Relativity (Wald), *A First Course in General Relativity* (Schutz), or *Gravitation & Cosmology* (Weinberg)

Resources:
Much material will be related to the modern astrophysical literature. You will need to read papers, and the usual place to start is ADS:
http://adsabs.harvard.edu/abstract_service.html
or their newer interface:
https://ui.adsabs.harvard.edu//#
You can search by author, title, keyword, object, etc.

After you find a paper you can click on the links to read it. Note that some papers are published in journals that you cannot read from home. Most modern papers, though, are also listed at:
https://arxiv.org
where you can read them for free. [Note that most papers will use cgs units. Be careful!]

Evaluation:
- •Problem sets (bi-weekly): 70%; lowest problem set will be dropped
- •Final project: 30%

The final project will be an oral presentation to the class (20-min) and a written report. A 1 page project proposal must be presented to the instructors and approved by March 11.

Time Investment:
- Lectures: 3 hours/week
- Final project preparation: 15 hours
- Bi-weekly problem set: 4 hours/week
- Reading and preparation for lectures: 1.5 hours/week

University Policies: For information on university policies such as religious observances, incompletes, discriminatory conduct, and so forth, see: http://www.uwm.edu/Dept/SecU/SyllabusLinks.pdf

Topics:
- •Preliminaries
- •Fluids
- •Stellar Structure
- •Stellar Evolution
- •Structure of white dwarfs and the cold equation of state below neutron drip
- •Neutron stars and the equation of state above neutron drip
- •Stellar stability
- •Pulsars & magnetars
- •Black holes
- •Compact binaries
- •Late inspiral & coalescence