Astronomy 45
Introduction to Extragalactic Astrophysics and Cosmology
Fall Semester 2005
Science Center 103B  Tues, Thurs : 10-11:30 am

Aims to focus on the modern questions in Astrophysics from radio to gamma rays. Course will be rooted in recent observational and theoretical results focused on black hole systems, dark energy, and cosmology. Some attention will also be given to the details of extant and future ground and space-based instruments devoted to answering some of these questions.

- Instructor : Prof. Julia Lee (jlee@cfa.harvard.edu)
- Teaching Fellow: Cesar Fuentes (cfuentes@cfa.harvard.edu)
- WWW: http://www.courses.fas.harvard.edu/~astro45
- Text: Introduction to Modern Astrophysics: Carroll & Ostlie
  This is a good general reference book for topics in Astronomy. The lectures will often supplement text from the book. Expect to skip around! -- We will not be proceeding in chronological order of the book.

- Grading : Homework (30%) : Will include problem sets (15%) and “research” (15%)
  - Special circumstances only for late homework.
  - Otherwise, 10% reduction per assignment per day late.

- Midterm 1 (20%) : October 13 -- see DoI below
- Midterm 2 (20%) : date to be determined (sometime in November)
- Final Exam : Research Paper (30%) -- due date on assigned date of final exam.
  - No extensions except for extraordinary circumstances

Once the fundamental physics tools are in your grasps, the next important step towards becoming a researcher is to learn how to apply the physics principles towards formulating your own experiments/observations/theories for addressing problems with a critical eye. THIS IS THE NATURE OF RESEARCH!

Therefore, the final exam will be a research paper on one of the topics discussed in this course. Various possible research topics can come up as I you think of them during lectures. Extra credit points will be given to those who take the effort to try to formulate a research proposal or engage in a small research project during the semester that will culminate into a final exam summary paper. This is clearly not required, and may be difficult at this point, but please don’t hesitate to discuss your ideas about a project/proposal with me! See also DoI.

Keep in mind the importance of referencing!!!

- Dates of Interest (DoI)
  - October 17 : last day to change grading status / drop course
  - November 2-4 : Astrophysics Conference in Cambridge (see some of the lectures!)
    http://cxc.harvard.edu/symposium_2005/index.html
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BROAD TOPICS OF INTEREST FOR THIS COURSE
The course will be aimed primarily at the basic physics intuition necessary for understanding, assessing, and developing solutions to modern astrophysical problems. More mathematically rigorous approaches to the topics discussed in this course will be treated in upper division classes.

• Cosmology : the “observables”
  – Big Bang
  – Cosmological Models
  – Cosmological Constant \( \Lambda \)
  – Cosmic Microwave Background (CMB)

• Cosmology : the not-so observables
  – Dark Matter & Dark Energy
    • What is it ? How do we study it ?

• Black Holes
  – How did they come into being ?
  – What fuels them & how.
  – Their hosts
    • AGN / Quasars; Nomenclature
    • Galactic Binaries

• Astrophysics !
  – Radiation Mechanisms
  – Basic atomic & nuclear physics
    (e.g. spectral lines; Hydrogen atom)

• Current & Future Instruments
  (time permitting)
  – What do we use to answer our questions ?
  – What are NASA plans for the future ?