AST 308
Galaxies & Cosmology
Fall 2007
MWF 3:00–3:50, Room 1420 BPS

SOME MAJOR RESEARCH THEMES IN GALACTIC & EXTRAGALACTIC ASTRONOMY

- **Cosmology and dark energy.**
- **Nature of dark matter.**
- **Formation of structure.**
- **Evolution of galaxies.**
- **Production of the chemical elements.**

Instructor: Jack Baldwin
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Office Hours: Regular office hours are Mo 11-12, Th 4-5. Or catch me in my office whenever you can… I'm usually there from 9AM – 5 PM, except TuTh before about 10:15, and Wed before class.

Textbook: Carroll & Ostlie, *An Introduction to Modern Astrophysics, 2nd edition.*
One copy is on reserve in the BPS library.

Some Websites to bookmark:
Course website: www.pa.msu.edu/courses/ast308
Some other important web sites (you can copy these links from course website)
ADS abstract service: http://adsabs.harvard.edu/abstract_service.html
ArXiv astro-ph eprint archive: http://xxx.lanl.gov/form/astro-ph?MULTI=form+interface
SIMBAD database: http://simbad.u-strasbg.fr/simbad
NED database: http://nedwww.ipac.caltech.edu/index.html
HST Digitized Sky Survey: http://archive.stsci.edu/cgi-bin/dss_form
Ned Wright's Javascript Cosmology Calculator: http://www.astro.ucla.edu/~wright/CosmoCalc.html

Grading:
Homework: 20% 2 midterms: 25% each Final: 30%

The final is over the whole course, but it will be strongly weighted to the material after Midterm 2. It will be on Tuesday Dec 11 at 3PM.

AST308 COURSE OUTLINE *(REVISED 11/7)*

Subject to change at any moment

- Numbers in square brackets [25.1], etc. refer to sections in Carroll & Ostlie, 2nd ed., which you are always responsible for reading.
- *Italicized* topics are mostly add-ons not covered in the textbook. I'll hand out notes.

Week	Topic
Week 1: 8/27–8/31	**Course Introduction** **The Big Picture** – An Overview of Cosmology [25.1] **Classifying Galaxies:** The Hubble Sequence
Monday 9/3	**Labor Day**
Week 2: 9/5–9/7	**The Milky Way Galaxy** [24.1] Counting stars [24.2] The Morphology of the Galaxy [12.1] Interstellar Dust and gas
Week 3: 9/10–9/14	*H II regions. The Orion Nebula, et al.*
Week 4: 9/17–9/21	[24.3] Kinematics, + Determining distances within the Galaxy *(including trig parallax and pulsating variables)*
Week 5: 9/24–9/28	**The Nature of Galaxies** [25.2] Spiral and Irr galaxies [25.3] Spiral structure, density waves
Week 6: 10/1	[25.4] Elliptical galaxies *Relative numbers of galaxies with different Hubble types* *Schecter luminosity function, L_* galaxies.*
Wednesday 10/3	**Midterm 1**
10/5, + Week 7: 10/8–10/12	**Cosmology** [27.1] The extragalactic distance scale [27.2] The Expansion of the Universe [29.1] Newtonian Cosmology
Week 8: 10/15–10/19	[29.2] The Cosmic Microwave Background [17.1] The general theory of relativity [17.2] Intervals and geodesics [17.3] Black holes (just read thru pg. 636, "The Schwarzschild Radius")
Week 9: 10/22–10/26	[29.3] Relativistic Cosmology
Week 10: 10/29–11/2	[29.4] Observational Cosmology
Wednesday 11/7	**Midterm 2**
Week 11: 11/9	[30.1] The very early universe and inflation
Week 12: 11/12–11/16	**The Structure of the Universe & Evolution of Galaxies** [27.3] Clusters of galaxies [28.4] Using quasars to probe the universe (grav. lenses) *What is dark matter?*
Week 13: 11/19+11/21	[30.2] The origin of structure; WMAP measurements.
Friday 11/23	**Thanksgiving Holiday**
Week 14: 11/26–11/30	[26.1] Interaction of galaxies [26.2] The formation of galaxies *Steller Population Synthesis*
Week 15: 12/3–12/7	Quasars & Active galactic Nuclei (AGN) *We may not get to here.* [28.2] Unified model of AGN … *(Skip [28.1], [28.3])* [18.2] Accretion Disk description pp. 661-666 [24.4] The Galactic Center
Tuesday 12/11	**Final Exam 3–5PM**

Prerequisites:

AST 208 and PHY 215 (thermo) *and* (PHY 321=class. mech. or concurrently).
Meaning you should also have taken:

AST 207
PHY 183 or similar mechanics course; *and*
PHY 184 or similar E&M course; *and*
Math 132+133+234 or similar calculus + line & surface integrals sequence.

➔ Things I Think You Already Know:

Physics

- Classical mechanics at the level of Newton's laws, energy and angular momentum conservation, and basic problem solving using them.
- Light [3]
  - $E=h\nu= hc/\lambda$
  - $F=L/(4\pi r^2)$
  - Black body radiation [CO 3.4,3.5]
- Basic idea of Special Relativity [CO 4]
  - [CO 4.3] is a useful catalogue of some S.R. effects that are relevant in astronomy.
- Bohr model of the atom [CO 5.3]
  - What atomic energy levels are.

Math

- Calculus, able to solve simple differential equations as used in physics problems.

Astronomy

- Apparent and absolute magnitude scales [3.2]
- What UBV photometry is
- Basic idea of the Hertzprung-Russell diagram
  - Something about age-dating clusters using H-R diagram
- Stellar spectral types OBAFGKM

Thumb through CO chapters [3], [4], [5] and make sure that it all looks familiar. If not, take the time to read it carefully.

Getting into Grad School

- Get advice early, from at least two astro profs.
- Bring your transcript.

- Grad school does not *have* to immediately follow your B.S. degree.
  - Going off and working for a while can be a good idea.
- You should receive full financial support, if they actually want you.
  - Think twice before taking out that 5th student loan.
- Many grad schools start evaluating applications in January, despite having later deadlines.
- You usually can *NOT* start in January, or at least get any funding at that point.

- Admissions committees consider:
  - Overall GPA
  - GPA in upper division Physics & Astro courses.
  - GRE scores
  - GRE Physics subject exam
  - Letters of recommendation

- You can take these more than once and use the highest score.
- So take them early, just in case.

- What does it take to get admitted (my best guess):
  - To get into a top-10 astronomy program:
    - 4.0 GPA or close
    - Strong GRE scores
    - Great letters

Probably will get you admitted to 1 program, if you apply to 6 of top-10. But also apply to a couple of fallback schools.

  - To squeak into a reputable PhD program
    - 3.2 GPA
    - No more than 1-2 grades below 3.0 in upper division Physics & Astro courses.
    - GRE
      - Verbal: 60th %tile is pretty average.
      - Math: most applicants have at least 75-80th %tile.
      - Physics subject exam: at least in 500's; 600+ much better

Apply to a wide range of schools (6 or more).

Senior Thesis

- 2 options
  - Review paper to satisfy capstone writing requirement, based on reading many scientific papers.
  - Or… research project, plus paper about it to satisfy capstone writing requirement.
- Most students should *NOT* undertake a research project.
  - Concentrating on getting better grades will help you more.
- Doing a research project requires you to find a professor who can supervise you.
- To do either type of senior thesis this year:
  - Prof. Smith must sign off on topic/supervisor choice. *TALK TO HIM NOW!*