PHYS 431/531
Galactic Astronomy
Fall 2011

Instructor:	Prof. S. McMillan (12-610, x2723)
Time and place:	Tu Th 9:30–10:50, Disque 919
e-mail:	`steve (at) physics.drexel.edu`
URL:	`http://www.physics.drexel.edu/courses/physics-431`
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Course Outline

Galaxies are among the most spectacular objects in the night sky. These huge collections of stars, gas, dust, and dark matter trace out the structure of the universe on the largest scales, and each represents a complex and dynamic "ecosystem" in which stars form, evolve, and interact with their environment. The goal of this course is to present an introduction to the processes responsible for the formation, structure, evolution, and present-day appearance of the Milky Way and other galaxies. Using the Milky Way Galaxy as a guide, we will develop analytical and numerical tools to help us understand of the properties of these magnificent objects, near and far. For the most part, these tools will be based on familiar concepts in classical mechanics and thermodynamics. The list of topics covered is presented in more detail in the course syllabus. For the most part, these tools will be based on familiar concepts in classical mechanics and thermodynamics. The course material will include the following topics:

- **Stars and Stellar Evolution**
  - review of stellar properties
  - review of stellar evolution
  - the stellar mass spectrum
- **Star formation and the Interstellar Medium**
  - properties of interstellar matter
  - molecular clouds and cloud complexes
  - Jeans instability
  - competitive accretion and radiation processes
- **Galactic Structure and Dynamics**
  - kinematics of the disk, bulge, and halo
  - motion in a general potential field
  - the 2-body problem
  - the many-body problem: the virial theorem
  - relaxation: collisional and collisionless systems
  - globular clusters and the Galactic spheroid
  - 21 cm observations and the Galactic disk
  - the Galactic rotation curve and dark halo
  - the Galactic nucleus and central black hole
  - dynamical friction

- **Galaxy Formation and Evolution**
  - the Hubble sequence
  - quantifying galaxy properties
  - cosmological context
  - growth of structure in the universe
  - galaxy interactions and star formation
  - galaxy mergers and growth
  - supermassive black holes in galaxies

A more detailed breakdown, including text references, can be found on the course web page, at the above URL.

Textbooks

The principal text for this course is *Galaxies in the Universe*, second edition, by Linda Sparke and Jay Gallagher (Cambridge University Press, 2007). This advanced undergraduate text provides excellent discussions of galaxy properties and current research, as well as providing good introductions to many of the theoretical issues involved. However, the scope and level of this course mean that we may supplement this text at times with the following:

- *Galactic Dynamics*, second edition, by James Binney and Scott Tremaine (Princeton University Press, 2008). The definitive graduate-level theoretical text in the field. An excellent reference, with many technical details and important theoretical insights, but a little inaccessible for an introductory course.

- *Galactic Astronomy*, by James Binney and Michael Merrifield (Princeton University Press, 1998). Another graduate-level text, this time primarily observational in focus, covering in detail the structure of the Milky Way and other galaxies.

Selected material may be drawn from these texts, and will be distributed in class as needed. All handout material should be regarded as required reading.

Evaluation

The final grade for the course will be based on

1. a mid-term examination (30% of the total), tentatively scheduled for Tuesday, October 25 (week 6),

2. a final examination (30%), to be held during finals week, and

3. approximately 6 homework assignments completed during the quarter (40%).

The homeworks will be similar but not identical for the undergraduate and the graduate versions of the course, with some additional problems intended for graduate students only. Some of the homeworks will include computing assignments, in which you will be expected to write a program (in the language of your choice) to solve a physical problem. Assignments will be due one week after they are distributed. Late homeworks will receive reduced credit, at a rate of roughly -10% per week late. Homeworks turned in after they are discussed in class (about 2 weeks after they are due) or after the final examination will receive zero credit.