

Astronomy 418/518  
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Class Web Page: <http://www.astro.yale/mgeha/dynamics/>

### **Class Times/Dates**

Class will meet twice weekly Tuesday/Thursday from 4:00 - 5:15pm in J. W. Gibbs 263. There will be classes during reading week (April 24 and April 26).

### **Course Description**

Stellar dynamics attempts to answer the following question: what happens when you have a large number of particles orbiting under the influence of their mutual gravity? The answer depends on both the number and configuration of particles. This course will cover the dynamics of objects ranging from binary stars to globular clusters to galaxies. Particular emphasis will be placed on connecting theory to observations

### **Textbook**

The textbook for the course is the second edition of *Galactic Dynamics* by Binney & Tremaine (2008, Princeton University Press). The book is available in the University bookstore.

Also recommended, but not required is *Galactic Astronomy* by Binney & Merrifield (1998, Princeton University Press) which is available in the Astronomy library.

### **Evaluation**

Grading will be divided as follows:

- 40% Problem sets. There will be 4 to 6 sets in total which will be given out roughly every other week. I encourage interactions with other students on the problem sets, however the answers should be presented in your own words and style.
- 30% Midterm exam: in class on Tuesday April 10, 2012
- 30% Final project. See below.

### **Lecture Notes and Reading**

Reading in Binney & Tremaine will be assigned for each lecture. Readings should be done *before* lecture. Lecture notes will be handed out at the start of every class. A course outline is available online.

### **Final Project**

The final project will consist of a 12-page term paper and 25-minute oral presentation (plus time for questions). This can either be a review of a major topic in dynamics, or a report on original work. The project should constitute of a critical assessment of the recent literature on the topic chosen and not simply be a summary of one or two papers. If reporting on

original work, the project should summarize methods, results and state clearly how this work fits in the context of previous results. A list of suggested topics is below. This project will be 30% of your grade and will be assessed in three parts:

- a) A preliminary plan should be in note form (about 1 page), state the main issues to be discussed and list some relevant research and/or review papers. The preliminary plan is due on March 1, 2012.
- b) The paper (15%) must be typewritten and approximately 12 pages in length. It is due on April 19, 2012.
- c) Oral presentation (15%): You will make a half hour presentation of your paper to the rest of the class. The presentation will be assessed for a clear explanation of why the topic is of interest, the central few points of the paper, statements of the main uncertainties and criticisms, and finishing within the allotted time. Presentations will be in classes in the last couple of weeks of the semester.

Topics must be cleared with me and I encourage you to decide early as topics will be assigned on a first come, first serve basis. Below is a list of possible presentation topics:

- The Milky Way Potential : Recent studies of the shape and components of the Milky Way (do we live in a barred galaxy? thick and/or thin disk?)
- Evidence and significance of counter-rotating disks in elliptical galaxies.
- The core/cusp issue. Predictions from LCDM and observational evidence primarily based in rotation curves of dwarf galaxies.
- Planetary nebula as dynamical tracers in nearby galaxies.
- Summary of recent work on the 3-body problem
- Evidence for and against MOND (e.g., from rotation curves of spiral galaxies, dynamics of globular clusters).
- Dynamical evidence for black holes in galaxies
- Dynamical evidence for black holes in globular clusters
- Evidence for relaxation processes in globular clusters
- Stability of planetary orbits
- Evidence for/against triaxial galaxies
- The Millennium Simulation: methods and major results.
- The Aquarius Simulation: methods and major results.