

# Astronomy 406

## Galaxies and the Universe

### Fall Semester 2013

MWF 11:00–11:50 pm 134 Astronomy

#### Course web page URL

<http://go.illinois.edu/ASTR406>

#### Professor

Brian Fields  
Astronomy Building Room 216  
Email: [bdfields@illinois.edu](mailto:bdfields@illinois.edu)  
Office Hours: Wed. 1:00–2:00pm, or by appointment

#### Teaching Assistant

Chun Yin (Ricky) Chue  
Astronomy Building Room 130  
Email: [chue2@illinois.edu](mailto:chue2@illinois.edu)  
Office Hours: Thurs. 1:00–2:00pm

## Course Goals

The subject of this course is sweeping in scales of both space and time. We will discuss the large-scale structure of our Milky Way Galaxy, and use our understanding as a springboard for a study of the other galaxies that fill the universe today. Then we will further enlarge our scope to encompass the universe itself. We will discuss the earliest moments of the big bang, from the Planck time of  $10^{-43}$  sec to the birth of stars and galaxies to the future fate of the universe billions of years from now.

The emphasis will be on physical arguments and quantitative estimates to understand observations. We will see that laboratory physics allows us to understand much about the cosmos on these grand scales. For example, we will see that when the early universe cooled to its present state, it went through phases controlled by nuclear and then atomic processes. Thus, by applying some basic nuclear and atomic physics (which we'll review), we can understand the formation of the lightest elements, and of the cosmic fireball that we see today as the microwave background. But we will also find unanswered questions, such as the nature and identity of the dark matter and dark energy, and of the matter-antimatter asymmetry of the universe. The answers to these questions may require new physics beyond that currently known. Indeed, we will see how the universe can be used as “the poor person’s accelerator,” to probe conditions inaccessible to terrestrial laboratories and accelerators.

## Course Requirements

Requirement	Percentage of Grade	Points
Problem Sets (best 11 of 12)	$11 \times 6\%$ each	66%
Hour Exam		12%
Final Exam		18%
Participation		3%
Planetarium		1%
<b>Total</b>		<b>100%</b>

## Grading

The following table shows the approximate grading scale in this course. Final course grades will follow these guidelines. Plusses and minuses will be used.

The ranges are approximate in that I may have to adjust them if, for example, I give an exam that is a little too hard. In any case, I will not increase the minimum cutoffs for each letter grade.

Grade	Approximate Range
A	92–100%
B	82–91%
C	72–81%
D	60–71%
F	< 60%

## Texts

- Linda S. Sparke and John S. Gallagher, *Galaxies in the Universe: an Introduction*, 2nd Edition, 2007, Cambridge University Press.  
[Required] This text is written at about the right level, and covers much of the material we will discuss in the first half of the course, with a more cursory discussion of the later topics.

Some additional readings may be taken from handouts, and from the Web.

## Problem Sets

There will be 12 problem sets given throughout the course. These assignments represent the bulk of the work you will do for the course. The problem sets are meant to sharpen your thinking on the material covered in lecture, to develop physical intuition and quantitative skills, and to help prepare you for the exams. Problem sets are due at the beginning of class on almost every Friday.

Problem sets count for the bulk of your grade, at 66% of the total points. Your best 11 homework grades will be counted. However, you are responsible for all of the material covered on all 12 homework assignments. Thus, it is to your advantage to do all 12 of the assignments, and hand them in on time.

## Exams

There will be one hour exam and a comprehensive final exam. Dates are as follows.

- Hour Exam 1: in class, Friday, Oct. 18
- Final Exam: **8:00-11:00 am, Friday, Dec. 20**

Further information about each exam will be forthcoming as the exam approaches.

## Participation

You are expected to attend lectures. I will cover material in class that will not always be in the text, and the lecture material will be included on the exam. Class time is the most valuable for you if you come prepared, and are ready to actively engage the material. To encourage your engagement, the lectures will often be punctuated by opportunities for your feedback, in the form of asking questions, voting on the possible outcomes of observations or demonstrations, or brainstorming answers to open-ended questions. To reward your participation in these activities,

you will often be asked to respond via the iClicker. Either the old iClicker or the new iClicker2 will work.

These participation surveys are not “quizzes” in the usual sense, in that you are not required to get all answers right. Rather, you will always get some credit simply by offering a scientifically reasonable response even if it is wrong (and in some cases the questions have no single correct answer, in which case all responses receive full credit). The point of this is that the survey is always an opportunity to gain points as long as you are actively engaged, even if you are still a little confused. Indeed, the most difficult and potentially confusing subjects are precisely those that most require your participation!

For each iClicker poll, 0.75 participation points will be available: the full 0.75 points will be awarded to correct response(s), while 0.5 points will be given for any other scientifically reasonable responses. Your total participation points will accumulate until they reach a maximum of 30 total participation points; if you faithfully attend class and answer correctly most of the time, you can reach this maximum a few weeks before the end of the semester. There are thus ample opportunities to attain this maximum score, even if several classes are missed due to situations such as late class registration, family emergencies, job interviews, and malfunctioning iClickers; therefore no additional participation opportunities will be available beyond those in each class.

The iClicker scores will reflect what is recorded by the instructor’s receiver. Recorded iClicker scores will be posted on Compass every few days. Students are responsible for checking throughout the course and verifying that their clicker responses are properly received.

## Planetarium

To help you visualize how the Galactic and extragalactic objects in this course are arranged on the night sky, there will be a special planetarium show for this course, designed by and hosted by your instructor with help from the staff at Stearkel Planetarium on the campus of Parkland College in Champaign.

**Session Date: Thurs Oct 24.** The planetarium doors open at 6:30pm. The session begins at 7pm and should last until about 8pm.

**Door charge:** Tickets for the session are \$3.00 at the door, please bring exact change to make life easier for the planetarium staff. Checks are accepted, but not debit/credit cards.

A very brief assignment, worth 10 points, will be given. For those who cannot come to the session, an alternate assignment will be given.

## Course Schedule

The course schedule is posted online. The lecture material may vary, but the assignment dates are fixed. Check back to the course webpage for updates on the topics and readings.

## Academic Integrity and Collaborative Work

Academic honesty is essential to this course and the University. Any instance of academic dishonesty (including but not limited to cheating, plagiarism, falsification of data, and alteration of grade) will be documented in the student’s academic file. In addition, the particular exam, homework, or report will be given a zero.

*Guidelines for collaborative work:* Discussing course material with your classmates is in general a good idea. However, you are expected to do your own work. You are responsible for understanding every part of your results and solutions, and for writing these in your own words. Finally, on exams your work and your answers must of course be entirely your own.

## Accessibility

To insure that disability-related concerns are properly addressed from the beginning, students with disabilities who require reasonable accommodations to participate in this class are asked to see the instructor as soon as possible.

## Classroom Etiquette and Use of Electronic Devices

For the benefit of your fellow students and your instructor, you are expected to follow these basic rules of decorum.

- Show up for class on time. If you must be late on a regular basis, please inform the instructor.
- Turn off or mute your cell phone before class begins.
- Do not leave class early, and do not rustle papers or pack up bags in preparation for leaving before class time is up.
- Be attentive in class. Do not use headphones, read newspapers, or prop your feet up on other chairs or desks.
- Be respectful in your interactions with your fellow students and your teachers, whether in person or in cyberspace.

Electronic devices such as laptops, tablets, mobile phones, and the like, are tools that can enhance the classroom but also can be disruptive if misused. I will allow the use of such devices in class for the purpose of taking notes only. But you are expected to pay attention in class, and these devices can be very distracting; you are expected to use them only for note-taking.

Students must respect the classroom environment. Unless specifically directed by the instructor, students shall refrain from sending email and instant messages, or from engaging in other activities (reading non-course materials, engaging in private conversations and so on) that disrespect the classroom environment and learning conditions for others.

Disruptive behavior and/or misuse of electronic devices can affect your participation grade for that day. If the behavior continues, there will be additional reduction in the overall course participation grade.

## Late Course Registration

*Students considering late registration, particularly after Sept. 6, are welcome but strongly encouraged to speak with the instructor prior to joining the course.*

Out of fairness, the same grading standards will be used for all students in the course, and all students will be responsible for all assignments and all lecture material. Those students who register late are welcome, but join the course with the understanding that they are responsible for the material covered before they joined the course. The policy of dropping the lowest homework assignment allows late registering students to avoid penalty on any assignment missed before joining the course, as long as the remaining assignments are completed.