

ASTRON 3580: Galactic and Extra-galactic Astronomy

Term: 2204 (Spring 2020)

Meeting Time: Tuesdays and Thursdays, 09:30-10:45 AM, 210 Thaw Hall

Instructor: Prof. Rachel Bezanson

rachel.bezanson@pitt.edu (email/slack is the best way to get in touch with me!)

Office: 308 Allen Hall

Phone: 412-624-9013

Logistics: I will hold regular office hours on Mondays and Thursdays between 3:30-4:30 PM in 308 Allen Hall (these times may change during the semester, but will always be up to date on courseweb and in this syllabus and any changes would be announced in class). If you cannot make these times, please contact me and we can arrange to meet at another time. I would encourage you to use me as a resource - the problem sets in this course can be challenging and I want to help you work through them.

Course Description:

Galaxies are the fundamental building blocks of the present universe. This class will give an overview of galaxies, their properties, and their formation and evolution with an emphasis on current research areas. Topics will include observational properties (morphology, masses, colors, concentrations), scaling relations, evolution with redshift, stellar populations, gas and dust, dynamics and dark matter, evolution and mergers, and active galaxies.

Course Objectives:

My goal for this class is to provide a strong understanding of extragalactic astronomy. In one semester this survey course will not cover all topics in detail, but I hope for this to be a launching point from which you will be able to dive into research talks and or papers and fill in the details.

Textbook:

I will point you towards material from a number of sources in this class, ranging from textbooks to review articles (mostly from the Annual Reviews of Astronomy and Astrophysics). I will post most of these materials on courseweb, however the book that I recommend that you rely upon most is *Galaxy Formation and Evolution* by Mo, van den Bosch, and White (henceforth MvdBW). Although we will not follow that book completely (it has a very theoretical bent), it is an excellent reference. Another promising book just came out: *Introduction to Galaxy Formation and Evolution: From Primordial Gas to Present-Day Galaxies* by Cimatti, Fraternali, and Nipoti - I have a copy in my office if you are interested.

Grading Policy:

I expect to assign six “problem sets” (ranging from traditional problems to a telescope proposal) over the course of the semester, in addition to one 15 minute in-class presentation and an oral exam at the end of the semester. You are encouraged to collaborate on problem sets, but individual write-ups are expected. Please hand in all problem sets on paper and *on time*, unexcused late problem sets will go down by 10% each day.

Finally, I expect students to regularly attend astro coffee on Monday/Thursday at 2:30. This does not mean that you have to be present every single meeting (I don’t make it!), but I expect to see your smiling faces on most days when you don’t have a conflict. I expect that over the course of the semester each student will *present at least four papers*. I have set up a google form (see link on courseweb) that you can fill out quickly each time you present so that I have a record. These papers don’t have to be explicitly related to galaxies (but of course, basically all stars live in a galaxy and much of modern cosmology utilizes extragalactic sources).

Your overall grade in the class will be computed as:

- 50% Problem Sets (6)

- **15%** Presentation
- **10%** Astro Coffee (zero papers - F, 1 paper - D, 2 papers - C, 3 papers - B, 4 papers - A)
- **20%** Oral Final Exam
- **5%** Class Participation

Course Topics in Detail:

Here is a rough outline of topics covered in ASTRON 3580, which will likely be modified according to student interests and pacing as the semester progresses.

Lectures 1-5	Course overview, fundamental galaxy global properties, statistical trends and correlations	MvdBW §2.3 & 2.4
Lectures 6-7	Stellar Populations	ARAA review (Conroy, 2013)
Lectures 8-9	Gas and star formation	ARAA review (Kennicutt & Evans, 2012), theory: MvdBW §9-9.6
Lectures 9-11	Chemical Evolution	MvdBW §10.4, CGM ARAA review (Tomlinson, 2017)
Lecture 12	Dark Matter	MvdBW §XX
Lectures 13-14	Disk galaxies: scaling relations, structures, formation and evolution	MvdbW Chapter 11
Lectures 15-17	Elliptical galaxies: scaling relations, structures, formation and evolution	MvdBW §2.3.2, Chapter 13
Lecture 18	Groups and Clusters	
Lecture 19	Interactions and Mergers	MvdBW Chapters 7.3,12
Lecture 20	Large Scale Structure and Clustering	MvdBW §1.4,2.7-2.7.1,15.6, ARAA review (Wechsler & Tinker, 2018)
Lecture 21	Galaxies over cosmic time	ARAA reviews (Shapley, 2011; Stark, 2016; Madau & Dickinson, 2014)
Lecture 22	Models of galaxy formation	
Lectures 23-28	How to write a proposal (problem set 6!), Presentation tips (and class time for presentations!)	

CourseWeb:

The University of Pittsburgh provides a web-based resource called Courseweb, which is a portal to web sites for individual courses. A Courseweb site for this course has been created and there you can view announcements, send email to the instructor or the TAs, and download course material such as the syllabus and lecture slides. Reading and homework assignments will all be announced on Courseweb. To access Courseweb go to <http://courseweb.pitt.edu>. Use your Pitt email username and password to login to Courseweb. If you have forgotten your username and password or need to set up an account, contact the help desk at 412-624-4357, or 4-HELP. Once you have logged into the system simply click on the link for this course to access the available material.

What to do if you miss a lecture?

I will not take attendance during lectures but, especially because we will not be following a textbook, I strongly encourage you to attend all lectures. If you must miss a lecture, please review the lecture slides on courseweb and get notes from a classmate. If you have remaining questions please come to office hours.

Academic Integrity:

The integrity of the academic process requires fair and impartial evaluation on the part of faculty and honest academic conduct on the part of students. To this end, students are expected to conduct themselves at a high level of responsibility in the fulfillment of the course of their study. It is the corresponding responsibility of faculty to make clear to students those standards by which students will be evaluated and

the resources permissible for use by students during the course of their study and evaluation. The educational process is perceived as a joint faculty-student enterprise which will perforce involve professional judgment by faculty and may involve - without penalty - reasoned exception by students to the data or views offered by faculty.

Cheating/plagiarism will not be tolerated. Students suspected of violating the University of Pittsburgh Policy on Academic Integrity, from the February 1974 Senate Committee on Tenure and Academic Freedom reported to the Senate Council, will be required to participate in the outlined procedural process as initiated by the instructor. A minimum sanction of a zero score for the quiz or exam will be imposed. For details, refer to the University Guidelines on Academic Integrity (https://provost.pitt.edu/sites/default/files/academic_integrity_guidelines.pdf).

Diversity and Inclusion:

I consider this class to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability - and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

Disabilities:

If you require special accommodations or classroom modifications, please notify both your instructor and Disability Resources and Services by the end of the first week of the term. The office of Disability Resources and services is located in 140 William Pitt Union, (412) 648-7890, drsrecep@pitt.edu, (412-228-5347 [voice or TDD]), and their website is at <http://www.drs.pitt.edu>. If you have a physical, learning, or emotional disability, please let me know as early as you can so that appropriate accommodations can be made.