

ASTRON 3580: Galactic and Extragalactic Astronomy

Term: Spring 2024

Meeting Time: Tuesdays and Thursdays, 2:30-3:45 PM? (Eastern time), 103 Allen (or possibly 319)

Instructor: Prof. Jeff Newman (he/him)

jnewman@pitt.edu (slack is the best way to get in touch with me at @jnewman_pitt_edu, email is second best!)

Office: 310 Allen Hall

Co-instructor: Prof. Brett Andrews (he/him)

andrewsb@pitt.edu (slack: @brett)

Office: 306 Allen Hall

Logistics: I will hold regular office hours at times to be announced (once I know when my other meetings will be). If you cannot make the scheduled times, please contact me and we can arrange to meet at another time. I 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 the Milky Way and other galaxies, including their properties, 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 Canvas, 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.

Grading Policy:

I expect to assign five problem sets 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 (unless instructed otherwise) and *on time*; unexcused late problem sets will have their score reduced by 10% each day.

Finally, I expect students to regularly attend astro coffee on Mondays (at 2-3 PM) and Thursdays (11-12 AM). This does not mean that you have to be present every single meeting (I don't manage that!), but I expect to see you 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 two papers*. I will set up a google form (see link on Canvas) 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). Two in-astrocoffee presentations may be replaced by one astrobites-style article. All instructions will be posted on Canvas.

Your overall grade in the class will be computed as:

- **50%** Problem Sets (5)
- **15%** Presentation
- **10%** Astro Coffee (Graduate Students: zero papers - F, 1 paper - C, 2 papers - B, 3 papers - A, Undergraduate students: zero papers - F, 1 paper - B, 2 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, overview of the Milky Way, fundamental galaxy global properties, statistical trends and correlations	MvdBW §1.1, 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 10-11	Chemical Evolution	MvdBW §10.4, CGM ARAA review (Tumlinson, 2017)
Lecture 12	Dark Matter	MvdBW Chapter 7
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	MvdBW §2.5
Lecture 19	Interactions and Mergers	MvdBW §7.3, Chapter 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 (Madau & Dickinson, 2014, Förster Schreiber & Wuyts 2020)
Lecture 22	Models of galaxy formation	ARAA review (Somerville & Davé 2015, Naab & Ostriker 2017)
Lectures 23-28	AGN: Presentation tips (and class time for presentations!)	MvdBW Chapter 15

Canvas:

The University of Pittsburgh provides a web-based resource called Canvas, which is a portal to web sites for individual courses. A Canvas site for this course has been created and there you can view announcements, send email to the instructor and download course material such as the syllabus and lecture slides. Reading and homework assignments will all be announced on Canvas. To access Canvas go to <http://canvas.pitt.edu>.

Use your Pitt email username and password to login to Canvas. 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 Canvas 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).

Equity 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. The University of Pittsburgh does not tolerate any form of discrimination, harassment, or retaliation based on disability, race, color, religion, national origin, ancestry, genetic information, marital status, familial status, sex, age, sexual orientation, veteran status or gender identity or other factors as stated in the University's Title IX policy. The University is committed to taking prompt action to end a hostile environment that interferes with the University's mission.

For more information about policies, procedures, and practices, see: <https://www.diversity.pitt.edu/civil-rights-title-ix-compliance/policies-procedures-and-practices>. I ask that everyone in the class strive to help ensure that other members of this class can learn in a supportive and respectful environment. If there are instances of the aforementioned issues, please contact the Title IX Coordinator, by calling 412-648-7860, or e-mailing titleixcoordinator@pitt.edu. Reports can also be filed online: <https://www.diversity.pitt.edu/civil-rights-title-ix-compliance/make-report/report-form>. You may also choose to report this to a faculty/staff member; they are required to communicate this to the University's Office of Diversity and Inclusion. If you wish to maintain complete confidentiality, you may also contact the University Counseling Center (412-648-7930).

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.

Take Care of Yourself!

Graduate school can be an exciting and challenging time for students. Taking time to maintain your well-being and seek appropriate support can help you achieve your goals and lead a fulfilling life. It can be helpful to remember that we all benefit from assistance and guidance at times, and there are many resources available to support your well-being while you are at Pitt. You are encouraged to visit Thrive@Pitt to learn more about well-being and the many campus resources available to help you thrive.

If you or anyone you know experiences overwhelming academic stress, persistent difficult feelings and/or challenging life events, you are strongly encouraged to seek support. In addition to reaching out to friends and loved ones, consider connecting with a faculty member you trust for assistance connecting to helpful resources.

The University Counseling Center is also here for you. You can call 412-648-7930 at any time to connect with a clinician. If you or someone you know is feeling suicidal, please call the University Counseling Center at any time at 412-648-7930. You can also contact Resolve Crisis Network at 888-796-8226. If the situation is life threatening, call Pitt Police at 412-624-2121 or dial 911.

Copyright Information

All course materials should be protected by copyright. United States copyright law, 17 USC section 101, et seq., in addition to University policy and procedures, prohibit unauthorized duplication or retransmission of course materials. See Library of Congress Copyright Office and the University Copyright Policy.

Note: The schedule and procedures in this course are subject to change. Any changes will be posted on the ASTRON 3580 Canvas site and announced in class in the case of major changes. If you ever have any questions about anything in the class, please contact me and ask!