

ASTR 540 Structure and Dynamics of Galaxies
Fall 2022

Lecture Meeting Time & Place: MW 2:00-2:50 PM. Steward Obs, Rm 208

This class will meet in-person. The only exception is if I get sick, and then we will make other arrangements.

Professor David Sand

Office: N506.

Email: dsand@arizona.edu

Office Hours: You should just come by. When my door is open (nearly always), you are welcome.

Formal office hours will be after class on Wed. 3-4pm.

If there is more demand, further times will be added.

Textbook & Materials: I hear graduate students hate required textbooks. Much of this course will be following ‘Galaxies in the Universe: An Introduction’ by L.S. Sparke & J.S. Gallagher. I highly recommend it. There will be heavy doses of ‘Galactic Astronomy’ by Binney & Merrifield, as well as ‘Galactic Dynamics’ by Binney & Tremaine. We will introduce papers directly from the literature as well, when appropriate. If you are not already familiar with the arXiv and/or NASA/ADS, now is a good time to start.

Website: Lectures, Homework and Grades will all be posted on D2L. We will make regular use of D2L.

It is your responsibility to check D2L regularly for course notifications, updates and assignments.

Everything will be posted there. Here is the site:

<https://d2l.arizona.edu/d2l/home/1210936>

Course Description and Topics Covered: We will try to touch on many topics in galactic and extragalactic astronomy! There is a lot of ground to cover. As this is a 2-unit class, we will go for breadth rather than depth in most instances. I want you to have heard about most topics you will encounter in colloquium even if they are out of your field of interest.

Topics will include–

- The Structure & Kinematics of the Milky Way
- Resolved and unresolved stellar populations
- Distance determinations within and beyond our Galaxy
- Stellar populations and chemical evolution in the Milky Way
- Spiral galaxy structure, gas and stellar populations
- Gas and star formation in galaxies
- Galaxy Dynamics: Orbits, Potentials, Relaxation
- Elliptical galaxy morphology, kinematics and stellar populations
- Dwarf galaxies and the mass function of galaxies
- Scaling relations for galaxies (Tully-Fisher, Faber-Jackson)
- Observational evidence for dark matter
- The Hubble Law and Expansion of the Universe
- Properties of Dark Matter Halos
- Clustering of galaxies: groups, clusters
- Black Holes and Active Galaxies
- High-redshift galaxies

- Galaxy formation and evolution

Course Learning Outcomes

Upon completion of this course, students will be able to:

- Exhibit an expert-level facility in the field of galaxies. This includes being able to engage with the principle findings, common applications, current problems, fundamental techniques and underlying theory of galaxies.
- Demonstrate advanced discipline skills and knowledge necessary to utilize the observational techniques, computational methods and software applications used in modern studies of galaxies.
- Develop expertise with communicating, translating and interpreting fundamental concepts and research results related to galaxies in oral and/or written formats.
- Engage in the scholarly, ethical, and discipline specific practices of the field at a professional level.

These learning outcomes will be met through attendance of lectures, homework, and in-class activities.

Grading: Your course grade will be based on –

1. Homework (Problem Sets & Writing assignments): 70%
2. Two 5-minute astroph presentations: 20%
3. Class Participation: 10%

Homework: There will be a problem set approximately every two weeks throughout the semester; sometimes this may involve writing a paragraph or two explaining a physical concept (I think writing is undervalued). For more complex problems you are encouraged (if you want) to work with other students in the class. For your own good, it is worthwhile to attempt each problem on your own first. Even if you work with others, the writeup should be your own. If I see identical HW answers, I will mark all offenders with a 0. So be good to your classmates! In general, the homework problems should be doable. If homework scores are trending low, I will be generous with partial credit.

Astroph Presentations: I am old school, and I think it is important to look at astroph every day and at least read the abstracts and figures for papers that are close to your field of study. During the term, each student is required to give two astroph ‘presentations’ on a ‘galaxies’ topic, broadly defined. Preference will be given for ‘new’ results that have come out in the last few weeks or months. The presentation should be 5 minutes in length. A presentation will include a) 1-3 slides, b) a summary of the paper, c) an important figure or two, along with an explanation of the result, d) a brief statement on the larger context. Take this seriously – if you are not prepared I will give you a near-zero.

Class Participation: This is a small class and attendance and active participation, broadly defined, is required. Absences will be excused for religious observances, work-related travel, and observing – please let me know well in advance. If you are sick (see covid-19 discussion below), you should stay home and follow all protocols. That will not be counted against you.

The correspondence between final percentages and letter grades will be: **A: 80-100%; B: 60-79%; C: <60%; D or E if you do not complete many/most assignments. Again, I have the right to change this if the grades are on average lower than I expect.**

Course Reading: I will often assign reading during class, and I will try to post this to D2L as well. Reading prior to class is essential for engaging with the material and participating in class discussions.

Deadlines: We will accept no late assignments. Exceptions are only possible for excused absences, as well as covid-related issues. Do not assume you can miss a deadline though, you must talk to me well ahead of time.

Classroom Attendance: This class will be taught in-person. As discussed above, you will be partially evaluated based on your attendance and participation.

- If you feel sick, or if you need to isolate or quarantine based on [University protocols](#), stay home. Except for seeking medical care, avoid contact with others and do not travel.
- Notify Professor Sand if you will be missing a course meeting or an assignment deadline.
- Non-attendance for any reason does not guarantee an automatic extension of due date or rescheduling of other assessments. Please communicate and coordinate any request directly with Professor Sand.
- Voluntary, free and convenient [COVID-19 testing](#) is available for students on Main Campus.
- If you test positive for COVID-19 and you are participating in on-campus activities, you must report your results to Campus Health. To learn more about the process for reporting a positive test, visit the [Case Notification Protocol](#).
- The COVID-19 vaccine and boosters are available for all students at [Campus Health](#).
- Visit the [UArizona COVID-19 page](#) for the most up-to-date information.

UA Nondiscrimination and Anti-harassment Policy The University is committed to creating and maintaining an environment free of discrimination; see <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>

Subject to Change Statement. Information contained in the course syllabus, other than the grade and absence policy, maybe subject to change with advance notice, as deemed appropriate by the instructor.