

# Astronomy 394P: Planetary Astrophysics

Fall 2022, Unique Number: 48075

TTh 12:30pm, PMA 15.216B

*Professor:*

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Office hours: TBD

**Course-Level Learning Goals:** Our understanding of extrasolar planets has advanced at a remarkable pace — from the first discovery of a planet orbiting a Sun-like star in 1995, we now know of thousands of exoplanets orbiting the stars in our galaxy. We will embark on a journey to understand the alien worlds orbiting other stars. Topics covered will include exoplanet detection, exoplanet demographics, planet formation and evolution, planetary atmospheres and interiors, and habitability. Along the way, we will develop skills using tools that will be useful for the future, including writing analysis and plotting scripts, fitting data with established tools, using models, etc.

At the end of the course, you will be able to:

1. Understand the techniques used to find and characterize exoplanetary systems
2. Write scientific analysis scripts
3. Use established tools to solve scientific problems
4. Be comfortable reading scientific papers and discussing results with peers

**Textbook:** The Exoplanet Handbook by Michael Perryman is fairly recently updated (~2018) and is a good reference book. Given the rapid pace of exoplanet science, we won't directly follow a textbook for this class.

**Class Structure:** The class will meet in-person. It will include a mix of lecture, small-group discussions & problem solving, and full-class discussions & problem solving. Typically Tuesdays will have a bit more lecture and Thursdays will have paper discussions. We will read 2-3 papers per week related to the course material.

**Communication:** Please use either *Canvas* or *email* to send a message to me. I will aim to respond during normal working hours (M-F, 9-5pm) within 24 hours.

**Class Website:** This course will be primarily run through the Canvas system, at [canvas.utexas.edu](https://canvas.utexas.edu). All class communication will be done through Canvas. You are responsible for checking Canvas daily. I recommend setting up email alerts to be notified when I send messages or post assignments. You may also wish to download the mobile app.

**COVID-19:** Our students' physical and mental health is of the utmost importance to all UT instructors including me. I don't believe anyone's opportunities to learn here at UT should be diminished due to the still-ongoing pandemic. Remember that all your classmates have different health concerns and everyone should be respected in the classroom.

- I respectfully ask that everyone **follow current CDC and university guidelines** about vaccines and masking. Disposable masks will be made available by the College of Natural Sciences for anyone who needs one in the classroom.
- Out of respect for your classmates, please don't come to class sick. Please get COVID tested if you feel ill, or may have been exposed. Your grade will not be affected by missing class because you are sick (see absence policy below).

# Grading Components and Policies:

You will receive the grade you earn. The composition of the course grade is:

1. Problem sets = 50% (7 problem sets, due every other week)
2. In-class paper discussions (20%)
3. In-class problem solving (10%)
4. Oral midterm exam (5%) and final exam (15%)

1. **Problem Sets:** Much of Astrophysics requires coding, for both theoretical and observational astrophysics. Problem sets will give you a chance to practice these skills. These problem sets will be varied. Some may include working with data and doing data analysis. In some, you'll start from a blank page and write your own scripts from "scratch". In others, you'll download an existing tool and use it. All of these are things we do as professional astronomers, so all are useful skills to practice. Depending on your coding background, these may be challenging, so please reach out if you're feeling challenged: I am here to help you learn! Instructions for turning these in will be given on each assignment; you'll turn in both your code and a specific set of outputs.

2. **In-Class Paper Discussions:** On Thursdays, we will discuss papers relevant to the topic we're discussing that week. Everyone will read each paper and come up with at least one question. Students in the class will take turns leading the discussions. You should expect to lead ~4 such discussions over the course of the semester.

3. **In-Class Problem Solving:** The course will require active participation during class. Typically, ~1/3 of each class session will consist of problems and derivations that you will work out in small groups or as a class. While I can present material, I cannot make you learn, and without your help this class will not be a success. To get an "A", I expect you to:

- Attend class
- Ask questions (before, during, or after class)
- Answer questions (being correct is not important)
- Attempt in-class problems
- Work effectively, respectfully, and collegially with their fellow classmates

4. **Oral Midterm and Final Exam:** The class will have an oral midterm and final exam, scheduled outside of the course hours. These are designed to give you practice for future higher-stakes moments like your Qualifying Exam. The midterm is very low stakes (only 5% of your course grade) to give you a chance to become more comfortable with the format before the final.

## Three important policies:

**Absence Policy: Please don't come to class sick.** But please do let me know if you will be absent on any given day! Because 30% of your grade is based on what we do in class together, I'll let you know how to make the material up. If you have extenuating circumstances that will cause you to miss many classes (e.g., hospitalization, family emergency, etc.) definitely reach out as soon as you're

able and we will come up with a plan for you to succeed in the course. If you need confidentiality, you can contact Student Emergency Services who will contact me.

**Collaboration Policy:** I encourage you to collaborate in class and on problem sets. The course is graded on an absolute scale, so you won't reduce your grade by helping others. Your fellow classmates are an important resource to help you understand the course material in order to complete the homework. The best strategy is to first attempt to complete an assignment on your own, before consulting with your fellow students. If you are having trouble completing a homework problem, you may wish to consult with any of the following resources: your textbook, your class notes, your professor, or your classmates. Other resources are not allowed unless I specifically approve them. If you have any questions about appropriate use of outside resources, please come speak with me directly. If you collaborate on a homework assignment, **you must submit your own individual, original solutions and code**, which you write without consulting someone else's solutions.

**Late work:** My philosophy for this course is mutual respect, flexibility, and grace. Like prior semesters, it may end up being a roller coaster of a semester, and you are all adults with complicated lives and competing responsibilities. All due dates are "target dates" this semester. If you will miss a target date, you must **email me before the assignment is due** and let me know when you will be able to complete the assignment by; we will confer and mutually **choose a date** that works for you. I would prefer that you do the work and learn the material than rush the assignment and turn in something half-finished (or, worse, plagiarized).

If you **miss a due date without contacting me**, you cannot turn the assignment in late for credit.

## **Accommodations:**

**Accommodations for disabilities:** The University of Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-6441 TTY or Division of Diversity and Community Engagement, Disability & Access (previously known as Services for Students with Disabilities, SSD), 512-471-6259, <https://diversity.utexas.edu/disability/how-to-register-with-ssd/>. **Your SSD letter will be sent to me by the Disability & Access department; we can discuss any necessary accommodations so that you can succeed in the course.**

**Accommodations for other things:** My goal is for all students to be given the opportunity to be successful: please talk to me if you are concerned and feel like you need accommodations.

## **Two other important items:**

**Regarding harassment/assault:** Harassment of any sort will not be tolerated in this classroom or related workspaces. Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights violations subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, etc. If you or someone you know has been harassed or assaulted, you can find the appropriate resources through the University Title IX Coordinator (512-232-3992), UT Austin Campus Police (512-471-4441), the

Student Ombuds Services (which can provide *confidential* advice, resources and help; 512-471-3825), and the UT Counseling and Mental Health Center (512-471-3515).

**Academic Dishonesty:** The minimum penalty for cheating — in any way whatsoever — is receiving a zero on the assignment on which you cheated. I reserve the right to seek a penalty I deem appropriate for the given case of academic dishonesty, including failing the class and being reported to Student Judicial Services. In this class, cheating would include plagiarism (e.g., cutting and pasting sentences from a website or paper), copying a classmate's problem set or code, utilizing "cheat sheets" of any form or fashion either paper or digitized, getting an advance copy of an assessment. If the academic dishonesty is sufficiently serious, I will proceed by filing a formal report to the Judicial Services in the Dean of Students Office as is policy. Judicial Services would decide the final penalty after a hearing on the matter. For more information, read in the General Information Catalog about scholastic dishonesty (i.e. cheating).

## Course Schedule

Day	Topic
Aug 23	Week 1: Introduction, logistics, intro, stars and orbits, how to read a paper
Aug 25	
Aug 30	Week 2: Detecting exoplanets: radial velocities & astrometry
Sep 1	<b>(Problem set 1 due)</b>
Sep 6	Week 3: Detecting exoplanets: transits & timing
Sep 8	
Sep 13	Week 4: Detecting exoplanets: direct imaging
Sep 15	<b>(Problem set 2 due)</b>
Sep 20	Week 5: Exoplanet demographics
Sep 22	
Sep 27	Week 6: Planet formation
Sep 29	<b>(Problem set 3 due)</b>
Oct 4	Week 7: Orbital evolution & migration
Oct 6	
	<b>Midterm scheduled Oct 11-14</b>
Oct 11	Week 8: Planetary interiors
Oct 13	<b>(Problem set 4 due)</b>
Oct 18	Week 9: Guest lecture from Yifan Zhou! Intro to atmospheres, direct imaging characterization, and variability
Oct 20	

Day	Topic
Oct 25	Week 9: Theory of atmospheres: 1D
Oct 27	<b>(Problem set 5 due)</b>
Nov 1	Week 10: Spectroscopy of transiting planets
Nov 3	
Nov 8	Week 11: Theory of atmospheres (3D) and phase curves
Nov 10	<b>(Problem set 6 due)</b>
Nov 15	Week 13: Life and habitability
Nov 17	
Nov 29	Week 14: Catchup and class choice
Dec 1	<b>(Problem set 7 due)</b>
	<b>Final scheduled Dec 2-6</b>
Dec 8	<b>HARD DEADLINE FOR EVERYTHING</b>