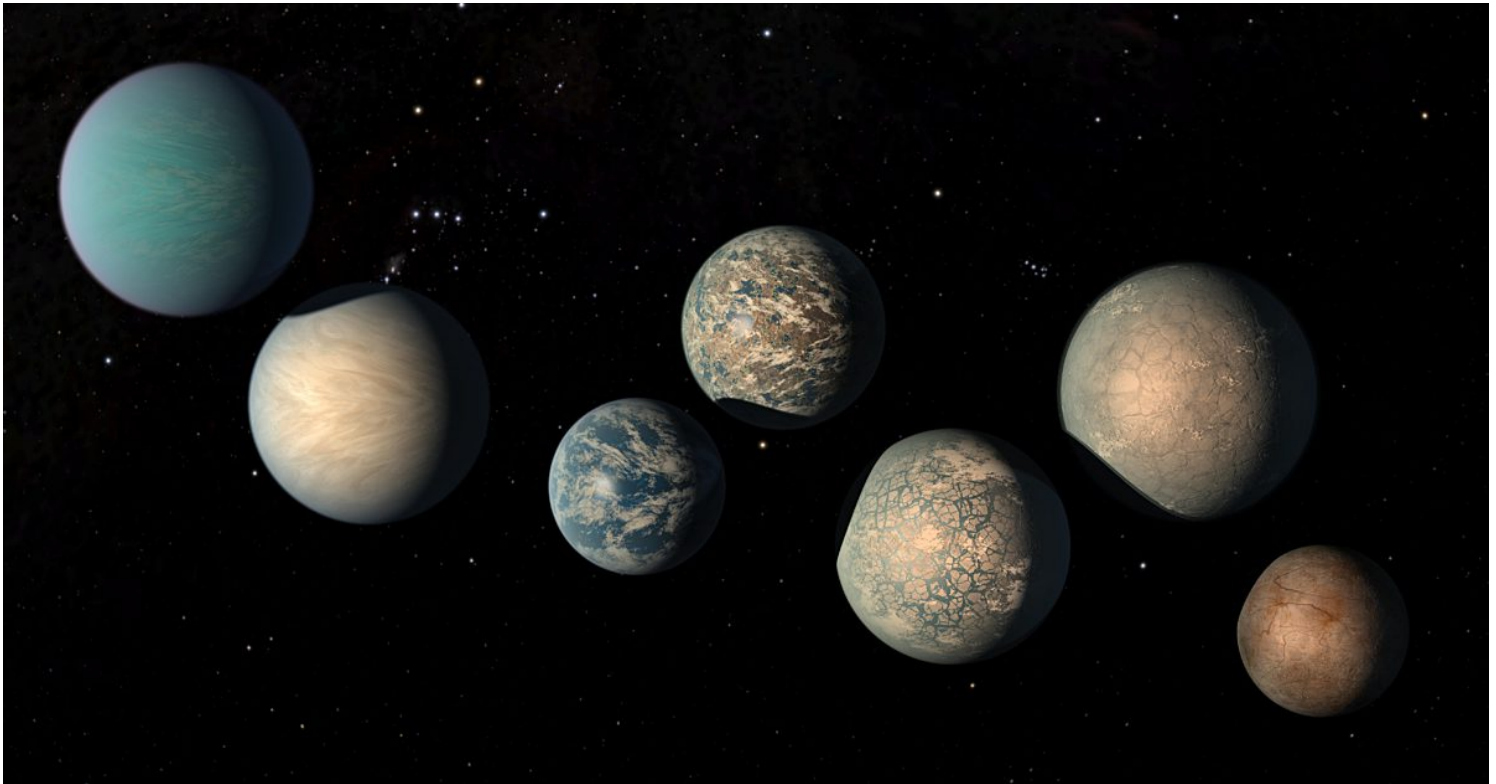


AST4930-0212(23658) - Special Topics

Syllabus for Astronomy 4930: Exoplanets



Your Instructor

Professor: Sarah Ballard

- Email: sarahballard@ufl.edu
- Phone: TBD
- Office Hours/Location: Mondays and Thursdays, 2-3 PM

General Information

This course is a survey of the rapidly-evolving field of the detection and characterization of planets orbiting other stars, designed for upper-division astronomy majors. Prerequisites for this class are the AST3018/3019 Introduction to Astrophysics series, with Observational Techniques highly recommended. If you are considering enrolling in the class without these prerequisites, or if you are taking these courses concurrently, at a bare minimum it is essential have completed a semester of Classical Mechanics; it will be very hard to succeed in the course otherwise. I will attempt to convey the breadth of scientific knowledge of exoplanets along two axes: time (how planets form and planetary systems evolve), and space (the occurrence rates of exoplanets across the Milky Way, in addition to the composition of individual planets and their atmospheres). A major component of the course will involve coding in Python, so that students can experience for themselves the technical processes involved in detecting planets around other stars.

This class uses physics-based calculus, and plenty of it! For students who are interested in exoplanets but haven't taken calculus, I recommend instead AST2003 (Introduction to the Solar System) or AST2037 (Life in the Universe), which cover a lot of the same ground!

A major component of this course is group work; students will be assigned into teams for the semester, with one lecture period per week (our longer Thursday lecture) devoted fully to worksheets for group problem solving. You will submit these worksheets to be graded at the end of the two-hour period. However, note that they will be curved (with the understanding that if one group gets stuck on an in-class problem, very likely other groups did as well!).

Your grade in this course will be determined from (in order of contribution to the total): Homeworks (7 total), in-person weekly group worksheets (14 total), a final project, two midterm exams, and a paper presentation of a famous paper in the scientific literature about exoplanets.

Topics for the course include: orbital mechanics, proto-stellar collapse and star formation, models of planet formation, methods of detecting extrasolar planets; composition and physical structure of planets, planetary atmospheres, habitable zones, and biosignatures.

Materials:

Both textbooks for this course are available for free online to UF students through the library. Note that you will need to be logged into a VPN client in order to access them.

- **The Exoplanet Handbook, 2nd Edition** by Michael Perryman (ISBN 9781108419772). If buying the book used or online, check the title and edition carefully: avoid the first edition (the field changes fast!).
- **Exoplanets**, edited by Sara Seager (ISBN 9780816529452)
- Supplementary textbook: How to Find an Exoplanet by John Johnson (ISBN 9781400873999)

Course Assessment

Your grade is based on:

30%: Homework

Your lowest homework score will be dropped. Late homework loses 50% credit but is still worth doing. Note that showing your work is required for credit.

25%: In-class activities:

Worksheets (20%): These will be curved, so that the mean score is set to 85% (B), and a standard deviation above and below the mean will be B+ and B-, respectively. Note that showing your work is required for credit. Your lowest worksheet score will be dropped.

Pair presentation of a famous exoplanet paper from the literature (5%)

25%: Midterm exams

While we will have two midterms in the course, only the higher of the two scores will contribute to your overall grade. These exams will be held in-person.

20%: Final project











Replicating a canonical result in exoplanets, namely [Fisher & Valenti \(2005\)](https://iopscience.iop.org/article/10.1086/428383/pdf), using a Bayesian statistical toolset (whether or not the original paper used one).

Grading scale:

>93.3 is an A
 90-93.3 is a A-
 86.6-89.9 is a B+
 83.3- 86.6 is a B
 80-83.3 is a B-
 76.6-79.9 is a C+
 73.3- 76.6 is a C
 70-73.3 is a C-
 66.6-69.9 is a D+
 63.3- 66.6 is a D
 60-63.3 is a D-
 <60 is an F

Course Calendar

Week	Day	Date	Topic	Paper	Reading
1	Tues	1/10	Welcome/Overview	---	Seager pp. 15-18, Perryman 1.1, 1.2,
	Thurs	1/12	Orbital mechanics		
2	Tues	1/17	Orbital mechanics	---	Seager 20-23 (Section 6)
	Thurs	1/19	Orbital mechanics		
3	Tues	1/24	Formation and Evolution	ALMA Partnership 2015	Perryman Chapter 10 introduction, 10.1.2, 10.2.2, 10.3 (s
	Thurs	1/26		[Link] https://arxiv.org/pdf/1503.02649.pdf	

4	Tues	1/31	Radial velocity	Mayor & Queloz 1995 [Link] 	Supplementary Johnson textbook, Sec
	Thurs	2/2			
5	Tues	2/7	Transits	Charbonneau et al. 2001 [Link] 	Perryman 16.1 (introduction), 6.13.1, 6.1
	Thurs	2/9			
6	Tues	2/14	Transits	Lissauer et al. 2011 [Link] 	---
	Thurs	2/16			
7	Tues	2/21	Midterm 1 Occurrence rates & demographics	N/A	Supplementary Johnson textbook 92-103, S
	Thurs	2/23			
8	Tues	2/28	Occurrence rates & demographics	Dressing et al. 2015 [Link] 	N/A
	Thurs	3/2			
9	Tues	3/7	Internal composition	Xu et al. 2014 [Link] 	McSween (1989) review article  https://ufl.instructure.com/courses/475653/files/7/download_frd=1
	Thurs	3/9			
10	Tues	3/14	Holiday		
	Thurs	3/16			
11	Tues	3/21	Atmospheres	Robinson et al. 2014 [Link] 	TBD
	Thurs	3/23			
12	Tues	3/28	Dynamics	Ballard et al. 2011 [Link] 	TBD
	Thurs	3/30			
13	Tues	4/4	Midterm 2 Host stars	Shields et al. 2013 [Link] 	TBD
	Thurs	4/6			
14	Tues	4/11	Patterns & trends	Fischer & Valenti 2005 [Link] 	TBD
	Thurs	4/13			

15	Tues Thurs	4/18 4/20	Habitability & extremophiles	Sousa-Silva et al. 2020 [Link] ↗ (https://www.liebertpub.com/doi/pdf/10.1089/ast.2018.1954)	TBD
16	Tues	4/25	Remote detection of life	Carrigan 2009 [Link] ↗ (https://iopscience.iop.org/article/10.1088/0004-637X/698/2/2075/pdf)	TBD

Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, www.dso.ufl.edu/drc/ ↗) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Course Evaluation

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu> ↗ (<https://evaluations.ufl.edu>). Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/> ↗ (<https://evaluations.ufl.edu/results/>).

Class Demeanor

Students are expected to arrive to class on time and behave in a manner that is respectful to the instructor and to fellow students. Please avoid the use of cell phones and restrict eating to outside of the classroom. Opinions held by other students should be respected in discussion, and conversations that do not contribute to the discussion should be held at minimum, if at all.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/> ↗ (<https://sccr.dso.ufl.edu/process/student-conduct-code/>)) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Counseling and Wellness Center

College can be a very stressful place. For contact information for the Counseling and Wellness Center, look to <https://counseling.ufl.edu> ↗ (<http://www.counseling.ufl.edu>), or call 352-392-1575, 8am-5pm Monday through Friday. If you need mental health services urgently for yourself or others after business hours, phone consultation with a counselor is available 24 hours a day, 7 days a week. Call UF CWC at 352-392-1575 or the Alachua County Crisis Center at 352-264-6789.