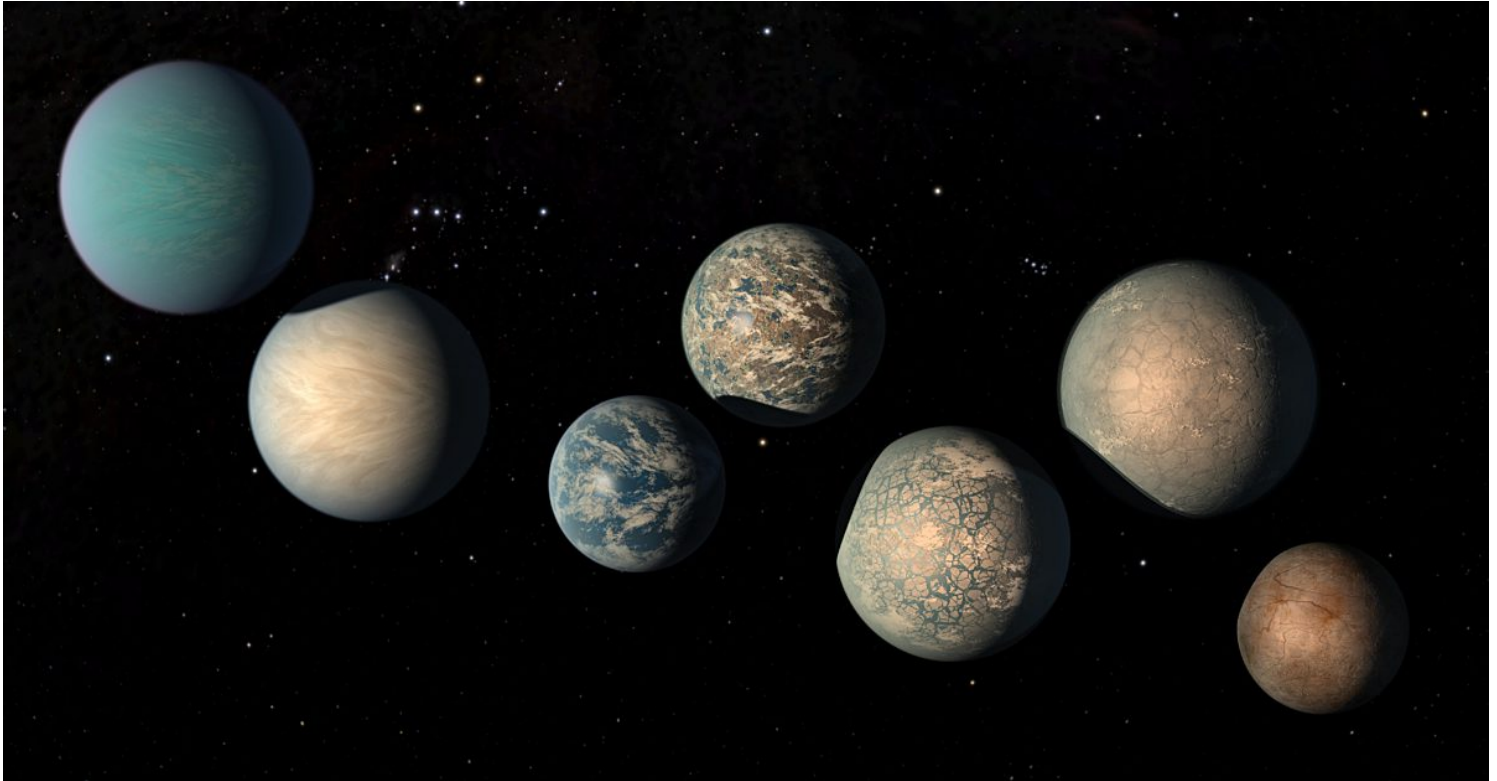


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Syllabus for Astronomy 4930: Exoplanets



Your Instructor

Professor: Sarah Ballard

- Email: sarahballard@ufl.edu
- Phone: TBD
- Office Hours/Location:

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. 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 devoted fully to worksheets for group problem solving. You will submit these worksheets to be graded at the end

of the hour-- however, they will be curved (with the understanding that if one group gets stuck on an in-class problem, very I other groups did as well!). **This means that in-person attendees must bring a laptop to class**-- your group discussions w... take place online, to facilitate discussion for both in-person and remote students in your group.

This course will have no midterm or final exam. Homeworks (9 total), in-person weekly group worksheets (14 total), a paper presentation (of a famous paper in the scientific literature about exoplanets), and a final project will contribute toward your grade.

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.

This course has both an online and in-person section, with all materials fully available online. Prof. Ballard will be live broadcasting her lectures, which will be recorded and posted later. Lectures in this class are highly interactive! I urge you to view the recorded lectures as a studying tool, rather than watching them after the fact as your primary way of learning.

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)

Course Assessment

Your grade is based on:

20%: In-class worksheets

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.

40%: 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.

20%: Final project

Detecting an exoplanet from data, using one of two methods. To receive full credit on the final project, you will generate synthetic planet data AND detect a planet in data. Each student will generate a planet signal from properties I assign; that data will then be randomly swapped with another student who will attempt to recover your planet properties while you attempt to recover theirs.

Course Calendar

Week	Day	Date	Topic	Paper	Reading	What's due
1	Mon	1/11	Welcome/Overview	---	Seager pp. 15-18, Perryman	--
	Wed	1/13	Orbital mechanics			---
	Fri	1/15				

					1.1, 1.2, 1.4 & 1.5	In-c worksheets
2	Mon	1/18	Holiday		TBD	--
	Wed	1/20	Orbital mechanics	---		HW1
	Fri	1/22	Orbital mechanics			In-class worksheet
3	Mon	1/25	Formation and Evolution	ALMA Partnership 2015	TBD	---
	Wed	1/27		[Link] (https://arxiv.org/pdf/1503.02649.pdf)		---
	Fri	1/29	Radial velocity			In-class worksheet
4	Mon	2/1		Mayor & Queloz 1995	TBD	---
	Wed	2/3	Radial velocity	[Link] (https://web.pa.msu.edu/courses/2011spring/AST208/mayorQueloz.pdf)		HW2
	Fri	2/5				In-class worksheet
5	Mon	2/8		Charbonneau et al. 2001	TBD	---
	Wed	2/10	Transits	[Link] (https://arxiv.org/pdf/astro-ph/9911436.pdf)		---
	Fri	2/12				In-class worksheet
6	Mon	2/15		Lissauer et al. 2011	TBD	---
	Wed	2/17	Transits	[Link] (https://arxiv.org/pdf/1102.0291.pdf)		HW4
	Fri	2/19				In-class worksheet
7	Mon	2/22	Microlensing & direct imaging	Marois et al.	TBD	---
	Wed	2/24		[Link] (https://arxiv.org/pdf/0811.2606.pdf)		---
	Fri	2/28	Occurrence rates & demographics			In-class worksheet
8	Mon	3/1		Dressing et al. 2015	TBD	---
	Wed	3/3	Occurrence rates & demographics	[Link] (https://iopscience.iop.org/article/10.1088/0004-637X/807/1/45/pdf)		HW6
	Fri	3/5				In-class worksheet
9	Mon	3/8	Internal composition	Xu et al. 2014	TBD	---
	Wed	3/10				---

	Fri	3/12		[Link] (https://iopscience.iop.org/article/10.1088/0004-637X/783/2/79/pdf)		In-c worksheets
10	Mon	3/15	Atmospheres	Robinson et al. 2014 [Link] (https://www.pnas.org/content/pnas/111/25/9042.full.pdf)	TBD	---
	Wed	3/17				HW7
	Fri	3/19				In-class worksheet
11	Mon	3/22	Dynamics "Recharge" day (no class) Dynamics	Ballard et al. 2011 [Link] (https://iopscience.iop.org/article/10.1088/0004-637X/743/2/200/pdf)	TBD	---
	Wed	3/24				---
	Fri	3/26				In-class worksheet
12	Mon	3/29	Host stars	Shields et al. 2013 [Link] (https://www.liebertpub.com/doi/pdf/10.1089/ast.2012.0961)	TBD	---
	Wed	3/31				HW8
	Fri	4/2				In-class worksheet
13	Mon	4/5	Patterns & trends	Fischer & Valenti 2005 [Link] (https://iopscience.iop.org/article/10.1086/428383/pdf)	TBD	---
	Wed	4/7				---
	Fri	4/9				In-class worksheet
14	Mon	4/12	Habitability & extremophiles	Sousa-Silva et al. 2020 [Link] (https://www.liebertpub.com/doi/pdf/10.1089/ast.2018.1954)	TBD	---
	Wed	4/14				HW9
	Fri	4/16				In-class worksheet
15	Mon	4/19	Remote detection of life	Rugheimer et al. 2013 [Link] (https://arxiv.org/pdf/1212.2638.pdf)	TBD	---
	Wed	4/21				---

Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, www.dso.ufl.edu/drc/ (<http://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.

Course Summary:

Date	Details	
Mon Jan 11, 2021	 AST4930-0212(29628) - Special Topics (https://ufl.instructure.com/calendar? event_id=1838797&include_contexts=course_423620)	11:45am to 12:45pm
Wed Jan 13, 2021	 AST4930-0212(29628) - Special Topics (https://ufl.instructure.com/calendar? event_id=1838798&include_contexts=course_423620)	11:45am to 12:45pm
Fri Jan 15, 2021	 AST4930-0212(29628) - Special Topics (https://ufl.instructure.com/calendar? event_id=1838799&include_contexts=course_423620)	11:45am to 12:45pm