

Syllabus for AST 7939: Exoplanets (Fall 2008) – version 2

Basic Information:

Course website: <http://www.astro.ufl.edu/~eford/teach/ast7939/>

Classroom: Bryant Space Science Center (BRT) Room #3 (in basement)

Class Meeting Times: Mondays 4:05-6:00pm, Fridays 1:35-2:25pm

Section Number: 2695

Instructor: Prof. Eric Ford

Email: eford@astro.ufl.edu (please write AST7939 in the subject line)

Office hours: Fridays between Journal Club/Frontiers and class or by appointment

Office: 212 Bryant Space Science Center (392.2052 ext. 209)

Text Book: None. The vast majority of readings will be available via arxiv and/or UF's electronic journal subscriptions. I've asked the library to make pdf files for those that aren't.

Prerequisites: None. This course is primarily targeted towards graduate students in astronomy and physics. I expect that students will enter the class with a variety of backgrounds (e.g., physics undergrad degree and no astronomy classes). Any prospective students from other backgrounds are encouraged to contact me to determine if this course would be a good match for them.

Goals & Objectives: In this class we will consider the detection and characterization of extrasolar planetary systems, as well as their physical and orbital properties. The greater purpose is to help you develop physical intuition and research skills that are applicable beyond this course. Finally, I aim to stimulate your interest in exoplanet research and make you aware of research opportunities in the coming years. Objectives for you to achieve during this semester are:

- *Knowledge & Comprehension:* Learn technical terms, facts, and observational data so that you can participate in scientific discussions about extrasolar planets.
- *Application & Analysis:* Describe the purpose and implications of observations and theoretical models. Explain how the results have led to the current state of scientific understanding. Apply scientific reasoning to deduce the implications of hypothetical experiments and observations.
- *Synthesis:* Explain how future instruments, observations, or theoretical research could address open questions about extrasolar planetary systems.
- *Evaluation:* Identify the limitations of observations and theoretical models. Critically evaluate claims and research proposals.

Teaching Philosophy: While I enjoy sharing my knowledge and experiences with students, I hope that this class will not be dominated by lectures. I strongly encourage student questions and significant discussion during class. Should our class discussion leave you uncertain about concept or idea, please let me know, so we can arrange a time for further discussion. During this course, the discussions and assignments will build upon the concepts from previous lessons. If you fall behind on understanding material early in the semester, it can be very hard to catch up. The sooner in the semester you talk to me, the better the chance that we can clarify any confusion.

Grades: Final grades will be based on the weighted average of: homework assignments (30%), an in class presentation on “your” planetary systems (20%), a mock research proposal (30%), your comments on your peers' proposals (10%), and general class participation and/or quizzes (10%). Final letter grades are to be based on the absolute scale shown below. Letter grades will be assigned as follows: A (90%-100%), B+ (85%-89.9%), B (80%-84.9%), C+ (75%- 79.9%), C (70%-74.9%), D+ (65%-69.9%), D (60%-64.9%), E (0%-59.9%). Students with S/U grades will need to obtain at least a D+ in the final point average in order to pass.

Special Accommodations: If you have a documented disability and anticipate needing accommodations in this course, please see me as soon as possible. You would need to request that the Counselor for Students with Disabilities send me a letter verifying your disability.

Assignments

Getting Started: Everyone taking the class should pick 2 planetary systems (including at least one multiple planet system and one transiting planet). Three homework assignments, an in-class presentation, and a mock research proposal will all be based on “your” planets/planetary systems. Since most of the assignments will revolve around “your” planetary systems, I suggest picking planets/systems with an above average amount of observational data, so we'll have a more interesting semester. I've emailed all students registered for class a pair of suggested systems. If there's any confusion about this, please talk to me soon.

Homework (30% of grade): There will be three homework assignments where you calculate some properties of “your” planets/planetary system. The assignments will often involve performing your own estimates of various properties based on observables. Since you could easily find “the answers” in the literature, you should show enough work to demonstrate that you actually did your own calculations. Of course, you are encouraged to read the scientific literature and verify that your answer is in the right ball park. If you find a significant disagreement, then you should discuss the likely causes. Using a calculator/computer is certainly allowed, as long as you write the code yourself. In other assignments, we will do numerical modeling/integrations for your planetary system. For these, I suggest that you use the systemic console (http://oklo.org/?page_id=86) for analyzing radial velocity data and performing n-body integrations.

In-class presentation (20% of grade): In November, I'll ask each student to give an in-class presentation describing the various observational and theoretical constraints for one of their planetary systems and highlighting what makes their systems interesting. Grading will be based on demonstrating a familiarity with the relevant scientific literature, identifying one or more interesting aspects to emphasize, identifying the strengths and weaknesses of previous observations/models, and effectively communicating these ideas to your peers. I will provide details such as the presentation lengths later, once we know the total number of students who will be presenting. If you'd like to use the computer projector, please provide me with an electronic copy in pdf, odt, or ppt format (no later than early morning of the day of your presentation), so we don't waste time switching computers. I've tentatively planned Nov. 3, 7, and 10 for student presentations. If your travel plan exclude one of these dates, please let me know as soon as possible.

Mock research proposal (30% of grade): After the student presentations are over, everyone should submit a short (~3-4 page) “proposal” for a possible project related to one of their systems. Your proposal could describe some desirable observations, a new instrument that would enable new observations of the system, a numerical method to model the system, etc. While I will not insist on a particular style, we will discuss the key ingredients of strong proposals in class. You'll need to provide me with both an electronic version (ps or pdf) and a hard copy (single spaced, double sided is good) of your proposal by Nov. 14.

Comments on your peers' proposals (10% of grade): We will have one in-class proposal review session (Nov. 24) where we discuss the strengths of each proposal and it could be improved. Each student will be assigned to read and review two proposals (due by end of day Nov. 20), as well as lead the discussion for these proposals. All students should also quickly skim all the other proposals, so that they will be able to contribute to the discussion.

Class participation and/or quizzes (10% of grade): If people are typically well prepared for class, then I would be more than happy to have zero quizzes. In this case, points will be earned for regularly making a positive contribution to in-class discussions and/or submitting questions about the readings (via email before class).

Course Policies

Prepare for class – I have made an effort to identify useful and concise readings. Please make a serious effort to read and consider these readings prior to class. You don't need to fully understand everything, but you should at least be able to articulate questions about what you don't understand. The more you put into the class, the more you will get out of it. You should refer to the course webpage for an updated reading schedule, including links to . For some readings, you will likely need to access PDFs from the Ares server (<https://ares.uflib.ufl.edu>). If you want to access Ares from off-campus, then you will likely need to use VPN software. Please check that you are able to access these well in advance.

Contribute to class – Regular attendance and active participation in the classes is expected and will be important for ensure success in this course. I highly recommend that you take written notes during class. Many students find taking notes helps them maintain focus on class, reinforces concepts in their memory, and provides an excellent reference for homework assignments.

Missed classes – I recognize that some of you have research obligations such as observing runs and/or scientific conferences that necessitate traveling and missing class. In these cases, I expect you to let me know via email in advance of any classes you miss. Be sure to do the reading extra carefully, get and read class notes from a classmate, and arrange to meet with me after your return if you have any questions, so that you do not get behind in class. If assignments are due while you are traveling, you can submit them via email in postscript or PDF format.

Respect other students – After the first day, I will aim to begin and end class on time. You should arrive on time with cell phones muted. If we run over time, please let me know promptly. I want students to engage in serious discussion, and sometimes that may include students advancing differing viewpoints. That's great, but please be respectful of me and particularly the other students.

Submit all assignments on time – I strongly encourage you to submit all assignments on time. Otherwise, it is very easy to fall behind in class and encounter bigger problems. To encourage timely submission, I expect to impose a modest grade penalty for late homework assignments or a *substantial* grade penalty for a late proposal or comments on your peers' proposal. Obviously, I will make exceptions for unexpected emergencies. Regardless, please let me know as soon as practical, if you will not be submitting an assignment on time.

Academic Honesty – You are expected to be familiar with and always follow the UF student honor code (<http://www.dso.ufl.edu/studentguide/studenthonorcode.php>). You are encouraged to discuss all with other students. However, you are expected to submit only your own work. If there is any doubt as to whether something is acceptable for any assignment, then you should ask *first*.

Tentative Class Schedule

Date		Reading / Assignment Due
Aug 25	Overview of Solar System & its Formation (Gustafson)	NA
Aug 29	Overview of Solar System & its Formation (Gustafson)	Syllabus
Sept 1	Labor Day Holiday	NA
Sept 5	Detection: Radial Velocity Technique	Your planet's RV discovery paper
Sept 8	Detection: Transit Technique	Your planet's transit disc. paper
Sept 12	Modeling: Global Search	Danby 6.1-6.6, 6.15*
Sept 15	Modeling: Quantifying Uncertainties	Ford 2005 (§1-4)
Sept 19	Reitz Union Talks	HW #1
Sept 22	Modeling: Significance of Detections	Cumming 2004 (§1-2,4)
Sept 26	Modeling: N-body integration	Trenti & Hut (§1,2.4,3-3.2,3.8) Gladman et al. 1991 (§3)
Sept 29	Dynamics: Orbital Stability & Chaos	Gozdziewski et al 2008 (§1-2,4-6)
Oct 3	Dynamics: Secular Evolution	Zhou & Sun 2003 (§1-2.2,4)
Oct 6	Dynamics: Planets in Binary Systems & Clusters	Holman et al. 1997 / HW #2
Oct 10	Dynamics: Resonant Systems	Beauge et al. 2005 (excl. §2)
Oct 13	Dynamics: Orbital Migration	Armitage 2007 (§IV.A & IV.B)
Oct 17	Dynamics: Eccentricity Evolution	Ford & Rasio 2008 (excl. §4)
Oct 20	Characterization: Giant Planet Bulk Properties	Charbonneau et al 2006 (§1,2,4)
Oct 24	Holiday / UF-UCF Star & Planet Formation Day	NA / HW #3
Oct 27	Characterization: Giant Planet Atmospheres	Marley et al 2006 (§1-3.3,3.8-4.2,5)
Oct 31	Characterization: Terrestrial Planets	Borucki et al 2008
Nov 3	Research Skills: Proposal Writing/Student Presentations	Handout via email
Nov 7	Student Presentations	NA
Nov 10	Student Presentations	NA
Nov 14	Detection: Transit Timing Variations (Veras)	Holman & Murrery 2005/ Proposal
Nov 17	Detection: Direct Imaging	Graham et al. 2007
Nov 20	NA	Peer Proposal Reviews
Nov 21	Detection: Gravitational Microlensing	Peer Proposals
Nov 24	Research Skills: Mock Panel Review	NA
Nov 28	Thanksgiving Holiday	NA
Dec 1	Detection: Disks	Wyatt et al. 2008
Dec 5	Detection: Future	Beichman et al 2006
Dec 8	Open Discussion	Revised Proposal (Optional)

* = Available via Ares (<https://ares.uflib.ufl.edu>). Please make sure you can access these well in advance.