AST 364: Solar System(s)

Fall 2015 - Course # 46770

MWF 11–12 RLM 15.216B

Professor: Dr. Adam Kraus
Office: RLM 15.310B
E-mail: alk@astro.as.utexas.edu
Office Hours: M 12-1, Th 3:30-4:30

Teaching Assistant: Andrew Riddle
Office: RLM 16.220
E-mail: ajriddle@astro.as.utexas.edu
Office Hours: W 2-3, Th 1-2

Course Logistics

Text: There is no textbook - the field is moving so fast that past attempts were obsolete almost immediately. I will assigning readings, both pop-science journalism and real journal articles, over the course of the semester. If the students feel they need extra resources, they should contact the instructor and ask for recommendations on introductory astronomy or physics textbooks.

Web page: See Canvas for announcements, documents, readings, and assignments.

Prerequisite: PHY 316 and PHY 116L. The course will make extensive use of algebra, logarithms, and trigonometry. I don't anticipate too much calculus, but some might be seen. I also strongly recommend AST 301 or 307, or at least other upper-level classes (like mechanics) that familiarize you with orbits and blackbodies. We'll be touching on a lot of basic astronomical topics, and we don't have the time to stack an entire introductory course on top of the topical course material.

Course Description & Philosophy

The course title is "Solar System", but in the modern era, this really means "Solar System**(s)**". We will talk about our own solar system in some cases, but this is 2015 and there are thousands of planetary systems known. Ours isn't anything special anymore!

The course is designed to emphasize conceptual understanding and an appreciation for the discovery process, rather than memorization of facts. The students will learn how scientific discoveries were made, and in the process hopefully develop an appreciation for the universe.

The students should feel free to look up any numbers or equations that they need in order to solve a problem on the homework. In exams, complicated numbers and equations (anything beyond what you should remember from PHY 316) will be given; it is the responsibility of the student to know how to use them. As a result of this philosophy, there will be a heavy emphasis on showing your work on math problems. The correct answer, if not justified by the appropriate mathematical work, will receive no credit.

We assume that most members of this class will go onward to work in some field of science, mathematics, or engineering, so this class should be regarded as practice in how to think like a scientist. Personally, I will consider this class a success if you develop the habit of asking one question: **Does this answer make sense?** Astronomy deals with some very large numbers,

rapidly outgrowing a person's intuitive sense of scale. We want to build a new sense of intuition that encompasses large numbers, and the ability to ask if an answer is even on the right order of magnitude. Think logarithmically, not linearly!

Class Structure

The class meets on Monday, Wednesday, and Friday at 11 AM, for 50 minutes per lecture. The first two-ish weeks will be used for a general review of background that will be needed for the rest of the course, and then we'll plan to cover one broad topic per week. Astronomy, as with all STEM classes, is fundamentally a cumulative topic. Once a topic is discussed, you shouldn't be surprised if it shows up again - yes, even if we've already had an exam on it!

In a normal week, Monday and Wednesday will be introductory lectures introducing the broad topic, and then Friday will be spent talking you through results in the current literature. The expectation is that most readings will not be journal articles, but rather will be at the level of a pop-science article or a bloggy summary of a journal article. If I assign a bloggy summary of a journal article, you should at least go glance at the abstract/summary and look at the figures before class. You might see those figures again on exams, with instructions to interpret them!

There are no participation points assigned for coming to class. You can attend or not, but much of the class material will only be available in lecture, and so you'll find the exams and homework much more difficult.

Grading

Course grades will use the plus/minus system, along with the standard cutoffs. There will be no rounding. The composition of the course grade is:

- Final paper: 20% = 15% for the paper, plus 5% for turning in a rough draft that is sufficiently complete for feedback and for providing substantive feedback to a classmate via peer review.
- Final presentation: 10%.
- In-Class Exams: 45% = 3 $\times$ 15%
- Homework: 30%

Yes, this adds up to 105%. That is by design. Note that the class will not be otherwise curved with respect to the final sum of these parts, though I reserve the right to curve the grade distributions for distinct assignments or exams upward if I decide the distribution isn't to my liking.

There will be approximately 6–8 homework assignments given over the course of the semester. Many will be classical cases of solving problems with math, though I'm also working with researchers on campus to develop more interesting homework options. (They have a grant from UT to develop homework based on video games and other online activities. I assume few of you will object.) Late homework can be turned in up until solutions are posted or an assignment is otherwise returned to the class, but the final score will be halved. **No homework will be accepted more**

than one week after the deadline, but this might be less if an exam is looming and I need to distribute solutions.

There will be three exams during the semester, scheduled for Sep 28, Oct 26, and Dec 4. These will likely be a combination of mathematical problem solving and interpretation of real data. For example, I might give you a figure out of a paper and ask you to estimate some results and explain what they mean. Makeup exams for verified illnesses or certain university functions will be scheduled as needed, but I need to be notified beforehand, and will expect to see a doctor's note or official university documentation afterward stating you were physically unable to attend. All exams will be closed-book and closed-notes; the instructor reserves the right to give you any equations that are deemed too complicated to be worth remembering, as well as any physical constants.

There also will be a final paper due on Dec 2, in which the students are expected to summarize a journal paper at a level suitable for a senior-level undergraduate to understand. They will be expected to turn in a rough draft on Nov 20 that is substantively complete, so that the TA and instructor can provide feedback. There also will be a class (or at least part of one) devoted to peer reviewing outlines and ideas earlier in November. A list of acceptable journal papers will be provided, though students are also welcome to select their own (subject to instructor approval). The last $\sim$2 weeks of the semester will be reserved for students to give short (10 minute) presentations to the class where they summarize the paper that they chose.

SHOW YOUR WORK. The correct answer will earn no points if we can't see how you derived that answer. Conversely, if you follow all the correct steps and get the wrong answer due to an arithmetic error, we don't really care and will award most or all of the points. If you want partial credit, then help us to help you, and show what you did.

Approximate Course Schedule

1. Aug 26-28: Introduction and overview. Review: Gravity and orbits.
2. Aug 31 - Sep 4: Review: How stars work (stellar properties and evolution, blackbody radiation). How telescopes work.
3. Sep 9-11. Planet searches (radial velocity method).
4. Sep 14-18. Planet searches (RVs and the transit method).
5. Sep 21-25. Planet searches (more transits).
6. Sep 30-Oct 2. Planet searches (direct imaging and microlensing methods).
7. Oct 5-9. Cosmic debris (Dust disks, asteroids, and KBOs).
8. Oct 12-16. Planet characterization (bulk composition).
9. Oct 19-23. Planet characterization (spectra and atmospheres).

10. Oct 26-30: Planet formation (from molecular clouds to protostars).
11. Nov 2-6: Likely to be guest lectures. (Instructor is probably going to be out of town. Note, material will be covered on exams/homework!)
12. Nov 9-13: Planet formation (from protostars to protoplanetary disks)
13. Nov 16-20: Planet formation (from disks to planets).
14. Nov 23-25: Final presentations.
15. Dec 30-2: Final presentations.

The instructor reserves the right to change the course content or the content on exams as needed to match the pace of the class or to tell the class about breaking astronomical news.

Class Policies

- The course webpage and/or Canvas will be updated with announcements, reading assignments, and deadlines. It is your responsibility to check these on a regular basis. Please come to class prepared, having read the required reading assignments, since understanding the lectures and being able to take good notes will be crucial for doing well on homework and exams.
- Do not pack up or leave class early unless you have talked to me in advance, as a consideration to me and your fellow students.
- Phones: Phone use and texting during class will not be tolerated. Make sure your phones are off, and keep them put away during class. Students using their phones will be asked to leave.
- Laptops/tablets: Though laptop and/or tablet use will not be a necessary part of the class, I acknowledge that some students prefer to take notes electronically, and therefore their presence will be permitted. Students using their computers for non-class activities are a distraction to those around them, and will be asked to leave. I tend to wander around the room while talking, and I know what Facebook looks like - don't assume you can blend into the crowd! If laptop distraction becomes a problem, I reserve the right to reverse this policy.

Academic Dishonesty

University of Texas Honor Code: The core values of The University of Texas at Austin are learning, discovery ,freedom, leadership, individual opportunity, and responsibility. Each member of the university is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community. Students who violate University rules on scholastic dishonesty are subject to disciplinary penalities, including the possiblity of failure in

the course and/or dismissal from the University. Standards for Academic Integrity are posted at http://deanofstudents.utexas.edu/sjs/acint_student.php.

In other words, you should turn in work that is your own.

Documented Disabilities

Please notify me of any modification/adaptation you may require to accommodate a disability-related need. The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact Servies for Students with Disabilities at 471-6259 (voice) or 232-2937 (video phone) or http://www.utexas.edu/diversity/ddce/s

Email

Email is recognized as an official mode of university correspondence, so you are responsible for reading your email for university and course-related information and announcements. Please check your email regularly and frequently.