



Adv. Topics: Planetary Astrophysics

PHYS 480/581

Instructor Info

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Course Info

-  MATH 1522 and PHYS 2310.
-  Tue & Thu
-  2:00pm - 3:15pm
-  PAIS 1160

Office Hours

-  Thu: 10:00 - 11:00am
or by appointment
-  PAIS 3226

Course Overview

This is an upper undergraduate/graduate PHYS course that will introduce the physics of planetary systems. Because the topic is so large, it will be impossible to cover everything in just one semester. A tentative course schedule is given at the end of this syllabus, but it will almost certainly change and evolve as the course progresses. I intend to interweave the study of our own solar system with the study of exoplanets, since they share a common underlying physics and chemistry. The general topics we will cover are: orbital mechanics from 2-body problem to more complicated cases; energy transport; planetary atmospheres, surfaces and interiors; minor bodies; and planet formation and evolution. If time permits, we may also discuss the emerging star-planet connections that observations of extrasolar systems are hinting at, and/or the topic of life elsewhere.

About Me

I am an observational astronomer whose focus is on exoplanets. I aim to measure the properties of exoplanets (particularly, but not exclusively, sub-Jovian exoplanets), and how these properties correlate to the planets' formation and evolution. Therefore I also have a keen interest in planetary science, astrochemistry and astrobiology, and I look forward to sharing that with you.

Material

Required Text

Planetary Sciences, de Pater and Lissauer, 2nd edition. Cambridge University Press. 2015. (ISBN: 978-0521853712)

Lecture Notes on the Formation and Early Evolution of Planetary Systems, Philip J. Armitage, [arxiv link](#).

Credit-hour statement

This is a three credit-hour course. Class meets for two 75-minute sessions of direct instruction for sixteen weeks during the Fall 2021 semester. Students are expected to complete a minimum of six hours of out-of-class work (or homework, study, assignment completion, and class preparation) each week.

Grading Scheme

The details of the grading scheme and grading components could be subject to minor changes, but if so I will inform the class ahead of time during lectures and via email.

40%	Homework Assignments
30%	Term paper and Presentation
30%	Class Participation

Assignments and the term paper will be longer for students enrolled in PHYS 581.

Note: If you take this class "Credit/No Credit", according to university policy, your final grade must be a "C" or better in order to receive credit.

Homework Assignments

There will be five or six homework assignments spread out over the course of the semester. They will be due every ~3 weeks. They will be posted on the course webpage. Homeworks are to be submitted in class. Credit for late homework will drop by 15% for every day late within a week, and no credit thereafter. While you may discuss the homework assignments with your classmates, the work you hand in must be entirely yours.

At least some of the homework will also contain an essay question for which I will ask for 1-2-page answers that will be expected to also include your own thoughts on the topic of the question. Undergraduate students will not be required to answer those questions.

Final Project

Each student is expected to prepare a term paper on a topic they have selected. This should be ~5000 words (about 10 pages) for students enrolled in PHYS 480, and ~6000 words (about 12 pages) *plus* figures and references for students enrolled in PHYS 581. It should cover the background, give a detailed development of the topic, and give conclusions and a complete reference list. The style should be similar to that of a scientific review paper. Papers will be due November 18.

Students will also give an in-class presentation on their topic, about two weeks after submitting the paper. We will allocate about 20 minutes per student, including questions, so the presentation itself should last 10-12 minutes. I will ask each student a couple of relevant questions (based partly on the paper) that you should be able to answer based on the material we covered in the course and your literature research for the paper. The class is also encouraged to ask questions, but students will not be evaluated on their answers to those questions.

Class Participation

There are assigned readings for every class (except for the first class). Throughout the class, I will periodically randomly select a student (with a many-sided die) to answer questions about the topics just covered, or from the readings. I will be fairly lenient with these, so as long as you give at least try to work your way to the answer, demonstrating that you have done the reading (and arrived to class on time), you will get the points. I expect each student will be asked a question on average once per week, but in any case I will keep track to make sure everyone gets asked more or less the same number of times through the course. Note that there will be a few guest lectures throughout the semester, and during those I will not be asking you questions. However, I suggest you keep up with the reading relevant to the guest lecture topics anyway, as I may ask questions on it in related subsequent classes.

The second part of class participation will consist of short calculations or problems to solve, either individually or in groups. Then I will select a student or group at random to briefly present their answers. Evidently you must be present in class and participate in these problem solving sessions in order to get the participation points.

The final part of class participation involves attending (or watching recorded) each of the two planetary science-related PandA department colloquia this semester (given by Drs. Daniel Apai and Meredith McGregor), and submitting to me a question about each. I will then incorporate answers to those questions when we get to those topics in subsequent lectures. The questions must be submitted within seven days past the colloquium.

Learning Objectives

Upon successful completion of this course, students will be able to:

- Obtain a working knowledge of physical processes which shape the properties of planets, including gravity, radiation, and thermodynamics, and construct quantitative estimates of planet properties using these basic physics principles.
- Apply elementary classical mechanics to planetary orbits with an emphasis on Kepler's Laws, perturbations and resonances.
- Explain and quantitatively apply concepts of energy transport and atmospheric dynamics to planetary atmospheres.
- Compare and contrast terrestrial and Jovian planetary atmospheres and interiors.
- Compare and contrast the physical and orbital properties, as well as the architectures of Solar System planets and exoplanets.
- Explain the mechanisms of formation of the solar and extrasolar planetary systems.
- Synthesize material from multiple sources, critically assess it and present it clearly and concisely in written and oral form.

Diversity and Inclusivity Statement

I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability - and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

Citizenship and/or Immigration Status: All students are welcome in this class regardless of citizenship, residency, or immigration status. Your professor will respect your privacy if you choose to disclose your status. UNM as an institution has made a core commitment to the success of all our students, including members of our undocumented community. The Administration's welcome is found on our [website](#).

Title IX

A Note About Sexual Violence and Sexual Misconduct: As a UNM faculty member, I am required to inform the Title IX Coordinator at the [Office of Equal Opportunity](#) of any report I receive of gender discrimination which includes sexual harassment,

sexual misconduct, and/or sexual violence. You can read the full [campus policy](#) regarding sexual misconduct. If you have experienced sexual violence or sexual misconduct, please ask a faculty or staff member for help or contact [LOBORESPECT](#).

Accommodations for Students with Disabilities

In accordance with University Policy 2310 and the Americans with Disabilities Act (ADA), academic accommodations may be made for any student who notifies the instructor of the need for an accommodation. It is imperative that you take the initiative to bring such needs to the instructor's attention, as I am not legally permitted to inquire. Students who may require assistance in emergency evacuations should contact the instructor as to the most appropriate procedures to follow. Contact [Accessibility Resource Center](#) at (505) 277-3506 for additional information.

If you need an accommodation based on how course requirement interact with the impact of a disability, you should contact me to arrange an appointment as soon as possible. At the appointment we can discuss the course format and requirements, anticipate the need for adjustments and explore potential accommodations. I rely on the [Accessibility Resource Center](#) for assistance in developing strategies and verifying accommodation needs. If you have not previously contacted them I encourage you to do so.

Academic Integrity

Each student is expected to maintain the highest standards of honesty and integrity in academic and professional matters. The University reserves the right to take disciplinary action, up to and including dismissal, against any student who is found guilty of academic dishonesty or otherwise fails to meet the standards. Any student judged to have engaged in academic dishonesty in course work may receive a reduced or failing grade for the work in question and/or for the course.

Academic dishonesty includes, but is not limited to, dishonesty in quizzes, tests, or assignments; claiming credit for work not done or done by others; hindering the academic work of other students; misrepresenting academic or professional qualifications within or without the University; and nondisclosure or misrepresentation in filling out applications or other University records.

UNM Administrative Mandate on Required Vaccinations

All students, staff, and instructors are required by UNM Administrative Mandate on Required Vaccinations to be fully vaccinated for COVID-19 as soon as possible, but no later than September 30, 2021, and must provide proof of vaccination or of a UNM validated limited exemption or exemption no later than September 30, 2021 to the UNM vaccination verification site. Students seeking medical exemption from the vaccination policy must submit a request to the UNM verification site for review by the UNM Accessibility Resource Center. Students seeking religious exemption from the vaccination policy must submit a request for reasonable accommodation to the UNM verification site for review by the Compliance, Ethics, and Equal Opportunity Office. For further information on the requirement and on limited exemptions and exemptions, see the UNM Administrative Mandate on Required Vaccinations.

UNM Requirement on Masking in Indoor Spaces All students, staff, and instructors are required to wear face masks in indoor classes, labs, studios and meetings on UNM campuses, see masking requirement. Qualified music students must follow appropriate specific mask policies issued by the Chair of the Department of Music and the Dean of the College of Fine Arts. Vaccinated and unvaccinated instructors teaching in classrooms must wear a mask when entering and leaving the classroom and when moving around the room. When vaccinated instructors are able to maintain at least six feet of distance, they may choose to remove their mask for the purpose of increased communication during instruction. Instructors who are not vaccinated (because of an approved medical or religious exemption), or who are not vaccinated yet, must wear their masks at all times. Students who do not wear a mask indoors on UNM campuses can expect to be asked to leave the classroom and to be dropped from a class if failure to wear a mask occurs more than once in that class. With the exception of the limited cases described above, students and employees who do not wear a mask in classrooms and other indoor public spaces on UNM campuses are subject to disciplinary actions.

Acceptable masks and mask wearing in class

A two-layer mask that covers the nose and mouth and that is cleaned regularly is acceptable, as are disposable medical masks, KN95, KF94, FFP1 and FFP2 masks. A face shield is not sufficient protection. It is vital that you wear your mask correctly, covering your nose and mouth. Removing your mask for an extended period to eat or drink in class violates the university mask requirement and endangers others.

Consequences of not wearing a mask properly

If you don't wear a mask, or if you do not wear a mask properly by covering your nose and mouth, you will be asked to leave class. If you fail to wear a mask properly on more than one occasion, you can expect to be dropped from the class. If you insist on remaining in the classroom while not wearing a mask, class will be dismissed for the day to protect others and you will be dropped from the class immediately.

The President and Provost of UNM may direct that classes move to remote delivery at any time to preserve the health and safety of the students, instructor and community. Please check the course webpage regularly for updates about our class and please check the [Bringing Back the Pack website](#) regularly for general UNM updates.