

PHY490: Space Physics

Spring 2022, 4 credits

TTh 11:30-1PM

Cousins 115

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Office hours: Monday, Wednesday, and Thursday afternoons 2-3:30. But I have a generous open-door policy and can usually be found in my office 8-4 when not in class. If you would like to schedule virtual office hours, please email.

Textbook: All readings will be posted on Perusall via Canvas.

LEARNING OBJECTIVES OF THE COURSE

This Special Topic course studies the physics and history of our utilization of space and the challenges of making in situ observations. Topics include the history of solar system exploration, fundamental plasma physics, the solar cycle, the interaction of the solar wind with planetary objects, and the methods by which these systems are studied.

By the end of this semester students will

- Understand the fundamental plasma physics that governs electromagnetic interactions in space.
- Be able to read and understand peer-reviewed journal articles describing space physics research.
- Understand how instruments are designed and used to measure properties of space.
- Be able to acquire and analyze datasets from NASA missions.

COURSE REQUIREMENTS

1. *Reading Annotations* – Reading is an essential part of this course. Before almost every class meeting there will be assigned readings on Perusall. These may include textbook chapters or excerpts, journal articles, or videos. **Readings will be posted a minimum of three days before they are due.** Perusall is a social annotation site that scores your responses (annotations) to the reading as well as the time you spend on the reading and the level you engage with it. You are expected to read all material before class, and may follow up by re-reading or leaving additional annotations after class. Each reading will be scored on a 5 point scale, and your lowest 2 scores will be dropped.
2. *Attendance and Class Participation* – Be an active participant in class. Asking and answering questions is an integral part of learning. If you miss class, you may miss an important piece of information. You are expected to read the chapters **before** they are discussed in class. The classroom experience will be much more successful and productive if you are prepared for class. You are responsible for making up any work missed. You may have 4 absences from the course for any reason (sports, illness, sleeping-in). Each additional absence will result in a 5-point deduction to the final course grade. Arriving to class more than 10 minutes late will be considered an absence. *Obviously, we live in unique times. In the event of a mandated quarantine that forces you to miss class I will give you the opportunity to meet with me via Zoom to review the class notes. If you attend these make-up sessions, you will not be considered absent.*

3. *Homework* – I’m using the category “homework” this semester as a catch-all for a variety of different types of assignments. The first couple of homework assignments will be traditional problem sets, as we learn the basics of plasma physics. Over the course of the semester the homework may take the form of reading and responding to a journal article, researching a topic, or doing calculations. **All homework assignments will be posted a minimum of one week before they are due.** Some homeworks may have a resubmission option; often a grading rubric will be distributed.
4. *Science Quiz & Reading Quiz* – There are two major assessments during the semester, the **Science Quiz** and the **Reading Quiz**.
 - **Science Quiz:** A closed-note, closed-book in-class quiz that will cover the fundamental plasma physics necessary to understand the content of this course. Because this material is fundamental to the course, you may re-take the quiz as many times as necessary during the semester until you score at least a 70%. Once you have earned a 70%, you may take it one additional time to raise your grade (note that there may be small changes to the quiz each time you take it – it won’t literally be a carbon-copy). Students who do not earn a 70% on the quiz by the end of the semester will not be able to receive a course grade greater than a C (75%).
 - **Reading Quiz:** This closed-note, closed-book quiz will take place during the final exam period. This will be a reading comprehension quiz. You will be given a peer-reviewed journal space physics journal article and asked to assess it using methods we will have developed during the course of the semester.
5. *Mission Project* – The mission project is the “meat” of this class. This class is designed to simulate the experience you would have if you joined a research group (as an undergraduate or graduate student). In such a scenario, you would be expected to work mostly independently with one or two other students. For the mission project, students will be teamed up (in the case of an odd number there will be one group of 3). Each team will pick an interplanetary mission to study over the course of the semester. Details about the mission project can be found in the Mission Project Details document.

COURSE POLICIES

Technology in the classroom: Cellphones can be kept on the desk in silent mode. Students observed texting or using their phones for non-course related purposes will be asked to stow their phone for the remainder of the class. Laptops and tablets should not be used in class except when I have specified that we will need them for an activity, or if you have asked for permission to take electronic notes. If you use an eText and need access to the textbook during class, please inform me of this. If you are observed to be using your laptop or tablet for non-course related purposes, you will be asked to stow the device. If you have a documented reason for using technology in the classroom, please inform me. If you are reprimanded twice in one class period for improper use of technology, you will be marked absent for that class.

Assignment due dates: All assignments are due on the date specified on the syllabus and/or on Canvas. Late assignments will not be accepted unless the extended due date is discussed and agreed upon **before the original due date**. If you will be absent on a day that an assignment is due in class, you must arrange to turn in the assignment before the start of that class period.

Dropping the Course: The course may be dropped with a grade of W through Monday, April 4th (provided that the student's work to that point has been of passing quality). After this date the grade of W will be assigned only in the case of withdrawal from the University or prolonged illness.

Pivot to Remote Learning: It is my hope that we can make it through the semester entirely in-person. However, I recognize that the University may decide that we must move to remote learning to ensure the safety of our students, faculty and staff. In that situation, as little as possible will change about the course. We will continue to meet synchronously via Zoom. Classes will not be recorded and you will be expected to attend. I will use the Zoom whiteboard just like I would a whiteboard in class, and you will be put into breakout rooms for problem solving sessions. Problem sets will be submitted online – please make sure you have a way to scan and upload your work before the semester begins. Exams will be taken in a synchronous Zoom meeting.

EXPECTATIONS

Students should be prepared to question, learn and complete assignments in a timely and professional manner. For a four-credit hour course such as this, you should expect to spend **at least 8-12 hours per week** on the coursework, including attending class, reading, working on homework and working on your project. Students are expected to be courteous and respectful to the instructor and fellow students in all written or verbal communications. In return the instructor will work to provide a respect filled environment in which every student can learn. The instructor will also give students timely and professional feedback (including graded assignments) and assistance in their learning.

There is a zero-tolerance policy for any form of academic dishonesty in this course. Disciplinary action will be taken against any student found guilty of academic dishonesty such as cheating or plagiarism. **If your words match those of others, I will assume you copied rather than composing the answers yourself.** The penalty for being dishonest in this way is far greater than simply getting a wrong answer. Those committing academic dishonesty will be subject to disciplinary action up to and including failing the assignment, failing the course, and/or expulsion from the course or college.

Academic Honesty: Persons who come to Oglethorpe University for work and study join a community that is committed to high standards of academic honesty. The honor code contains the responsibilities we accept by becoming members of the community and the procedures we will follow should our commitment to honesty be questioned.

The students, faculty and staff of Oglethorpe University expect each other to act with integrity in the academic endeavor they share. Members of the faculty expect that students complete work honestly and act toward them in ways consistent with that expectation. Students are expected to behave honorably in their academic work and are expected to insist on honest behavior from their peers.

Oglethorpe welcomes all who accept our principles of honest behavior. We believe that this code will enrich our years at the University and allow us to practice living in earnest the honorable, self-governed lives required of society's respected leaders.

Our honor code is an academic one. The code proscribes cheating in general terms and also in any of its several specialized sub-forms (including but not limited to plagiarism, lying, stealing and interacting fraudulently or disingenuously with the honor council). The Code defines cheating as “the umbrella under which all academic malfeasance falls. Cheating is any willful activity involving the use of deceit or fraud in order to attempt to secure an unfair academic advantage for oneself or others or to attempt to cause an unfair academic disadvantage to

others. Cheating deprives persons of the opportunity for a fair and reasonable assessment of their own work and/or a fair comparative assessment between and among the work produced by members of a group. More broadly, cheating undermines our community's confidence in the honorable state to which we aspire."

The honor code applies to all behavior related to the academic enterprise. Thus, it extends beyond the boundaries of particular courses and classrooms *per se*, and yet it does not extend out of the academic realm into the purely social one.

Examples of cheating include but are not limited to:

- 1.1 The unauthorized possession or use of notes, texts, electronic devices (including, for example, tablets, computers and smartphones), online materials or other such unauthorized materials/devices in fulfillment of course requirements.
- 1.2 Copying another person's work or participation in such an effort.
- 1.3 An attempt or participation in an attempt to fulfill the requirements of a course with work other than one's original work for that course.
- 1.4 Forging or deliberately misrepresenting data or results. Submitting results of an experiment, at which one was not present or present for less than the full time, as one's own.
- 1.5 Obtaining or offering either for profit or free of charge materials one might submit (or has submitted) for academic credit. This includes uploading course materials to online sites devoted, in whole or in part, to aiding and abetting cheating under the guise of providing "study aids." There is no prohibition concerning uploading exemplars of one's work to one's personal website or to departmental, divisional, University or professional society websites for purposes of publicity, praise, examination or review by potential employers, graduate school admissions committees, etc.
- 1.6 Violating the specific directions concerning the operation of the honor code in relation to a particular assignment.
- 1.7 Making unauthorized copies of graded work for future distribution.
- 1.8 Claiming credit for a group project to which one did not contribute.
- 1.9 Plagiarism, which includes representing someone else's words, ideas, data or original research as one's own and in general failing to footnote or otherwise acknowledge the source of such work. One has the responsibility of avoiding plagiarism by taking adequate notes on reference materials (including material taken off the internet or other electronic sources) used in the preparation of reports, papers and other coursework.
- 1.10 Submitting one's own work for a course that was previously submitted for the same course, or another course, without proper citation.
- 1.11 Lying, such as: Lying about the reason for an absence to avoid a punitive attendance penalty or to receive an extension on an exam or on a paper's due date; fraudulently obtaining Petrel Points by leaving an event soon after registering one's attendance and without offering to surrender the associated Petrel Point, or by claiming fictitious attendance for oneself or another; forging or willfully being untruthful on documents related to the academic enterprise, such as on an application for an independent study or on a registration form.
- 1.12 Stealing, such as: Stealing another's work so that he/she may not submit it or so that work can be illicitly shared; stealing reserve or other materials from the library; stealing devices and materials (such as computers, calculators, textbooks, notebooks and software) used in whole or in part to support the academic enterprise.
- 1.13 Fraudulent interaction on the part of students with the honor council, such as: Willfully refusing to testify after having been duly summoned; failing to appear to testify (barring a *bona fide* last-minute emergency) after having been duly summoned; testifying untruthfully.

Students pledge that they have completed assignments honestly by attaching the following statement to each piece of work submitted in partial fulfillment of the requirements for a course taken for academic credit:

"I pledge that I have acted honorably." (Followed by the student's signature)

The honor code is in force for every student who is enrolled (either full- or part-time) in any of the academic programs of Oglethorpe University at any given time. All cases of suspected academic dishonesty will be handled in accordance with the provisions established in this code. The honor council has sole jurisdiction in matters of suspected academic dishonesty. Alternative ways of dealing with cases of suspected academic fraud are prohibited. In cases of alleged academic dishonesty on the part of students, the honor council is the final arbiter. Reference the current Oglethorpe University Bulletin for information concerning all aspects of the honor code.

QUESTIONS & CONCERNS

If at any time you feel that you are falling behind the material, please email me. There are many ways we can work together to help you better understand the concepts and improve your quantitative analysis skills. It is my goal to make the material as accessible as possible, while still addressing the learning goals of the course. I welcome and encourage feedback to make the class run as smoothly and efficiently as possible.

Counseling Services: Free and confidential counseling services are available on campus. Licensed counselors are here to provide a space where you can get support and guidance privately about whatever is on your mind. For more information see their website, e-mail counselingcenter@oglethorpe.edu, or text inquiries to 1 (470) 231-5836.

Respect for Diversity: It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength, and benefit. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious events, please let me know so that we can make arrangements for you. If you would feel more comfortable discussing your concerns about this course with an outside person, Dr. Charlie Baube is the division chair (cbaube@oglethorpe.edu).

GRADING POLICY

Grading scale:

A.....90-100	(A-....90-92)
B.....80-89	(B-....80-82, B+....87-89)
C.....70-79	(C-....70-72, C+....77-79)
D.....60-69	(D+....67-69)
F.....0-60	

Note that Incomplete (I) is given only under the rarest of circumstances. Refer to section 6.20.2 of the 2020-2021 Bulletin for a summary of requirements.

Due to inherent uncertainties in evaluating student work, course grades are rounded to 2 significant figures before determining final grade. That is an 82.4 would result in an assigned grade of B-, while an 82.5 will result in an assigned grade of B. **I will not consider grade change requests at the end of the semester** however I do reserve the right to consider student effort for those who are right at those boundaries between grades – that is, a student who ends with a 82.4 but has been actively attending office hours or emailing questions may find that they have earned a B when all is said and done. I will never abuse that right by *lowering* student grades arbitrarily.

Your grade will be computed as follows:

Reading Annotations	10%
Homework	15%
Science Quiz	10%*
Reading Quiz	15%
Mission Project (several components)	50%

*May be retaken as often as necessary to earn a 70%. Failure to earn a 70% will limit overall maximum course grade to 75%.

Course Schedule PHY490 (These dates are tentative and subject to change)

Week	Deliverables	Topic
1 (1/31-2/4)		History of Space Physics
2 (2/7-2/11)		Plasma Physics Fundamentals
3 (2/14-2/18) *No class Tuesday	HW 1 (Thursday) Choose a Mission	
4 (2/21-2/25)	HW 2 (Thursday)	Solar Physics
5 (2/28 – 3/4)	Science Quiz (Tuesday)	
6 (3/7 – 3/11)	Paper/Presentation 1 (Th)	Solar Wind
7 (3/14 – 3/18)	HW 3(Th)	
8 (3/21 – 3/25)		
9 (3/28 – 4/1)	Data Analysis Proposal	Magnetosphere Basics
10 (4/4 – 4/8)	Paper/Presentation 2	
11 (4/11 – 4/15)		Magnetospheric Dynamics
12 (4/18 – 4/22)	HW 4	
13 (4/25 – 4/29)	LASS Poster Presentation	
14 (5/2 – 5/6)	Final Paper AB/Outline	
15 (5/9 – 5/13)	HW 5 Reading Quiz	

Important Dates

February 2 - First day of classes

March 21-25 – Spring Break

April 27 – LASS, no class

May 5 – Last day to withdraw

May 10 – Last day of classes

May 17 – Last day of finals, **final paper due**

Tentative More Detailed Schedule

Week	Tuesday	Thursday
1 (1/31-2/4)		Topic: History of Space Physics
2 (2/7-2/11)	Topic: Plasma Basics	Topic: Single Particle Motion
3 (2/14-2/18)	NO CLASS	Topic: Intro to MHD Due: HW #1 and pick mission
4 (2/21-2/25)	Topic: Reconnection, <u>plus</u> mission research	Topic: Intro to the Sun Due: HW #2 (MHD stuff)
5 (2/28 – 3/4)	SCIENCE QUIZ	Topic: Solar activity <i>activity</i> , <u>plus</u> mission research
6 (3/7 – 3/11)	Topic: Solar Wind (intro)	PAPER/PRESENTATION #1
7 (3/14 – 3/18)	Topic: Solar Wind (shocks)	Topic: Journal club, <u>plus</u> how to find data Due: HW #3 (Solar stuff)
8 (3/21 – 3/25)		
9 (3/28 – 4/1)	Topic: Mission research plus LASS proposal	Topic: Magnetosphere Basics Due: Data Analysis Proposal
10 (4/4 – 4/8)	Topic: M-I coupling	Topic: Research project
11 (4/11 – 4/15)	Topic: PAPER/PRESENTATION #2	Topic: Magnetosphere dynamics, Project Time
12 (4/18 – 4/22)	Topic: Project Time	Topic: Journal Club & Posters Due: HW #4 (ionospheres)
13 (4/25 – 4/29)	Topic: Outer Planet Magnetospheres	NO CLASS (PROJECT TIME) Due: LASS presentation (WED)
14 (5/2 – 5/6)	Topic: Writing the final paper	Science Quiz Take 2?
15 (5/9 – 5/13)	Drafts of paper; group meetings with Dr. Meier	READING QUIZ

Final papers are due May 17