Contact Information

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Office Hours:	1:30 pm days MWF (or by appointment or just stop by)

Course Information

Lecture:	8:00–8:55 am MWF (Mods A&B)
Room:	319 Peter Engel Science Center
Textbook:	**Space Physics: An Introduction** by Russell, Luhmann, and Strangeway
Web Sites:	http://www.physics.csbsju.edu/~jcrumley/368/ https://csbsju.instructure.com/courses/12381

Course Catalog Information

Space physics is the study of plasma which fills the space between the Sun and planets of our solar system. The course will include an introduction to plasma physics, followed by a study of the atmosphere of the Sun, the solar wind, the Earth's magnetosphere, auroras, and space weather. Prerequisite: 320.

Introduction

Space Physics is the study of what goes on in the solar systems between the Sun and its satellites — the planets, moons, comets, asteroids, etc. In elementary science classes this region is often described as vacuum that contains no matter. This is an exaggeration — even though the number density of particles in most regions of the solar system is small enough to be considered a vacuum by earthbound standards, matter still exists in all regions. This matter usually exists as a plasma. Along with the plasma, many different types of waves exist in space. Much of this course will deal with the plasma and waves in space and their interactions with each other.

In some ways, Space Physics is one of the oldest branches of physics. Since before recorded history, people have been fascinated by the night sky. Much of what interested ancient people involved the stars, which would now be classified as astronomy, but some of the most striking phenomena, including most importantly the aurora borealis and australis, have their roots in Space Physics. Though Space Physics has its roots in the distant past, it did not really come into its own as a field of study until after man-made satellites were first launched into space. In-situ measurements are key to understanding the space environment and in this course we will often look at spacecraft data.

Learning Goals

In this course students will learn:

- basic plasma physics and be able to apply it in space physics problems.

- about the solar and heliospheric physics, and be able to apply what they learn in problems.
- magnetospheric physics, and be able to apply what they learn in problems.
- and present about a topic of their choosing related to space.

Research Projects

For this you will be required to write a 5–8 page research paper and make a 7–9 minute presentation on your topic. You can have a lot of latitude in picking your topics — almost anything related to Space (broadly defined) is fair game. Scientifically focused papers on on the current understanding of a topic from Astrophysics, Planetary Physics, Astrobiology, Cosmology, or Space Physics would great. Topics of a less technical nature that bring in areas like science policy would be great too. For example, manned versus robotic space exploration, or space versus ground-based observations.

Homework Assignments

Homework will be assigned roughly once a week and be due roughly a week later.

Grading

The grade in this class will be 35 % from the homework, 20 % from the research project, 10 % from quizzes/participation, 17 % from the first test grade, and 18 % from the final test. This course may be taken for S/U grading *only* by students who don't need it as a physics elective.

References

- *Understanding Space Weather and the Physics Behind It* by Delores Knipp — This book covers a lot of topics at a reasonable level, but there is too little emphasis on plasmas. I used this book the last time that I taught this course.
- *Physics of Space Plasmas* by Parks — an introductory Space Physics book aiming at the first year of grad school level. Fairly completely and readable, though it focuses more on plasma physics than I like for this course. I have used this text previously in this course.
- *Introduction to Space Physics* edited by Kivelson and Russell — at a similar level to Parks, but organized by space physics structures and regions instead of by plasma physics topic as Parks does. Used this text the first time that I taught this course.
- *Introduction to Plasma Physics* by Chen — classic plasma physics book with examples focused on lab plasmas.
- *Basic Space Plasma Physics* by Baumjohann and Treuman — divides things by plasma topics like Parks, but orders them differently. Not quite as easy to read as Parks.

Course Schedule

	Date	Sections	Topics	Project
M	8/26	1	Solar terrestrial physics	
W	8/28	3.1–3	Single particle motion	
F	8/30	3.4–6	Kinetic theory	
M	9/02	3.7–8	Magnetohydrodynamics	
W	9/04	4.1–2	Solar Structure	
F	9/06	4.2–3	Solar magnetic field	
M	9/09	4.5–7	Corona	
W	9/11	5.1–2	Solar Structure	
F	9/13	5.3–5	Heliosphere	
M	9/16	1, 3–5	Review	first draft
W	9/18	1, 3–5	Test 1	
F	9/20	6.1–2	Shock Basics	
M	9/23	6.3-5	Shocks in Space	
W	9/25	6.6–10	Still More Shocks	
F	9/27	7.1–4	Solar Cycle	talks start
W	10/02	7.5–8	Solar Activity	
F	10/04	9.1–5	Geomagnetic field	
M	10/07	10.1–4	SW / magnetosphere	final draft
W	10/09	11.1–4	Aurora	
F	10/11	11.5–8	Aurora effects	
M	10/14	1-11	Review	Review for Final
W	10/16	1-11	Final Exam	

Links to Institutional Policies:

- Course Attendance policy
  https://www.csbsju.edu/academics/catalog/academic-policies-and-regulations/courses/class-attendance
- Statement on accommodations for students with disabilities
  https://www.csbsju.edu/student-accessibility-services/information-for-faculty/syllabus-statement
- Academic Misconduct and Plagiarism
  https://www.csbsju.edu/academics/catalog/academic-policies-and-regulations/rights/academic-misconduct
- Sexual Misconduct
  https://www.csbsju.edu/human-rights/sexual-misconduct/sexual-misconduct-policy
- Title IX policy
  https://www.csbsju.edu/joint-student-development/title-ix