## Contact Information


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| Instructor: | Jim Crumley |
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| Office Hour: | 1 pm days 1 and 2, noon day 5 (or by appointment or just stop by) |


## Course Information

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|---|---|
| Lecture: | 8:00–9:10 am Days 246 (Mods C+D) |
| Room: | 319 Peter Engel Science Center |
| Textbook: | *Space Science* edited by Harra and Mason |
| Web Site: | http://www.physics.csbsju.edu/368/ |

## 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.

## Homework Assignments

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

## Research Projects

For this you will be required to write a 5–8 page research paper and make a 5-8 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.

Please begin thinking about topics now, and talk to me about your topic ideas before the topic deadline.

## Grading

The grade in this class will be 30 % from the homework, 15 % from the research project, 10 % from quizzes/participation, 17 % from the first test grade, and 28 % from the final test. Overall

grades will be curved.

## Course Schedule

| Cycle | | Date | Sections | Title | Topics | Project |
|---|---|---|---|---|---|---|
| 7-2 | W | 3/09 | 1, 4.1–4.4 | Intro. to Space Phys. | Plasmas and space | |
| 7-4 | F | 3/11 | 4.5.1–4.5.4 | Basic Plasma Physics | MHD and shocks | |
| | | | | Spring Break | | |
| 7-6 | T | 3/22 | 4.5.5–4.5.7 | Plasma as Particles | Reconnection and magnetospheres | topics |
| 8-2 | R | 3/24 | 4.5.7–4.6 | Magnetospheres | SW interaction with other bodies | |
| 8-4 | M | 3/28 | 6.1–6.3 | Intro. to the Sun | Solar structure, energy | |
| 8-6 | W | 3/30 | 6.4–6.6 | More on the Sun | Neutrinos, helioseismology, $B_{Sun}$ | |
| 9-2 | F | 4/01 | 6.7–6.9 | Solar atmosphere | Photosp., chromosp., corona | |
| 9-4 | T | 4/04 | 6.10–6.12 | Solar Wind | Solar wind and flares | first draft |
| 9-6 | R | 4/07 | 1,4,6 | Review | Review for Test 1 | |
| 10-2 | M | 4/11 | 1–5 | Test 1 | | |
| 10-4 | W | 4/13 | 5.1–5.4 | Aurora | Solar activity and aurora | |
| 10-6 | F | 4/15 | 5.4–5.6 | Aurora II | Aurora and substorms | |
| 11-2 | T | 4/19 | 5.7–5.12 | Solar Activity | Flares, ionosphere, CMEs | |
| | | | | Easter Break | | |
| 11-4 | T | 4/26 | 5.13–5.16 | Magnetic Storms | Storms, substorms, and CMEs | talks start |
| 11-6 | R | 4/28 | 9.1–9.3 | Intro. to MHD | Conservation and Maxwell's eqns | final draft |
| 12-2 | M | 5/02 | 9.4–9.7 | MHD details | Momentum eqn, reconnection | |
| 12-4 | W | 5/04 | 9.8–9.9 | MHD waves | Acoustic and Alfven waves | |
| 12-6 | F | 5/06 | 1,4–6,9 | Review | Review for Final | |
| Final | R | 5/12 | 1,4–6,9 | Final Exam | | |

## References

- *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. Used this test the last time I taught 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.
- *Space Physics* by Kalleronde — tries an approach somewhere between Parks and K&R. It starts with quite a bit of theory, then moves through regions of space.