PHYS 510: Magnetospheric Physics

Fall 2017

Contact Information

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Course Objectives and Learning Outcomes

The Earth's magnetosphere, which results from the interaction of the Solar wind with the Earth's magnetic field exhibits surprisingly complex behavior on multiple spatial and temporal scales. Because of this complex behavior and the fact that there is a scarcity of in-situ data, much of our understanding of the magnetosphere remains an area of intense study and controversy. Our most detailed understanding of Space plasmas come from the Earth's magnetosphere and much of this knowledge can be used to understand plasmas throughout the universe. The goal of this course is for you to obtain a working familiarity of the current understanding of the plasma physics of Earth's magnetosphere, which will feasibly allow you to do research in this, or related, areas related to plasma physics.

Because of the slightly unusual approach in this class another learning outcome is the experience researching the latest understanding of a particular topic in magnetospheric experience, then preparing and presenting lectures and notes to the class. It will give you valuable experience in teaching.

Required Texts and Materials

There are no up to date and comprehensive textbooks available that cover the magnetospheric physics that would make a good textbook for this course. The closest and most recent is the more general book "Space Physics: An Introduction" by Russell et al 2016 (Cambridge) but it is somewhat more general. About 20 years ago, Rice Emeritus Professor Richard Wolf wrote and almost completed a textbook on the subject but he never published it for lack of time. While much of the theory discussed in the book remains perfectly valid today, many of the observations and understanding of the magnetosphere discussed in the book have changed. We will use this this manuscript as a starting point for

this course, that will be posted online on the Rice Canvas website with periodic updates.

Since part of the goal is to for you become up to date with the latest discoveries in magnetospheric physics part of your role in this class will be to pick a relevant chapter from the Wolf manuscript, understand the background material do the research to find that latest developments and prepare and present 2 lectures and notes to the class on this material. Material labelled with a (*) in the schedule below are potential topics for lectures. I will work closely with you on preparing your lectures and notes beforehand. This may take a few iterations, so it will take some planning on your part as well as me and will require scheduling regular meetings with me. Your classmates will also be asked to provide feedback on your teaching style. My plan is that your notes could be added to the text to what could become a dynamic document that we keep updated, sort of like Wikipedia where everyone will be able to edit and change the document.

Exams and Papers

30% of the grade comes homework assignments.
30% of your grade will be for your class lectures.
30% from in in-class final at the end of the semester.
10% of your grade will be for class participation.

Late Policy: Unless there are mitigating circumstances, assignments and presentations will be due at specified dates. Any work handed in late will have the grade reduced by 10% for each part of a day late, up to 50% off Grade Policies.

Honor code: You are welcome to help each other in completing assignments, but all work that you turn in must be your own and will fall under the pledged policy. Any evidence of copying will result in an automatic zero for the assignment for all parties involved and in some cases honor council involvement.

Absence Policies

If you expect to be absent for any period of time, please inform me ahead of time so I can plan accordingly. Since this class is heavily dependent on your lectures, please make sure that you will be available during the dates assigned for your lectures and to let me know well ahead of time if this changes. In the event of illness or any other unforeseen circumstances, please contact me ASAP.

Rice Honor Code

In this course, all students will be held to the standards of the Rice Honor Code, a code that you pledged to honor when you matriculated at this institution. If you are unfamiliar with the details of this code and how it is administered, you should consult the Honor System Handbook at http://honor.rice.edu/honor-system-

handbook/. This handbook outlines the University's expectations for the integrity of your academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process.

Disability Support Services

If you have a documented disability or other condition that may affect academic performance you should: 1) make sure this documentation is on file with Disability Support Services (Allen Center, Room 111 / adarice@rice.edu / x5841) to determine the accommodations you need; and 2) talk with me to discuss your accommodation needs.

Syllabus Change Policy

This syllabus is only a guide for the course and is subject to change with advanced notice.

Tentative Course Schedule – Preliminary and Subject to Change

Date	Topics
Tuesday, August 22, 2017	• Class Introduction and course outline • History of Solar Terrestrial Physics • Introduction to magnetospheric structure and terminology • Coordinate Systems
Thursday, August 24, 2017	Review of Basic Plasma Physics
Tuesday, August 29, 2017	Review of Basic Plasma Physics -2
Thursday, August 31, 2017	No class scheduled
Tuesday, September 5, 2017	The Solar Wind, Bow Shock, and the Magnetosheath
Thursday, September 7, 2017	Solar-Wind/Magnetosphere Coupling
Tuesday, September 12, 2017	Solar-Wind/Magnetosphere Coupling -2
Thursday, September 14, 2017	Ground and Ionospheric Observations and their Implications for Solar-Wind/Magnetosphere Coupling
Tuesday, September 19, 2017	The Magnetospheric Magnetic Field
Thursday, September 21, 2017	The Magnetospheric Magnetic Field - 2
Tuesday, September 26, 2017	Theory of Adiabatic Particle Motion in the Inner and Middle Magnetosphere
Thursday, September 28, 2017	Theory of Adiabatic Particle Motion in the Inner and Middle Magnetosphere -2
Tuesday, October 3, 2017	Magnetopause Observations (*)
Thursday, October 5, 2017	Magnetopause Observations -2 (*)
Tuesday, October 10, 2017	Midterm Break - NO CLASS
Thursday, October 12, 2017	The Outer Magnetotail (*)
Tuesday, October 17, 2017	The Outer Magnetotail (*) -2
Thursday, October 19, 2017	Ionosphere-Magnetosphere Coupling
Tuesday, October 24, 2017	Ionosphere-Magnetosphere Coupling - 2

Thursday, October 26, 2017	The Plasma Sheet and Substorms (*)
Tuesday, October 31, 2017	The Plasma Sheet and Substorms -2 (*)
Thursday, November 2, 2017	Magnetic Storms (*)
Tuesday, November 7, 2017	Magnetic Storms -2 (*)
Thursday, November 9, 2017	The Radiation Belts (*)
Tuesday, November 14, 2017	The Radiation Belts - 2(*)
Thursday, November 16, 2017	Other Magnetospheres (*)
Tuesday, November 21, 2017	Other magnetospheres -2 (*)
Thursday, November 23, 2017	Thanksgiving – NO CLASS
Tuesday, November 28, 2017	Reserved for schedule overruns
Thursday, November 30, 2017	In class test – Last Class