PHYS 672: Magnetospheric Physics Syllabus Spring 2020

Instructor: Prof. Hui Zhang
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Time: Mondays, Wednesdays, and Fridays, 9:15am-10:15am
Place: REIC 203
Office Hours: Mondays, 10:15am-1:15pm, or by appointment.
Credits: 3 credits, 3 hours/week of lecture
Useful Books: (all on reserve in the GI-IARC Library)

Space Physics: An Introduction, Author: C. T. Russell, J. G. Luhmann, R. J. Strangeway, Publisher: Cambridge University Press (2016), ISBN-10: 1107098823

Introduction to Space Physics, edited by Kivelson and Russell, Cambridge University Press (1995), ISBN-10: 0521457149

Physics of Space Plasmas: An Introduction, Second Edition, Author: George Parks, Publisher: Westview Press (2003), ISBN-10: 0813341302

Basic Space Plasma Physics, Author: W. Baumjohann and R. A. Treumann, World Scientific Publishing Company (1996), ISBN-10 186094017X

Course Description
The UAF Catalog listing for PHYS 672: "The physics and dynamics of Earth's magnetosphere. Discusses the magnetosphere as a test bed for microscopic plasma processes equilibrium configurations, plasma instabilities, highly nonlinear eruptive plasma processes, and global dynamics which involve the interaction of various regions of the magnetosphere. Introduction to various aspects of magnetospheric physics with a systematic discussion of the various elements of the magnetosphere, their structure and dynamics, and a discussion of the relevant plasma physics."

The Earth's magnetosphere is the region where the Earth's magnetic field is confined by the solar wind. It is made up of various large-scale regions, which vary in terms of the composition, energies, and densities of the plasmas that occupy them. The Earth's magnetosphere changes dynamically due to changes in the dynamic pressure and orientation of the interplanetary magnetic field (IMF). This course provides an introduction to established theory and phenomenology as well as a discussion of current problems on the structure and dynamics of the magnetosphere at the graduate level. The magnetosphere itself provides the structure for the course. The course follows an outside-in approach to the magnetosphere, starting with the solar wind, bow shock, and magnetosheath, then the magnetopause, and on to the inner magnetosphere, the magnetotail, and dynamics of the magnetosphere and its interaction with the ionosphere. It is desirable to have knowledge about "Electromagnetism" and "Plasma Physics". This course is recommended for graduate students with research interests in space physics.

Grades
45% of the grade will be based on problem sets (expect one every week), 15% on the mid-term

exam, 20% on the final exam, and 20% on the project.

The course will be graded approximately on the following scale:

> 85 %	A
80 % -- 85 %	A-
75 % -- 80 %	B+
70 % -- 75 %	B
65 % -- 70 %	B-
60 % -- 65 %	C+
55 % -- 60 %	C
50 % -- 55 %	C-
45 % -- 50 %	D+
40 % -- 45 %	D
35 % -- 40 %	D-
< 35 %	F

Course Policies
Problem sets will be given in class and are due in class on the due date stated in the problem sets. You are expected to show not only your answer but also steps leading to that answer. Your work should be clean and clear enough for me to understand.

High ethical standards are essential for maintaining credibility. Plagiarism is defined as appropriating passages or ideas from another person's work and using them as one's own. You may work with your classmates on problem sets, however, you should submit your own work, not a copy from another source. Plagiarism on homework or on a project will result in a failing grade.

Students with Disabilities Notice
The University of Alaska Fairbanks is committed to equal opportunity for students with disabilities. Students with disabilities are encouraged to contact the coordinator of Disability Services (Mary Matthews) at the Center for health & Counseling (x7043). See section on "Disability Services" of the UAF Class Schedule (http://www.uaf.edu/schedule/).

Student Protections and Services Statement
Every qualified student is welcome in my classroom. As needed, I am happy to work with you, disability services, veterans' services, rural student services, etc. to find reasonable accommodations. Students at this university are protected against sexual harassment and discrimination (Title IX), and minors have additional protections. For more information on your rights as a student and the resources available to you to resolve problems, please go the following site: www.uaf.edu/handbook/.

UA is an AA/EO employer and educational institution and prohibits illegal discrimination against any individual: https://alaska.edu/nondiscrimination/.

Your instructor follows the University of Alaska Fairbanks Incomplete Grade Policy: "The letter "I" (Incomplete) is a temporary grade used to indicate that the student has satisfactorily

completed (C or better) the majority of work in a course but for personal reasons beyond the student's control, such as sickness, has not been able to complete the course during the regular semester. Negligence or indifference are not acceptable reasons for an "I" grade."

Effective communication: Students who have difficulties with oral presentations and/or writing are strongly encouraged to get help from the UAF Department of Communication's Speaking Center (907-474-5470, speak@uaf.edu) and the UAF English's Department's Writing Center (907-474-5314, Gruening 8th floor), and/or CTC's Learning Center (604 Barnette Street, 907-455- 2860).

Tentative Course Outline

I. Introduction
II. The Bow Shock and the Magnetosheath
III. The Magnetopause
IV. The Magnetospheric Cusp
V. The Inner Magnetosphere
VI. Quiet Magnetotail
VII. Magnetosphere-Ionosphere Coupling
VIII. Storm and Substorms

Tentative Weekly Schedule

Week	Date	Lecture Subject	Problem Sets
1	M Jan 13	Introduction	Problem Set 1
	W Jan 15	The Solar Wind and IMF	
	F Jan 17	MHD Shocks and Discontinuities	
2	M Jan 20	**Alaska Civil Rights Day (no classes)**	
	W Jan 22	The Bow Shock	Problem Set 1 is Due
	F Jan 24	The Magnetosheath	
3	M Jan 27	Location of the Magnetopause	
	W Jan 29	Magnetopause current	Problem Set 2 is Due
	F Jan 31		
4	M Feb 3	The Magnetic Reconnection	
	W Feb 5		Problem Set 3 is Due
	F Feb 7		
5	M Feb 10	Other plasma transport mechanisms	
	W Feb 12		Problem Set 4 is Due
	F Feb 14		
6	M Feb 17	The Magnetospheric Cusp	
	W Feb 19		Problem Set 5 is Due
	F Feb 21		
7	M Feb 24	Mantle, LLBL	
	W Feb 26		Problem Set 6 is Due
	F Feb 28		
8	M Mar 2		
	W Mar 4	The Magnetospheric Convection	Problem Set 7 is Due
	F Mar 6		
	M Mar 9		

X	W Mar 11	**Spring Break**	
	F Mar 13		
9	M Mar 16	The Plasmasphere	
	W Mar 18	The Plasmaspheric Plume	Problem Set 8 is Due
	F Mar 20	Review	
10	M Mar 23	Mid-term Exam	
	W Mar 25	Plasmapause	
	F Mar 27		
11	M Mar 29	Ring Current	
	W Mar 31	Radiation Belt	Project topic chosen
	F Apr 3		
12	M Apr 6	Inner Belt, South Antactic Anormaly	
	W Apr 8	Outer Belt	Project progress report
	F Apr 10	Inner Magnetosphere Coupling	
13	M Apr 13	Quiet Magnetotail	
	W Apr 15	The Magnetosphere-Ionosphere Coupling	Project progress report
	F Apr 17		
14	M Apr 20	The Magnetospheric Substorm	
	W Apr 22	The Magnetospheric Storm	
	F Apr 24	Review	Project is due
15	M Apr 27		Presentations
	W Apr 29	8-10am, Final Exam	