PHYS F672 Magnetospheric Physics

Spring 2026

Course Information

Title: Magnetospheric Physics

Number: F672

Credit: 3

Prerequisites:

- PHYS F626 or an equivalent of 'Fundamentals of Plasma Physics'
- Graduate Standing

Location: Paul B Reichardt 204

Meeting Time: Tuesday and Thursday, 11.00-12.30

Course Type: In-person

Instructor

Name: Doğacan Su Öztürk

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Office location: TBD (Reichardt Office) and 706A Elvey Building (GI Office)

Office hours: Tuesdays 14.00-15.00 at Reichardt and by appointment at the GI Office

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Textbooks

- *Earth's Magnetosphere formed by the Low-latitude Boundary Layer*, Second Edition, Wayne Keith, Walter Heikkila, Elsevier, 2020, ISBN: 978-0-12-818160-7, doi: 10.1016/C2017-0-04309-4
- Physics of Space Plasma Activity, Karl Schindler, 2006, Cambridge University Press, ISBN: 9780511618321, doi: 10.1017/CBO9780511618321
- The Dynamic Magnetosphere, William Liu, Masaki Fujimoto, 2011, Springer, ISBN: 978-94-007-0500-5, doi: 10.1007/978-94-007-0501-2

The lecture notes, workbooks, and reading materials will be made available online. The students do not need to purchase the textbooks. All textbooks have been adopted for the Spring 2026 semester.

Course Description and Goals

This course is a 3-credit course aimed at graduate students. The course aims to introduce students to Magnetospheric Physics, which revolves around the physics and dynamics of Earth's magnetosphere. The class 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. The class introduces various aspects of magnetospheric physics through regions and processes that dominate the Earth's magnetosphere.

Course Schedule

Tт Class	Tт Dates	Tт Topic	⏰ Deadlines
1	01/13	Introduction to Magnetospheric Physics	
2	01/15	The Sun and the Solar Wind	
3	01/20	Single Particle Motion	
4	01/22	Magnetic Reconnection	
5	01/27	MHD Shocks and Discontinuities	
6	01/29	Earth's Magnetic Field	
7	02/03	Bow Shock	HW1 Due
8	02/05	Magnetopause	
9	02/10	Magnetospheric Cusp	
10	02/12	Plasmasphere	
11	02/17	Magnetotail	
12	02/19	Radiation Belts	HW2 Due
13	02/24	Magnetosphere-Ionosphere Coupling: Convection	
14	02/26	Magnetosphere-Ionosphere Coupling: Precipitation	
15	03/03	Magnetospheric Current System	

Class	Dates	Topic	Deadlines
16	03/05	Midterm Exam	
	03/10	Spring Break	
	03/12	Spring Break	
19	03/17	Magnetospheric Waves	
20	03/19	Magnetic Substorms	HW3 Due
21	03/24	Magnetic Storms	
22	03/26	Spacecraft and Ground-based Observations	
23	03/31	Global MHD Modelling	
24	04/02	Space Weather	
25	04/07	Planetary Magnetospheres: Inner Planets	
26	04/09	Planetary Magnetospheres: Outer Planets	HW4 Due
27	04/14	Lunar Bodies, Exoplanets, and Recap	
28	04/16	Final Presentations	
29	04/21	Final Presentations	
30	04/23	Final Presentations	
31	04/28		Final Reports Due

Student Learning Outcomes

The students will learn about the magnetospheres and fundamental physical processes that govern itsdifferent regions. At the end of the class, students will be able to:

- Understand the dominant physical mechanisms that govern different regions of the Earth's magnetosphere.
- Identify and differentiate between different types of magnetospheres.
- Use data, models, and forecasting tools to analyze different magnetospheric phenomena.
- Understand open problems in Magnetospheric Physics.

Instructional Method

The class will consist of 30 lectures, designed as two 1.5-hour long in person lectures per week. Students are expected to attend lectures in person at the designated time. Lecture materials will primarily consist of slideshow presentations and workbooks. All lecture notes will be made available via Canvas.

Course Policies

- Quizzes will be given each week at a random date and used as a way of checking and enforcing attendance.
- Due to time limitations, there won't be enough time to go in-depth for all materials of interest. Students are highly recommended to read and study the designated supplementary materials by themselves before each class and ask questions during a class, office hours, or by setting up an appointment.
- Homework will be posted and collected through Canvas. Please submit your homework on the due date stated in the homework. Late homework will not be accepted without evidence of illness or genuine emergency.
- Deadline extensions will be granted collectively if the whole class agrees upon it. Students are encouraged to use Canvas to achieve consensus on deadline extension requests.
- Students are encouraged to work together on the homework problems. However, the submitted material must reflect student's own work.
- Plagiarism and cheating are not accepted with no exception and will result in a grade of zero for the assignment.
- Use of generative AI (such as Gemini, ChatGPT, Bard, DeepSeek, Copilot, Claude, etc.) is prohibited unless instructed.

Grading Policy

Type	% Percentage
Homework	40 (10% each)
Midterm	25
Final Project Presentation	10

Type	% Percentage
Final Project Report	25
Total	100

There will be four written assignments, a written midterm exam, a final project presentation and report. The final reports will be graded using a specification grading policy. The final project will include a final presentation and a project report on the paper the student selected. The project report will detail the paper's motivation, its importance, and a discussion of the gained physical understanding in a commentary format. Final grades will be returned as letter grades with plus/minus modifiers. These will be derived from the overall percentage grade. The approximate conversions for each letter grade will be as follows: A+ (>97.5), A(>87.5), A-(>85), B+(>82.5), B(>72.5), B-(>70), C+(>67.5), C(>57.5), C- (>55), D+(>52.5), D(>42.5), D-(>40), F (<40)

Student Protections Statement

UAF embraces and grows a culture of respect, diversity, inclusion, and caring. Students at this university are protected against sexual harassment and discrimination (Title IX). Faculty members are designated as responsible employees which means they are required to report sexual misconduct. Graduate teaching assistants do not share the same reporting obligations. For more information on your rights as a student and the resources available to you to resolve problems, please go to the following site: https://catalog.uaf.edu/academicsregulations/students-rights-responsibilities/.

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

Academic Honesty

UAF expects and requires academic honesty from all members of the University community, and takes any act of plagiarism and cheating seriously. It is expected that all assignments, including homework and reports, that are turned in for this course

must the original work of the individual student. Failure to comply with this policy will result in penalty as stipulated under UAF regulations.

Incomplete Grade Policy

The 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."

Disabilities Services

The UAF Office of Disability Services implements the Americans with Disabilities Act (ADA), and ensures that UAF students have equal access to the campus and course materials. Any student who may need assistance with disabilities, should feel free to contact the Office of Disabilities Services (208 WHIT) by calling 907- 474-5655, or through email: uaf-disability-service@alaska.edu.

I will work with the Office of Disability Services to provide any reasonable accommodation to students with disabilities.

Effective Communication

Students who have difficulties with oral presentations and/or writing are strongly encouraged to seek assistance 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).

Use of Generative AI

Generative artificial intelligence (AI) tools and large language models (LLMs), such as ChatGPT, are designed to assist in creating and analyzing text, code, video, audio, and other multimedia. Use of these resources in your coursework comes with benefits and risks. In this course, the rules for usage are as follows:

- Do not use AI unless the assignment explicitly allows for it in the instructions and/or rubric. If you are unsure if your use of AI on an assignment is acceptable, ask the instructor and ensure you have documentation of permissions as appropriate.
- Identify Contributions: Any work you submit that has incorporated AI-generated content should indicate which parts of the work are yours and which parts were generated or informed by AI. AI contribution should be no more than 10% of assignment content.
- Provide Attribution: All use of AI tools (such as ChatGPT and others) must be explicitly cited with an explanation of how the AI tool was used and which prompts were given. This may be lengthy. Consider including as an appendix. Correct formats for attribution can be found at: Citing ChatGPT - UAF Elmer E. Rasmuson Library.
- Include Reflection: Any use of AI tools must include a brief reflection on what you learned by using the tool. For example, did you identify incorrect elements within generated work? How will you refine future prompts to address similar problems?

Any use of AI within the course that does not meet these rules may be considered a breach of the UAF Code of Conduct and carry substantial penalty. While exercising responsible and ethical engagement with AI is a skill you may hone over time, your unique human insights, critical thinking, and creative contributions remain pivotal to your learning experiences and success.