

SPACE 595: Magnetosphere and Solar Wind Winter 2025

Instructor:

Dr. Shasha Zou, Associate Professor
Room 1431, Climate and Space Research Building
Email: shashaz@umich.edu
Office phone: 734-936-8184

Lecture Time and Office Hour:

Tuesday/Thursday 12 pm -1:20 pm at 1024 FXB
Office hour: Thursday 2 – 3 pm at CSRB1431

Textbook:

- Kivelson and Russell “Introduction to Space Physics”, 1995
Or Russell et al. “Space Physics: An Introduction”, 2016
- Lyons and Williams “Quantitative Aspects of Magnetospheric Physics”
ebook: <http://link.springer.com/book/10.1007/978-94-017-2819-5>
- Auroral Plasma Physics, Space Sciences Series of ISSI
ebook: <https://link.springer.com/book/10.1007/978-94-007-1086-3>
- Tutorial and review papers

Grading Apportionment:

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| • Homework | 40% |
| • Midterm | 30% |
| • Project | 30% |

Grading Breakdown:

A+	95%
A	90%
A-	85%
B+	80%
B	75%
B-	70%
C+	65%
C	60%

Major Topics:

- The Sun and its atmosphere
 - Solar corona activity
- The solar wind and heliosphere
 - Basic solar wind property
 - Major interplanetary transients: CMEs and CIRs
- Basic space plasma physics review
 - Distribution function
 - Plasma moments
 - Magnetohydrodynamics (MHD)
 - Single particle motion
- Solar wind-magnetosphere coupling
 - Magnetopause
 - Magnetic reconnection driven convection
 - Magnetotail and plasma sheet
- Inner magnetosphere
 - Ring/Partial ring current
 - Wave-particle interaction basics
 - Plasma source and loss
- Magnetosphere-ionosphere coupling
 - Field-aligned currents and ionospheric currents
 - Auroral physics
 - Conductivity
- Planetary magnetosphere
- Extreme space weather

Milestone Dates:

- Midterm: Feb 27
- Project presentations: April 15, 17 and 22
- Project report: April 25 by midnight

Project:

There will be one term project for this class, done individually. They will be assigned in early March (more details at that time). The written report should be on the order of 6-8 pages without figures and references. It should include a literature review and research investigation. The oral part would be a presentation given to the class, ~10 min including Q&A.

SPACE 595 Course Outline (Winter 2025)
(tentative)

Date	#	Topic	Due
Th Jan 9	1	Introduction	
Tu Jan 14	2	The Sun and solar atmosphere	
Th Jan 16	3	The solar coronal activities	
Tu Jan 21	4	Interplanetary transients: modeling aspects	
Th Jan 23	5	Solar wind: observational aspects	
Tu Jan 28	6	Intro to kinetic theory	HW #1
Th Jan 30	7	Particle motion and acceleration	
Tu Feb 4	8	Particle motion and acceleration cont.	
Th Feb 6		Travel, no class	HW #2
Tu Feb 11	9	MHD	
Th Feb 13	10	Shock	
Tu Feb 18	11	Solar wind and magnetosphere interaction	
Th Feb 20	12	Magnetosphere-ionosphere coupling	HW #3
Tu Feb 25	13	Geospace modeling	
Th Feb 27	14	Midterm	
Tu Mar 4		Winter break	
Th Mar 6		Winter break	
Tu Mar 11	15	Review Midterm; Remote sensing of global boundaries	
Th Mar 13	16	Remote sensing of global boundaries cont.	
Tu Mar 18	17	Particle source process	
Th Mar 20	18	Magnetotail dynamics	
Tu Mar 25	19	Magnetotail dynamics cont.	
Th Mar 27	20	Particle loss process: precipitation and aurora	
Tu Apr 1	21	Particle loss process cont.	HW #4
Th Apr 3	22	Currents in the inner magnetosphere	
Tu Apr 8	23	Geomagnetic disturbances: storm vs substorm	
Th Apr 10	24	Planetary magnetospheres	
Tu Apr 15	25	Project presentation	
Th Apr 17	26	Project presentation	
Tu Apr 22	27	Project presentation	

Late Homework Policy

There will be four homework sets on the specified days. Late homework submitted within two days after the due date will have 20% points deducted and homework submitted later than two days but before four days after the due date will have 50% points deducted. Homework submitted later than four days after the due date will not be accepted. Please send an email to the instructor for any excused late homework.

Honor Code

Please conduct yourself ethically and responsibly. Please read the UM Honor Code. Copying of assignments, submitting work of others as your own, and violating exam rules will not be tolerated. See <https://ecas.engin.umich.edu/honor-council/honor-code/> for details.

Accommodations for Students with Disabilities

If you think you need an accommodation for a disability, please let me know at your earliest convenience. As soon as you make me aware of your needs, we can work with the Services for Students with Disabilities (SSD) office to help us determine appropriate academic accommodations. SSD (734-763-3000; <http://ssd.umich.edu>) typically recommends accommodations through a Verified Individualized Services and Accommodations (VISA) form. Any information you provide is private and confidential and will be treated as such.

E-mail Communication and CANVAS Discussion Board

I will regularly send you course announcements, reading assignments, and articles of interest via email through the Canvas Site. Please feel free to email any individual questions you may have directly to me. However, please use the discussion board on the CANVAS site for course logistics, homework, and project questions.