Space 598: The Sun & Heliospheric Physics

Class time: 9:00 – 10:30 AM on Tuesdays

9:30 – 11:00 AM on Thursdays

Location: Donahue Room (2422), except for 1/25 when we will be at 2424 (the next door)

Class duration: 1.5 hours

Office Hours: Liang Tuesday 11:00 AM – 12:00 PM 2436C

Chip Thursday 11:00 AM – 12:00 PM 2417B

Purpose of this course

What we will impart to you in this course is the ability to do original research and the ability to write compelling research papers. To think for yourself, to challenge existing ideas, and transition from a graduate student into an independent researcher.

Evaluation

There are no problem sets or exams, but rather we will have three projects to do in this course. We encourage that these projects be done by small teams of 2 or at most 3 students. While we strongly encourage working in teams, it is also acceptable to complete the projects as an individual with appropriate project scaling. Each team project should begin with a development/work plan, which identifyies the contribution of each team member and will be included with the final report.

Project 1: Journal Review, which is a detailed summary of one of three possible topics: the solar wind, the solar corona, or the Heliosphere or CME Modeling (related to project 2). Requirements for written paper: no more than 10 pages single spaced (including figures) and citing a minimum of 10 papers.

Project 2: We will provide 3D MHD model output from a solar wind simulation and a coronal mass ejection simulation, which the student may choose to analyze. The student is expected to produce a research paper describing (1) a physical question with supporting background material (2) brief model description (3) analysis (4) results and (5) summary and discussion of results in context with current literature. Topics may address any aspect of the simulation such as solar wind acceleration, thermodynamics, stream interaction, turbulence structure etc.

Project 3: Data Analysis Project: Using solar wind in-situ data to discover, explain, or solve some real heliophysics questions.

For each of the project, you are expected to write up your results, as if they were to be published or part of a publishable result, and we will schedule presentation time to discuss your results.

	Date	Topics	lecturers
1	Jan 11 (Th)	Introduction of the course	Liang & Chip
2	Jan 16 (Tu)	Intro of the Sun, the corona, the solar cycle, and the magnetic field and Description for Project 1	Liang
3	Jan 18 (Th)	Solar dynamo and solar cycle	Liang
4	Jan 23 (Tu)	Still solar dynamo, not cover "Magnetic field & open flux of the Sun" yet	Liang
5	Jan 25 (Th)	Spectroscopic (invited lecture) Room: 2424	Enrico
6	Jan 30 (Tu)	Solar eruptive activities: Theory	Chip
7	Feb 1 (Th)	Solar wind disturbances and CME propagation	Chip
8	Feb 6 (Tu)	Solar dynamo simulations	Chip
9	Feb 8 (Th)	Project 1: journal review reporting – postponed	Chip
10	Feb 13 (Tu)	Project 1: journal review reporting	C & L
11	Feb 15 (Th)	Model Corona & CME Output: Description for Project 2	Chip
12	Feb 20 (Tu)	MHD modeling , global Heliosphere	Chip (Liang will be out of town)
13	Feb 22 (Th)	Numerical modeling in Heliophysics field	Chip
	Feb 27 (Tu)	University break, no regular classes	
	Feb 29 (Th)		
14	Mar 5 (Tu)	Magnetic field & open flux of the Sun	Liang
15	Mar 7 (Th)	Solar wind origin 1	Liang
16	Mar 12 (Tu)	Instruments & in-site data / Turbulence	Liang/Chip
17	Mar 14 (Th)	Energetic particles	Chip
18	Mar 19 (Tu)	Project 2 reporting	C & L
19	Mar 21 (Th)	Project 2 reporting	Chip
20	Mar 26 (Tu)	Particle description	Valeriy Tenishev (remote)
21	Mar 28 (Th)	Solar wind composition & Description for Project 3	Liang
22	Apr 2 (Tu)	Solar wind origin 2	Liang
23	Apr 4 (Th)	Pump acceleration theory	Len Fisk (to confirm)
24	Apr 9 (Tu)	Recent results from PSP or Solar orbiter	Liang
25	Apr 11 (Th)	Machine Learning application on Heliophysics research	Liang
26	Apr 16 (Tu)	Project 3 reporting	C & L
27	Apr 18 (Th)	Project 3 reporting	C & L
28	Apr 23 (Tu)	Feedback of the final reports and snacks/treats	C & L

Outline of the course (subject to change)

In each lecture, we will present the conventional understanding of the subject. We will summarize current theories, but we note that some theories may be incomplete and in other cases competing theories are vying for acceptance. You are welcome to create your own theories.