ISRO-ESA HELIOPHYSICS WORKSHOP ON
ADITYA-L1, SOLAR ORBITER AND PROBA-3

ABSTRACT BOOK

HOSTED BY

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY (IIST),
THIRUVANANTHAPURAM, KERALA, INDIA

JANUARY 19-23, 2026

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- ✓ Tanmoy Samanta, Indian Institute of Astrophysics (IIA), Bengaluru, India, Member
- ✓ Tarun Kumar Pant, Space Physics Laboratory/ VSSC, Trivandrum, India, Member

2. Program

2.1 Program Schedule

Day 0 (18 Jan 2026): Registration

- **ATF Guest House:** From 17:30 hrs to 19:00 hrs (IST)
- **Hotel Uday Samudra:** From 17:00 hrs to 18:30 hrs (IST)

Day 1 (19 Jan 2026) – Coronal Science: Current Understanding and Observations

Time (IST)	Agenda		Title
08:30-09:00	Registration (Continuation of registration)		-
09:00-10:15	Opening Ceremony • ISRO and ESA welcome and opening remarks • Overall science program briefing • Vote of Thanks		-
10:15-10:45	High Tea		-
10:45-11:45 **Session 1**	10:45-11:15	**Vincenzo Andretta** (Invited) INAF-OAC Naples	Wave-like coronal density fluctuations observed by Metis
	11.15-11:30	**Andreas Debrabandere** (Royal Observatory of Belgium, Belgium)	Quasi-Periodic Density Perturbations in the Inner Corona Revealed by PROBA-3/ASPIICS
	11.30-11:45	**Yara De Leo** (INAF-Astrophysical Observatory of Catania, Italy)	A comprehensive study on two eruptive events seen by Metis on October 28, 2021
11:45-13:00	11:45-12:15	**Vaibhav Pant** (Invited) Indian Institute of Technology Delhi	High-Resolution Observations of Transverse Waves in the Solar Corona

Time (IST)	Agenda		Title
Session 2	12:15-12:30	**Daye Lim** (Royal Observatory of Belgium, Belgium)	Accessing the fine temporal scale of EUV brightenings and their quasi-periodic pulsations: 1 second cadence observations by Solar Orbiter/EUI
	12:30-12:45	**Sarah Gibson** (National Center for Atmospheric Research, United States)	PROBA-3 ASPIICS: Investigating the Inner Corona in a Global Context
	12:45-13:00	**Deepan Patra** (National Centre for Radio Astrophysics, India)	Probing the Coronal Plasma with MeerKAT, Aditya-L1, and Solar Orbiter
13:00-14:00	Group photo followed by lunch		-
14:00-15:30	Data analysis and hands-on session		-
15:30-16:00	Tea Break		-
16:00-17:30	Data analysis and hands-on session		-

Day 2 (20 Jan 2026) – Coronal Science: Current Understanding and Observations

Time (IST)	Agenda		Title
09:30-10:45 **Session 3**	09:30-10:00	**Stephanie Yardley** (Invited) Northumbria University	Exploring the Connection Between the Sun and the Heliosphere
	10.00-10:15	**Daye Lim** (Royal Observatory of Belgium, Belgium)	Solar Orbiter observations and Bifrost simulations of plasmoid mediated reconnection
	10.15-10:30	**Brigitte Schmieder** (Observatoire de Paris , France)	Thermodynamic Data-driven models based on observations (EUV and white light)

Time (IST)	Agenda		Title
	10.30-10:45	**Sunit Pradhan** (Indian Instiute of Astrophysics, India)	Probing the CME Core–Prominence Relation Using Inner Coronal Observations
10:45-11:45	Poster viewing + Tea (15+30+15 min)		
11:45-13:00 **Session 4**	11:45-12:15	**Stefaan Poedts** (Invited) KU Leuven	Towards a global model for the solar atmosphere
	12:15-12:30	**Senthamizh Pavai Valliappan** (Royal Observatory of Belgium, Belgium)	Comparative Analysis of low coronal structures: Proba-3 observations vs. COCONUT
	12:30-12:45	**Supriya Hebbur Dayananda** (Astronomical Institute of the Czech Academy of Sciences, Czech Republic)	Forward Modeling of Coronal Spectral Lines with P-CORONA
	12:45-13:00	**Shaonwita Pal** (CESSI, IISER Kolkata, India)	Optimized Century-Scale Reconstruction of Solar Magnetic Evolution: From Surface Fields to the Corona and Heliosphere
13:00-14:00	Lunch		
14:00-15:30	Data analysis and hands-on session		
15:30-16:00	Tea Break		
16:00-17:30	Data analysis and hands-on session		
19:00	Conference Dinner		

Day 3 (21 Jan 2026) – Chromopheric Science: Current Understanding & Observations

Time (IST)	Agenda		Title
09:30-10:45 **Session 5**	09:30-10:00	**Stanislav Gunar** (Invited) Astronomical Institute, Czech Academy of Sciences	State of the art of prominence research
	10.00-10:15	**Annu** (Indian Institute of Astrophysics, India)	On the Origin of Coronal Picoflare Jets
	10.15-10:30	**Clementina Sasso** (INAF-Astronomical Observatory of Capodimonte, Italy)	Multi-Spacecraft Observations of a Large Prominence Eruption and a CME
	10.30-10:45	**Debesh Bhattacharjee** (Udaipur Solar Observatory/ PRL, India)	*Time evolution of flare-accelerated electrons using X-ray observations (observed by RHESSI and Solar Orbiter) and the warm-target model*
10:45-11:45	Poster viewing + Tea (15+30+15 min)		
11:45-13:00 **Session 6**	11:45-12:15	**Alessandra Giunta** (Invited) University of Catania	Fingerprints of the Sun: spectral diagnostics with Solar Orbiter SPICE
	12:15-12:30	**Nancy Narang** (Royal Observatory of Belgium, Belgium)	Influence of magnetic-field distribution on the spatio-temporal properties of EUV brightenings in the solar atmosphere
	12:30-12:45	**Alessandro Liberatore** (INAF - National Institute for Astrophysics, Italy)	Unveiling the Hidden Sun: A Polarimetric Approach to Identify the Solar Center and Enable In-flight Calibration in Metis and ASPIICS Coronagraphs
	12:45-13:00	**Shane Maloney** (Dublin Institute for Advanced Studies, Ireland)	sunkit-spex: STIX Spectral Fitting
13:00-14:00	Lunch		

Time (IST)	Agenda	Title
14:00-15:30	Data analysis and hands-on session	
15:30-16:00	Tea Break	
16:00hrs onwards	Free Time / Excursion	

Day 4 (22 Jan 2026) – Chromopheric Science: Current Understanding & Observations

Time (IST)	Agenda		Title
09:30-10:45 **Session 7**	09:30-10:00	**Soumya Roy** (Invited) MCNS, MAHE	*White-Light Continuum Observations across the Balmer Jump for SOL2024-10-03T12:18*
	10.00-10:15	**Janmejoy Sarkar** (Max Planck Institute for Solar System Research, Germany)	Test and Calibration of the SUIT payload on board Aditya-L1
	10.15-10:30	**Vishwa Vijay Singh** (Udaipur Solar Observatory/ PRL, India)	Source of HXR emission in dual-peak structured X-class confined flare and associated coronal dynamics: XRSs/Aditya-L1 and AIA/SDO observations
	10.30-10:45	**Ravi Chaurasiya** (Udaipur Solar Observatory/ PRL, India)	*Unveiling the Multithermal Nature of Solar Spicules and Their Associated Dynamics*
10:45-11:45	Poster viewing + Tea (15+30+15 min)		

Day 4 (22 Jan 2026) – Heliospheric Science: Current Understanding & Observations

Time (IST)	Agenda		Title
11:45-13:00 **Session 8**	11:45-12:15	**Wageesh Mishra** (Invited) Indian Institute of Astrophysics, Bengaluru	Kinematics, Thermodynamics, and Geoeffectiveness of Interacting Coronal Mass Ejections
	12:15-12:30	**Shibotosh Biswas** (Space Physics Laboratory, Vikram Sarabhai Space Centre, India)	Pinching of ICME Flux Rope: Unprecedented Multipoint Observations of Internal Magnetic Reconnection during Gannon's Superstorm
	12:30-12:45	**Pawan Kumar** (University of Florence, Italy)	Probing Solar Wind Origins and coronal parameters through PSP–SolO Quadrature and Corotation Studies
	12:45-13:00	**Ronish Mugatwala** (University of Genoa, Italy)	Probabilistic Drag-Based Model (P-DBM) in Heliosphere: Data and Tools
13:00-14:00	Lunch		
14:00-15:30	Hands-on Tutorials on Science Workflows		
15:30-16:00	Tea Break		
16:00-17:30	Hands-on Tutorials on Science Workflows		

Day 5 (23 Jan 2026) – Heliospheric Science: Current Understanding & Observations

Time (IST)	Agenda		Title
09:30-10:45 **Session 9**	09:30-10:00	**Domenico Trotta** (Invited) European Space Agency (ESA), European Space	Chasing Shocks with Solar Orbiter: Insights into Particle Acceleration During Solar Cycle 25

Time (IST)	Agenda		Title
		Astronomy Center (ESAC)	
	10.00-10:15	**Puja Majee** (National Centre for Radio Astrophysics, India)	A Detailed Polarimetric Study of a Type-II Solar Radio Burst with MWA
	10.15-10:30	**Bijoy Dalal** (Physical Research Laboratory, India)	Measurements of energetic particles from the Earth's magnetosphere and interplanetary medium by ASPEX-STEPS on board Aditya-L1
	10.30-10:45	**Ankush Bhaskar** (Space Physics Laboratory, Vikram Sarabhai Space Centre, India)	Multi-Point Observations of Spatially Varying Turbulence Inside the Interplanetary Coronal Mass Ejection of the October 2024 Extreme Solar Storm
10:45-11:45	Poster viewing + Tea (15+30+15 min)		
11:45-13:00 **Session 10**	11:45-12:15	**Ranadeep Sarkar** (Invited) University of Helsinki	*Heliospheric Evolution of CMEs and Their Space Weather Impacts: Insights from Observations and Modeling*
	12:15-12:30	**Shivam Parashar** (Physical Research Laboratory, India)	Probing ICME–ICME Interaction Using Directional Ion Energy Flux Observations from Aditya-L1/ASPEX-SWIS
	12:30-12:45	**Gopika S Vijayan** (Christian College, Chengannur)	Influence of Solar Flare X-ray Flux and Interplanetary Parameters on Geomagnetic Variability and Analysis of Temporal Evolution of Geomagnetic Disturbance Across Different Latitudes
	12:45-13:00	**Shirsh Lata Soni** (University of Iowa, United States)	*Super Expansion of Interplanetary Coronal Mass Ejection Observed by Solar Orbiter and Wind spacecraft within 0.14 AU Radial Separation*
13:00-14:00	Lunch		

Time (IST)	Agenda	Title
14:00-15:30	Hands-on Tutorials on Science Workflows	
15:30-16:00	Tea Break	
16:00	Preliminary results presentation from the hands-on teams	

2.2 Data Analysis and Hands-on Session

Day 1 (19 Jan 2026) – Solar Orbiter Hands-On Day

Time (IST)	Session	Speaker
14:00 – 14:15	SOAR introduction + data access (15 mins)	**Arnaud Masson**
14:15 – 14:30	SunPy / Fido basics + sunpy_soar (15 mins)	**Laura Hayes**
Remote Sensing:		
14:30 – 14:50	EUI tutorial (20 mins)	**Nancy Narang**
14:50 – 15:10	STIX tutorial (20 mins)	**Shane Maloney**
15:10 – 15:20	SPICE mini-demo (short overview) (10 mins)	**Laura Hayes**
15:20 – 15:30	Buffer / Q&A	
15:30 – 16:00	Tea Break	
16:00 – 16:10	PHI mini-demo (short overview) (10 mins)	**Nancy Narang**
16:10 – 16:30	METIS tutorial (20 mins)	**METIS Team**
In-situ:		
16:30 – 16:50	SWA (20 minutes)	**Chandra Anekallu**
16:50 – 17:10	MAG + EPD (20 minutes)	**Chandra Anekallu**
17:20 – 17:30	Wrap-up + Q&A	

Day 2 (20 Jan 2026) – Aditya-L1 Hands-On Day

Time (IST)	Session	Speaker
14:00 – 14:15	Aditya-L1 intro + data access (15 mins)	**Tanmoy Samanta**
Remote Sensing:		
14:15 – 14:35	VELC tutorial (20 mins)	**Tanmoy Samanta** (*Instrument description + data demo*)
14:35 – 14:55	SUIT tutorial (20 mins)	**Nived V. N.** (*Instrument description + data demo*)
14:55 – 15:15	HELIOS tutorial (20 mins)	**Manju Sudhakar** (*Instrument description + data demo*)
15:15 – 15:30	Buffer / Q&A	
15:30 – 16:00	Tea Break	
16:00 – 16:20	SoLEXS tutorial (20 mins)	**Abhilash Sarwade** (*Instrument description + data demo*)
In-situ:		
16:20 – 16:40	ASPEX-STEPS tutorial (20 mins)	**Bijoy Dalal** (*Instrument description (7–8 mins)*) **Aakash** (*Data Demo*)
16:40 – 16:55	ASPEX-SWIS tutorial (15 mins)	**Shivam Parashar** (*Instrument description + data demo*)
16:55 – 17:10	MAG tutorial (15 mins)	

Time (IST)	Session	Speaker
17:10 – 17:30	Wrap-up + Q&A(20 mins)	**Bijoy Dalal** (*Instrument description + data demo*)

Day 3 (21 Jan 2026) – PROBA-3 Hands-On Day

Time (IST)	Session	Speaker
14:00 – 14:15	Introduction to PROBA-3 and ASPIICS (15 mins)	**Laurent Dolla**
14:15 – 15:00	ASPIICS tutorial (data access + basic quicklook)	**Laurent Dolla**
15:00 – 15:30	Cross-mission orientation (how Solar Orbiter, Aditya-L1, and PROBA-3 complement each other) *Discussion on collaboration between coronagraphs, notebooks, and maps*	All METIS, PROBA-3 and VELC Teams (Leads)
15:30 – 16:00	Tea Break	
Note: An excursion is planned after 4:00 PM		

Day 4 (22 Jan 2026) – Hands-on Tutorials on Science Workflows

Day 5 (23 Jan 2026) – Hands-on Tutorials on Science Workflows

2.3 Information on Data Analysis and Hands-on Session

During the first three days of the workshop, the participants will be introduced to the instruments, data structure and analysis procedures of the instruments from Aditya-L1, Solar Orbiter and Proba 3.

The participants will be taken through the process on how to access the data, use the instrument specific software for displaying data products, and a brief description on data analysis.

For reference the link for Solar Orbiter tutorials is provided

https://github.com/SolarOrbiterWorkshop/solo8_tutorials

Details on the different instruments on Aditya-L1 are provided in the link

https://pradan1.issdc.gov.in/al1/

If you click on the "Access Data" link, you will be prompted to register. Once you have registered, you will be able to access the user manuals for each instrument. The data structure, software requirements and detailed examples will be provided in these user manuals.

Please note that newer software and/or user manuals may be generated and will be shared on the workshop website.

Expected Outcome of the hands-on session:

The main takeaway of this hands-on session will be to enable the participants to understand the importance of multi-messenger data to address solar and heliospheric science problems. Keeping beginners in mind, participants will be introduced to the workflow and tools while advanced participants are encouraged to take this activity forward. Understanding that the time is limited to complete a problem, the participants are encouraged to present their findings during the last day of the workshop.

2.4 Hands-on Tutorials on Science Workflows

The Hands-on Tutorials on Science Workflows will take place on the final two days of the workshop (**January 22–23, 2026**). Based on your responses to the tutorial interest form, participants have been organized as equitably as possible into the following three parallel science workflows:

1. **Flares and Eruptions**
2. **Coronal Structures**
3. **Heliospheric Science**

If you did not receive your first choice of topic, please do not be concerned. All Jupyter notebooks from every track will be made available to all participants after the workshop concludes.

What the Workflows Cover

Each session is designed to provide a comprehensive, reproducible scientific experience. The workflows will demonstrate:

- **Multi-mission synergy:** Integrating data from Solar Orbiter, Aditya-L1, PROBA-3, and other relevant datasets.
- **End-to-end analysis:** Working through a specific event or dataset from start to finish.
- **Ready-to-run Notebooks:** Practical Python scripts that can be executed in real time.
- **Scientific Problem Solving:** A science question paired with a workflow to answer it.

Technical Setup & Requirements

To ensure a smooth experience, please note the following:

- **Bring Your Own Laptop:** Windows, Ubuntu/Linux, or macOS.
- **Environment:** Python-based packages via **Jupyter Notebook** or **Google Colab**.
- **Prerequisites:** Please ensure the following are installed before the session:
  - Pandas
  - NumPy
  - Matplotlib
  - SunPy
  - Jupyter Lab / Notebook
- If you encounter any installation issues, volunteers will be available on-site to assist you.

Detailed, mission-specific software tool installation steps will be discussed during the sessions.

Support and Discussion

These sessions are designed to be interactive and informal. Extra time has been built in for:

- General Q&A and troubleshooting
- Instrument-specific side groups and informal discussions.

2.5 Executive Session

Day 1 (January 19, 2026)	
Time	**14:00 to 15:30 hrs**
Topic	**Mission and Instrument Concepts**
Panelists	Matthew West, Damien Galiano, Clementina Sasso, Silvano Fineschi, Sankarasubramanian K., K. Nagaraju
Moderator	**Dipankar Banerjee**
Time	**16:00 to 18:00 hrs**
Topic	**Mission and Instrument Concepts**
Panelists	Luca Teriaca, Tanmoy Samanta, Hamish Reid, Santosh Vadawale, Radhakrishna V.
Moderator	**Yannis Zouganelis**
Day 2 (January 20, 2026)	
Time	**14:00 to 15:30 hrs**
Topic	**Multispacecraft and Instrument Coordination**
Panelists	Anik De Groof, Sankarasubramanian K., Andrei Zukov, Shibu K Mathew
Moderator	**Sankarasubramanian K.**
Time	**16:00 to 18:00 hrs**

Topic	**Mission, Instrument Concepts and Coordination with Space-based Instruments**
Panelists	Sreejith Padinhatteeri, Rohit Sharma, Mugundhan Vijayaraghavan, Anshu Kumari, Dibyendu Chakraborty, Srikar Tadepalli
Moderator	**Manju Sudhakar**
Day 3 (January 21, 2026)	
Time	**14:00 to 15:30 hrs**
Topic	**Programmatic and Operational Modeling and Data Usage**
Panelists	Dibyendu Nandi, Bhargav Vaidya, Arnaud Masson, Madhulika, Matt Taylor
Moderator	**David Berghmans**

3. Invited Talks and Oral Contribution

Monday, 19th January 2026

ISROESA10464	Vincenzo Andretta	Invited
Wave-like coronal density fluctuations observed by Metis		
The Metis coronagraph on board Solar Orbiter can provide observations of the solar corona at high spatial and temporal resolution. Its unique capabilities include spatial scales down to 2000 km (visible light) and 15,000 km (UV light) over the critical region spanning 1.7 to 3.6 solar radii at perihelion, with cadences down to 20 seconds for extended periods. Since the beginning of the nominal science phase in 2022, these combined capabilities have opened a new window on coronal dynamics. In this talk, I will present discuss the unexpected detection of density fluctuations in the corona above 2 solar radii with characteristic periods in the range 3-5 minutes. These observations can provide critical constraints on the nature of waves or other magnetohydrodynamic processes acting in the corona and solar wind.		

ISROESA10655	Andreas Debrabandere	Contributed
Quasi-Periodic Density Perturbations in the Inner Corona Revealed by PROBA-3/ASPIICS		
We present early results from the recently released ASPIICS coronagraph onboard PROBA-3, focusing on radially propagating, quasi-periodic density perturbations in the low solar corona. Using high-cadence (30 s) white-light observations from orbits 308–310 (August 14–16, 2025), we traced coherent, outward-moving periodic trains of density blobs, visible within running-difference images spanning 1.5–2.4 R⊙. These features exhibit propagation speeds of ~350 km/s, interspacing of ~100 Mm, and angular coherence across 5°–20° in latitude. They are most prominent in streamers, streamer flanks, and fan-like structures rooted in closed-field regions, and have also been noted in prior observations of the extended corona. ASPIICS's continuous radial coverage, exceptionally low stray light, and high temporal resolution now enable finer tracking of such dynamics closer to the limb. In a southern region of interest (150°–210°), we observe persistent field-aligned propagation without clear acceleration, suggesting compressive disturbances consistent with slow magnetoacoustic waves or modulated outflows. Their occurrence above closed arcades raises the possibility of upward leakage of p-mode power and conversion into slow-mode waves along extended field structures. We briefly discuss these observations in the context of MHD wave theory, mode conversion, and solar wind source modeling. The ubiquity of these features suggest that coherent compressive dynamics extend into regions beyond streamer cores, including fan structures and diffuse closed-field domains. These results highlight the unique diagnostic potential of PROBA-3/ASPIICS, especially in conjunction with multi-perspective data from Solar Orbiter and Aditya-L1. Ongoing efforts focus on automated detection, field extrapolations, and coordinated imaging to further constrain their physical nature.		

ISROESA10422	Yara De Leo	Contributed

A comprehensive study on two eruptive events seen by Metis on October 28, 2021

On October 28, 2021 the first X-class solar flare of Solar Cycle 25 occurred in active region NOAA AR 12887 with a peak at 15:35 UT. It produced the rare event of ground-level enhancement of the solar relativistic proton flux and a global extreme ultraviolet wave, along with a fast halo coronal mass ejection (CME) as seen from Earth's perspective. A few hours before the flare, a slower CME had erupted from a quiet Sun region just behind the northwestern solar limb. Solar Orbiter was almost aligned with the Sun-Earth line and, during a synoptic campaign, its coronagraph Metis detected the two CME events in both Visible Light (VL) and UltraViolet (UV) channels. The earlier CME took place in the north-west (NW) sector of Metis field of view, while several bright features of the flare-related event appeared mostly to the south-east (SE). The NW and SE events have two distinct origins, but were both characterized by a very bright emission in HI Ly-alpha visible in the UV images of Metis up to 8 solar radii. This work is a follow-up study of two out of the six events analyzed by Russano et al. 2024 (A&A, 683, A191), aimed at investigating the evolution of these two almost co-temporal CMEs but originating in such distinct source regions. To that end, we extensively inspect data sets from numerous remote-sensing instruments observing the Sun in several spatial and spectral regimes. We characterize several aspects of these CMEs, including their three-dimensional properties, kinematics, mass, and temporal evolution of those quantities.
Results of this work point to notable differences between these two events showing significant UV emission in the corona.

ISROESA10684	Vaibhav Pant	Invited

High-Resolution Observations of Transverse Waves in the Solar Corona

Transverse waves are prevalent in the solar corona and can be observed at various spatial and temporal scales. Since the launch of the Solar Orbiter and IRIS, these waves have been studied with high spatial and temporal resolution. In this presentation, I will provide observational evidence for the existence of transverse waves in short coronal loops, which are approximately 10 Mm in length, found in active regions, quiet regions, and coronal holes. Additionally, I will present observations of propagating waves within the fine structures of polar plumes. Finally, I will discuss the energy content of these waves, their significance in heating the solar corona, and the associated seismology.

ISROESA10421	Daye Lim	Contributed

Accessing the fine temporal scale of EUV brightenings and their quasi-periodic pulsations: 1 second cadence observations by Solar Orbiter/EUI

Small-scale extreme-ultraviolet (EUV) transient brightenings are observationally abundant and critically important to investigate. Determining whether they share the same physical mechanisms as larger-scale flares would have significant implications for the coronal heating problem. A recent study has revealed that quasi-periodic pulsations (QPPs), a common feature in both solar and stellar flares, may also be present in EUV brightenings in the quiet Sun (QS). We aim to characterise the properties of EUV brightenings and their associated QPPs in both QS and active regions (ARs) using unprecedented 1 s cadence observations from Solar Orbiter's Extreme Ultraviolet Imager (EUI). We applied an automated detection algorithm to analyse statistical properties of EUV brightenings. QPPs were identified using complementary techniques optimised for both stationary and non-stationary signals, including a Fourier-based method, ensemble empirical mode decomposition, and wavelet analysis. Over 500000 and 300000 brightenings were detected in ARs and QS regions, respectively. Brightenings with lifetimes shorter than 3 s were detected, demonstrating the importance of high temporal resolution. The QPP occurrence rates were approximately 11% in AR brightenings and 9% in QS brightenings, with non-stationary QPPs being more common than stationary ones. QPP periods span from 5 to over 500 s and show similar distributions between AR and QS. Moderate linear correlations were found between QPP periods and the lifetime and spatial scale of the associated brightenings, while no significant correlation was found with peak brightness. We found a consistent power-law scaling, with a weak correlation and a large spread, between QPP period and lifetime in EUV brightenings, solar, and stellar flares. The results support the interpretation that EUV brightenings may represent a small-scale manifestation of the same physical mechanisms driving larger solar and stellar flares. Furthermore, the similarity in the statistical properties of EUV brightenings and their associated QPPs between AR and QS regions suggests that the underlying generation mechanisms may not strongly depend on the large scale magnetic environment.

ISROESA10518	Sarah Gibson	Contributed

PROBA-3 ASPIICS: Investigating the Inner Corona in a Global Context

Sarah Gibson, Craig DeForest, Leon Golub, Russell Howard, Jon Linker, Dan Seaton, Guillermo Stenborg, Angelos Vourlidas, and Andrei Zhukov

Much of the early evolution that ultimately defines the quiescent solar wind and eruptions known as coronal mass ejections (CMEs) takes place in the inner corona, between approximately 1.1 and 4 solar radii (Rs) from the Sun center. ESA's Proba-3/ASPIICS coronagraph observes this region as never before. We present early analyses of ASPIICS data, considering both fine-scale structure and large-scale CME dynamics in the context of MHD models and other mission data. As a particular case study, we will follow one or more CMEs from the ASPIICS inner corona field of view into the PUNCH wide field of view, and consider how the CME's structure and dynamics evolve.

ISROESA10605	Deepan Patra	Contributed

Probing the Coronal Plasma with MeerKAT, Aditya-L1, and Solar Orbiter

Studying the dynamics and structure of the solar corona requires a multi-wavelength approach that can probe its magnetic and plasma environments. Space-based missions such as Aditya-L1 and Solar Orbiter provide unprecedented measurements of various physical quantities in corona such as the magnetic field, in-situ plasma parameters etc. On the other hand, radio observations offer a unique and complementary diagnostic capability. In particular, new-generation radio telescopes like The MeerKAT radio interferometer, operating between 580–1710 MHz, enables high-fidelity spectroscopic snapshot imaging

of the Sun at centimetre wavelengths, corresponding to emission heights of approximately 1.02–1.3 R_sun.

MeerKAT's broad frequency coverage and dynamic range allow full-disk imaging of both quiescent and active coronal plasma, directly measuring thermal free–free emission integrated along the line of sight. This capability bridges the diagnostic gap between slit-based EUV spectrographs and full-disk imagers, providing sensitivity to plasma across a wide temperature range (from the TR to the low corona). Recent observations have demonstrated MeerKAT's ability to capture coronal holes, filaments, cavities, and eruptive phenomena such as flares and CMEs, while tracking spectral index evolution that reveals changing plasma conditions and non-thermal particle acceleration. MeerKAT's high time–frequency resolution further allows the detection of quasi-periodic pulsations (QPPs), offering insights into magnetohydrodynamic oscillations and periodic reconnection processes.

Combined with Aditya-L1's continuous monitoring of the corona in visible, UV, and X-ray wavelengths, and Solar Orbiter's high-resolution EUV, magnetographic, and in-situ measurements, radio observations enable comprehensive multi-thermal and multi-height diagnostics of coronal plasma and magnetic field. This presentation will demonstrate some of the early results from a few solar observations from MeerKAT and how this will significantly enhance our ability to measure and model the coronal plasma and magnetic field, contributing to a better understanding of solar activity and its heliospheric impact.

Tuesday, 20th January 2026

ISROESA10314	Stephanie Yardley	Invited
Exploring the Connection Between the Sun and the Heliosphere		
One of the main goals of solar and heliospheric physics is to gain a complete picture of the dynamic processes occurring in the solar atmosphere and how these influence the inner heliosphere. Missions such as ESA/NASA's Solar Orbiter, which couples unprecedented, close-up views of the solar atmosphere to solar wind measurements in the inner heliosphere, provide invaluable insights into the sources, release and transport of the solar wind, coronal mass ejections (CMEs), and solar energetic particles. Multi-spacecraft observations from Solar Orbiter combined with more recent additions like ISRO's Aditya-L1 and ESA's Proba-3 offer complementary perspectives that enhance our understanding of the Sun-heliosphere connection. In this review, I will highlight recent results using Solar Orbiter data to trace the relationship between solar atmospheric phenomena and their heliospheric manifestations, demonstrating how these multi-viewpoint approaches are advancing our knowledge of solar wind structure and CME evolution.		

ISROESA10049 / ISROESA10421	Reetika Joshi / Daye Lim	Contributed
Solar Orbiter observations and Bifrost simulations of plasmoid mediated reconnection		
Coronal jets are ubiquitous, collimated million-degree ejections that contribute to the energy and mass supply of the upper solar atmosphere and the solar wind. Solar Orbiter provides an unprecedented opportunity to observe fine-scale jets from a unique vantage point close to the Sun. We analyze eleven datasets from the High Resolution Imager 174 Å of the Extreme Ultraviolet Imager (HRIEUV) onboard Solar Orbiter, focusing on narrow jets from Coronal Bright Points (CBPs) and signatures of magnetic reconnection within current sheets and outflow regions. To aid interpretation, we compare the observations with radiative-MHD simulations of a CBP conducted with the Bifrost code. In one of the datasets, we directly identify plasmoid-mediated reconnection through the development within the current sheet of a small-scale plasmoid that reaches a size of 332 km and propagates at 40 km/s. The simulation self-consistently produces a current sheet and small-scale plasmoids similar to those observed, whose synthetic HRIEUV emission reproduces both direct imprints within the current sheet and intermittent patterns in the outflow region associated with their ejection. Our findings highlight Solar Orbiter's unique capability to capture narrow jets and sub-megameter-scale plasmoid mediated reconnection signatures in the corona, motivating future statistical studies to assess the role of such fine-scale phenomena in coronal dynamics and solar wind formation.		

ISROESA10315	Brigitte Schmieder	Contributed
Thermodynamic Data-driven models based on observations (EUV and white light)		
Solar filament eruptions, flares, and coronal mass ejections (CMEs) are manifestations of drastic releases of energy in the magnetic field, which are related to many eruptive phenomena, from the Earth's magnetosphere to black hole accretion disks. With the availability of high-resolution magnetograms on the solar surface, observational databased		

modeling is a promising way to quantitatively study the underlying physical mechanisms behind observations. We use as a case study the X1.0 flare on 2021 October 28 in NOAA active region 12887, including the morphology of the eruption, the kinematics of the flare ribbons, extreme ultraviolet (EUV) radiations , and the two components of the EUV waves. We develop a new data-driven MHD model incorporating thermal conduction and radiation losses in the energy equation which captured the thermodynamic evolution of the loops.We find that flare ribbons separate initially and ultimately stop at the outer stationary quasi-separatrix layers (QSLs). Such outer QSLs correspond to the border of the filament channel and determine the final positions of flare ribbons, which can be used to predict the size and the lifetime of a flare before it occurs. In addition, the side views of the synthesized EUV and white-light images exhibit typical three-part structures of CMEs, where the bright leading front is roughly cospatial with the non wave component of the EUV wave. Combining EUV data of SDO, Solar orbiter, Aditya data (SUIT, VELC..) it will be possible predict the arrival of the ICME at Earth by using EUHFORIA.

ISROESA10260	Stefaan Poedts	Invited

Towards a global model for the solar atmosphere

In my ERC-AdG project 'Open SESAME' (project No 101141362), we aim to develop a time-evolving model for the entire solar atmosphere, including the chromosphere and transition region, based on a multifluid description. Currently, models are primarily steady, rely on a single-fluid description and include only the corona due to computational challenges. We plan to use time-evolving ion-neutral and ion-neutral-electron models. The multifluid approach will enable us to describe the intricate physics in the partially ionised chromosphere and quantify the transfer of momentum and energy between the atmospheric layers. The questions of where the solar wind originates and how solar flares and coronal mass ejections are driven have fundamental scientific importance and substantial socio-economic impact. This goal is now achievable by combining our implicit numerical solver with a high-order flux reconstruction (FR) method. The implicit solver avoids the numerical instabilities that lead to strict time-step limitations on explicit schemes. The high-order FR method enables high-fidelity simulations on very coarse grids, even in zones of high gradients. We started with this new development and will introduce three critical innovations. First, we will combine high-order FR with physics-based r-adaptive (moving) unstructured grids, redistributing grid points to regions with high gradients. Second, we will implement CPU-GPU algorithms for the new heterogeneous supercomputers advanced by HPC-Europa. Third, we will implement AI-generated magnetograms to make the model respond to the time-varying photospheric magnetic field, which is crucial for understanding important solar plasma properties and processes. Thus, we will develop a first-in-its-kind high-order GPU-enabled 3D time-accurate solver for multifluid plasmas. If successful, we will implement the most advanced data-driven solar atmosphere model in an operational environment. The project commenced on September 1, 2024, and we have already obtained interesting results in time-dependent full MHD corona modelling, AI-generated magnetograms, and high-order flux reconstruction simulations.

ISROESA10402	Senthamizh Pavai Valliappan	Contributed

Comparative Analysis of low coronal structures: Proba-3 observations vs. COCONUT

The observations of low solar corona in white light were up to now possible only during the solar eclipses. Though some remote-sensing observations of the lower corona are available in extreme ultraviolet (EUV) or X-ray emission, frequent observations in white-light were not available up to now. Internally occulted coronographs, like LASCO C1 and SECCHI COR1, provides coronograph images but starting only from the height of 1.1 R⊙. The ASPIICS (Association of Spacecraft for Polarimetric and Imaging Investigation of the Corona of the Sun) coronograph, on board of the recently launched Proba-3 mission, is providing high time resolution white light observations of the inner solar corona at low heights, between 1.099 R⊙ and 3 R⊙. The ASPIICS is an externally occulted coronagraph that images the inner solar corona in white light and in two narrow passbands, covering the gap between EUV images and images from externally occulted coronographs. The recently developed global coronal model, COCONUT (The COolfluid COroNa UnsTructured, Perri et al., 2022), is an ideal-MHD model of the low corona that reconstructs the dynamics of the plasma flows in the solar corona up to ~ 0.1 au (21.5 R⊙). In this work, we employ the COCONUT model to simulate the lower coronal structures. We then compare it with the white light observations from the ASPIICS coronograph, by evaluating their agreement with the observations.

ISROESA10048	Supriya Hebbur Dayananda	Contributed

Forward Modeling of Coronal Spectral Lines with P-CORONA

Forward modeling is a powerful approach for studying the behavior of spectral lines under various coronal conditions. P-CORONA is one such theoretical tool developed to compute the intensity and polarization of both forbidden and permitted coronal lines in three-dimensional (3D) magnetohydrodynamic models of the solar corona. For any coronal line of interest, it calculates line-of-sight integrated Stokes profiles while accounting for symmetry breaking caused by magnetic fields and non-radial solar wind velocities. In this contribution, I will briefly introduce P-CORONA and present results obtained for lines spanning a wide wavelength range. The focus will be on the influence of non-radial solar wind velocities on ultraviolet (UV) lines such as H I Ly-α at 1216 Å and He II Ly-α at 304 Å, and infrared (IR) lines such as the Fe XIII 10747 Å and 10798 Å. Non-radial solar wind velocities can induce Doppler dimming or brightening in the radiation field seen by coronal atoms, altering both the observed intensity and polarization. While Doppler dimming is generally expected to influence permitted UV lines with strong disk emission, we also examine whether it has a measurable impact on forbidden IR lines, despite their nearly flat disk radiation profiles. These results illustrate how forward modeling helps assess the sensitivity of coronal lines to velocity fields, guiding their use for solar wind diagnostics.

ISROESA10536	Shaonwita Pal	Contributed

Optimized Century-Scale Reconstruction of Solar Magnetic Evolution: From Surface Fields to the Corona and Heliosphere

The Sun's magnetic field governs the dynamics of the corona, drives the solar wind, and modulates space weather throughout the heliosphere. Yet, our understanding of its long-term evolution remains limited by the short span of direct heliospheric magnetic field measurements. In this work, we present an optimized century-scale reconstruction of solar magnetic evolution that connects the solar surface, corona, and heliosphere. By combining data-driven surface flux transport simulations with coronal magnetic field models and historical geomagnetic observations, we reconstruct the interplanetary magnetic field and solar open flux over the past century. We introduce a novel optimization scheme to calibrate the polar flux evolution and open solar flux variations, addressing the long-standing open flux problem. To further validate the reconstructed coronal structure, we analyze historical solar eclipse observations spanning both solar minima and maxima, linking large-scale surface field evolution to changes in coronal morphology. This reconstruction provides a unified, observation-calibrated picture of the Sun's magnetic variability over multiple solar cycles. It offers improved physical insight into the coupling between the surface field and the heliosphere, advancing our capability to model and predict long-term variations in solar activity and space weather conditions.

Wednesday, 21st January 2026

ISROESA10468	Stanislav Gunar	Invited

State of the art of prominence research

Solar prominences are condensations of cool and dense plasma with chromospheric characteristics, but suspended in the hot and rarified corona. Their existence is thanks to the coronal magnetic field. It supports the dense prominence material against gravity, keeping prominences up in the corona for long periods of time. The magnetic field also insulates the prominence plasma from the surrounding corona, allowing it to cool down to chromospheric temperatures. While prominences often last for days and weeks, their magnetic field configurations may become unstable and cause powerful prominence eruptions and associated Coronal Mass Ejections (CMEs). We will explore where the edge of our understanding of prominences is currently, where we need to go further, and why space coronagraphs are the tools we need.

ISROESA10033	Annu	Contributed

On the Origin of Coronal Picoflare Jets

Small-scale jet-like eruptions, such as picoflare jets and jetlets, are recognized as potential contributors to coronal heating and solar wind acceleration, yet their physical origin is still not fully established. Using ultra-high-resolution extreme ultraviolet imaging datasets from the Extreme Ultraviolet Imager on board the Solar Orbiter mission, we investigate tiny coronal jets observed off-limb in the Sun's polar regions. Visual inspection reveals that the majority of these jets display simultaneous presence of a bright spire and a narrow, collimated dark structure. We analyzed eleven such jets in detail and found that their spatial and temporal scales are comparable to previously reported jetlets, while their kinetic energies are two to three orders of magnitude lower, placing them in the picoflare regime. The bright and dark components show distinct dynamics, with the dark structures generally displaying lower speeds. A comparison with coordinated Interface Region Imaging Spectrograph and the Atmospheric Imaging Assembly on board the Solar Dynamics Observatory data, together with 2.5D radiative-MHD simulations performed with the Bifrost code, reveals a one-to-one morphological correspondence between the dark counterparts and cool chromospheric surges accompanying the bright jet spire. This association suggests that flux emergence and magnetic reconnection at low atmospheric heights produce coupled bright–dark structures, providing a plausible mechanism for the generation of picoflare jets. Our results demonstrate Solar Orbiter's ability to resolve the dynamics of small-scale jets and place new constraints on their origin.

ISROESA10516	Clementina Sasso	Contributed

Multi-Spacecraft Observations of a Large Prominence Eruption and a CME

We report a multi-spacecraft observation of a large prominence which erupted on December 24, 2021, at the NE limb of the Sun. The eruption was initially observed by the EUI/FSI instrument on board Solar Orbiter, starting at around 18:00 and last seen in the field of view of FSI on December 25 around 03:30 UT. The eruption was observed also by other EUV instruments like GOES-17/SUVI, STEREO-A/EUVI, PROBA2/SWAP, SDO/AIA, and it was also possible to follow the evolution of the subsequent CME with different coronagraphs, such as SOHO/LASCO-C2 and -C3, STEREO-A/COR1 and COR2, and Solar Orbiter/Metis. In addition, the eruption was in the direction of the PSP spacecraft. Thanks to this multi-perspective view we were able to investigate the various phases of the evolution of the prominence eruption and the CME structure and dynamics. We applied different 3D reconstruction techniques to get information on the characteristics of the plasma. Finally, relying on modeling tools by using PSP in-situ measurements we could also gain information on the magnetic structure of the event.

ISROESA10490	Alessandra Giunta	Invited

Fingerprints of the Sun: spectral diagnostics with Solar Orbiter SPICE

As part of Solar Orbiter remote sensing payload, the Spectral Imaging of the Coronal Environment (SPICE) is the high resolution spectrometer that observes the Sun in two extreme ultraviolet wavelength bands, 70.4–79.0 nm and 97.3–104.9 nm. SPICE is designed to provide spectroheliograms using a core set of emission lines, formed over a wide range of temperatures, and arising from ions of elements such as hydrogen, carbon, nitrogen, oxygen, neon, magnesium, sulphur, argon and iron. This enables the analysis of the different layers of the solar atmosphere, from the chromosphere (20 000 K) to the upper transition region (0.6 MK), complementing the IRIS and Hinode/EIS instruments. The SPICE spectral range extends also to the corona at temperatures up to 10 MK and beyond when observing flares. SPICE spectroheliograms can be processed to study the source regions of outflows and ejection processes which connect the solar surface to the heliosphere, providing a quantitative knowledge of the physical state of the emitting plasma and the composition in the solar atmosphere. In synergy with the other instruments aboard Solar Orbiter, specifically EUI, PHI and Metis, the source region emission observed by SPICE is tracked off limb into the heliosphere. SPICE is the first spectrometer that looked directly at the poles in March 2025 providing a set of observations of the polar region surroundings. This work focusses on the identification of the spectral lines observed by SPICE since the Solar Orbiter Cruise Phase and through the Nominal Mission Phase, and on the potential spectral diagnostics in different solar conditions. It concentrates on spectroscopic measurements, providing intensity maps for the full Sun with isolated transition region and coronal lines, and building up basic composition maps to be traced into the heliosphere. A preliminary analysis of the first SPICE polar observations is also shown.

ISROESA10365	Nancy Narang	Contributed

Influence of magnetic-field distribution on the spatio-temporal properties of EUV brightenings in the solar atmosphere

The extreme-ultraviolet (EUV) brightenings identified by Solar Orbiter, commonly known as "campfires", are one of the fine-scale transient brightenings detected in the solar corona. Using closest-perihelion observations of Extreme-Ultraviolet Imager (EUI) onboard Solar Orbiter, recently we have reported the presence of smallest and shortest-lived EUV brightenings in the quiet-sun to date. We will present the spatio-temporal distribution of EUV brightenings over different magnetic environments of the solar atmosphere. By using various sets of quiet-sun and coronal-hole observations from HRIEUV/EUI we will present a comparative analysis of morphological and photometrical properties of EUV brightenings. We will discuss the interlinks of EUV brightenings to the photospheric dynamics and magnetic field distribution using HRT/PHI observations. Further their potential coupling through the solar atmosphere will be addressed using SPICE and IRIS observations.

ISROESA10095	Alessandro Liberatore	Contributed

Unveiling the Hidden Sun: A Polarimetric Approach to Identify the Solar Center and Enable In-flight Calibration in Metis and ASPIICS Coronagraphs

Blocking direct light from the photosphere is essential to observe the solar atmosphere — the corona — which is a billion times fainter than the solar disk. However, the absence of direct disk observation introduces uncertainty in determining the Sun's center behind the occulter, especially when instrument limitations or low signal-to-noise ratios make it difficult to apply standard astrometric approaches. We present a novel method for determining the Sun's center behind an occulter during coronagraphic observations, based on the linearly polarized brightness (pB) of the K-corona. The method was applied to the Metis coronagraph onboard Solar Orbiter, which performs polarimetric observations of the K-corona using its visible-light channel (580–640 nm) equipped with electro-optically modulating Liquid Crystal Variable Retarders. Since the linear polarization vector of the K-corona is tangent to the solar limb, it is possible to geometrically determine the Sun's center by finding the intersection of two straight lines, each defined by two points separated by about 180 degrees. The method was successfully tested during Solar Orbiter's first close perihelion, for different heliocentric distances and during an off-pointing procedure. The discrepancy between the astrometric Sun center and that derived through this method is about 3 pixels on the Metis VL detector (~60 arcsec) under general conditions, and approximately 1.6 pixels (~30 arcsec) for data acquired below ~2.40 Rsun. The technique has also been applied to data from PROBA-3/ASPIICS, demonstrating its adaptability to different coronagraphic configurations and formation-flying conditions. Moreover, the first steps toward assessing its use for in-flight calibration of coronal polarimeters have been initiated. We report the results of this method, which provides an alternative to traditional astrometric approaches, with promising applications in both space-based and total solar eclipse observations.

ISROESA10503	Shane Maloney	Contributed

sunkit-spex: STIX Spectral Fitting

The SolarSoft - Interactive Data Language (SSWIDL) package OSPEX has long served as the standard solar spectral analysis tool for hard X-ray and gamma-ray data from missions such as RHESSI, FERMI, GOES, and more recently Solar Orbiter/STIX and ASOS/HXI. However, with the growing need for open, sustainable, and interoperable scientific software, the solar community is transitioning towards fully open-source Python tools. sunkit-spex aims to be the OSPEX of the future. This talk will discuss the motivations, challenges, and opportunities associated with this transition, emphasising the importance of open development practices, community contributions, and long-term maintainability. I will outline how sunkit-spex builds upon the scientific foundations of OSPEX while integrating with modern Python ecosystems such as astropy, sunpy, and scipy, enabling

reproducible workflows and easier cross-instrument analysis. The talk will also highlight efforts to ensure continuity of heritage functionality including spectral fitting, response handling, and uncertainty propagation. Alongside the implementation of modular interfaces for instrument-specific extensions. Looking forward, we will discuss how sunkit-spex is being designed to address the evolving needs of current and future missions. These include enhanced analysis capabilities for instruments that measure X-ray and gamma-ray directivity and polarisation, as well as those employing focusing optics. The framework aims to support high-resolution, multi-dimensional data analysis and facilitate comparisons across instruments with diverse detection technologies.
By adopting open-source development and leveraging collaborative platforms such as GitHub, the sunkit-spex project fosters transparency, accessibility, and community-driven innovation. This transition marks a critical step toward a unified, extensible, and future-proof analysis environment initially focused on X-ray analysis but eventually supporting other observations. I will close the presentation by demonstrating some STIX spectral fitting examples using sunkit-spex.

Thursday, 22nd January 2026

ISROESA10661	Janmejoy Sarkar	Contributed

Test and Calibration of the SUIT payload on board Aditya-L1

The Solar Ultraviolet Imaging Telescope (SUIT) onboard Aditya-L1 performs spatially resolved full-disk imaging of the Sun within the 200-400 nm wavelength band. SUIT encompasses eleven bandpasses, observing various heights of the solar atmosphere, helping us monitor dynamic solar features, like flare, jets, and magnetic phenomena, such as plages, active regions, and network regions. Notably, the absorption of UV wavelengths shorter than 310 nm by O2 and O3 in Earth's upper atmosphere holds immense significance for comprehending Ozone-Oxygen chemistry and the Sun-Earth climatic connection, making SUIT a unique addition to the existing assemblage of instruments observing the Sun. The multitude of observations planned by SUIT necessitates reliable calibration to study the radiative phenomena associated with various dynamic solar processes. The derivation of payload optical characteristics and the generation of calibration profiles, such as plate scale, MTF, field of view, and total photometric error, are essential for the reliable calibration of raw images within the image processing pipeline. This presentation demonstrates the test methodology employed and its corresponding results, which help quantify SUIT’s optical properties and enable the reliable calibration of Level 0 raw images to deliver Level 1 science products.

ISROESA10409	Vishwa Vijay Singh	Contributed

Source of HXR emission in dual-peak structured X-class confined flare and associated coronal dynamics: XRSs/Aditya-L1 and AIA/SDO observations

Solar flares are energetic explosions, releasing immense energies up to 10^32-10^33 ergs in 10-1000 seconds. They are either eruptive, expelling material into space, or confined, failing to erupt. This study presents a comprehensive multi-wavelength analysis of two distinct episodes of HXR emission in a confined X2.0 solar flare. The investigation utilises data from a suite of instruments connected by the triggering and rapid coronal expansion of a magnetic flux rope (MFR) that ultimately failed to erupt. A key aspect of this research involves a comprehensive investigation of data from the X-ray spectrometer (XRS) on board the Aditya-L1 mission, where a joint fitting of data from the low and high-energy X-ray spectrometers, SoLEXS and HEL1OS, respectively, is performed. Simultaneously, EUV imaging data from AIA/SDO is utilized to gain insights about the spatial and temporal evolution of this confined X-class event, along with its preceding but connected M4.6 event. Analysis of the soft X-ray and EUV light curves, along with EUV multi-channel imaging, reveals that the two events essentially represent a single failed flux rope eruption with a two-stage energy release, with a time gap of approximately 10 minutes. Interestingly, the hard X-ray light curve exhibits a well-resolved dual phase of non-thermal emission, suggesting two distinct events of particle acceleration, separated by 8 minutes. The first stage is associated with the activation of an MFR, revealed by the brightening of an EUV hot channel. During this phase, the plasma reaches a peak temperature of ~21 MK, while in the second phase, a peak temperature of ~24 MK was observed. A particularly important aspect of this analysis focuses on the HEL1OS observation. A photon spectral index of ~5 is observed with the maximum HXR energy of ~50 keV, above the background, during the first phase, dropping to ~3.2 with peak HXR energy up to ~150 keV, above the background, during the second phase. Despite these energetic signatures, two stages of heating and particle acceleration, and the successful activation of the hot channel, the MFR ultimately failed to erupt, resulting in this high-energy confined solar flare.

ISROESA10410	Ravi chaurasiya	Contributed

Automated Identification of Spicules in Hα and Ca II 8542 Å and Their Link to Shock Waves and Coronal Disturbances

Solar spicules are thin, jet-like plasma structures that are ubiquitously observed in the solar chromosphere, displaying rapid upward and downward motions. Despite decades of study, the physical mechanisms responsible for their formation, heating, and contribution to the energy balance of the upper solar atmosphere remain topics of active debate. Using the observations from SST, we investigate the heating and dynamic evolution of spicules and their role in channeling energy through the solar atmosphere. Our analysis reveals that spicules exhibit a distinct multithermal nature during their evolution in the solar atmosphere and could also be responsible for the observed redshifts in the transition region. Our results also indicate that they may channel low-frequency waves upward into the higher layers of the solar atmosphere, as evidenced by the power spectra derived from the average spicule locations. Furthermore, we find that at least some spicules are generated by small-scale magnetic reconnection events, which appear as Ellerman bombs (EBs) in active regions and as quiet-Sun Ellerman bombs (QSEBs) in quieter regions. Using non-LTE inversions with the STiC code, we infer that these reconnection-driven events can produce localized temperature enhancements of up to approximately 1180 K for EBs and around 710 K for QSEBs in the lower chromosphere.

ISROESA10469	Wageesh Mishra	Invited

Kinematics, Thermodynamics, and Geoeffectiveness of Interacting Coronal Mass Ejections

Interactions between coronal mass ejections (CMEs) play a crucial role in governing their heliospheric evolution and space weather impact. Multi-view remote and in-situ observations, which are helpful for 3D reconstructions, reveal that colliding CMEs undergo significant kinematic and thermodynamic alterations, including rapid speed changes, plasma compression, and magnetic restructuring. The Graduated Cylindrical Shell (GCS) model is used to derive their 3D kinematics near the Sun, while the Flux Rope Internal State (FRIS) model constrains their thermal evolution. Multiple CME–CME interactions are identified, leading to the formation of complex ejecta at 1 AU, characterised by multiple magnetic ejecta, embedded interaction regions, and double flux rope–like structures. A polytropic analysis of in-situ plasma data of interacting CMEs reveals a dominant heat-release regime in electrons and a bimodal ion temperature distribution. These results highlight that CME–CME interactions substantially modify both dynamical and thermodynamic properties of ejecta. The study highlights the importance of integrating 3D reconstruction using remote observations from coronagraphs and heliospheric imagers onboard various space missions, as well as in situ observations at varying distances from the Sun, and the applications of such observations for thermodynamic modelling of CMEs to advance space weather prediction.

ISROESA10337	Shibotosh Biswas	Contributed

Pinching of ICME Flux Rope: Unprecedented Multipoint Observations of Internal Magnetic Reconnection during Gannon's Superstorm

The solar storm of May 10, 2024, during solar cycle 25, stands out as one of the most extreme space weather events of recent decades. With the Sym-H index plunging to nearly -500 nT, this storm ranks as the strongest since the Halloween event of 2003. Its exceptional intensity, combined with the availability of modern spacecraft positioned at different vantage points in the interplanetary medium, created a rare opportunity to investigate the dynamics of interplanetary coronal mass ejections with unprecedented detail.

By utilizing multipoint observations from NASA's WIND, ACE, DSCOVR, ARTEMIS-P2, STEREO-A, MMS, and ISRO's newly operational Aditya-L1 mission, we examined the evolution of plasma and magnetic field conditions associated with this storm. These coordinated measurements allowed us to resolve the spatio-temporal variations within the ICME, providing new insights into its internal structure and evolution. Our analysis suggests that large-scale, quasi-steady magnetic reconnection occurred deep inside the ICME flux rope. This reconnection was likely triggered by interactions between multiple ICMEs that merged during their transit from the Sun to Earth. The interaction resulted in the formation of a well-defined current sheet (CS) embedded within the flux rope, enabling internal reconnection between concentric magnetic field surfaces. This process resulted in a dramatic reversal of the interplanetary magnetic field (IMF) B-y component observed at the L1 point. At the same time, reconnection exhausts accompanied by pronounced enhancements in both electron and ion fluxes were detected along the CS, which extended more than 200 RE (approximately 1.3 million kilometers) across the GSE-y direction. These findings demonstrate that internal reconnection can play a crucial role in restructuring the magnetic topology of ICMEs. Such restructuring not only altered the morphology of the flux rope but also amplified the geoeffectiveness of the ICME, thereby intensifying its space weather impact on Earth.

ISROESA10515	Pawan Kumar	Contributed

Probing Solar Wind Origins and coronal parameters through PSP–SolO Quadrature and Corotation Studies

The quadrature and corotation configurations between Parker Solar Probe (PSP) and Solar Orbiter (SolO) provide an exceptional opportunity to study the coupling between the solar corona and the nascent solar wind. We analyze coordinated remote-sensing (RS) and in-situ observations obtained during periods when PSP corotated with the Sun while SolO viewed the same source regions from near-quadrature vantage points. This unique geometry enables simultaneous sampling of coronal structures and their heliospheric extensions. Using the SolO Metis coronograph's high-resolution ultraviolet (UV) and polarized visible light (VL) diagnostics, we derive the coronal electron density, proton density, and magnetic topology. Meanwhile, PSP in-situ data constrain plasma and field properties at several solar radii. Additionally, by combining these datasets through the Doppler Dimming Tool (DDT), we reconstruct the plane of the sky distribution of solar wind speed and identify the coronal origins of distinct solar wind streams and the cause of solar wind acceleration.

ISROESA10431	Ronish Mugatwala	Contributed

Probabilistic Drag-Based Model (P-DBM) in Heliosphere: Data and Tools

Coronal mass ejections (CMEs) are key drivers of space weather disturbances. Therefore, it is necessary to have accurate prediction models for both their scientific understanding and operational forecasting. The Probabilistic Drag-Based Model (P-DBM) is a Monte Carlo-based framework to simulate the heliospheric propagation of CMEs, yielding probabilistic predictions of CME arrival times, impact velocities, and the associated uncertainties.

Although P-DBM demonstrates robust predictive capabilities, its operational flexibility has been constrained by observational input limitations. To address these constraints, we have now implemented a comprehensive data-driven approach that boosts the model's predictive capabilities significantly. Our data-driven framework includes the development of two critical data products: (1) a comprehensive catalogue of geo-effective CME/ICME characteristics and (2) a systematically constructed CME-ICME lineup catalogue that enables a much improved model parameter correlation.

Additionally, we have developed a sophisticated web-based application to maximise accessibility and foster collaboration within the space weather community. This web application enables real-time model execution, visualisation tools and export capabilities for both research and operational applications.

Friday, 23rd January 2026

ISROESA10531	Domenico Trotta	Invited

Chasing Shocks with Solar Orbiter: Insights into Particle Acceleration During Solar Cycle 25

Interplanetary (IP) shock waves propagate through the heliosphere as a result of solar activity. These shocks are key sites of energy conversion and particle acceleration and can be observed in situ through spacecraft measurements, providing a unique link to remote astrophysical environments and an excellent "natural laboratory" for testing still-debated acceleration mechanisms.
The current fleet of heliospheric observers offers an unprecedented opportunity to study IP shocks, marking a "new golden era" for understanding their role in heliospheric energetics. In particular, Solar Orbiter provides high-resolution measurements in the suprathermal (above ~50 keV) range, opening a new observational window on how particles are accelerated out of the thermal population.
In addition to presenting the statistical properties and trends of Solar Orbiter IP shocks up to the solar maximum of cycle 25, I will showcase specific events that uncovered new aspects of energetic particle production. I will show how leveraging state-of-the-art numerical simulations alongside multi-spacecraft observations makes it possible to probe the fundamental physics driving these acceleration processes in unprecedented detail. Together, these results offer fresh insights into how shocks energize particles across both heliospheric and astrophysical environments.

ISROESA10489	Puja Majee	Contributed

A Detailed Polarimetric Study of a Type-II Solar Radio Burst with MWA

Type-II solar radio bursts are plasma emissions generated by collisionless shocks in the corona and interplanetary space, typically driven by energetic solar eruptions such as flares and coronal mass ejections (CMEs). Their close association with such large-scale eruptions makes them relevant for space weather studies as well. The geoeffectiveness of a CME largely depends on the properties of the magnetic field it carries and how it interacts with the ambient solar magnetic field. Therefore, probing the magnetic field entrained in CMEs is crucial. The polarimetric properties of type-II bursts offer one of the few remote-sensing tools available for directly studying the strength and topology of magnetic fields in CME-driven shocks. However, reported polarization levels in the literature span a broad range, from negligible or weak polarization to strong circular polarization of several tens of percent. Most of the earlier studies are based on Sun-as-a-star observations, which provide spatially averaged measurements. Given the presence of multiple active regions and spatially varying polarized emission on the Sun, such integrated measurements are susceptible to beam depolarization, potentially leading to inaccurate results. To overcome these limitations, spatially resolved imaging is essential. The advent of new-generation instruments, like the Murchison Widefield Array (MWA), has made it possible to obtain high-dynamic-range, high-fidelity full-polar solar radio images with good temporal, spectral, and angular resolution. Leveraging these capabilities, we have conducted a detailed polarimetric imaging study of a type-II solar radio burst. Our analysis includes characterization of sources in both total intensity and polarized emission, along with an in-depth examination of their temporal and spectral evolution. This study represents an important step toward using polarimetric imaging to advance our understanding of type-II bursts and coronal propagation.

ISROESA10450	Bijoy Dalal	Contributed

Measurements of energetic particles from the Earth's magnetosphere and interplanetary medium by ASPEX-STEPS on board Aditya-L1

The SupraThermal and Energetic Particle Spectrometer (STEPS) of the Aditya Solar wind Particle EXperiment (ASPEX) payload on board the Aditya-L1 has been designed to measure suprathermal and energetic particles (ions) from multiple directions. After its launch on 02 September 2023, Aditya-L1 completed several rotations around the Earth in different highly elliptical orbits till 18 September 2023. Two (Parker Spiral and North Pointing) among the six detector units of ASPEX-STEPS were turned on during this Earth-bound phase. On some occasions, these two ASPEX-STEPS detectors measured energetic ions with very soft spectra (spectral indices close to 5 in the differential intensity vs energy approach) that are generally observed for energetic ions accelerated within the Earth's magnetosphere. Further investigations suggest that magnetospheric substorms are responsible for producing energetic ions with softer spectra. During the nominal operational phase of ASPEX-STEPS, it has recorded many solar energetic particle (SEP) and energetic storm particle (ESP) events. In most of the cases, spectra of these energetic ions are observed to be best represented by conventional double power law and/or power law followed by exponential rollover. However, a number of SEP events exhibit 'unusual' turnover spectra. Upon further investigations, we have found that strong particle acceleration by interplanetary shocks associated with high speed coronal mass ejections (CMEs) might have caused such 'unusual' spectral shapes of SEPs. The details of these results will be discussed.

ISROESA10659	Ankush Bhaskar	Contributed

Multi-Point Observations of Spatially Varying Turbulence Inside the Interplanetary Coronal Mass Ejection of the October 2024 Extreme Solar Storm

This study examines an October 2024 ICME observed near the Sun–Earth L1 point that produced an extreme geomagnetic storm (Dst y variable magnetic features. Power spectral density analysis shows changing turbulence intensity and age across ICME regions. The sheath exhibits nearly isotropic turbulence due to shock-driven mixing. Inside the magnetic cloud, turbulence anisotropy varies strongly, with enhanced parallel steepening near the core. Evidence of elevated turbulence and plasma heating suggests internal reconnection within the magnetic cloud, offering new insights into ICME turbulence evolution and space weather.

ISROESA10029	Shivam Parashar	Contributed

Probing ICME–ICME Interaction Using Directional Ion Energy Flux Observations from Aditya-L1/ASPEX-SWIS

Interactions between successive interplanetary coronal mass ejections (ICMEs) can influence their geoeffectiveness, often amplifying geomagnetic disturbances that impact space- and ground-based technologies. Understanding the complex plasma processes that occur during such interactions remains a key challenge in heliophysics. The major geomagnetic storm of May 2024, the most intense in nearly two decades, was driven by multiple CMEs launched in close succession from the Sun. As these ICMEs propagated through the heliosphere, they interacted and merged into large-scale complex ejecta, providing a unique opportunity to examine the dynamics of ICME–ICME interactions. In this study, we present in situ observations from the Solar Wind Ion Spectrometer (SWIS), part of the Aditya Solar Wind Particle Experiment (ASPEX) onboard India's Aditya-L1 mission. The SWIS instrument measures ion energy fluxes in two mutually orthogonal planes through its top-hat analyzers (THA-1 and THA-2), offering unprecedented directional insights into solar wind plasma behavior. Analysis of these measurements reveals the formation of a distinct downstream interaction region extending over 13 hours, produced by a forward shock driven by one ICME into a preceding ejecta. Within this region, signatures of proton and alpha particle energization, redistribution, and enhanced plasma heating are observed. Complementary energetic particle flux data from the ASPEX-STEPS instrument confirm the presence of shock-associated acceleration. These findings highlight the importance of multi-directional ion measurements in uncovering the microscopic and macroscopic processes governing ICME interactions and their space weather consequences.

ISROESA10477	Gopika S Vijayan	Contributed

Influence of Solar Flare X-ray Flux and Interplanetary Parameters on Geomagnetic Variability and Analysis of Temporal Evolution of Geomagnetic Disturbance Across Different Latitudes

The effect of solar flare on the geomagnetic field is analyzed in this work. The correlation between solar flare X- ray flux and the impact of the solar flare on the geomagnetic field is investigated using the daily Vertical Variance (VV). The VV is a modified form of the VV index which is a time- dependent function varying within specified temporal end points. This study analyzes the impact of 40 solar flares that occurred in the year 2012, a year of high solar activity during the solar cycle 24. Various space weather conditions for the period are examined in the context of the flares.

The complex nonlinear nature of the solar wind-magnetosphere system has made it difficult to quantify the extent to which various solar wind parameters determine geomagnetic disturbance. A comparative statistical analysis is done to elucidate the relative effectiveness of various interplanetary conditions in disturbing the geomagnetic field and their latitudinal depends. Pearson correlation method is used to carry out the statistical analysis. It has been found that geomagnetic disturbances depend more on the fluctuations in the interplanetary conditions than on the solar flare flux. We also investigate the time-shifted propagation of geomagnetic disturbances across different latitudes along nearly the same longitude during the geomagnetic storm of 15

July 2012. Using normalized geomagnetic field data, continuous wavelet transform (CWT), wavelet packet transform (WPT), and cross-correlation analysis. These results confirm that geomagnetic disturbances can exhibit frequency-dependent and directionally variable time shifts across latitude. The combination of time-domain cross-correlation with frequency-selective wavelet techniques provides a robust framework for quantifying and understanding the latitudinal propagation dynamics of storm-time geomagnetic activity.

ISROESA10639 / ISROESA10315	**Prof Bernard Foing / Brigitte Schmieder**	**Contributed**
Cubesat Orbiters and Landers Payload for Solar and Space Weather Observations (S&SWO)		
Following recommendations from COSPAR PEX Panel on Exploration (Ehrenfreund et al 2012, Blanc et al 2025), and Horizon 2061 foresight (Blanc et al 2023, Foing et al 2023), we have developed cubesat and shoebox-size payload (CSP4X) for lunar, planetary and solar system exploration (Foing et al 2025). We are now designing an adapted 'Solar and Space Weather Observations Cubesat' S&SWOC. This includes a solar imaging telescope with vacuum UV filters covering 160 nm continuum, C IV, Ly alpha (Foing, Bonnet et al 1984, 1986, 1988, Wiik et al 1996) as well as an VUV hyperspectral imager. We also include an X-ray solar monitor as flown on SMART1 (Huovelin et al 2002), and solar particle and radiation sensors. We also include geocorona and auroral imager . We are considering possible designs of S&SWOC in earth orbit (S&SWOC-EO) , lunar orbit (S&SWOC-LO), or on the lunar surface (S&SWOC-LS) in particular attached to landers in polar peak of quasi-eternal sunlight . We are considering possible designs of S&SWOC in earth orbit (S&SWOC-EO) , lunar orbit (S&SWOC-LO), or on the lunar surface (S&SWOC-LS) in particular attached to landers in polar peak of quasi-eternal sunlight . We look also to develop ML techniques for on board processing and advanced analysis and modelling, as well as MHD predictive simulation tools for flares, CMEs and their space weather effects. (Schmieder et al 2013, 2015, 2020, Baratashvili et al 2022, 2025) These could be also precursor for future cubesats in Mars orbit (S&SWOC-MO), or packages on Phobos Surface (S&SWOC-PS) . We also consider adapted cubesats in Jupiter Orbit (S&SWOC-JO), or packages on the surface of Icy Moons such as Callisto (S&SWOC-CS) to monitor space weather interactions with the Jupiter-Io-Icy Moons system.		

4. Posters

A. Coronal and Chromospheric Science

ISROESA10261	Ramesh Chandra	Poster
Sympathetic Extreme Ultraviolet Waves		
Extreme Ultraviolet (EUV) waves are large propagating fronts observed on the Sun. An investigation of the kinematics of EUV waves reveals that they consist of two components: a fast-mode wave and a non-wave component. In this study, we present Solar Dynamics Observatory observations of two sympathetic EUV waves that occurred on December 6, 2021, on the western solar limb. The first wave originated from NOAA Active Region (AR) 12898 and propagated in a northward direction. When this wave reached AR 12902, it triggered the second EUV wave, which propagated in a southward direction. The first wave exhibited two components with speeds of approximately 400 km/s and 180 km/s, respectively. For the second wave, we only observed the non-wave component, which had a speed of approximately 240 km/s. Our analysis suggests that the second wave was triggered by the non-wave component of the first wave.		

ISROESA10088	MAHADEV A. V.	Poster
Coexistence of Longitudinal and Transverse Oscillations in Polar Plumes: Magnetohydrodynamic Simulation and Forward Modelling		
Magnetohydrodynamic (MHD) waves are fundamental for understanding solar coronal heating mechanisms and energy transport processes in the solar atmosphere. Recent high-resolution observations from the Extreme Ultraviolet Imager (EUI) on board Solar Orbiter have, for the first time, shown the simultaneous presence of slow magnetoacoustic and Alfvénic waves within the same polar plumes. This discovery raises new questions about how these different wave modes couple and dissipate their energy. In this work, we investigate the same scenario using 3D MHD numerical simulations with the MPI-AMRVAC code. We develop a realistic model of an open coronal magnetic flux tube, including gravitational stratification. We then introduce drivers designed to simultaneously excite both longitudinal (slow) and transverse (Alfvénic) oscillations, aiming to reproduce the coupled wave dynamics reported in recent observational studies. To bridge the gap between theoretical models and observational data, we utilize the FoMo forward modeling code to synthesize EUV emission and investigate the intensity, line width and Doppler shift signatures from our simulated plasma conditions, specifically targeting the EUI 174 Å passband. Our goal is to understand the physical implications of this wave coupling, investigate damping mechanisms, and provide a physics-based model to help interpret the data currently being gathered by Solar Orbiter and Aditya-L1.		

ISROESA10329	Garima Karki	Poster
Counter-streaming Flows Observed by THEMIS and IRIS in a Quiescent Filament		
Filaments/prominences are cold (≈ 10000 K) and dense plasma suspended in the million degree hot solar corona and their formation and stability is still debatable. In this study we present the counter-streaming flows in a quiescent filament of 29 September 2023. For our		

analysis, we used high spatial and spectral observations from THEMIS (in Hα) and IRIS (in Mg II k). For imaging the filament/corona and measuring the photospheric magnetic field we use data from AIA and HMI onboard SDO, respectively. In the filament fibrils, we detect counter-streaming flows in both the blue and red wings of Hα and Mg II k. We derive that a fraction of the filament plasma is moving at supersonic speed (≈ 20 km/s) since the filament is optically thick. We conclude that the counter-directed Doppler shifts might not be magnetic field aligned flows but rather correspond to kink transverse oscillations of the magnetic field with independent motions in nearby strands. Next, we intend to conduct such analysis on prominences recorded by the large field of view of FSI instrument onboard Solar Orbiter.

ISROESA10430	Hasil Dixit	Poster
Characterizing small-scale transient chromospheric brightenings using data from MAST and SDO.		
The solar atmosphere is dominated by intense magnetic activities, where strong heating events occur throughout the different layers of the atmosphere. Small-scale transient events, such as Ellerman bombs, UV Bursts, are thought to play a crucial role in transferring energy from the Sun's lower atmosphere to its outer layers. When observed in Ca II filters, the solar chromosphere constantly shows several small-scale compact brightening events in sunspot plage regions, which are not well understood. Here, we present an analysis of narrow-band images of Ca II 8542 Å data observed by the Multi Application Solar Telescope (MAST). These observations are complemented by multi-channel data from the Atmospheric Imaging Assembly (AIA) and Helioseismic and Magnetic Imager (HMI), both onboard the Solar Dynamics Observatory (SDO). We detected some of these brightening events using our algorithm, which is based on the intensity of their surroundings. We detected 62 bright points from the AIA 1700 Å passband and characterized them using various factors, such as occurrence, lifetime, area, and magnetic field. We utilized time-lag analysis to study their origin and evolution. We found that most of these bright points have a lifetime of less than 6 minutes and are associated with flux cancellation/emergence. We found that more than 50% of these brightenings reach the transition region temperature during their lifetime. 24% show their signature in MAST Ca II 8542 Å observations. We also studied their spatial distribution around the active region to find any possible relation with their occurrence. In this presentation, we will present a detailed statistical investigation of such compact brightenings with their origin and thermal evolution.		

ISROESA10453	Ananya Rawat	Poster
Apparent and actual damping of 3-min slow waves along individual umbral fan loops		
Coronal fan loops rooted in sunspot umbra constantly show a 3-min period propagating slow magnetoacoustic waves (SMAWs) in the corona (upper solar atmosphere). Using the recently devised technique of Rawat & Gupta (2023), we trace these loops along with their cross-sectional area with height from the photosphere to the corona via the transition region and chromosphere (lower solar atmosphere). We estimated the relative amplitude and energy flux of propagating 3-min SMAWs in the lower and upper solar atmosphere along the fan loops. We obtained their damping length of 208 km and 4.3 Mm in the lower and upper atmosphere, respectively. We further investigated the role of the area expansion of these loops on the damping of these SMAWs. We deduced the decay of total		

wave energy content within the loop cross-sectional area with height and estimated the damping length to be 303 km in the lower atmosphere. Henceforth, we present the first report on the actual damping of SMAWs after incorporating the geometric effect of area expansion of the loops. Findings reveal that the area expansion of loops with height plays an important role in the damping of these waves in the lower atmosphere, while the effect is negligible in the upper atmosphere. These actual damping lengths can be utilized to investigate the dominant damping mechanisms in the lower (photosphere to corona) and upper solar atmosphere (corona). We would like to carry out similar study of wave damping along the offlimb coronal loops using the data from Extreme Ultraviolet Imager (EUI) on-board Solar Orbiter, Visible Emission Line Coronagraph (VELC) on-board Aditya-L1, and Association of Spacecraft for Polarimetric and Imaging Investigation of the Corona of the Sun (ASPIICS) on-board Proba-3.

ISROESA10348	Kanika Sharma	Poster

Coronal Dimming Signatures and its Recovery of an limb CME Event on 16 July 2024

Coronal dimmings are observed as reductions in extreme ultraviolet (EUV) emission and soft X-ray (SXR) flux and serve as useful proxies for coronal mass ejections (CMEs). During a CME eruption, closed magnetic field lines open, allowing plasma to escape into the heliosphere. Understanding the properties and evolution of dimmings provides key insights into CME initiation, mass loss, and kinematics. Following an eruption, dimming regions gradually recover via plasma refilling and/or temperature increase, processes that are closely linked to coronal mass and energy transport and may provide clues to coronal heating.

We analyzed an off-limb CME that occurred on 16 July 2024 to investigate the dimming and its recovery. Using differential emission measure (DEM) analysis derived from six EUV channels of SDO/AIA, we examined the temperature and emission evolution of the dimming regions. Our preliminary results reveal two distinct dimming behaviours: (1) a diffuse dimming region that reached maximum depletion within the first 2-3 hours, consistent with CME mass removal, and (2) a structured, loop-like dimming adjacent to it, which continued to deepen for more than six hours. Unlike the diffuse dimming, this loop-like dimming does not appear to be directly connected to CME mass loss.

ISROESA10398	Kariyappa, R.	Poster

Chromospheric and Coronal Heating at the Sites of Fine-Scale Magnetic Features Observed by Solar Orbiter/EUI

Chromospheric and Coronal Heating at the Sites of Fine-Scale Magnetic Features Observed by Solar Orbiter/EUIR. Kariyappa (IIA, India), B. Prabhu Ramkumar (IIA/KSO, India), J. Zender (ESA/ESTEC, The Netherlands), S. Masuda (ISEE/NU, Japan), L. Dame (CNRS/LATMOS, France)

The heating of the solar chromosphere and corona, the physical nature of the wave propagation, and the foot points of the chromospheric and coronal fine-scale structures with respect to the underlying photospheric magnetic features are extremely important issues in Solar Physics.

A 30-min time sequence images observed by Solar Orbiter/EUI on March 17, 2022 simultaneously in 174 A (3s cad) & 1216 A (12s cad) have been analysed. We selected totally 28 campfires/bps and derived the cumulative intensity values in the campfire/bps locations. The time series and the corresponding power spectrum plots have been generated. It is seen that the intensity variations in all the campfires/bps over the total observed period. We derived the period of intensity oscillations and noticed that the period is independent of their brightness variations. We observed a phase delay/shift of around 2-min between 174 A and 1216 A in campfires/bps time series, suggesting that the campfires are associated with the upward propagating waves. It looks from the intensity oscillations that the campfires are more diverse and dynamic in nature. Further studies are in progress (i) to bring out the differences among the campfires/bps, (ii) to bring out the differences and similarities between the different campfires and bright points, (iii) the phase delay/shift, (iv) heating mechanism in all the cases, and (v) estimate the energy contribution of campfires/bright points in the heating of the corona. The important results of the analysis will be presented in this poster paper.

ISROESA10496	Sunit Sundar Pradhan	Poster

Probing the CME Core–Prominence Relation Using Inner Coronal Observations

Coronal mass ejections (CMEs) often exhibit a three-part structure consisting of a bright inner core, an outer leading edge, and an intervening dark cavity. While the core has traditionally been attributed to prominence material, a recent alternative interpretation suggests it may arise from the projection effects of a twisted flux rope. To reassess the link between prominence material and the bright inner core of CMEs, we analyzed limb events observed by the Mauna Loa Solar Observatory (MLSO) K-Coronagraph (K-Cor, white light), with associated prominence eruptions detected by the Global Oscillation Network Group (GONG) Hα and the Atmospheric Imaging Assembly (AIA) 304 Å in the plane of the sky. Our results show a strong spatial correspondence between Hα prominences and CME cores in white light, with an average image correlation of ~0.7, while correlations between white light and AIA 304 Å are comparatively weaker (~0.5). Several events could be continuously traced into the Large Angle and Spectrometric Coronagraph Experiment (LASCO/C2) field of view (FOV), confirming the persistence of prominence material into the outer corona. Extrapolation of CME cores from LASCO/C2 FOV onto the solar disk under straight-line or constant-velocity assumptions showed maximum spatial and temporal offsets of ~40° and ~140 minutes, underscoring the importance of inner coronal observations for constraining CME dynamics. Overall, our findings suggest that in prominence-associated CMEs, the bright cores are predominantly composed of prominence material.

ISROESA10521	Rohan Bose	Poster

Multi-wavelength Study of Polar Coronal Hole Jets

Coronal jets are ubiquitous small-scale transient events in the solar atmosphere, often associated with magnetic reconnection. In this study, we investigate polar coronal hole jets observed simultaneously by HRI/ Solar Orbiter, SJI/ IRIS, and AIA/ SDO, providing a comprehensive multithermal view of the jet evolution. The multi-instrument observations reveal the presence of both hot and cool plasma components, indicating complex temperature structuring within the jet. A notable finding is the interaction of a dark material, likely a mini-filament, with the jet spire, suggesting the involvement of filament activation in the jet onset. We also identify a horizontal drift motion of the jet during its evolution, which we interpret in the framework proposed by Chandrasekhar et al. (2014).

Furthermore, we report another case showing sequential jet eruptions, consistent with the scenario described in the same model. Despite an extensive search, similar examples of horizontal drift have not been found so far in the polar coronal hole region, making this observation particularly intriguing. Our results highlight the dynamic nature and magnetic complexity of polar jets, emphasizing their importance in understanding magnetic reconnection and mass transfer processes in the solar corona.

ISROESA10535	Shruti Sinha	Poster

On the umbral flashes and the response of the upper atmosphere: MAST and SDO observations

Umbral flashes are the periodic brightness mostly seen in the chromopsheric umbra of a sunspot. It is believed that they are produced by the propagation of shockwaves. In this work, we utilize Ca II 8542 spectral imager observations from the Narrow-band imager installed on Multi-Application Solar telescope (MAST). Wave propagation properties are explored using multi-height velocities derived from the observations. We also explored the response/counter parts of these flashes in the transition region and corona using the observations from AIA/SDO. The relation between the umbral flashes and the upper atmosphere phenomena may provide insights into energy transportations from the Sun's lower atmosphere to the corona.

ISROESA10050	Binal D. Patel	Poster

Unveiling the CME evolutions from ASPIICS/ Proba-3 observations

Coronal Mass Ejections (CMEs) are large-scale eruptive phenomena originating from the Sun, primarily observed as outward propagating structures in the white-light coronagraph images. The study of their early evolution is limited by the field of view (FOV) of most existing coronagraphs, which usually begins around ~2.5 solar radii (Rs). Consequently, the low corona (1 to 3 Rs) - where the crucial initiation and acceleration phases of CMEs occur - remains largely obscured. A comprehensive understanding of the physical mechanisms driving CME initiation and early evolution therefore requires direct observations within the low corona. The Association of Spacecraft for Polarimetric and Imaging Investigation of the Corona of the Sun (ASPIICS) coronagraph aboard the Proba-3 mission of ESA addresses this observational gap. It provides the FOV of the solar corona from 1.099 Rs to 3Rs, with a high spatial resolution (2.8 arcsec/pixel) and high temporal cadence (up to 30 s for typical CME observation programs). We present the study of the initiation and evolution of CMEs observed by ASPIICS. To construct a comprehensive, multi-perspective view of the eruptions, these unique low corona observations are complemented with observations from the Atmospheric Imaging Assembly aboard the Solar Dynamics Observatory (SDO/AIA), Large Angle and Spectroscopic Coronagraph aboard the Solar and Heliospheric Observatory, and multi-vantage point imagers including the Extreme Ultraviolet Imager (EUI) on Solar Orbiter and Extreme UltraViolet Imager (EUVI) on STEREO-A. This integrated approach enables a detailed investigation of the impulsive and evolution phases of CMEs in the low solar corona.

ISROESA10530	Janvi Manoj Agarwal	Poster

Multi-wavelength analysis of a CME to study the three - part structure
Coronal Mass Ejections (CMEs) are eruptions of solar plasma from the surface of the Sun that often exhibit a three-part structure: a bright leading front, a dark cavity, and a compact bright core. In this study, we perform a multi-wavelength analysis of CMEs using white-light observations from K-Cor and extreme ultraviolet (EUV) observations from GOES-SUVI, which provides an extended field of view (up to ~1.8 solar radii). Multiple CMEs are studied in this project where we have compared the data of K-Cor and SUVI. While white-light data reveal density structures, EUV imaging enables temperature diagnostics across different plasma regimes. By correlating CME features observed in white light with their EUV counterparts, we aim to identify the thermal characteristics of the structures seen in density alone. This approach provides insights into the long-debated question of whether CME cores represent hot or cool plasma. The methodology developed here is extendable to upcoming missions such as PROBA-3 (white light + Fe XIV) and SUIT (Mg II channel for cool plasma), offering a framework for future multi-wavelength CME studies.

ISROESA10080	Gazi Ameen Ahmed	Poster
SUIT and the Sun in Near-Ultraviolet		

The Solar Ultraviolet Imaging Telescope (SUIT) is an off-axis Ritchey-Chrétien solar telescope onboard Aditya-L1, India’s first dedicated solar observatory in space. Launched on Sep 2, Aditya-L1 is placed in a halo orbit around the Lagrange point L1 of the Sun-Earth system to make 24x7 observations of the Sun. SUIT will study the Sun in near-ultraviolet (200nm to 400nm) spectral range using eight narrowband and three broadband filters with high cadence full-disk and region of interest images.

The scientific goals of SUIT are primarily to study four areas, viz. 1. Near simultaneous observations and study of coupling and dynamics in the solar atmosphere from the photosphere to the upper chromosphere; 2. Detailed study of Prominences, filaments, and their dynamics in NUV spectral range; 3. Study of Solar flares, especially their effect in the chromosphere and to capture the early phases of the flare trigger; 4. Study of Sun-Earth connections concerning Earth’s climate, the effect of UV irradiance variation on Earth’s upper atmosphere chemistry, etc. Additionally, coordinated SUIT observations with observatories like IRIS, Solar Orbiter, and SUNRISE will help us better understand the Sun's physics.

This presentation will explain the SUIT instrument specifications and capabilities, and how these will help address the primary science goals. This will enable us to strongly establish our scientific conclusions and provide a multiwavelength insight of the Sun.

ISROESA10494	Suraj Kumar Tripathy	Poster
Multi-instrument Comparison of the Slow Magnetoacoustic Waves’ damping in the Active Region Fan Loops		

Propagating slow magnetoacoustic waves are commonly observed in the active region fan loops. Their rapid damping has been studied extensively from both theoretical and observational vantage points. To explain the rapid damping of slow waves, different physical mechanisms have been proposed, although significant discrepancies still remain between the theory and observations. Recent high-resolution observations of the solar corona, captured simultaneously by the EUI (Extreme Ultraviolet Imager) onboard Solar

Orbiter and the AIA (Atmospheric Imaging Assembly) onboard SDO (Solar Dynamics Observatory), reveal different damping lengths for slow magnetoacoustic waves, despite their similar passbands. In order to check the prevalence of such cases and understand the reason behind this behavior, we analyse multiple cotemporal observations taken using the SolO/EUI and the SDO/AIA. The choice of our sample is such that the angular separation between SDO and SolO is within 10 degrees, to minimize any discrepancy arising from different line-of-sights. Our results indicate that a discrepancy in the damping lengths of slow waves between the two instruments is quite uncommon, with only one such case found in our sample. Our earlier analysis involving cotemporal observations from Hi-C and SDO/AIA also corroborates this.

ISROESA10557	Dibyendu Nandi	Poster

Understanding and Predicting the Large-Scale Structure of the Solar Corona

The Sun's million degree outer atmosphere, the corona, plays host to a diversity of dynamic phenomena such as solar flares, coronal mass ejections and plasma jets. It also spawns the solar wind that encompasses interplanetary space. Together, these phenomena create space weather, governing the state of the heliosphere. While it is widely accepted that magnetic fields govern the structure and dynamics of the solar corona, constraining and predicting coronal magnetism has remained an outstanding challenge. Two processes are primarily responsible for governing coronal magnetic structure and its evolution; the emergence of flux through the photosphere which acts as localized perturbations and the slow magnetic flux transport processes on the solar surface that governs its global structure and long term evolution. Through coupled magnetohydrodynamic simulations of the solar surface and corona, and confronting these simulations with total solar eclipse and coronagraph observations, we demonstrate that the corona has a magnetic memory, which allows for predictions of its large scale structure sufficiently in advance even during phases of maximum solar activity. This opens up the possibility of using data driven simulations and multi-instrument observations from HMI, LASCO, Proba-3 and Aditya-L1 for testing and validating coronal models, and predicting the future state of the solar corona.

ISROESA10055	David Berghmans	Poster

Extreme UV Imaging with EUI onboard Solar Orbiter

The EUI instrument onboard Solar Orbiter has expanded our view on the Solar Corona from the smallest lengths scales (>100km) up to the Middle Corona up to 7 Rsun, and from subsecond temporal scales up to the solar cycle evolution. EUI brings innovations that allow for unprecedented imaging modes such EUV coronagraphy and ultrashort exposure to capture unsaturated flare evolution. In this talk we will highlight the potential of EUI data as illustrated by recent new insight on diverse topics such as e.g. nanoflares, picoflare jets and high-frequency oscillations. During the upcoming high-latitude phase of the Solar Orbiter mission, EUI will be the first EUV imager to image the solar poles from a non-ecliptic perspective. Future perihelia of Solar Orbiter will be near the Sun-Earth line giving opportunities for joint observations with Earth-bound observatories, such as Aditya-L1 and Proba-3, with complementary wavelengths.

The EUI team is committed to a fully open data policy and is happy to support external research on EUI data. Quick-look viewing and data download will be demonstrated.

ISROESA10106	Safna Banu K	Poster
Effects of Multi-Sigmoidal Structures in an Active Region Flare		
Sigmoid structures are forward or inverse S-shaped magnetic structures that are generally found in the solar corona. The appearance of a sigmoid in an active region is crucial in the study of magnetic topology and magnetic instability, which can lead to eruptive events such as solar flares and coronal mass ejections. In this paper, we present observations and analysis of consecutive formation of sigmoidal structures and eruption of a sigmoid, associated jet formation, coronal wave generation and propagation, and related M-class solar flare using multi-wavelength observational data sets from the Atmospheric Imaging Assembly (AIA) onboard Solar Dynamic Observatory (SDO) and the Extreme Ultraviolet Imager (EUVI) from the Solar Terrestrial Relations Observatory (STEREO). Initially, we discuss the possible causes for the simultaneous appearance of forward and inverse S-shapes in nearby regions of the active region. Furthermore, we investigate the potential role of the sigmoid eruption in triggering the flare, accompanied by parallel and circular flare ribbons, where high twist or shear and multi-stage successive magnetic reconnection may play the crucial role. We further estimate the velocity of the erupting jet and the propagation speed of the coronal waves. We will explore such events further using observations from the EUI onboard Solar Orbiter and the SUIT onboard Aditya-L1.		

ISROESA10584	Ananya Hore	Poster
Relevant Spatial Scale of the Global Solar Surface and Atmospheric Magnetic Field During Cycle 24		
The Sun's internal dynamics give rise to magnetic and plasma structures spanning an extensive range of spatial scales, from the photosphere to the corona. To interpret these solar processes effectively, one must identify the characteristic scales that define them. Sunspots with diameters from 10 to 200 Mm, require relatively finer spatial resolution corresponding to at least a spherical harmonic degree of l=63, in contrast to the diffused, large-scale magnetic background on the solar surface. Likewise, coronal features cover a wide spectrum, from sub-megameter current sheets in flares to streamers stretching across half a hemisphere. This study provides a quantitative mathematical analysis of the characteristic length scales that governs global magnetic field evolution, both at the surface and within the corona. We employ spherical harmonic-based modal decomposition of photospheric and coronal magnetic fields obtained through PFSS extrapolations, using SOHO/MDI and SDO/HMI full-disk magnetograms covering Solar Cycle 24 (2009 - 2020). By evaluating the effective mode contributions, effective degree, and total unsigned magnetic flux, we find that even with degree less than 30 (146 Mm), most of the photospheric contribution is preserved, with dominant contributions restricted to effective degrees 7 - 19 (minimum scale 220 Mm). The coronal magnetic field is primarily governed by the underlying photospheric distribution. When transient phenomena such as CMEs are excluded, large-scale, quasi-static coronal configurations like streamers are well represented with l=7, indicating the reduced influence of individual sunspots with altitude. Both the effective degree and modal strength decrease progressively with height, and beyond 1.5 solar radius, the field predominantly exhibits either dipolar, quadrupolar, or octopolar characteristics. These		

quantitative findings reaffirm the significance of earlier low-resolution datasets for global solar simulations and also demonstrate that even coarse stellar magnetic field measurements can yield valuable information about stellar atmospheres and their planetary impacts.

ISROESA10497	Sanmoy Bandyopadhyay	Poster

Plages Detection in Ca II K Solar Images Using Hybrid Threshold-guided Fuzzy C-Means Segmentation Approach

This work focuses on the detection of plages in images captured by the The Precision Solar Photometric Telescope (PSPT), operated at the Mauna Loa Solar Observatory (MLSO) in Hawaii. Plages are bright regions in the Sun's chromosphere, typically found near sunspots and active regions. They are associated with strong magnetic fields and have temperatures around 3000° K. Detecting and analyzing plages is vital in solar physics, as they are often precursors to sunspot formation and contribute significantly to understanding solar cycle activity due to their continuously varying area. In PSPT solar images, plages are particularly prominent in the 393.416 nm channels, which are tuned to the strong emission lines of Calcium II K (Ca II K) originating from the chromosphere. However, these images often suffer from intensity inhomogeneity, noise, and unclear plage boundaries, making accurate detection challenging. To address these issues, a novel adaptive fuzzy c-means (FCM) clustering technique has been developed. This method initially identifies and pre-classifies the brightest regions of the image as foreground using a pre-masking step based on their intensity characteristics. The remaining unmasked regions, which contain mixed or uncertain intensity values, are then segmented using the Fuzzy C-Means (FCM) algorithm to achieve a more precise separation of foreground and background. Finally, the results from the pre-masked and FCM-segmented regions are combined to generate a complete and refined foreground segmentation. Finally, a disconnected component analysis is applied to remove redundant or spurious regions, ensuring accurate extraction of the true plage areas. A comparative visual analysis between the proposed approach and classical detection methods has demonstrated the superior performance of this technique in accurately identifying plage regions in Ca II K images. This enhanced detection capability contributes to improved monitoring and understanding of solar activity and dynamics. As a future work, the method can be applied for the detection of plages in NB03 SUIT/Aditya-L1 images.

ISROESA10650	Anjan Banerjee	Poster

Solar Flare Prediction Using a Nonlinear Force-Free Field (NLFFF) Model: Reconstruction and Evolution of Coronal Magnetic Fields

The magnetic field in the Sun's corona plays a key role in driving energetic solar events such as flares and coronal mass ejections. These eruptive structures in the corona often contain excess magnetic energy compared to their lowest-energy potential configuration, implying the presence of electric currents. Because continuous direct measurements of the coronal magnetic field are not yet possible, researchers rely on extrapolation techniques that reconstruct the coronal field from photospheric magnetogram observations. In this study, we investigate the temporal evolution of the coronal magnetic field in a flaring active region by reconstructing its three-dimensional magnetic structure from photospheric vector magnetogram data, assuming a force-free configuration.

We solve the nonlinear force-free field (NLFFF) equations, which describe a state where magnetic forces dominate the plasma dynamics in the corona. A boundary-weighted optimization scheme is employed so that the extrapolated solution depends only on the observed boundary data. To further improve the reliability of the results, the input magnetogram is preprocessed to minimize noise and ensure compatibility with the force-free assumption. The accuracy of the method is first validated using a known semi-analytical force-free solution. It is then applied to real solar data, and the model's robustness is tested by evaluating the alignment between the magnetic field and electric current, as well as ensuring the solenoidal (divergence-free) nature of the field throughout the domain. Additionally, we monitor the evolution of key physical quantities such as the maximum current density and total magnetic energy over time to identify possible thresholds associated with flare onset or eruptions.
In summary, this optimization-based NLFFF approach, enhanced through careful data preprocessing, offers a robust framework for reconstructing the coronal magnetic field in three dimensions and for exploring the magnetic conditions that lead to solar eruptive phenomena like flares and coronal mass ejections.

ISROESA10632	Yogesh Kumar Maurya	Poster
Study of underlying magnetic topology and field line dynamics of small-scale phenomena of Quiet-Sun dynamics		

The quiet Sun hosts numerous small-scale energetic phenomena such as Ellerman bombs and extreme ultraviolet (EUV) brightenings [1-4]. Recent high-resolution observations from Solar Orbiter and other solar telescopes suggest that these events are ubiquitous and highly frequent. They are considered potential contributors to chromospheric and coronal heating [1, 2, 5] and some studies indicate that these events are driven by magnetic reconnection [6, 7], but their physical origins remain less understood and merits further attention. Understanding their magnetic topology and its evolution may help in understanding physical origin of these small-scale events and is therefore important. In this study, we investigate the magnetic topology associated with small-scale brightenings using observations from Solar Orbiter and the Solar Dynamics Observatory, combined with Non-Force Free Field extrapolated coronal magnetic fields and topology-identification techniques such as trilinear null detection. To further probe their physical origins, we will employ data-constrained magnetohydrodynamic (MHD) simulations.

B. Flares and Eruptions

ISROESA10070	SUNIL KUMAR SAINI	Poster
Investigation of Solar Flare Dynamics using Aditya-L1/SUIT		

We present a comparative analysis of solar flare observations using SUIT narrowband channels (NB01–NB07), STIX, and GOES SXR data. Our results show that NB01, NB03, NB04, NB08, and STIX peak nearly simultaneously, while NB02 and NB05 exhibit a ~4-minute delay relative to STIX. GOES SXR peaks lag STIX by ~3 minutes, and NB06–NB07 peaks are delayed by ~13 minutes compared to GOES. These temporal offsets highlight the wavelength-dependent response of solar flare emissions and provide insights into the flare energy release and transport processes.

ISROESA10174	Mahender Aroori	Poster

A Statistical Study of Low-Frequency Solar Radio Type III Bursts

We have studied low-frequency (45 -410 MHz) type III solar radio bursts observed using the e-Compound Astronomical Low-cost Low-frequency Instrument for Spectroscopy and Transportable Observatory (e-CALLISTO) spectrometer located at Gauribidanur Radio Observatory, India, during 2013 – 2017. After inspecting 1531 type III bursts we found that 426 bursts were associated with flares, while the others might have been triggered by small scale features/weak energy events present in the solar corona. In this study, we have carried out a statistical analysis of various observational parameters like start time, lowerand upper-frequency cut-offs of type III bursts and their association with flares, variation of such parameters with flare parameters such as location, class, onset, and peak times. From this study, we found that most of the high frequency bursts (whose upper-frequency cut-off is > 350 MHz) originate from western longitudes. We interpret that this could be due to the fact that Parker spirals from these longitudes are directed towards the Earth and high frequency bursts are more directive. Further we report that the number of bursts that reach Earth from western longitudes is higher than from eastern longitudes.

ISROESA10330	Hitesh Paliwal	Poster

Sloshing Oscillations in a coronal loop triggered by M- and C-Class Flare

Loops associated with flares often exhibit plasma oscillations, where a disturbance moves back and forth between the loop footpoints. These oscillations are known as “sloshing oscillations.” Current understanding suggests that they are triggered by flares; however, they do not appear after every flare. The connection between flare strength and the occurrence of oscillations is still not well understood. To investigate this, we compared the properties of sloshing oscillations occurring during M- and C-class flares in a single loop. Our sample includes seven such loops observed by AIA onboard SDO. The oscillations were visible only in the AIA 131 Å and 94 Å channels, indicating that these loops are very hot. The time period and damping time of the oscillations were extracted from the time series, while plasma temperatures were estimated through DEM analysis. Our results show that, in most cases, the damping time of oscillations during M-class flares is longer than that during C-class flares. DEM analysis further indicates that the temperature of oscillating loops during M-class flares is generally higher than during C-class flares, suggesting that thermal conduction may not be the primary damping mechanism in all cases. Additionally, we found that in some cases, the oscillation period during M-class flares is shorter than that during C-class flares, which may be related to the higher loop temperature in M-class events.

ISROESA10379	Pooja Devi	Poster
A Failed Solar Filament Eruption creating Brightening at Remote Location		
Solar filament eruptions are among the most dynamic and violent phenomena on the Sun. Sometimes, a filament rises to a certain height and then collapses back onto the solar surface — known as a failed eruption. In this study, we examine a failed eruption that originates on 19 March 2024 from active region NOAA 13615. The event is observed by the Solar Dynamics Observatory (SDO), the High Resolution Imager (HRI) aboard Solar Orbiter (SO), and the Interface Region Imaging Spectrograph (IRIS). Our analysis shows that the filament rises with a velocity of ~ 150 km/s and then reconnected with the overlying loops. Part of the filament material falls back to its original location, while another portion travels along the overlying loops, producing brightenings at their remote footpoints. The motion of this material is clearly visible in the observations, tracing a path from the eruption site to the remote brightening region. Time-distance analysis reveals that the material takes about two minutes to reach the remote site. IRIS spectroscopic data show both redshifted and blueshifted flows at the location of the remote brightening, indicating complex plasma dynamics. We interpret these findings in the context of previous studies, while also highlighting new insights provided by this multi-instrument observation. The future campaigns of multi instruments including SUIT/Aditya-L1 combined with Solar Orbiter are suitable and will bring a new perspective in this domain.		

ISROESA10594	Divya Paliwal	Poster
A high-frequency type II radio burst associated with an intense X2.3 class flare		
Radio observations provide access to the corona, heliosphere, and ionosphere, and are thought to be an excellent indicator of disturbances in the solar atmosphere. An immediate indicator of solar transients, such as solar flares and coronal mass ejections, are solar radio bursts, especially in the inner and middle corona. We studied a rare type II high frequency (start freq: ~ 750 MHz), fast drifting (~ 0.5 MHz/s) type II radio burst on Nov 6, 2024. The active region source location for this burst was S08E14. There was an X2.3 class flare associated with this burst, which started at 13:24 UT, peaked at 13:40 UT, and ended at 13:46 UT. The duration of the X-ray flare was ~ 22 min. There was an EUV wave seen just after the flare at ~ 13:55 UT in the SDO-AIA field of view (fov). Several ground-based radio spectrographs had recorded this type II radio burst at 13:50 and 13:56 UT from ~ 750 MHz to 45 MHz. Radio imaging observations with the Nancay radio heliograph (NRH) in the frequency range 444-150 MHz, which corresponds to a height range 1.29-1.01 $R_\odot$, reveal that the radio sources were moving in the east direction. We used the High Energy L1 Orbiting X-Ray Spectrometer (HELIOS) on-board Aditya-L1 data for spectroscopy to find the cut-off energy range for non-thermal emission. We used the Spectrometer Telescope for Imaging X-rays (STIX) on-board Solar Orbiter (SoLO) to locate the hard X-ray emission region at the eruption footpoints. Our preliminary analysis suggests that the type II bursts was associated with the shock generated due to the strong X2.3 class flare. we are also looking at the Magnetohydrodynamic Algorithm outside a Sphere (MAS) model to investigate the inner corona's physical properties, such as density, Alfvén speed, and magnetic field.		

ISROESA10031	Prakhar Singh	Poster

Diagnosing Solar Flare Dynamics: A Comparative Study of Confined and Eruptive Events Using Aditya-L1/SoLEXS
Solar flares and coronal mass ejections (CMEs) are the Sun's most energetic eruptions, but what determines whether a flare is "confined" or "eruptive" remains unclear. A key factor is how magnetic energy is divided among plasma heating, particle acceleration, and eruption kinetic energy. In this study, we investigate the thermal evolution of eruptive and confined flares by comparing the high-cadence soft X-ray (SXR) spectral data from the Solar Low-energy X-ray Spectrometer (SoLEXS) aboard Aditya-L1. We analyze a sample of flares spanning different GOES classes (M and X), including both CME-associated (eruptive) and non-eruptive (confined) events. For each flare, we perform time-resolved spectroscopic analysis to derive key plasma parameters: temperature (T), emission measure (EM), and elemental abundances. By examining the temporal evolution of T and EM across flare phases, we aim to identify systematic differences in heating and cooling between the two event types. We hypothesize that the energy required to initiate a CME may result in observable differences in the peak thermal properties or decay timescales of the flare plasma. Furthermore, we investigate whether the large-scale magnetic restructuring in eruptive events leads to distinct elemental abundance signatures, potentially indicating different plasma source regions or supply mechanisms compared to their confined counterparts. This work provides new observational constraints on the thermodynamics of solar flares and offers insights into the fundamental processes governing the flare–CME relationship.

ISROESA10445	Dinesh mishra	Poster
Simulating the magnetic evolution of active region 12975 for the formation and eruption of filament structure.		
Solar flares and coronal mass ejections (CMEs) are major explosive phenomena on the Sun that significantly affect space weather and space-based technologies. These events are triggered by the sudden release of magnetic energy gradually stored in the solar corona due to plasma motions on the solar surface. Understanding the processes of magnetic energy storage and release requires a detailed examination of magnetic field evolution. In this study, we investigate the magnetic field evolution in active region (AR) 12975, which produced two successive CMEs associated with M-class flares over an eight-hour period on 28 March 2022. Using the DAVE4VM method, we estimate the magnetic helicity and its energy injection rates to investigate their role in the eruption. To model the evolution of the coronal magnetic field, we used a time-dependent magnetofrictional (TMF) approach, which simulates the formation and eruption of a filament and the associated flux rope. The simulation starts two days prior to the eruption to account for the energy buildup phase. The time profiles of magnetic helicity and energy injection indicate a gradual buildup, consistent with significant magnetic energy accumulation prior to the eruptions. To validate the model, we compared simulated results with EUV observations from the Atmospheric Imaging Assembly (AIA) aboard the Solar Dynamics Observatory (SDO). Our findings demonstrate that the TMF model successfully captures the slow and continuous evolution of magnetic fields, accurately reproducing the formation and eruption of twisted structures driven by the buildup of magnetic energy and helicity within observed timescales.		

ISROESA10420	Simrat Kaur	Poster

Numerical study of an A-class flare using XSM, HMI/SDO and AIA/SDO

Solar flares are one of the most fascinating activities on the sun, releasing huge amounts (10^23–10^32 erg) of stored magnetic energy in the form of electromagnetic radiation and acceleration of charged particles. Energetically large flares (like X, M, C), which are more easily detected and have significant impacts on space weather, are studied more. Whereas the small energy release events or energetically small flares play an important role in the continuous heating of the solar corona, but their detection requires more sensitive observations. Fortunately, the solar X-ray monitor (XSM) on board Chandrayaan-2 has detected many energetically small flares (like A and sub-A class), giving an opportunity to explore the properties of these flares as well as the magnetic topologies associated with them. Focusing on the latter, in this study, we are analyzing an A-class flare, detected by the solar X-ray monitor (XSM) on board Chandrayaan-2. In addition to that, a rise in intensity is also observed in different AIA channels. Further, the magnetic field extrapolation of the flaring region has been done using the HMI data and non force-free field extrapolation (NFFF). The visualization of the extrapolated magnetic field reveals a flux rope co-located with the flare brightening. The dynamics of this flux rope is then explored using the data-constrained MHD simulation --- EULAG-MHD.

ISROESA10024	Kiran Kumar Kalisetti	Poster

Spatial and temporal evolution of multi thermal plasmas during M4.9 class solar flareare

In this study, we are analysing an M4.9 class solar flare that occurred on February 23, 2025, from the active region AR14001 located at the western limb (N24W90). According to GOES, the flare began at 02:00 UT, peaked at 02:13 UT and ended at 02:23UT. It is already known that solar flares are one of the most energetic events in the solar atmosphere associated with the rapid release of a large amount of magnetic energy stored in non-potential magnetic fields. This released energy is converted into plasma heating, particle acceleration and radiation across the entire electromagnetic spectrum from radio waves to gamma rays. However, it is not yet clearly understood how this energy is released and transported across the solar atmosphere during solar flares. Investigating the spatial and temporal evolution of multiple thermal plasmas during solar flares will offer valuable insights into energy partition and transport in the solar atmosphere.
We utilise data from HEL1OS (High Energy L1 Orbiting X-Ray Spectrometer), SoLEXS (Solar Low Energy X-ray Spectrometer) on board Aadithya L1, STIX (Spectrometer Telescope for Imaging X-rays) on board Solar Orbiter, and AIA (Atmospheric Imaging Assembly) on board SDO. By combining these datasets and applying both spectral fitting and DEM (Differential Emission Measure) analysis, we aim to investigate the spatial and temporal evolution of thermal and non-thermal plasma components during the flare

ISROESA10054	Sreebala P S	Poster

Multiwavelength study of a prominence eruption using AIA/SDO, SUIT/Aditya L1 and SolO.

The study and evolution of solar prominence offer crucial insights into the physical processes behind various large-scale eruptions. The plasma suspended along the magnetic field lines is found to exhibit noticeable temperature variations. We present the results of the study on the formation and evolution of an off-limb prominence eruption on December 30, 2023, through coaligned observations from the Atmospheric Imaging Assembly (AIA/SDO) and Solar Ultraviolet Imaging Telescope (SUIT/Aditya-L1). This gradual growth and motion of the prominence observed in NB04 (Mg II h, 280.3 nm) is one of the earliest observations using SUIT and the first prominence observed using the same. We observed a distinct rising phase and gradual evolution of the prominence in a two-hour duration. Some part of the rising plasma is ejected as a CME, and the rest of the material is being relocated. The brightening at footpoints and formation of cusp-like structures were observed in the high-temperature SDO EUV channels. Motion of the footpoint, followed by the appearance of footpoint brightenings, can be clearly observed in AIA 171, 193, 211 and 304 Angstrom channels. However, the formation of cusps was observed in AIA 94 well before the prominence started erupting. We employed differential emission measures (DEM) on the AIA observations to study the thermal evolution of plasma material at various locations during different stages of this prominence eruption. The same event was observed in SWAP174(PROBA2) with a larger field of view as well. This study can be expanded through coupled observation of an associated solar flare (C-class) recorded in STIX/SolO and coronal mass ejection (CME) observed in Lasco/SOHO. This multiwavelength study is expected to provide details on the formation and evolution of prominences and their underlying mechanisms.

ISROESA10527	Bimal Pande	Poster

Analysis of the Characteristics of Doublet Type II Radio Bursts in relation to Flares and CMEs during solar cycles 23 and 24

In this paper, a statistical study of doublet type II radio bursts i.e. first type II (type II1) and second type II (type II2) associated with flares and CMEs for solar cycle 23 & 24 is presented. We have considered radio rich CMEs that are accompanied by type-II radio bursts for our analysis. Our study spans a duration of 15 years extending from November 1997 to December 2015, including solar cycles 23 and 24. We have analyzed the key attributes such as lifetime, start frequency, end frequency, band width, drift rate and estimated shock speed (ESS) of doublet type II radio bursts by utilizing the data available at Culgoora radio spectrograph. A comparative study of the association of both type II solar radio burts with flares and CMEs for solar cycle 23 & 24 has been undertaken. In solar cycles 23 & 24, the flares start before the start of both two types of radio bursts and CMEs start after the onset of radio bursts which suggests that the solar flare is a precursor to both the radio bursts and the subsequent CME. The flare triggers the acceleration of particles that lead to the radio bursts. CME speed and acceleration are negatively correlated with a correlation coefficient of r = -0:57 and r = -0:72, this suggests that as CME speed increases, deceleration increases in both solar cycles 23 & 24.

ISROESA10542	Swetha Gopinathan	Poster

Analysis of Doppler Velocity Power Spectra and Magnetic Fields in the Solar Active Region NOAA 13842

The distribution of acoustic (p-mode) power in solar active regions provides critical insight into the interaction between magnetic fields and solar oscillations. In this study, we examine the oscillatory power in NOAA Active Region 13842 using high-resolution Dopplergram data obtained from the Helioseismic and Magnetic Imager (HMI) onboard the Solar Dynamics Observatory (SDO). Through time–frequency analysis of the Doppler velocity signals, we identify significant suppression of acoustic power in regions with strong magnetic fields compared to the quiet Sun. This reduction is consistent with the absorption and damping of p-modes by magnetic structures, likely due to mode conversion, scattering, and altered wave propagation in magnetized plasma. By analyzing the spatial distribution of power across different frequency bands, we further explore the frequency dependence of power suppression and its relation to local magnetic field strength. These results provide valuable evidence for the complex coupling between magnetic topology and helioseismic oscillations, contributing to a deeper understanding of wave behavior in magnetized solar atmospheres. Such studies are crucial for advancing the emerging field of flare–helioseismology interactions and for improving our ability to diagnose subsurface structures and energy transport processes in active regions.

ISROESA10378	Sachin Rajkapoor kanaujiya	Poster

Multi-Mode Quasi-Periodic Pulsations Associated with CME-Prominence Eruptions Observed by MLSO/K-Cor

We present an empirical mode decomposition (EMD)-based analysis of quasi-periodic intensity oscillations associated with coronal mass ejections (CMEs) and prominence eruptions.
Using white-light coronagraph observations from the Mauna Loa Solar Observatory (MLSO/K-Cor), we extracted eruption light curves to investigate underlying periodicities. Application of EMD to the time series revealed prominent intrinsic mode functions (IMFs) exhibiting distinct temporal behaviors. The second IMF displayed short-lived, amplitude-modulated oscillations re- sembling wavelet burst behavior, with a period of about 5 minutes, suggesting a transient, coherent oscillatory process possibly driven by magnetic reconnection dynamics. The third IMF exhibited a longer-period oscillation of approximately 8.5 minutes. These findings provide evidence for the pres- ence of multi-periodic, quasi-periodic pulsations (QPPs) during solar eruptive events and highlight the dynamic coupling between the solar corona and lower atmosphere.

ISROESA10543	Anoop K Mathew	Poster

Multi-Wavelength Analysis of Flare Ribbon Dynamics in Active Region NOAA 13614

We present a multi-wavelength investigation of an X1.1-class solar flare originating from active region NOAA 13614. Observations from the Atmospheric Imaging Assembly (AIA) and Helioseismic and Magnetic Imager (HMI) onboard the Solar Dynamics Observatory (SDO), combined with soft X-ray flux data from GOES, were used to study the flare's evolution. Two bright flare ribbons formed on opposite sides of the polarity inversion line (PIL) and gradually separated, reaching a maximum distance of about 36,000 km with an average speed of ~34.5 km s^{-1} and a peak velocity of 133 km s^{-1}. Multi-wavelength imaging revealed intense plasma heating, formation of hot coronal loops, and asymmetric ribbon brightness, all consistent with magnetic reconnection. The results align with the standard CSHKP flare model, emphasizing that magnetic reconnection governs both the energy release and ribbon expansion during major solar flares.

ISROESA10646	Mahendra Kumar Mehar	Poster

Multi-Wavelength Analysis of Solar Flare event

We present a multi-wavelength analysis of Solar flare event on 14 May 2024 from NOAA Active Region 13682, location on the Sun at (E65N 17). Solar flares are intense, short-lived releases of energy, radiate throughout the electromagnetic spectrum, and strongly influence the space weather. The Atmospheric Imaging Assembly (AIA) on board the Solar Dynamics Observatory (SDO) observes the surface and atmosphere of the Sun under ten different wavelength bands to reveal key aspects of solar activity. We used simultaneous observations from three AIA EUV channels 94 ˚A, 171 ˚Aand 304 ˚A, one UV channel 1600 ˚A and applied time series procedure to reveal the evolution phases of this solar flare event, and the result is supported by standard solar flare models. We also observed helical flow of plasma, visualizing complex and dynamic interaction between solar plasma and magnetic field lines. The CME signature of the flare event is also observed, and the calculated CME speed is 1407.2 Km/S.

ISROESA10588	Sandeep Kumar Dubey	Poster

Spatio-Temporal Evolution of the Chromospheric Plasma in an M-Class Solar Flare Using Ca II 8542 Å Line Scans from MAST

Magnetic fields play a central role in structuring and governing the dynamics of plasma in the solar atmosphere. They control the formation and decay of solar features ranging from hundreds to millions of kilometers. Solar flares are impulsive events in which magnetic field lines undergo reconnection, changing their connectivity and converting a large amount of magnetic energy into radiation and particle acceleration. These flares emit across the entire electromagnetic spectrum, with a significant fraction of the released energy being of thermal origin. Flares are generally believed to occur in the solar corona, while a considerable portion of the released energy is deposited in the chromosphere during strong flare events. In this work, we analyze the chromospheric response to an M-class flare (M1.1) using the Ca II 8542 Å line scans obtained with the narrowband imager of the Multi-Application Solar Telescope (MAST), Udaipur, complemented by observations from AIA and HMI onboard SDO. The flare occurred in the active region NOAA 12994 between 04:52 UT and 05:28 UT, peaking at 05:14 UT on 22nd April 2022. The chromospheric flare ribbons displayed a complex shape, scattered over nearly the entire field of view (~4 x 4 arcmin square). We selected multiple regions of interest (ROIs) covering different parts of the flare ribbons. The temporal evolution of intensity, line-of-sight velocity, and temperature showed significant spatio-temporal variations across different ribbon segments. In the post-flare phase, we observed spectral signatures indicative of chromospheric plasma expansion caused by excessive energy deposition, manifested as simultaneous upflows and downflows (~10 km/s). The flare light curves over various ROIs were modulated by the regular chromospheric and photospheric oscillations (3- and 5-minute), which appeared largely unaltered by the flare energy deposition in the chromosphere. At this workshop, I will present the key findings of this study.

ISROESA10441	Girjesh Gupta	Poster

Response of a small-scale transient in the lower and upper atmosphere of solar active region
During solar flares, a considerable portion of the flare atmosphere becomes heated; however, the energy deposition process is still unclear, especially in the lower solar atmosphere. Here, we present spectroscopic and imaging observations of a small-scale transient of lifetime 10 MK) at the loop footpoint and subsequent formation of a small-scale transient loop with a loop-top temperature exceeding 8 MK. The Transient shows an enhancement in intensities in all the passbands of the AIA, IRIS, and HMI continuum. Light curves follow clean temperature-dependent time delays in the lower atmosphere, which, to our knowledge, has never been reported before. Beneath the transient, associated HMI magnetogram provides evidence of flux emergence of both polarities. Using the IRIS O IV line pair, we obtained the average electron number density of 10^11.25 cm^-3 at the transient. IRIS transition region lines such as O IV and Si IV show a redshift of 10-15 km s^-1. These Doppler shifts suggest a down-flowing warmer plasma in the lower atmosphere. The appearance of Mg II triplets in emission is also observed. We interpret these enhancements in intensities in the lower atmosphere as a result of heating due to both non-thermal electrons and thermal conduction operating simultaneously. In the future, we propose to study such transients using data from SUIT and SoLEXS, both onboard Aditya-L1, as well as EUI and STIX, both onboard Solar Orbiter.

ISROESA10432	Archana Giri Nair	Poster
Empirical Mode Decomposition Analysis of X-Class Solar Flares: Investigating Quasi-Periodic Pulsations and Energy Dynamics		
This thesis explores the nonlinear and nonstationary dynamics of X-class solar flares using Empirical Mode Decomposition (EMD) applied to Solar Orbiter/STIX observations in the 16–28 keV energy band. Five major events recorded between 2023 and 2024 were examined, supported by GOES/XRS and SDO/AIA/EUI data that provided contextual information on flare morphology and coronal loop parameters. STIX light curves were decomposed into intrinsic mode functions (IMFs), and Hilbert spectral analysis was used to derive instantaneous frequencies and energy profiles. The results reveal multiscale oscillatory behavior and quasi-periodic pulsations (QPPs) across all events. Frequency evolution varied between phases, with decay phases dominated by higher-frequency, more stable oscillations, while impulsive phases featured longer-period dynamics. Recurrent low-frequency modes (~4–8 mHz) reflected global coronal oscillations, whereas higher-frequency components were linked to localized reconnection and plasmoid activity. These observational findings are interpreted within the framework of the reduced magnetohydrodynamic (RMHD) model of Nigro et al. (2008), which represents coronal loops as high–aspect ratio resonant structures. The model emphasizes the balance between linear Alfvénic propagation along the loop and nonlinear turbulent couplings that redistribute energy across scales. It demonstrates how large-scale resonant modes interact with small-scale turbulence, providing an efficient mechanism for energy transfer and dissipation. By comparing EMD-derived oscillation signatures and loop aspect ratio estimates with this RMHD framework, the study highlights the complementary roles of resonance and turbulence in regulating flare energy storage, release, and dissipation, offering deeper insight into the physical processes underlying QPPs and coronal heating.		

ISROESA10613	Sumanth Rotti	Poster

Investigating the Spatiotemporal Pre-Flare Dynamics: Multi-Mission VLPs and Temperature-Emission Measure Diagnostics

Pre-flare quasi-periodic oscillations, also known as very long-period pulsations (VLPs), provide a valuable diagnostic window into the evolving magnetic and plasma conditions that precede solar flare onset. We investigate VLP signatures related to solar activity on 2024-03-23 using soft X-ray data from the SoLEXS instrument onboard Aditya-L1. Additionally, GOES-XRS and SDO-AIA data were used to verify the findings. The GOES flare list reports one X-class flare and several M-class flares on that day. This period is of particular interest as Solar Orbiter is aligned along the Sun–Earth line-of-sight. Our ongoing correlation studies using data from the STIX and EUI instruments onboard will offer additional insights into source evolution and spatially resolved flare diagnostics. Currently, it is understood that VLP periodicities provide insights into the underlying slow magnetohydrodynamic oscillations, offering valuable diagnostic clues to pre-flare energy storage and release. Our preliminary findings support the scenario that magnetically driven compressive or reconnection-triggered modulations precede large flare energy releases. For example, the fast Fourier transform (FFT) power spectrum during the pre-flare phase (~20 minutes) for the X-class flare showed a VLP period of approximately 5 minutes, consistent with timescales reported in earlier studies. Furthermore, the associated FFT peak exhibited a power of 8.581e-12, indicating a statistically meaningful oscillatory component. To probe plasma conditions during the pre-flare interval, we estimated temperature and emission measure from the soft X-ray fluxes. The resulting T-EM diagnostic curve showed evidence of hot-onset behavior, with onset temperature at ~6.5 MK, suggesting early heating and density evolution before the impulsive flare rise. Overall, this work demonstrates VLP observations using data from the Aditya-L1 mission, reinforced through multi-instrument validation. Our findings highlight the diagnostic potential of coordinated X-ray and EUV observations for revealing precursor processes leading up to major flares and assessing their implications for future flare forecasting methodologies.

ISROESA10647	Hema Kharayat	Poster

Energetics and dynamics of an erupting sigmoidal flux rope and associated interacting magnetic flux systems: Adiya-L1 and SDO observations

Understanding the feedback relation between large scale magnetic reconnection and acceleration phases of a magnetic flux rope (MFR) at the source region is of utmost importance to understand fundamental plasma processes occurring on the Sun and also because of the space weather perspective. With this objective, we investigate the eruption of a sigmoidal flux rope in a complex active region NOAA 13842. The EUV imaging from Atmospheric Imaging Assembly (AIA) on board Solar Dynamics Observatory (SDO) provide us observational inferences about the magnetic field topology of the active region. The MFR is oriented approximately in north-south direction along the polarity inversion line, while the magnetic flux system lying on both sides of it, east and west, is quite asymmetric. We find that the eruptive expansion of the flux rope has disturbed both the neighboring large-scale flux systems. The eruption of the flux rope resulted into an eruptive X-class solar flare and a halo CME. In the source region, we observed a typical two-ribbon flare and a remote circular ribbon, suggesting that magnetic reconnection significantly contributes to the acceleration of the MFR. The observations from HELIOS on board Aditya-L1 exhibit highly impulsive, with no pre-flare or precursor emission, suggestive of spontaneous magnetic reconnection. The soft X-ray observations from SoLEXS aboard Aditya-L1 show the event to be a a typical long duration flare. We provide a plausible interpretation of the triggering mechanism and the phenomena responsible for impulsive hard X-ray emission. The study can provide us with the important inputs to understand the cause behind super hot plasma and intense particle acceleration.

ISROESA10644	ADITHYA HN	Poster
Pre-flare Study Using Aditya-L1 Observations		
Solar flares are an intense release of magnetic energy in the form of electromagnetic radiation and accelerated particles. However, the mechanisms that trigger solar flares are not yet fully understood. Simultaneous observations of the chromosphere and corona during the pre-flare phase can provide valuable insights into the processes leading up to the onset of a flare. In this study, we utilise simultaneous observations from the Solar Ultraviolet Imaging Telescope (SUIT), Solar Low Energy X-ray Spectrometer (SoLEXS), and High Energy L1 Orbiting X-ray Spectrometer (HEL1OS) onboard Aditya-L1, which observe the Sun in the near-ultraviolet (NUV), soft X-ray, and hard X-ray regimes, respectively. We investigate multiple pre-flare events and find that in several cases, localised brightenings were observed in the SUIT Mg II h & k filters at or near the eventual flaring site prior to the flare onset. In this paper, we present the above results and support these observations with data from the Geostationary Operational Environmental Satellite (GOES) and the Spectrometer Telescope for Imaging X-rays (STIX) on the Solar Orbiter. Using the SUIT of data, the coupling between the chromosphere and corona before the flare onset is studied, including the recently proposed hot onset scenario.		

ISROESA10556	Jayalekshmi G. L.	Poster
Analysis of X-class flares from active regions observed by Solar Ultraviolet Imaging Telescope on board Aditya-L1		
Solar flares are explosion of strong bursts of electromagnetic radiations emanating from the Sun. These radiations can disrupt GPS and communication signals on the thermosphere. This study analyzes all the X-class flares observed by SUIT onboard Aditya L1 from 1st June 2024 onwards. Temporal evolution (start, peak and end times) of solar flares is monitored by Geostationary Operational Environmental Satellite (GOES). Near ultra violet images in Mg II h (NB04;280.3 nm) and Mg II k (NB03; 279.6 nm) filters are analyzed using SunPy tool. These flare observations are compared with extreme ultraviolet images produced by Atmospheric Imaging Assembly (AIA) onboard Solar Dynamics Observatory (SDO) at 1600 Å and 1700 Å wavelengths. Comparison of occurrence times of flare peaks is made GOES peak. Also, the spatial extent of emission features at different wavelengths can be compared from area of one-sigma contours.		

C. Heliospheric Science

ISROESA10058	Balveer Singh Rathore	Poster

Space weather variation with solar flare during ascending phase of cycle-24

The paper examines the solar flare and solar wind plasma parameters and its modulations in the time slot of ascending phase of cycle-24. Geomagnetic storms were less because solar activities are very less during the ascending phase of cycle-24; only 47 geomagnetic storms are occurred during the study period. Only moderate and intense geomagnetic storms are occurred and no severe storms are occurred during the ascending phase of cycle-24. Geomagnetic storms which associated with solar flares have been taken in present paper. Nine storms are occurred due to solar flares during the current cycle. X-class is the cause of intense storms and due to M-class flare only moderate storms are occurred. The response of the total average interplanetary magnetic field (IMF) B, Bz- component of IMF, solar wind temperature, solar wind density, solar wind dynamic pressure, solar wind velocity (V), and Ey along with geomagnetic storms (Dst) has been analyzed in the present study. We have selected 5 Major geomagnetic storms. (Dst

ISROESA10204	sindhuja	Poster

Comparative Analysis of 3He-Rich and 3He-Poor Solar Energetic Particle Events Observed by Solar Orbiter

Solar energetic particle (SEP) events enriched in the rare helium isotope ^{3}He represent a distinct class of impulsive events that provide important insights into particle acceleration and transport in the inner heliosphere. We present a study of 26 SEP events observed between 2021 and 2025 with Solar Orbiter/EPD (EPT and SIS) and STIX, selected through coincident STIX flares, EPD electron enhancements, and Type III radio bursts. Events were classified as ^{3}He-rich (^{3}He/4He ≥ 1) or ^{3}He-poor (^{3}He/4He), lower reconnection fluxes (median ~0.45 × 10^{21} Mx), little CME association (2 of 13), elevated ^{3}He/4He ratios (up to 23.5), higher Fe/O and ^{3}He/p ratios, and harder nonthermal electron spectra. These findings reinforce that ^{3}He-rich events largely reflect impulsive reconnection-driven processes lacking strong CME signatures, while ^{3}He-poor events share properties of more gradual events influenced by large-scale coronal structures.

ISROESA10063	Kishor Dattatray Kumbhar	Poster

Role of Kinetic instabilities in anisotropic heating and cooling of Corotating Interaction Regions at 1 Au

Corotating Interaction Regions (CIRs), formed by the interaction of fast and slow solar wind streams, and characterised by enhanced magnetic turbulence and elevated temperatures relative to the ambient solar wind. In this study, we investigate 465 Earth-directed CIR events observed by the Wind spacecraft from 1995 to 2009 to examine how microkinetic instabilities regulate proton heating and cooling near instability thresholds. The results reveal systematic signatures of anisotropic heating: the perpendicular proton temperature ($T_{p\perp}$) increases as plasma approaches the mirror mode (MM) threshold, while the parallel proton temperature ($T_{p\parallel}$) rises near the oblique firehose (OFH) threshold. Furthermore, plasmas unstable to proton cyclotron and parallel firehose instabilities exhibit substantially higher temperatures compared to stable plasma, in some cases by nearly a factor of three, indicating distinct and preferential heating pathways. Enhanced magnetic fluctuations are found close to the MM and OFH thresholds for $\beta_{p\parallel} > 1$, whereas plasmas with $\beta_{p\parallel} \leq 1$ show predominantly higher collisional age. Compressibility remains consistently elevated across all $\beta_{p\parallel}$ regimes, suggesting a robust role in shaping plasma dynamics. These findings collectively demonstrate that proton heating dominates over cooling in sustaining temperature anisotropy within CIR plasmas, while collisionality, compressibility, and magnetic fluctuations emerge as critical regulators of the overall plasma conditions.

ISROESA10322	Jibin V Sunny	Poster

Corotating Interaction Regions and Interplanetary Sheaths during Solar Cycle 24: A Comparative Study on Their Characteristics and Geoeffectiveness

Space weather events are initiated on the Sun and can cause immense impacts on the Earth's magnetosphere-ionosphere-atmosphere system. The events cause geomagnetic storms which can damage the satellite communication, navigation and power grid system. Corotating interaction regions (CIRs) and interplanetary sheaths are two such events. A CIR is the interaction region between the highspeed solar stream emanated from coronal hole and the slow speed stream. Interplanetary sheaths are turbulent regions formed by fast moving interplanetary coronal mass ejections (ICMEs). In this work, I used a long-term solar-wind measurement upstream of the Earth during Solar Cycle 24, from January 2008 to December 2019, to identify all CIRs and sheaths, to compare their solar-cycle and seasonal variations, characteristic features and geoeffectiveness. A total of 290 CIRs and 110 sheaths were encountered by Earth during this period. Both sheath and CIR are characterized by identical average solar-wind plasma density and ram pressure, and their fluctuations characterized by enhanced variance, and periodic variations of a few minutes to an hour. However, on average, the CIRs are faster, hotter, durationally longer and radially wider than the sheaths. Also, on average CIRs has stronger southward interplanetary magnetic field (IMF) component than sheaths which makes the CIRs more geoeffective than the sheaths. Comparative studies are also conducted between geoeffective and non-geoeffective CIRs and sheaths. The typical characteristic solar-wind and geomagnetic activity parameters given in this work may be useful for modelling and prediction purposes.

ISROESA10346	Shubham Kadam	Poster

Linking of Fluid and Kinetic Scale Turbulence in Solar wind

Turbulence in the solar wind spans a vast range of scales, from large magnetohydrodynamic (MHD) fluctuations at fluid scales to dispersive wave activity at ion and electron kinetic scales. Understanding how energy cascades across these scales is central to explaining plasma heating and particle energization in the heliosphere. In this study, we investigate the linkage between fluid and kinetic scale turbulence using in situ measurements from Solar Orbiter and STEREO A. Magnetic field and plasma data are analyzed to characterize solar wind intervals through parameters such as Alfvénicity, compressibility, plasma beta, and Elsasser variables. At fluid scales, spectral analysis is employed to identify the inertial range cascade and quantify power-law slopes. Transition to kinetic scales is examined via

Fourier and wavelet techniques, focusing on changes in magnetic helicity and polarization signatures across frequencies and propagation angles. Particular attention is given to the coexistence of wave modes (KAWs, ICWs, Whistlers), which represent key modes of energy dissipation.
Our results indicate that while the solar wind often exhibits high Alfvénicity at fluid scales, this property weakens at kinetic scales. Dispersive effects were seen to become more significant. Magnetic helicity analysis reveals alternating signatures consistent with a mixture of wave modes at different frequencies, suggesting that multiple dissipation pathways operate simultaneously. Comparison of fluid- and kinetic-scale parameters highlights correlations between large-scale turbulence drivers and small-scale energy conversion, providing evidence of a continuous cascade linking MHD and kinetic physics. This work contributes to the broader goal of understanding how turbulence mediates the transport of mass, momentum, and energy in space plasmas. The results have implications for solar wind heating, space weather prediction, and the interpretation of forthcoming high-resolution observations from missions such as Solar Orbiter and Parker Solar Probe.

ISROESA10164	Dr Naval Kishor Lohani	Poster

Corotating Interaction Regions and Their Role in Triggering Intense Geomagnetic Storms: A Statistical Perspective

In this talk we present a statistical investigation of intense geomagnetic storms (Dst ≤ −100 nT) associated with corotating interaction regions (CIRs) during 1995–2016, covering solar cycles 23 and 24. While CIRs are more commonly linked with weak or moderate storms, they occasionally generate intense disturbances capable of strongly influencing near-Earth space weather. Understanding these rare but impactful events is important for improving space weather prediction.
Using superposed epoch analysis, we examined the temporal evolution of key parameters for two categories of events: pure CIR-driven storms and CIR-ICME combined storms. Hourly values of the Dst and AE indices were analyzed alongside interplanetary plasma and field parameters, including solar wind speed (V), IMF magnitude (B), IMF Bz, and the convective electric field (Ey). To further identify the dominant solar wind drivers, a correlation analysis was performed between geomagnetic indices and interplanetary parameters.
Our results reveal distinct differences between pure CIR and CIR-ICME events, particularly in the efficiency of solar wind–magnetosphere coupling. CIR-ICME interactions tend to produce stronger and more prolonged disturbances, while pure CIRs, though less frequent, can still drive intense storms under favorable conditions. This study highlights the geoeffectiveness of CIRs and underscores their role as an important, yet sometimes underestimated, contributor to intense geomagnetic storms. The findings improve our understanding of storm drivers beyond CMEs and provide insights valuable for space weather.

ISROESA10336	Vasanth Anandan	Poster

Multipoint observations of the Large Scale Coronal Features and their association with the slow solar wind

The solar wind is generated as the hot solar atmosphere continuously expands into space, taking the Sun’s magnetic field along with it. The solar wind is typically classified into two main categories: Fast Solar Wind (FSW) and Slow Solar wind (SSW). It is generally considered that the FSW originates from the coronal holes, i.e., regions on the Sun associated with open magnetic field lines. On the other hand, the origin and mechanisms of the SSW generation are still strongly discussed. In this study, we present multipoint observations of the large-scale coronal features observed by the Extreme Ultraviolet Imager/Full Sun Imager (EUI/FSI) onboard Solar Orbiter, which are speculated to be the sources of SSW. The observations from SolO/EUI encompasses a broader field of view and offer higher resolution than any previous EUV instrument, enabling us to distinctly observe faint structures in the corona. In addition, observations from PROBA-2/SWAP, STEREO-A/EUVI, SDO/AIA and EUI/HRI concerning large-scale coronal features enabled us to pinpoint their footpoints. Furthermore, extrapolations from the Potential Field Source Surface (PFSS) model assisted in comprehending the magnetic configurations of these structures within the global coronal magnetic field. Subsequently, a thorough analysis was conducted to establish the link between the slow solar wind measured in-situ by WIND, ACE, PSP, SolO to large-scale coronal features, employed using magnetic connectivity tools and ballistic mapping techniques.

ISROESA10437	**Anshu Kumari**	**Poster**
Radio observations to probe particle acceleration in solar energetic particle events		
Solar radio bursts (SRBs) are intense emissions observed in radio wavelengths during solar transients, such as coronal mass ejections (CMEs) and flares. SRBs are direct signatures of accelerated electrons in the solar atmosphere. These solar transients have a direct impact on the near-Earth atmosphere. SRBs serve as key diagnostic tools for plasma processes, particle accelerations, magnetic field dynamics in the solar corona and the heliosphere, which are the root cause of these solar transients. We present two case studies on solar energetic particle (SEP) events involving type III storms and type II bursts in metric and decameter-hectometric (DH) wavelengths. In one case, a type III storm was disrupted by an eruption, while in the other, the storm remained unaffected. Both events featured fast and wide coronal mass ejections (CMEs) and regular type III bursts. Analysing radio imaging data, we found that in the high-intensity SEP event, the source locations of the type III storm and type II bursts were the same, indicating storm disruption. In contrast, the weak SEP event displayed spatial separation between the type III storm and type II bursts. These findings support the hypothesis that type III storm sources can accelerate ions, providing seed particles to SEP events. We plan to extend this study by combining SoLO and PSP radio observations with NRH dataset.		

ISROESA10274	**Pritam Das**	**Poster**
CME Kinematics with Optical Flow: Multi-Coronagraph Insights into Internal Velocity Dispersion		

Understanding CME kinematics in the middle corona is crucial for linking their initiation mechanisms with their interplanetary evolution. Traditional tracking methods, which are restricted to discrete position angles, often obscure the internal velocity dispersion between CME substructures such as the core and leading edge.
We employ an advanced optical-flow (OF) technique to derive two-dimensional velocity fields of CMEs from coronagraph observations, capturing their continuous spatiotemporal evolution. The method was tested on SOHO/LASCO C2 and STEREO/COR1 datasets and, despite their relatively lower spatial and temporal resolution, showed strong agreement with conventional height–time tracking. It was subsequently applied to Solar Orbiter/METIS and PROBA-3/ASPIICS observations. Extensive image processing was carried out to remove the background and isolate CME structures. Additionally, a Fourier-domain filtering technique was implemented to mitigate the brightness-flickering artifact around the occulter currently present in the PROBA-3 Level-2 data.
Our OF framework retrieves detailed flow fields and key dynamical quantities such as centre-of-mass and expansion velocities for multiple CMEs. For example, in the 16 April 2024 METIS event, the average centre-of-mass and expansion velocities were 337 km/s and 196 km/s, respectively. Analysis of prominence-associated CMEs using METIS Lyman-α and FSI 174 Å/304 Å, as well as the Wideband channel of ASPIICS/PROBA-3, reveals a critical height range where velocity dispersion between the core and the front first develops, offering insights into CME dynamics.
The method also enables automated CME detection through evolving velocity distributions, paving the way for cross-mission kinematic studies with next-generation missions such as PUNCH.

ISROESA10264	Aakash Gupta	Poster

Quiet and disturbed time behaviour of suprathermal ions: Multi-directional observations from ASPEX-STEPS on-board Aditya-L1

The processes governing the origin, acceleration, and anisotropy of suprathermal ions in the interplanetary medium are still not fully understood. As seed populations for solar energetic particles (SEPs), these ions critically influence space weather dynamics and pose potential risks to space-based assets. In this study, we examine the directional spectra of suprathermal ions during both quiet solar wind conditions and disturbed intervals associated with coronal mass ejections (CMEs). The analysis utilizes in situ observations from the Supra-Thermal and Energetic Particle Spectrometer (STEPS), a key instrument of the Aditya Solar Wind Particle EXperiment (ASPEX) aboard India's Aditya-L1 spacecraft. STEPS comprises four sensors—Parker Spiral (PS), Inter-Mediate (IM), Earth Pointing (EP), and North Pointing (NP)—three in the ecliptic plane and one (NP) orthogonal to it. Spectral indices derived from multiple quiet intervals in 2024 indicate nearly isotropic suprathermal ion distributions, providing strong observational support for the isotropic assumption commonly used in Parker transport equation solutions for suprathermal ion acceleration. Since STEPS does not discriminate ion species, complementary analyses of elemental abundance ratios ($^{3}He/^{4}He$, Fe/O, and C/O) were performed using the Ultra-Low Energy Isotope Spectrometer (ULEIS) on-board ACE. These results indicate that the quiet-time suprathermal pool includes residual ions from previous impulsive and gradual SEP events. During CME-associated intervals, however, the distributions vary - some events show isotropic behavior , while others exhibit pronounced anisotropy, suggesting directional differences in the shock acceleration process(es). The CME events are analyzed in detail to understand the anisotropic behavior in spectral indices whenever applicable. Therefore, this investigation based on directional measurements is expected to shed light on the process(es) that cause anisotropy of the suprathermal ions in the interplanetary medium.

ISROESA10040	Dr Subhash Chandra Kaushik	Poster

Transient Plasma Flows and Associated Geomagnetic Effects

The interaction between solar wind and terrestrial magnetosphere depends up on the plasma structures present in the solar wind. This interaction builds a chain of activities on the geo- magnetic environment. However the intensity of these activities depends up on the orientation and the strength of IMF Bz embedded within the solar wind. One such plasma structure is a magnetic cloud identified by its unique and measurable features. It is a kind of large scale interplanetary solar wind plasma structure resulted as a transient ejection of the solar plasma in the solar wind. Its characteristics were first time reported in 1981 by a group of scientists, who have studied the solar wind ejection with the help of several satellites data simultaneously. Present study deals with the behaviour of these interplanetary magnetic clouds and the behavior of ground level enhancement events (GLEs) as well as studying the Forbush decrease events simultaneously. We studied these events during the phase of highly intense or ultra-intense geomagnetic field perturbations. We have utilized the IMF and Solar data provided by Omniweb-NASA and the geomagnetic data obtained through magnetometers, measured and provided by WDC Kyoto. Events are further investigated using the data of SIS/ Ulysses to find He and HeO concentrations. Our results indicate that energetic particles coming from deep surface interact with these abnormal solar and IP conditions (Magnetic clouds) and suffer modulation effects. It is found that AP and AE indices show rise before the forward turnings of IMF, while the Dst index depicts a classic storm time decrease. The analysis indicates that the magnitude of all the responses depends on BZ component of IMF being well correlated with solar maximum and minimum periods.

ISROESA10250	Seema Pande	Poster

Geoeffectiveness of Solar Eruptions in Solar Cycle 24: A Study of DH-Type II Bursts, CMEs and Flares

We present a statistical analysis of the geoeffectiveness of coronal mass ejections (CMEs) accompanied by decametric–hectometric (DH) type II radio bursts during Solar Cycle 24 (March 2008–December 2015). A total of 119 DH-CME events were examined to explore their association with geomagnetic storms and interplanetary plasma and field parameters, including T, V, P, β, Bz, Bt, E, and the product BzV. Events were categorized as geoeffective (Dst ≤ −50 nT) and non-geoeffective based on the minimum Dst index. Our analysis reveals that geoeffective events tend to exhibit higher start frequencies, lower end frequencies, broader bandwidths, longer durations and slower drift rates than their non-geoeffective events. The speed of CMEs emerged as a key parameter, with faster CMEs more likely to trigger geomagnetic storms. A moderate correlation (r = 0.50) was observed between CME speed and flare flux, indicating that flares may contribute to geomagnetic activity through CMEs. The strong association between DH-type II CMEs and geomagnetic storms highlights the role of these events in space weather impacts. A strong correlation (r > 0.5) between Dst and the interplanetary parameter BzV underscores the importance of solar wind conditions in the occurrence of geomagnetic storms. These results provide valuable insights into the solar and interplanetary drivers of geomagnetic storms and helps to improve storm prediction models.

ISROESA10486	Verena Heidrich-Meisner	Poster

Comparing solar wind proton data at L1

The properties of the solar wind are influenced by its respective solar source region and its transport history. As the dominant component of the solar wind, the properties of protons , i.e. proton speed, proton density, and proton temperature, are routinely measured at various spacecraft and are utlized in a wide range of different scientific contexts. Here, we compare proton measurements obtained at L1 by the proton monitor (PM) which is part of the Charge, Element, and Isotope Analysis System (CELIAS) onboard the Solar and Heliospheric Observatory (SOHO) and the Solar Wind Electron Proton and Alpha Monitor (SWEPAM) onboard the Advanced Composition Explorer (ACE). Both instruments have been continuously providing solar wind data for more than two solar activity cycles. This allows a detailed comparison of the solar wind protons at L1 over a large range of different solar wind and solar activity cycle conditions. Therein, we focus on the physical and instrumental limits of such a comparison.

ISROESA10484	Shreya Ramkumar Mishra	Poster

Investigation of HILDCAA event during solar maximum of solar cycle-25 and its effect on electron acceleration

The occurrence of High Intensity Long Duration Continuous AE Activity (HILDCAA) event during the maximum of solar cycle-25 is studied. These events are associated with solar wind flows with speed > 600 Km/s , which are originated from coronal holes. The high speed solar wind stream interact with background slow solar wind which causes Alfvenic fluctuation in solar wind, leading to enhanced auroral activity. These events are seen in the recovery phase of the minor storms and well documented to be observed during solar minimum. We study HILDCAA events during maximum of the solar cycle-25, which include investigations from two giant coronal holes : events in July 2025 at polar region, and September 2025 at equator (most popular "butterfly coronal hole" event). We use Aditya L1 MAG and ASPEX-SWIS data to identify HILDCAA associated with these coronal holes. The two events are compared in respect with solar wind speed, duration and level of auroral activity associated with HILDCAA event. The GOES-18,19 - integrated and differential electron flux data is used to study the electron acceleration during these event.

ISROESA10462	Deeksha Rai	Poster

Small-scale negative density pulse in solar wind observed by Aditya-L1 and impulsive geomagnetic field response during October 10, 2024 storm

The geomagnetic storm of October 10, 2024, was the second strongest of Solar Cycle 25, with the Dst index reaching approximately −390 nT. This study focuses on a sudden decrease in the Sym-H index by about 73 nT within a few minutes during the main phase of the storm. The occurrence of such an impulsive decrease in Sym-H during the main phase makes it an interesting case to investigate. Solar wind measurements from ASPEX-SWIS onboard Aditya-L1 revealed a sharp decrease in density. This brief low-density parcel can be attributed to the reduction in solar wind dynamic pressure. Furthermore, magnetic field observations from MAG onboard Aditya-L1 and GOES-18 suggest that the magnetosphere expanded in response to this pressure discontinuity. A global snapshot of the geomagnetic field disturbance associated with this negative pressure pulse, and the role of key magnetospheric currents in driving such a brief yet effective solar wind discontinuity, is presented.

ISROESA10532	Mihir Desai	Poster

Suprathermal Ion Populations at the Heliospheric Current Sheet Crossings observed by Solar Orbiter and Parker Solar Probe

We report observations of time-intensity profiles, pitch-angle distributions, spectral forms, and maximum energies of by Solar Orbiter and Parker Solar Probe (PSP). We present detailed analysis of the evolution of the pitch-angle distributions and spectral properties during the crossings which have revealed, for the first time, important clues about the nature of ion acceleration via reconnection-driven mechanisms at the near-Sun HCS.

ISROESA10362	Dr. Partha Chowdhury	Poster

Evolution of Photospheric Magnetic Field and Electric Currents in the flare rich Active Region NOAA 12192 from 2 – 7 , September, 2017

The Sun is an active star. Its dynamics and interaction with planetary environments are governed by the solar magnetic activity. Active regions (ARs) are sites of strong magnetic fields on the solar surface; they spawn dynamic activity, sometimes resulting in severe space weather. AR12673 during its passage from 2 - 7 September, 2017 emitted a number of M and X class flares and unleashed some coronal mass ejections, which triggered geomagnetic storms. This work delves into the evolution of the magnetic field; Mean shear angle; Positive and negative magnetic flux; Mean current helicity and Electric current associated with some powerful M and X class flare that erupted from 2 – 7 ,September 2017, from the AR 12673. Finally, we have studied the change of photospheric Lorentz force during X13.3 flare on September, 6, 2017. We track these changes using high-resolution vector magnetograms from the Helioseismic and Magnetic Imager (HMI) on NASA's Solar Dynamic Observatory (SDO). We have discussed our results with standard models and their effects on space weather.

ISROESA10352	Karan Sahu	Poster

An unusually low solar wind density observed on Earth and Mars: Source region and its impact

In late December 2022, two distinct low solar wind density events were observed at different heliospheric locations.On 23 December, Solar Orbiter (SoLO), positioned near 1 AU, detected an unusually low solar wind density(orders of magnitude over a day.We investigate the cause of the DSW and low-density event observed by Wind and SoLO spacecraft respectively. In-situ measurements from the Wind spacecraft revealed that, prior to the event, solar wind density, magnetic field, and velocity increased, followed by a sharp decline in solar wind density (0.1-0.4 cm-3) on 25th December 2022.This suggests a high-speed solar wind stream preceded a trailing rarefaction region during which the unusually low density condition was observed both on Earth and Mars.In contrast, detailed analysis of the Solar Orbiter's low density event points to the passage of an interplanetary coronal mass ejection (ICME) exhibiting a magnetic cloud signature.Using potential field modeling of solar magnetic fields, we traced the source region of the DSW event to the vicinity of active region (AR 13169), adjacent to a coronal hole(CH) complex. Further, analysis of Atmospheric Imaging Assembly (AIA) data and Helioseismic and Magnetic Imager (HMI) from the Solar Dynamics Observatory (SDO) revealed dynamic changes in the source region, including a plasma jet eruption, the emergence of new magnetic structures, and a reduction in coronal hole area.Additionally, the DSW event was associated with significantly reduced solar wind dynamic pressure, leading to an expanded magnetopause and bow shock standoff distance at both Earth and Mars's magnetosphere.These results elucidate the distinct solar and interplanetary origins of the DSW event and its significant impact on the magnetosphere of Earth and Mars.

ISROESA10537	Akshay Kumar Remeshan	Poster

FDAT- Forbush decrease and CME analysis tool

Forbush decreases are short-term depressions in the galactic cosmic ray flux and can serve as signature for CMEs in interplanetary space. Cosmic ray flux is measured by various ground-based instruments at Earth and Mars, as well as various spacecraft throughout the heliosphere (most recently by Solar Orbiter). We present our recently developed Forbush decrease analysis tool (FDAT) to analyse in situ and galactic cosmic ray data from various spacecrafts and observatories. FDAT enables the user to analyse data from multiple sources conveniently in a single interface. The tool currently has capabilities to: quantify and analyse CME substructures (Shock/Sheath, magnetic obstacle/ejecta), fit expansion-modified force free flux rope model of Lundquist type to magnetic field and plasma data, and fit Forbush decrease model ForbMod (Dumbovic et al., 2018, 2020, 2024) to galactic cosmic ray data. The tool currently supports data from WIND, ACE, SOHO, Solar Orbiter, MAVEN, Ulysses, Helios 1/2, OMNI database, and ground-based measurements from neutron monitors at Earth (SoPo station) and Curiosity rover at Mars (MSL/RAD). Further, the tool provides prospects to add additional modules to use the existing data and pipeline to do additional analysis according to the user’s preference. This research was partly funded by the European Space Agency (projects ForbMod and ForbMod2) and partly by European Union (project SPEARHEAD, No 101135044). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Health and Digital Executive Agency (HaDEA). Neither the European Union nor the granting authority can be held responsible for them.

ISROESA10498	Sandeep Kumar	Poster

Multi-Spacecraft Investigation of the 3–4 March 2024 Interplanetary CME and Its Sheath-Driven Geomagnetic Storm

We report on the interplanetary coronal mass ejection (ICME) observed on 3-4 March 2024, which was associated with a major geomagnetic storm with Dst leading to −105 nT. The in situ observations by Wind spacecraft suggest that the geomagnetic storm main phase is mainly driven by the sheath which is uniquely characterized by an exceptionally dense and relatively steady interplanetary magnetic field within the sheath region. To better understand this event, we analyze and compare the in situ observations from different spacecraft, namely Aditya-L1, DSCOVR, STEREO-A, and Wind spacecraft. We also investigate the coherency, thermodynamics, and compression profile of the ICME across the in-situ observations obtained from multi-spacecraft. Interestingly, multiple coronal mass ejections (CMEs) were launched from the Sun around the estimated onset time of this ICME, suggesting the possibility of CME–CME interaction during its heliospheric propagation. Such an interaction could account for the unusually high temperature and distinct magnetic structure observed in the magnetic cloud region at L1. To establish the CME–ICME correspondence, we further investigate remote-sensing observations from the SOHO and STEREO-A spacecraft, aiming to identify the solar source region and determine the interaction dynamics that may have influenced the evolution of this ICME.

ISROESA10082	RENA ROSE A J	Poster

Statistical analysis of Soft X-ray flares during the raising phase of solar cycle 25 and comparative study with the previous solar cycle's raising phase.

In this work, we present a statistical analysis of soft X-ray (SXR) flares observed from December 2019 to January 2026, corresponding to the rising phase of the ongoing Solar Cycle 25. The analysis focuses on the north–south (N–S) and east–west (E–W) asymmetries of SXR flare occurrences. We also examine these asymmetries across different intensity classes (B, C, M, and X). Furthermore, the N–S and E–W asymmetries observed during the rising phase of Solar Cycle 25 are compared with those from the rising phases of previous solar cycles. This comparative analysis aims to provide insights that may assist in predicting the future progression of Solar Cycle 25.

ISROESA10403	Christopher J Owen	Poster

Recent Advances in our understanding of the solar wind supported by measurements from the Solar Orbiter Solar Wind Analyser (SWA) suite.

Measurements of the thermal and suprathermal particles in the solar wind are made by the Solar Wind Analyser SWA Suite on Solar Orbiter. SWA consists of 3 scientific sensors – the Electron Analyser System (EAS), the Proton-Alpha Sensor (PAS) and the Heavy Ion Sensor (HIS) – which are all served by a central suite data processing unit (DPU). Although the SWA/HIS unit has not been operational since April 2024, we have accumulated a large volume of data on the various solar wind particle populations over the last 5 years, covering a range of radial distances from~0.3 to 1 AU. In this presentation, we review some of the key results from the mission which are particularly supported by SWA, and detail some of the latest results. The latter include new insights into the degree in which the core and Strahl electron populations may preserve information on the temperature of their source regions, how electron populations are processed in and around interplanetary shocks, the radial evolution of ion and electron properties and the implications for solar wind dynamics. In addition, from February 2025, Solar Orbiter has been orbiting out of the ecliptic and thus able to access previously unsampled regions of space. We discuss some of these early observations, particularly with a view to identifying periods for possible joint study with Aditya-1 and Proba-3 measurements.

ISROESA10586	Kanchan Jangle	Poster

Measurements from Multiple In Situ Monitors near the L1 Point for the Interacting CMEs Driving the Great Geomagnetic Storm in May 2024

Coronal mass ejections (CMEs) are magnetised plasma structures expelled from the solar corona into the heliosphere and are the primary drivers of major geomagnetic storms. A great geomagnetic storm occurred on 10–11 May 2024 due to the arrival of six interacting CMEs launched between 8 and 9 May 2024. In this study, we use the 3D kinematics of these CMEs to identify their interaction stages at various heliocentric distances and confirm that they merged before reaching 1 AU. Our primary focus is to investigate the post-interaction characteristics of the merged ejecta using in situ measurements from multiple spacecraft near the Sun-Earth L1 point– Wind, ACE, Aditya-L1, and STEREO-A. We analyse how each spacecraft sampled different substructures within the complex ejecta and assess how these variations reflect intrinsic inhomogeneities that could have developed during or after the CME–CME interactions. This study demonstrates the importance of multi-point in situ observations in understanding the evolution of interacting CMEs and in improving the reliability of space weather prediction.

ISROESA10547	CHOUDHARY CHAMPABAI KISHNARAM	Poster

Mother's Day G5 Geomagnetic Storms of May 2024

The Earth’s geomagnetic field, generated by the geodynamo action of molten iron in the outer core, forms a protective magnetosphere that shields the planet from solar wind and cosmic radiation. However, during periods of intense solar activity—such as solar flares and coronal mass ejections (CMEs)—large amounts of charged plasma are ejected from the Sun, occasionally impacting Earth and producing geomagnetic storms. One of the most significant recent events was the Mother’s Day geomagnetic storm on 11 May 2024, triggered by multiple CMEs during Solar Cycle 25. This event caused severe global disturbances, with auroral displays visible at unusually low latitudes. In India, geomagnetic observatories at Hyderabad, Choutuppal, Jaipur, and Alibag recorded sharp declines in the total magnetic field intensity (300–500 nT) and strong fluctuations in the horizontal, vertical, and declination components. The disturbance peaked on 11 May, followed by gradual recovery by 13–14 May. The uniform timing across stations confirmed a nationwide geomagnetic response. This event highlights the dynamic coupling between solar and terrestrial magnetic systems and underscores the importance of continuous geomagnetic monitoring for understanding space weather impacts on Earth’s technological and geophysical environments.

ISROESA10540	Abhijit Banerjee	Poster

Deep Learning Prediction of Ionospheric Responses to Large X- and M-Class Solar Flares Using Geomagnetic and Solar Indices (June–October 2025)

This study analyzes the major X and strong M-class solar flares from May to October 15, 2025, focusing on their ionospheric impacts and predictive modelling of electron density parameters. For each flare event, we collate geomagnetic indices and Dst with interplanetary magnetic field components (Bz and, Bt) to quantify the geo-effective forcing. We compute correlations and time- lag regressions between these indices and observed TEC, Plasma frequency (f0F2) and peak electron density (NmF2) variations at multiple ground GNSS ionosonde sites. To forecast the time of variation of TEC, f0F2 and NmF2 during disturbed intervals, we design a Deep Learning architecture combining LSTM with Self-Attention, and a Transformer block to capture long- range dependencies and sudden disturbances. Input features include temporal sequences of Kp, Dst, Bz, Bt etc. and prior TEC, f0F2 and NmF2, solar flux (F10.7) w.r.t local time, latitude and longitude. The model is trained in a sliding- window fashion, with cross-validation across flare events. Results show that the hybrid LSTM-attention, Deep learning model achieves a significant timing accuracy in predicting onset, peak, and recovery phases of TEC and f0F2 perturbations. We also analyze feature attention weights, revealing critical observations on those lead-lag features on among indices and TEC disturbances, while geomagnetic indices shows a sustentation in the recovery phase. The predictions of NmF2 show dependent trends on f0F2 but with modified amplitude. This integrated approach demonstrates that combining geomagnetic forcing indices, magnetic field parameters and modern deep sequence models can yield accurate short- term forecasts of ionospheric responses to powerful solar flares highly beneficial for mitigating GNSS and HF communication disruption.

ISROESA10561	Ajay Kumar	Poster

Investigation of Small-Scale Magnetic Flux Ropes and Their Energetic Particle Signatures in the Heliosphere Using Multi-Mission Observations

Small-scale magnetic flux ropes (SMFRs) represent fundamental magnetic structures in the solar wind, contributing to turbulence, magnetic reconnection, and energetic particle transport across heliospheric scales. Despite extensive studies of large-scale flux ropes and ICMEs, the spatial evolution and energetic particle associations of SMFRs remain poorly understood, particularly across varying heliocentric distances.

In this study, we utilize multi-spacecraft observations from ACE, Wind, Solar Orbiter, and STEREO-A, complemented by Aditya-L1 in-situ measurements, to investigate the existence, evolution, and spatial distribution of SMFRs under different solar wind conditions. We employ a newly developed automated SMFR identification tool based on spectrograms of normalized turbulence and Alfvénic parameters, enabling the detection of flux rope–like signatures embedded within turbulent solar wind intervals. We further analyze the energy index distribution of solar wind particles during both quiet periods (2007–2008) and enhanced activity intervals, including Stream Interaction Regions (SIRs) and Corotating Interaction Regions (CIRs), to explore their association with SMFRs at stream interfaces. The study aims to extend these diagnostics across multiple heliocentric distances, near the Sun (PSP), mid-heliosphere (Solar Orbiter), and 1 AU (Aditya-L1, ACE), to understand how SMFRs evolve and influence particle dynamics during their outward propagation.

ISROESA10303	NADIYA K	Poster

Multilane type II radio bursts: Insights into shock propagation in the corona

Solar radio bursts can provide important insights into the underlying physical mechanisms that drive the small and large-scale eruptions on the Sun. Since metric radio observations can give us direct observational access to the inner and middle corona, they are often used as an important tool to monitor and understand the coronal dynamics. Type II metric radio bursts are signatures of shock in the corona and are considered as valuable proxies for other wavelength observations in the height range ~ 1.3-2.5 Ro, where Ro is the radius of the photosphere. We studied a multilane type II radio burst,with clear signatures of fundamental and harmonic lanes, with both lanes exhibiting spilt- bands. Preliminary analysis with radio images shows that there were multiple particle acceleration sites as relieved with Nancay radioheliograph (NRH) data. Our analysis suggests that the sources of these multilane type II radio busts were at the flank of the CME/EUV disturbance. Frequency–height discrepancies were also observed, with 228 MHz lanes sometimes appearing higher than 150 MHz and other times lower as expected. This indicates that shock geometry and plasma inhomogeneity strongly affect lane positions, suggesting that traditional FH–SB pairs may in fact consist of multiple shock-related bands.

ISROESA10037	Ketaki Deshpande	Poster
First imaging evidence of fundamental-harmonic type III radio bursts pair in interplanetary space.		
Type III radio bursts are the most commonly observed solar radio bursts and they have been studied for many decades. However, even after a lot of research, their origin and propagation through space are still not fully understood. Earliest studies used ground-based instruments, which can only observe radio waves in the metric range. In contrast, interplanetary (IP) type III radio bursts can only be observed using space-based instruments and are therefore not studied as extensively as their coronal counterparts. A persistent challenge in the solar radio bursts analysis is distinguishing whether the detected emission corresponds to the fundamental or harmonic component. In this study, we employ direction-finding observations from the STEREO and Wind spacecraft, combined with a radio triangulation technique, to derive three-dimensional (3D) source locations of IP type III bursts in the inner heliosphere. All studied bursts were simultaneously observed by the Parker Solar Probe during its second perihelion passage, providing high-resolution dynamic spectra.The first results reveal direct evidence for the simultaneous occurrence of fundamental–harmonic pairs in the interplanetary regime, offering new insights into their emission processes and propagation characteristics.		

ISROESA10520	Dr Prithvi Raj Singh	Poster
Variations of the Interplanetary magnetic field and Solar wind Plasma during Solar Cycles 22–24		
We have studied the relationship between the monthly variations of interplanetary magnetic field (IMF), solar wind plasma velocity, and geomagnetic activity index (Ap) during solar cycles 22–24 (1986–2020). The modulation parameter (ξ =V*B) is the product of strength of the interplanetary magnetic field (B) and solar wind plasma velocity (V). We		

have investigated the periodicities and their evolution using the RobPer periodogram and Continuous Wavelet Transformation methods. The significant periods present in the interplanetary magnetic field (B), geomagnetic activity index (Ap), solar wind plasma velocity (V), and modulation parameter include the Rieger type, semi-annual period, annual period, and quasi-biennial period. In this study, we have found that the rotation rate at the base of the convection zone is ~1.30 years. The modulation parameter appears to be a better representative of the geomagnetic changes than the other two.

D. Instruments, Techniques, Data Analytics and Operational Forecasting

ISROESA10318	K M Hiremath	Poster
The latitudinal variation of sun's radius		
Kodaikanal solar observatory white light image data is used to explore the possible variation of sun's radius with respect to latitude. For the year 1904, very good calibrated digitized and limb darkening removed image is used. After unambiguously detected solar edge, circle is fitted, mean radius and central coordinates are estimated. By knowing these important parameters, heliographic coordinates are fixed for the pixels of the detected edge and, radii at different position angles are computed. Preliminary results show that, for different position angles, from 0-360 degrees, there is indeed a variation of radius with respect to latitude with a mean variation of ~ 0.2 arc secs suggesting either possible asymmetric mass distribution in the solar interior or external perturbations due to unknown mass.		

ISROESA10079	Utkarsh Saxena	Poster
Automated Halo CME Event Identification from Coronagraph Data Using Deep Learning Approaches		
Coronal Mass Ejections (CMEs) are among the most energetic solar phenomena, releasing vast amounts of plasma and magnetic fields into interplanetary space. Halo CMEs, in particular, are of high geoeffective potential and play a crucial role in driving space weather disturbances at Earth. Timely and accurate identification of Halo CMEs is therefore critical for space weather forecasting and for enhancing the scientific return of missions such as Aditya-L1, Solar Orbiter, and Proba-3. Traditional CME catalogs rely on manual inspection of coronagraph images, which is time-consuming, subjective, and not scalable given the large volume of solar observational data. Recent advances in computer vision and machine learning (ML) offer promising alternatives for automating CME detection and classification. In this work, we explore the application of ML-based image analysis methods to identify Halo CMEs in coronagraph data. Our approach integrates preprocessing steps such as background subtraction and noise filtering with supervised learning models trained on labeled CME event datasets. Convolutional Neural Networks (CNNs) and region-based object detection algorithms are evaluated for their performance in distinguishing Halo CME signatures from other transient solar structures. Preliminary results indicate that ML methods can achieve competitive accuracy with reduced false positives compared to conventional thresholding techniques. More		

importantly, such approaches enable near real-time CME detection, which is vital for early-warning systems in space weather monitoring. With the upcoming coronagraph observations from Aditya-L1's VELC instrument and Solar Orbiter's Metis payload, automated CME identification pipelines can significantly improve data utilization and scientific insights. This study highlights the potential of ML techniques to complement mission data analysis efforts and to contribute toward building robust space weather forecasting frameworks.

ISROESA10065	Keshav Aggarwal	Poster

A generalised method for estimating solar wind speeds and densities using spectral broadening

We present a unified method to derive both solar wind velocities and coronal electron densities in the near-Sun corona using Doppler spectral broadening of spacecraft radio signals. The method is generalized to be frequency independent under the assumption that electron density fluctuations follow a Kolmogorov spectrum. We validate the approach using S-band data from India's Mars Orbiter Mission during the October 2021 superior conjunction at 5-8\,R$_\odot$, and X-band data from Japan's Akatsuki during June 2016 and October 2022 conjunctions spanning 1.4-10\,R$_\odot$. From S-band we obtained wind speeds of 100-150\,km\,s^{-1} and electron densities of order 10^{10}\,m^{-3}. X-band results show speeds ranging from $\sim$150\,km\,s^{-1} near the equator to $\sim$400\,km\,s^{-1} in coronal-hole regions, with consistent radial trends in density. We provide a compact, frequency-scaled relation that maps Doppler spectral width to both $v_{\perp}$ and N_e. The formulation enables consistent application across telecommunication bands and complements in-situ probes for coronal plasma studies.

ISROESA10396	Akash Vinod Shirke	Poster

Analysis of solar flare and sunspots on 4th Jan 2025 and its effect on space weather

Solar flares and coronal mass ejections (CMEs) are among the most energetic phenomena in the solar system, often impacting space weather and terrestrial technology systems. In this study we utilize SunPy, an open-source Python library for solar physics, to analyze solar active regions and their correlation with flare and CME events held on 4th January 2025. By processing observational data from space-based solar observatories, we extract key features such as magnetic field structures, flare intensities, and CME kinematics. Our result confirm that the observed solar flare is an X1.8 flare, which is classified as an X-class flare, the strongest type of solar flare. Our methodology employs SunPy's data retrieval and visualization tools to efficiently process multi-wavelength observations and track active region evolution and its role in triggering large-scale eruptions. We present a case study focusing on solar active region evolution and its role in triggering large-scalar eruptions. The analysis includes time-series data from the Solar Dynamics Observatory (SDO - NASA), Solar and Heliospheric Observatory (SOHO – NASA & ESA), GOES and Solar orbiter, highlighting the significance of SunPy in handling diverse datasets. Our findings provide insights into the precursors of solar eruptions and enhance predictive capabilities for space weather forecasting.

ISROESA10028	shifana koya	Poster

Assessment of near-Sun CME axial magnetic field via helicity budget and its application in CME propagation models: A case study of the 10 March 2022 CME observed by Solar Orbiter

Magnetic helicity plays a key role in understanding the magnetic properties of Coronal Mass Ejections (CMEs) during their early evolution. A dominant helicity accumulation in solar active regions (ARs) is widely recognised as a driver of CME eruptions. This study explores the application of the helicity budget of CMEs to constrain input parameters in inner heliospheric CME propagation models. We introduce a method to estimate the magnetic flux of the spheromak CME model in the European Heliospheric Forecasting Information Asset (EUHFORIA) by utilising the CME's helicity content. As a proof of concept, we examine the CME from NOAA AR 12962 on 10 March 2022, observed in situ by Solar Orbiter (SolO) and WIND, alongside remote sensing data. A helicity difference was estimated between the pre- and post-eruptive phases of the AR, attributed to the CME. The eruption-related helicity budget is related to the spheromak model's axial field, $B_{spheromak}$, using the Graduated Cylindrical Shell (GCS) forward-modelling technique. The toroidal magnetic flux is derived from $B_{spheromak}$ and the CME's geometry. EUHFORIA simulations constrained by helicity were compared with SolO measurements at 0.43 AU and WIND at 0.99 AU. The helicity-based method successfully reproduces in situ magnetic field profiles, with SolO data along the Sun–Earth line proving critical for refining input parameters and improving predictive accuracy at L1. Compared with the conventional post-eruption arcade (PEA) method, the peak magnetic field at 0.99 AU is underestimated by 13% using PEA, versus 19% with the helicity-based approach. These results demonstrate that the CME helicity budget can provide a robust, quantitative constraint on CME magnetic flux. A broader statistical study, encompassing multiple CME models and events observed by various spacecraft, is necessary to fully assess the method's reliability, efficiency, and applicability in comparison to conventional approaches.

ISROESA10060	Anjali Agarwal	Poster

Coherency and Expansion Dynamics of Magnetic Clouds

The duration of coronal mass ejections (CMEs) on Earth can depend on their instantaneous expansion speed, which is often difficult to estimate from the conventional method applied to single-point in situ observations. To overcome this limitation of the conventional method, we propose a Constant Acceleration Accounted Perspective (CAAP) method and validate it using the observations of the 2021 November 3–5 CME. The selected CME, classified as a magnetic cloud (MC), is in situ observed to offer simultaneous speed measurements of its centre by Solar Orbiter and trailing edge (TE) by Wind. These unique observations allow direct measurement of its instantaneous expansion speed, which matches the estimates from the CAAP method, confirming the method's reliability. Interestingly, the MC observations at two spacecraft show an unexpected increase in magnetic flux with distance, likely influenced by the ambient medium or possibly the presence of inherent MC inhomogeneities. This suggests that understanding the inhomogeneity of MCs across different scales is crucial. Such inhomogeneity in a CME across its larger angular span is established in the literature; however, there are limited efforts in examining the possible inhomogeneity at mesoscales. The unique observations of a CME at mesoscale were possible during 2023 September 24-26, when the CME was observed in situ by STEREO-A and Wind near 1 AU. We identify the compressed region of the MC using our novel method, and find that the MC is compressed at its TE while the compression is more pronounced at STEREO-A. Our study doubts whether an MC can truly be regarded as coherent across its angular span and even at mesoscales. These findings on coherence, compression and expansion dynamics of CMEs have the potential to improve space weather forecasting.

ISROESA10471	Saurabh Tripathi	Poster

An Investigation into the Solar Origins of Geo-Effective Coronal Mass Ejections during 1997–2024

Coronal mass ejections (CMEs) are large-scale eruptions from the solar atmosphere that can trigger intense geomagnetic storms (GMS), causing severe disruptions to space- and ground-based technologies. Therefore, understanding their origin, propagation, and evolution through the interplanetary medium is essential for early forecasting. In this study, we present a statistical analysis of geoeffective CMEs from 1997 to 2024. We investigate their solar sources, heliospheric propagation, and subsequent evolution into Interplanetary CMEs(ICMEs), detected at L1 via in-situ signatures. Using multi-instrument observations and established catalogs, we examine source-region properties and explore the relationship of storm intensity with flare class, CME speed, and longitudinal dependency. Although the background solar wind strongly influences the CME transit time from the Sun to L1, we find that CME and ICME speeds remain tightly correlated. Our detailed investigation shows that transit time follows a hyperbolic dependence on velocity, contrary to the earlier suggested linear relations, yielding more accurate arrival-time estimates. Our result further reveals a clear longitudinal asymmetry, with geoeffective CMEs more likely to originate from the western hemisphere. Storm intensity depends moderately on flare class and speed, with faster CMEs producing stronger GMS. Interestingly, the declining phase of Solar Cycles 23 and 24 produces more intense storms than their rising phase, primarily associated with fast CMEs and possibly linked to large-scale magnetic restructuring during the Sun's polarity reversal. These results, offering new insights into the link between solar activity and space weather, contribute to developing improved predictive models for intense geomagnetic storms.

ISROESA10473	Vohera Mahi Pareshkumar	Poster

Intelligent Prediction of Solar Flares through Short-Term Signal Variability

Solar flares represent sudden, high-energy eruptions on the Sun that can disrupt Earth's technological systems and communication networks. This research proposes an intelligent framework for forecasting such events by analyzing short-term solar signal variability. Using one-hour space weather data, the study extracts fluctuations in signal strength and interprets them as indicators of magnetic instability within active solar regions. The analytical process emphasizes temporal evolution and dynamic irregularities that precede flare onset. Methodologically, one-hour solar signal data were collected and cleaned for reliability, signal variability was quantified using the Scintillation Index (S4) and mapped over time, and patterns in S4 were analyzed to indicate solar activity and prepare data for AI-based flare prediction. Findings reveal that heightened signal variance consistently aligns with periods of increased solar turbulence, suggesting strong predictive potential. This work advances the development of AI-assisted, short-term solar flare prediction models that merge statistical precision with heliophysical insight, offering a forward-looking approach to real-time space weather preparedness.

ISROESA10385	Santanu Maity	Poster

A spatio-temporal hybrid deep learning model for forecasting multiple solar wind parameters at L1 point

The solar wind, a continuous stream of charged particles originating from the Sun and propagating through interplanetary space, can cause damages to space satellites and astronauts. Early prediction of its arrival can help us to protect space base as well as ground base technologies. It has been studied that categorization of solar wind streams by multiple physical parameters can provide deeper insights into their evolution through interplanetary. So, three specific parameters of solar wind have been chosen to predict their arrival based on their assigned weightage. In this work, a model to predict key solar wind parameters- namely solar wind speed (V), density (n) and temperature (T) at Lagrange-1 (L1) point of Sun-Earth System, based on convolutional neural network (CNN) coupled with long-short-term-memory (LSTM) units is designed to capture spatio-temporal variability of Sun's coronal surface. The input of this model consists of SDO/AIA coronal images at 193 A° which are [T-3] day, [T-4] day, and [T-5] day before to the target arrival. This will capture both high speed as well as low speed stream which usually require 3-5 days to reach at L1 point. These images are temporally aligned with in-situ solar wind measurements obtained from the OMNI database.

The proposed multiple parameters forecasting CNN-LSTM model has been trained using data from 2011 to 2016 with input features of AIA images and with target variables V, n, T from OMNI data at L1 point and tested with 2018 data. Preliminary results show that the proposed model achieves significantly improved predictions of both high-speed and low-speed streams in terms of mean absolute error compared to other existing approaches. These findings contribute to the timely monitoring and forecasting space weather activities, crucial for various sectors.

ISROESA10508	Purva Linaben Vaghela	Poster

Integration of Computer Engineering Concepts in Space and Space Weather Studies

Space and space weather studies are becoming increasingly significant as our dependence on satellite-based communication, navigation, and surveillance technologies continues to grow. Space weather encompasses dynamic solar phenomena such as solar flares, coronal mass ejections (CMEs), and solar winds that interact with Earth's magnetosphere and atmosphere, leading to geomagnetic storms and potential disruptions in technology-dependent systems. Understanding and predicting these effects demand advanced computational modeling, real-time data processing, and intelligent forecasting systems—core areas within computer engineering.

Computer engineering concepts such as machine learning, artificial intelligence (AI), data analytics, and simulation modeling play a pivotal role in monitoring and predicting space weather patterns. AI-based predictive models can analyze vast amounts of solar observation data, identify hidden correlations, and forecast solar disturbances with higher accuracy. Neural networks and deep learning algorithms are increasingly being used to interpret images from space observatories, detect early signs of solar flares, and classify magnetic field anomalies. High-performance computing (HPC) enables the real-time

processing of massive datasets from missions such as NASA's Parker Solar Probe, ESA's Solar Orbiter, and ISRO's Aditya-L1.
Furthermore, AI-driven automation in embedded systems supports intelligent decision-making for spacecraft operations, optimizing communication protocols and onboard data management. Integration of IoT and AI frameworks facilitates efficient coordination between space instruments and ground stations.
This paper explores the interdisciplinary integration of space science with computer engineering, emphasizing how computational intelligence, automation, and digital technologies contribute to solar observation, geomagnetic storm modeling, and the protection of critical infrastructure. The study highlights the growing importance of AI in shaping the future of heliophysics research, promoting innovation, collaboration, and technological resilience in an increasingly space-reliant world.

ISROESA10052	brenda dorsch	Poster

ESTIMATION OF THE TWIST IN THE SOLAR MAGNETIC FLUX ROPE USING EUV DATA

Magnetic flux ropes are ubiquitous features observed in the low corona and propagating through the solar atmosphere. They are formed by combined action of the magnetic field of the Sun and its internal processes, observed remotely and in situ. Flux ropes are one of the main components of Coronal Mass Ejections, drivers of major geomagnetic storms, and they are therefore of high importance in space weather. One of the intrinsic properties of the magnetic flux rope structure is a twist which quantifies the rotation of the magnetic field lines around its axis. Twist is also one of the key input parameters for some of the most advanced heliospheric MHD models simulating propagation of CMEs. Despite its importance, since its estimation is not a simple task, in most studies by default, only an average value of this parameter is used.
The twist parameter has a significant impact on the CME modelling results, in particular on the CME speed and the intensity of its internal magnetic field. It is therefore important to understand what the optimal method for the estimation of twist is, and what are the impacts of its variations in the context of space weather forecasting.
In this work, we validate a straightforward method for deriving the twist parameter based on observations, for its use in the forecasting workflow. We consider the relationship between the twist and the ratio of axial length to minor radius of the flux rope and adapt it to be implemented based on a selected EUV (Extreme Ultraviolet) image. We apply the adapted method to 43 flux rope events observed simultaneously in the EUV data by one or more spacecraft. Each analysed event is associated with a CME, for which we estimated the kinematics employing a 3D reconstruction method based on the extended geometry considered for the FRi3D (Flux-Rope in 3D) CME model. We study the influence of the projection effect on the estimation of the parameters of solar magnetic flux ropes and found its consistent impact on the estimation of the twist simultaneously observed by different spacecraft. The de-projected twist obtained for the selected events is found to be between 1.8 and 3.3 turns. We also inspected a relationship between the twist and the associated CME speed and flare energy. It was found that the twist value follows a polynomic trend with respect to the CME speed, regardless the flare energy, for C-class and M-class events. However, for events associated with more energetic flares, such trend becomes more diffuse.

ISROESA10442	Dr. Priyank Srivastava	Poster

Solar Cycle 25: High Energy, Moderate Flux, and the Enduring Challenge of Solar Prediction

Solar Cycle 25 (SC25), which commenced in December 2019, exhibited an unexpectedly rapid and vigorous rise, reaching its confirmed peak amplitude of 160.9 smoothed International Sunspot Number (SSN) in October 2024 far exceeding the 115 ± 10 SSN forecast by the 2019 prediction panel. While the cycle's timing was reasonably captured by kinematic precursors based on sunspot latitude migration (Schatten, 2002; Kane, 2008), its amplitude revealed a significant forecasting shortfall. SC25 demonstrated a non-linear relationship between photospheric activity (SSN) and eruptive outputs (X-ray flares and CMEs), generating an eruptive energy comparable to the much stronger Solar Cycle 23. The cycle produced four Ground Level Enhancements (GLEs), several major radiation storms, and the G5 geomagnetic storm of May 2024, which reached a Dst index of −406 nT, ranking as the seventh most intense since 1957. The divergence between predicted and observed solar activity underscores the limitations of traditional precursor models and highlights the superior performance of dynamical and machine learning based models. The findings call for a re-evaluation of predictive methodologies as SC25 transitions into its declining phase, emphasizing the need for integrated, data-driven approaches to improve future space weather forecasting.

ISROESA10504	SUGANYA SUNDARAMOORTHI	Poster

ESTIMATING THE CORONAL MAGNETIC FIELD STRENTH VIA CME-DRIVEN SHOCKS: A COMPREHENSIVE EVALUATION OF STAND-OFF DISTANCE (SOD) METHOD

We proposed the Stand-Off Distance (SOD) Method to estimate the coronal magnetic field strength via CME-Driven Shocks. In this study, we have analyzed the propagation characteristics of two limb Coronal Mass Ejections (CMEs) with their shocks for the period of 2017. Out of several CME events, we have identified two events which are associated with the TYPE-II Solar Radio Bursts. These two CME events which show a clear shock structure in the LASCO Field Of View (FOV). In this study, these CMEs were observed in 17 frames up to 17 Solar Radii using SOHO/LASCO white light running difference images. Gopalswamy and Yashiro introduced the Stand-Off Distance (SOD) Method to estimate the magnetic field in the Corona using CME-Driven Shocks. We have used this technique to determine the magnetic field strength and to study the propagation/shock formation condition of these CMEs at 17 different locations. Since the thickness of shock sheath (Stand-Off Distance) is not constant around CME, we estimate the shock parameters and their variation in large and small SOD regions of the shock. Our results indicate that the SOD Method can provide a reliable and consistent estimate of the Coronal Magnetic Field and has potential for use in future space weather forecasting models. Estimating the coronal magnetic field strength provides valuable insights into various space weather phenomena and enables accurate forecasting. This knowledge is crucial for safeguarding space assets, predicting geomagnetic storms, understanding auroral activity and enhancing communication and navigation systems. Additionally, this method provides important insight into the internal structure and dynamics of CMEs which might be aid in the development of improved CME prediction models.

ISROESA10452	manjunath hegde	Poster

Machine Learning Framework for Predicting CME Speeds at 20 R Using CDAW Data

Coronal Mass Ejections (CMEs) are major drivers of space weather, and accurately predicting their propagation speed is crucial for mitigating their impact on Earth's environment. In this study, we apply machine learning (ML) techniques to model and predict CME speeds at 20 R⊙ using data from the Coordinated Data Analysis Workshop (CDAW) catalog. We analyzed events from Solar Cycles 23 and 24, spanning different activity phases, to train multivariate linear regression, Random Forest, and XGBoost models. The models use CME linear speed, acceleration, width, and kinetic energy as input features. Results show that the Random Forest and XGBoost models outperform linear regression, achieving high predictive accuracy ($R^2 \approx 0.97$) and low relative errors (≈6%), particularly during high solar activity. Feature importance analysis identifies CME linear speed and acceleration as the dominant predictors, consistent with physical drag-based propagation models.
While the present analysis is based on CME parameters provided in the CDAW catalog, the developed ML-based predictive framework can be readily extended to utilize derived CME properties from missions such as Aditya-L1, Solar Orbiter, and Proba-3 once corresponding event catalogs become available.

ISROESA10267	Srinjana Routh	Poster

SUITron: A Detectron 2 based Model for real-time extraction of solar features for Aditya-L1 Support Cell

SUITron is a deep learning framework for real-time detection and segmentation of solar features in support of the Solar Ultraviolet Imaging Telescope (SUIT) aboard the Aditya-L1. Leveraging the robust architecture of Detectron2, an open-source object detection platform developed by Facebook AI Research, SUITron combines high-quality implementations of Mask R-CNN and related models to deliver state-of-the-art performance on solar data. The workflow includes calibration with histogram-equalized SUIT data and enhancement using Richardson-Lucy deconvolution, which optimizes feature clarity by iteratively correcting optical distortions and noise. This pipeline enables rapid identification of critical structures such as solar filaments active region, plages, to give realtime parameters of these structures which support scientific analysis and space weather forecasting. The resulting system offers a scalable toolset for the Aditya-L1 Support Cell, where it is to be integrated in the near future and is expected to facilitate continuous, high-resolution monitoring of solar activity crucial to heliophysics and space mission operations.

ISROESA10090	Swarna Girish Bennur	Poster

Finding Early Warning Signs of Solar Eruptions Using Aditya-L1 Observations

Solar eruptions—flares and coronal mass ejections (CMEs)—often arise abruptly, leaving limited time to mitigate their space-weather impacts on satellites, power systems, and communication networks. However, subtle variations in solar X-ray flux and magnetic-field activity can emerge hours before such eruptions. In this study, we investigate whether early patterns in Aditya-L1's soft and hard X-ray and magnetic-field observations can serve as reliable indicators of impending solar activity.

We combine publicly available data from the SoLEXS (Soft X-ray Spectrometer), HEL1OS (High-energy L1 Orbiting X-ray Spectrometer), and MAG (Fluxgate Magnetometer) instruments. These multi-instrument time series are temporally aligned with documented flare and CME events from international catalogs. Each segment is labeled as either quiet or pre-eruptive to enable pattern identification through interpretable machine-learning and statistical analysis.

Rather than employing complex black-box models, this work focuses on understanding which combinations of observable parameters—such as X-ray intensity variations, spectral ratios, and magnetic fluctuations—consistently appear before eruptions. The predictability and physical significance of these features are then evaluated in relation to solar active-region dynamics.

By emphasizing transparency and interpretability, this approach bridges data-driven modeling with physical understanding. The study demonstrates how open Aditya-L1 datasets can be leveraged with simple, explainable AI methods to revisit a classic heliophysics challenge from a fresh perspective. Even modest progress in identifying early warning trends could enhance near-term space-weather forecasting and provide valuable insights for both research and operational monitoring.

ISROESA10194	Apoorva Srinivasa	Poster

Long-Term Correlation Studies of the Ca-K and H-alpha Spectroheliograms from the Kodaikanal Archival Data

We present an enhanced analysis of the Sun's chromospheric evolution spanning nearly a century (1907-2004) using Ca-K and H-alpha spectroheliograms from the Kodaikanal Solar Observatory archives, extending our previous two-cycle study to cover 7-8 solar cycles. Our methodology has undergone substantial improvements: for Ca-K spectroheliograms, we replaced median filtering with the background estimation technique from Chatzistergos et al., which efficiently corrects for small-scale noise and limb darkening, while feature segmentation has been enhanced by incorporating region-growing algorithms alongside intensity thresholding and applying parts of the "equal-contrast technique" for optimal feature enhancement. These advances have been successfully adapted for H-alpha spectroheliograms to extract filament features with comparable accuracy. The enhanced pipeline extracts latitude-resolved and hemisphere-resolved fractional areas for plages, network regions, and filaments, allowing investigation of spatial asymmetries in chromospheric activity across solar cycles. We also extract quiet Sun intensities by systematically removing active regions, providing a clean measure of background chromospheric emission independent of localised magnetic disturbances. We quantify the temporal evolution of these chromospheric features through their fractional area coverage and investigate correlations with sunspot numbers and geomagnetic indices. This multi-parameter approach allows us to probe the connections between photospheric magnetic activity, chromospheric manifestations, and their terrestrial impacts, directly relevant to space weather forecasting and heliophysics. This work aims to bridge historical observations with modern space-based missions like Aditya-L1 and Solar Orbiter, contributing to understanding solar magnetic variability across atmospheric layers and its propagation through the heliosphere.

ISROESA10533	Aishmeen Kaur	Poster

Using Optical Flow method to study veloctiy profiles of CMEs

This project investigates the use of optical flow techniques for detecting and tracking solar transients, particularly Coronal Mass Ejections (CMEs). Optical flow, a well-established method in computer vision, estimates object motion across consecutive image frames. In this study, it is applied to time-series images of the solar corona to capture and analyze evolving dynamic structures.
The motivation behind this work lies in the growing demand for automated and accurate detection of solar eruptive events. Since CMEs are major drivers of space weather disturbances, their timely identification is essential for reliable forecasting. Manual detection methods are often slow and susceptible to human bias, highlighting the need for algorithmic approaches capable of efficiently processing large solar datasets. Solar images from instruments such as LASCO (onboard SOHO) were preprocessed to enhance coronal features. Subsequently, Farnebäck's optical flow algorithm was used to compute velocity fields that represent the apparent motion of plasma structures in the corona, helping to identify transient activity.
The final phase of the project focused on visualizing these flow maps and assessing their effectiveness in CME detection. The results for this small sample were compared with traditional threshold-based methods. Ongoing work aims to further develop the algorithm for real-time CME detection and personalized CME simulation.

ISROESA10626	Ahaan Nalavadi	Poster

On Modelling the Far-Side Evolution of NOAA Active Regions

Understanding the evolution of active regions on the far side of the Sun is critical for improving space weather forecasting and modeling the Sun's global magnetic field. However, direct measurements of the far-side magnetic field are unavailable due to the limitations of current solar instrumentation. In our study, we demonstrate the reliability of 304 Å (He II) emission as a proxy for unsigned magnetic flux measurements in NOAA Active Region (AR) 12192. We provide a framework for bridging the observational gap for regions beyond direct magnetographic observation by using this proxy to predict the far-side flux evolution of AR 12192. We design an SDO data pipeline that (i) co-aligns corresponding AIA and HMI observations, (ii) identifies plage regions, and (iii) computes unsigned magnetic flux and 304 Å intensity, for 2200 AIA-HMI data pairs at 720s cadence. The resulting flux-intensity correlation is applied to far-side STEREO 304 Å data to predict magnetic flux. This methodology presents a novel approach to modelling the near-term evolution of longer-lived active regions that survive multiple reappearances on the visible solar disk.

ISROESA10340	Mr RAMDAS	Poster

Comparative Study of Cosmic Ray Modulation Before and After the Heliospheric Magnetic Field Polarity Reversal: Implications for Solar Cycle 25

The modulation of Galactic Cosmic Rays (GCRs) within the heliosphere is strongly influenced by variations in solar activity and the large-scale structure of the Heliospheric Magnetic Field (HMF). During each solar cycle, the reversal of HMF polarity significantly alters cosmic ray transport mechanisms, including diffusion, drift, and convection. This

study presents a comprehensive comparative analysis of cosmic ray modulation before and after the HMF polarity reversal, spanning the period 2008–2025, which includes the transition from Solar Cycle 24 to 25.
Data from multiple space missions and ground-based observations—such as the Neutron Monitor Database (NMDB), ACE, SOHO, and Parker Solar Probe—were analyzed to examine correlations between solar wind velocity, interplanetary magnetic field (IMF) strength, and Galactic Cosmic Ray intensity at 1 AU. The results indicate notable hemispheric asymmetries in GCR fluxes and variations in modulation amplitude following the polarity reversal. The early phase of Solar Cycle 25 shows weakened modulation, likely due to reduced solar magnetic turbulence and a relatively quiescent heliospheric environment.
This study enhances the understanding of how solar magnetic field evolution governs cosmic ray behavior and its implications for near-Earth radiation exposure. The findings contribute to improved predictive models for cosmic ray flux variations during Solar Cycle 25, supporting the development of advanced space weather forecasting and astronaut radiation protection strategies.

ISROESA10570	Deepesh Ahlawat	Poster

A Novel Plasma-Based Early Warning System for Halo CME Detection Using Aditya-L1 Data

As India enters the peak of Solar Cycle 25 and prepares for the landmark Gaganyaan human-spaceflight mission, the need for a robust early-warning system against geoeffective Halo Coronal Mass Ejections (CMEs) has become critical. Existing operational frameworks rely predominantly on magnetic-field measurements, creating a vulnerable single point of failure: if magnetometer data is unavailable, corrupted, or delayed, the nation's spacecraft, power infrastructure, and astronauts remain exposed. To address this gap, we present a novel AI-driven CME detection system that operates solely on plasma particle data from the Aditya-L1 SWIS-ASPEX payload. This approach establishes the plasma-only, physics-aware early-warning channel that is completely independent of magnetic-field sensors, ensuring resilience during high-risk space-weather conditions.
Our custom neural network goes beyond simple thresholds by learning the time-evolving physical dynamics of the solar wind. By processing dozens of research-validated, physics-based features over a 60-minute window, the model identifies the characteristic turbulence signatures, plasma compressions, sheath-region development, and early "tremor-like" indicators that precede CME arrival. Crucially, the system is designed for full interpretability, enabling scientists to identify precisely which plasma parameters contributed to each alert, an essential requirement for reliability in human-safety-critical missions.
The model achieves 92% accuracy (can be improved even further) when distinguishing CME from non-CME events in a balanced test and maintains a false-alarm rate of only 5.45%, outperforming threshold-based and traditional approaches. Operationally, this provides a 60–90 minute advance warning from the L1 point, sufficient time to protect astronauts, secure communication satellites, mitigate power-grid vulnerabilities, and prevent mission disruptions.
This indigenous capability offers India a strategic technological edge in space-weather forecasting, ensuring mission safety for Gaganyaan, strengthening national infrastructure

resilience, and establishing ISRO as a global leader in AI-enabled heliophysics for the coming decade.

ISROESA10689	Aswin Amirtha Raj S	Poster
SHARP Magnetic Proxies for CME Velocity Prediction in Type II Burst CMEs		
Type II burst associated CMEs are key drivers of shocks, SEP production, and major space weather impacts. Predicting their initial velocity is essential for improving operational response and early hazard mitigation. In this study, the magnetic properties of CME source regions are examined using the full set of SHARP parameters to identify which magnetic proxies best represent the initial speeds of Type II burst CMEs during Solar Cycles 24 & 25. Events are grouped into two categories: fast CMEs with speeds greater than 900 km/s, and slow to intermediate CMEs with speeds below this threshold. Fast CMEs show clear positive correlations with several magnetic measures, indicating that enhanced shear, stronger current systems, and larger amounts of free magnetic energy support rapid early acceleration. In contrast, slow and intermediate CMEs display weaker correlations, suggesting a more complicated relationship between magnetic structure and ambient solar wind conditions. Among all the SHARP parameters evaluated, TOTPOT, TOTUSJH, ABSNJZH, USFLUX, and SAVNCPP provide the strongest and most consistent correlations with CME initial velocity. These findings identify a reliable set of magnetic proxies that can strengthen CME speed prediction frameworks and improve forecasting capabilities for SEP events and other space weather impacts.		

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