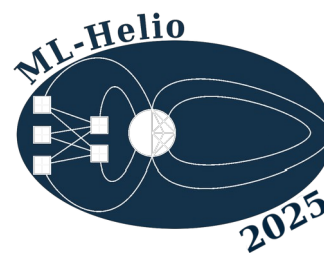


3rd Machine Learning in Heliophysics Madrid, 22-26 September 2025



Monday 22nd September

9:30 – 10:00 Welcome & Introductory Remarks

Session 1 – Chairs: TBD

10:00 – 10:30 *Sabrina Guastavino* Learning the Sun: Machine Learning and Physical Insight for Space Weather Forecasting (invited)

10:30 – 10:50 *Anant Telikicherla* A New HOPE for Accurate Solar Flare Prediction

10:50 – 11:10 *Youngjae Kim* Interpretable Data-Driven Models for Solar Flare Forecasting through Deep Learning and Symbolic Regression

11:10 – 11:40 Coffee break

11:40 – 12:00 *Ekaterina Dineva* Combining Physics-Derived and Machine-Learned Features for Probabilistic Solar Flare Forecasting

12:00 – 12:20 *Naoto Nishizuka* Operational Use of Deep Flare Net and AI techniques for Space Weather Forecasting

12:20 – 12:40 *Panagiotis Gonidakis* Soft X-ray Flux Prediction for Onboard 24-Hour Solar Flare Forecasting Using CNNs and SDO/AIA Images

12:40 – 13:00 *Linn Abraham* Interpretable Deep Learning for Solar Flare Predictions

13:00 – 13:20 *Daniel da Silva* Generative Diffusion Models of the Solar Corona

13:30 – 15:00 Lunch

Session 2 – Chairs:

15:00 – 15:30 *George Miloshevich* Data-Driven Closures for Hybrid Plasma Models in Space Plasmas (invited)

15:30 – 15:50 *Prateek Mayank* Next-Generation MHD Modeling Of Solar Wind Using Neural Operators

15:50 – 16:10 *Hiroshi Hasegawa* Reconstruction of two-dimensional MHD and Hall MHD equilibria in space using physics-informed neural networks

16:10 – 16:30 *Manuel Lacal* Physics-Informed Neural Networks for Modeling Geomagnetic Storm Dynamics

16:30 – 17:00 Coffee break

17:00 – 17:20	<i>Jithu J Athalathil</i> Investigating Nonlinear Quenching Effects on Polar Field Buildup Using Physics-Informed Neural Networks
17:20 – 17:40	<i>Mingyu Jeon</i> Real-time Reconstruction of Coronal Magnetic Fields using a Physics-informed Neural Operator
17:40 – 18:00	<i>Clinton Groth</i> Merging Observational Data and Magnetohydrodynamics: A Variational Data Assimilation Approach for the Solar Wind
18:00 – 18:30	<i>Robert Jarolim</i> The Sun in 3D: Bridging Gaps in Solar Observations with Physics-Informed Machine Learning (invited)
19:00 – 20:30	<u>Reception (on-site)</u>

Tuesday 23rd September

Session 3 – Chairs:

9:30 – 10:00	<i>Opal Issan</i> Bayesian Inference and Global Sensitivity Analysis for Ambient Solar Wind Prediction (invited)
10:00 – 10:20	<i>Seungwoo Ahn</i> Verification of Empirical and Deep Learning Models for Solar Wind Speed Forecasting
10:20 – 10:40	<i>Matthew Billcliff</i> Extended Lead-Time Geomagnetic Storm Forecasting with Solar Wind Ensembles and Machine Learning
10:40 – 11:00	<i>Esraa Elelimy</i> Long-Horizon Prediction of Solar Wind Events with Reinforcement Learning
11:00 – 11:30	<u>Coffee break</u>
11:30 – 11:50	<i>Peter Wintoft</i> Gaussian Process forecast of strong geomagnetic storms using CME-ICME properties
11:50 – 12:10	<i>Hannah Ruedisser</i> ARCANE: An Operational Framework for Automatic Realtime ICME Detection in Solar Wind In Situ Data
12:10 – 12:30	<i>Jiahui Shan</i> CAMEL-II: A 3D Coronal Mass Ejection Catalog Based on Coronal Mass Ejection Automatic Detection with Deep Learning
12:30 – 12:50	<i>Julio Hernandez Camero</i> Bayesian Inference for 3D CME Characterization and Uncertainty Quantification
12:50 – 13:10	<i>Matthew Rutala</i> Data-driven, Probabilistic Solar Wind Reconstruction Beyond the Earth
13:10 – 13:30	<i>Sadaf Shahsavani</i> Kp Prediction from Solar Wind Parameters Using Sparse Library Regression
13:30 – 15:00	<u>Lunch</u>

Poster Session 1

15:00 – 18:30 Poster session 1

Wednesday 24th September

9:30 – 10:20 ESA lab tutorial

10:20 – 10:50 *Caitriona Jackman* How to creatively account for the lack of an upstream monitor at planets other than Earth (invited)

10:50 – 11:20 *Paul Wright* From Model to Impact: Engineering Machine Learning for Space Weather Forecasting (invited)

11:20 – 11:50 Coffee break

Session 4 – Chairs:

11:50 – 12:10 *Abigail Azari* Towards Operational Planetary Space Weather with A Virtual Solar Wind Monitor at Mars

12:10 – 12:30 *Daragh Hollman* Classifying MESSENGER Magnetospheric Boundary Crossings Using a Random Forest Model

12:30 – 12:50 *Gautier Nguyen* Auto-encoder based reduced order emulation of the Earth electron radiation belt modeling

12:50 – 13:10 *François Ginisty* SPARTAI – an AI-based forecasting pipeline for energetic electrons in the Earth's radiation belts

13:10 – 13:30 *Dylan Weston* A threshold-based random forest forecasting model for the Outer Radiation Belt

13:30 – 15:00 Lunch

Poster Session 2

15:00 – 18:30 Poster session 2

Thursday 25th September

Session 5 -- Chairs:

9:30 – 10:00	<i>Henrik Eklund</i> Deep learning across multi-dimensional data (invited)
10:00 – 10:20	<i>Daniel Gass</i> Dataset Creation for ML Applications in Heliophysics - Lessons from ARCAFF
10:20 – 10:40	<i>Bhishek Manek</i> Cross-Calibrated Video Super-Resolution for Solar Dopplergrams
10:40 – 11:00	<i>Léa Zuili</i> MLOps for Reproducible Machine Learning in Space Science: Insights from ESAC
11:00 – 11:30	<u>Coffee break</u>

Session 6 – Chairs:

11:30 – 11:50	<i>Mohamed Nedal</i> Short-Term Solar Energetic Proton Flux Forecasting using Transformer Architectures
11:50 – 12:10	<i>Paulina Quijia Pilapana</i> Automatic Identification of Magnetic Reconnection to Assess its Role in Collisionless Turbulent Plasmas Using Unsupervised Machine Learning
12:10 – 12:30	<i>Joanna Slawinska</i> Koopman Operator Theory and new Data-Driven Approach to Modeling and Signal Processing of Spatiotemporal Data
12:30 – 12:50	<i>Junmu Youn</i> Aurora Detection in Sequential e-POP/FAI Images Using Deep Learning and Explainable AI
12:50 – 13:10	<i>Katherine Keegan</i> An AI-powered Surface Flux Transport model to measure high-resolution velocity fields and forecast magnetic flux emergence
13:10 – 13:30	<i>Francesco Carella</i> Transient-Oriented Clustering of Solar Wind Observations at 1 AU
13:30 – 15:00	<u>Lunch</u>

Poster session 3

15:00 – 18:30	Poster Session 3
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Friday 26th September

Session 7 – Chairs:

9:30 – 10:00	Early career awards
10:00 – 10:30	<i>Jonathan Citrin</i> TORAX: A Fast and Differentiable Tokamak Transport Simulator in JAX (invited)
10:30 – 10:50	<i>Nikita Balodhi</i> Bayes in Space: A Bayesian Deep Learning approach for Coronal Temperature estimation
10:50 – 11:10	<i>Andrés Muñoz-Jaramillo</i> HelioFM a foundation model in heliophysics
11:10 – 11:30	<i>Sergio Sánchez Hurtado</i> Toward Uncertainty-Aware Thermospheric Drag Forecasting via Time Series Foundation Models
11:30 – 12:00	<u>Coffee break</u>
12:00 -- 13:30	Open discussion
13:30 – 15:00	Farewell lunch

List of posters

Poster session 1

- 1) *Idowu Raji* A Multi-Stage Self Organizing Map-Autoencoder-LSTM Model for Total Solar Irradiance Prediction
- 2) *Simon Joyce* Revealing the Martian ionosphere using AI and 20 years of Mars Express data
- 3) *Samuel Abaidoo* CIR-Driven Geomagnetic Storm and High-Intensity Long-Duration Continuous AE Activity (HILDCAA) Event: Effects on Brazilian Equatorial and Low-Latitude Ionosphere—Observations and Modeling
- 4) *Simon Wing* Information theory based system level Babcock-Leighton flux transport model-data comparisons
- 5) *Armando Collado-Villaverde* Dst Forecasting with REDst: Pushing the Limits of Real-Time L1 Data
- 6) *Rong Sun* Automatic Detection of Lyman-alpha Solar Flares Based on GOES/EUVS Flux and ASO-S/SDI Images
- 7) *Maria Hasler* Unsupervised analysis of dangerous space weather: Combining ground and space-based measurement
- 8) *Yasmin Machuca* Automatic Identification of CMEs images using synthetically trained neural networks
- 9) *Shi Tao* Automated Detection of Foreshock Transients Using Machine Learning Techniques
- 10) *Emanuel Jeß* Discovering heat flux closures using machine learning methods
- 11) *François Ginisty* Augura Space Nowcast Platform: A Research-Focused, Open Demonstrator for Space Weather Data Integration and Visualization

- 12) *Emerick Laborde* Physics-Informed Deep Learning for the characterization of the electron radiation belts dynamics
- 13) *Daniele Telloni* Transition to a Critical State of Active Regions: Identifying Solar Flare Precursors
- 14) *Dibya Mishra* Neural Network-Based Detection of Plages in Historical Solar Drawings
- 15) *Alexandre Suteau* DeepHelio - Predicting Solar Wind Speed at L1 Using Solar Imagery and Deep Learning
- 16) *Samuel Burles* Data-Driven Plasma Closure Relation for Landau Damping in One Dimension
- 17) *Mariano Sanchez Toledo* Automatic GCS reconstruction of CMEs using synthetically-trained neural networks
- 18) *Ji-Hye Baek* DeepSDO: A Deep Learning-Based Approach for Automated Detection and Visualization of Solar Events
- 19) *Paloma Jol* Flare forecasting using Fully Convolutional Network to gain insight into active regions
- 20) *Verena Heidrich-Meisner* Anomaly detection applied to solar wind composition measured by SOHO/CELIAS/CTOF and ACE/SWICS
- 21) *Junmu Youn Ram* Stereoscopic DEM Analysis Using Solar Orbiter/EUI and AI-Generated Data
- 22) *KD Leka* SuperSynthia LOS: Learning to Estimate Photospheric Vector Fields from Line-of-Sight Magnetograms
- 23) *Andy Smith* Self Supervised Encoding to Find Similar Observations
- 24) *Francesco Ramunno* Enhancing image resolution of solar magnetograms: A latent diffusion model approach

Poster session 2

- 1) *Benjamin Grison* Comparison of automatic and machine-learning detections of EMIC waves
- 2) *Qiushuo Wang* Modeling Ring Current Oxygen Ions Using Neural Network
- 3) *Giuseppe Consolini* On timescale of geomagnetic storm recovery phase.
- 4) *Hiroshi Hasegawa* Revisiting the cold-dense plasma sheet formation mechanism using causal inference and information-theoretic analysis
- 5) *Daeil Kim* Solar EUV Channel Selection with Magnetogram via Multi-domain image Translation
- 6) *Poshan Belbase* Reconstructing Historical Solar Activity Indices to Model Past Space Weather Events
- 7) *Edoardo Legnaro* Solar Active Region Classification with Deep Learning
- 8) *Veronique Delouille* Mitigating hallucination with non-adversarial strategies for image-to-image translation in solar physics
- 9) *Atuel Villegas* High resolution TEC forecasting using transformers models
- 10) *Francesco Ramunno* AIA2STIX: Bridging the gap between UV and X-ray in solar imaging
- 11) *João Felipe Pereira* Comparing Machine and Deep Learning Techniques for Solar Flare Prediction
- 12) *Raman Mukundan* Towards an Interpretable Model of Localized Geomagnetic Disturbances in Terms of Solar Wind and M-I Processes
- 13) *Brianna Isola* ML-IMEF: A Machine Learning Approach to Global Modeling of the Inner Magnetospheric Electric Field
- 14) *Stefan Lotz* Solar wind - geomagnetic disturbance coupling predicted and interpreted with KnowIt
- 15) *Jihyeon Son* Time-Resolved Causal Analysis of Geomagnetic Storms Using Information Theory

- 16) *Iván Maseda-Zurdo* An Interpretable Approach to SYM-H Geomagnetic Index Forecasting
- 17) *Jakub Juranek* Self-improving solar events prediction system: exploring potential of Darwin Gödel Machine agentic AI framework for cosmic weather forecasting.
- 18) *Maria Elena Innocenti* Bridging Kinetic and Fluid Scales: Addressing the Plasma Closure Problem with ML
- 19) *Carl Shneider* Proxy Sensing of Space Weather Events Using Solar Panel Telemetry
- 20) *Herman le Roux* Automated Detection of Solar Radio Bursts Using Detectron
- 21) *Liam Smith* Using TEC to Enhance 3D Electron Density Models
- 22) *Silvia Kostárová* Opportunities for early detection of CMEs and CIRs by Vigil data and machine learning approach
- 23) *Subhamoy Chatterjee* Deep Generative model that uses physical quantities to generate and retrieve solar magnetic active regions
- 24) *Jan Raath* Machine Learning in Galactic Cosmic Ray Propagation

Poster session 3

- 1) *Stefan Lotz* TEC and Transfer Learning
- 2) *Francesco Ramunno* Predicting partially observable dynamical systems via diffusion models with a multiscale inference scheme
- 3) *Nina Bonaventura* Estimated high-resolution photospheric flows using an AI surface flux transport model
- 4) *Simon Mackovjak* Deep Learning Classification of Low-latitude Ionospheric Structures in Airglow Images
- 5) *Karen Júlia Ferreira* CIR-Driven Ion Injections and EMIC Wave Dynamics: Implications for Wave Generation Mechanisms and Outer Radiation Belt Variability
- 6) *Raphael Attie* CHES: Coronal Hole Extraction with Semantic Segmentation
- 7) *Shiva Kavosi* Ground Signatures of Magnetopause Surface Waves
- 8) *Nathaniel Laurent* World Coordinate System Framework to enhance AI applications in PyTorch
- 9) *Stephen Tete* Bayesian and Machine Learning for Geomagnetic Activity forecast: Where Causality augments Explainability
- 10) *Jose Espinoza Acosta* CCA-Informed Neural Networks for Predicting Plasma Sheet Conditions from Solar Wind Drivers
- 11) *Tania Varesano* Investigating plasma composition with deep learning
- 12) *Jacob Bortnik* Using interpretable AI to discover the drivers of acceleration vs depletion events in the radiation belt
- 13) *Dominique Stumbaugh* Reconstructing Equatorial Electron Flux Measurements from LEO
- 14) *Daniel da Silva* Data-Mining Similar Scenarios for Uncertainty Quantification of Solar Wind Predictions at L1
- 15) *Robert Jarolim* 3D Tomographic Reconstruction of Coronal Plasma Density and Temperature Using Neural Radiance Fields
- 16) *Sanjali Vuriti* Data Analysis for Multi-Hazard Risk Science: Risk and Resilience of Societal Critical Infrastructure to Space Weather and Compounding Natural Hazards
- 17) *Paraksh Vankawala* A Computer Vision Guided Detection and Classification of Plasma Waves in the Inner Magnetosphere

- 18) *Xiangning Chu* Unraveling Near-Earth Space Dynamics with Machine Learning
- 19) *Sandor Kruk* ESA Datalabs: Digital Innovation in Space Science
- 20) *David O'Ryan* AnomalyMatch: A Detection Method of Astrophysical Anomalies in Imaging Data
- 21) *Jan Reerink* The Heliophysics Extended Survey Environment
- 22) *Griffin T. Goodwin* An EUV Extension to the SWAN-SF Flare Forecasting Dataset
- 23) *Aikaterini Pesini* Solar Radio Burst Tracker: A citizen science initiative to identify Type III solar radio bursts

Sponsors

