Committee on Solar and Space Physics
Space Science Week Meeting (Spring 2025)

NASA Heliophysics Update

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SCIENCE MISSION DIRECTORATE

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National Aeronautics and Space Administration

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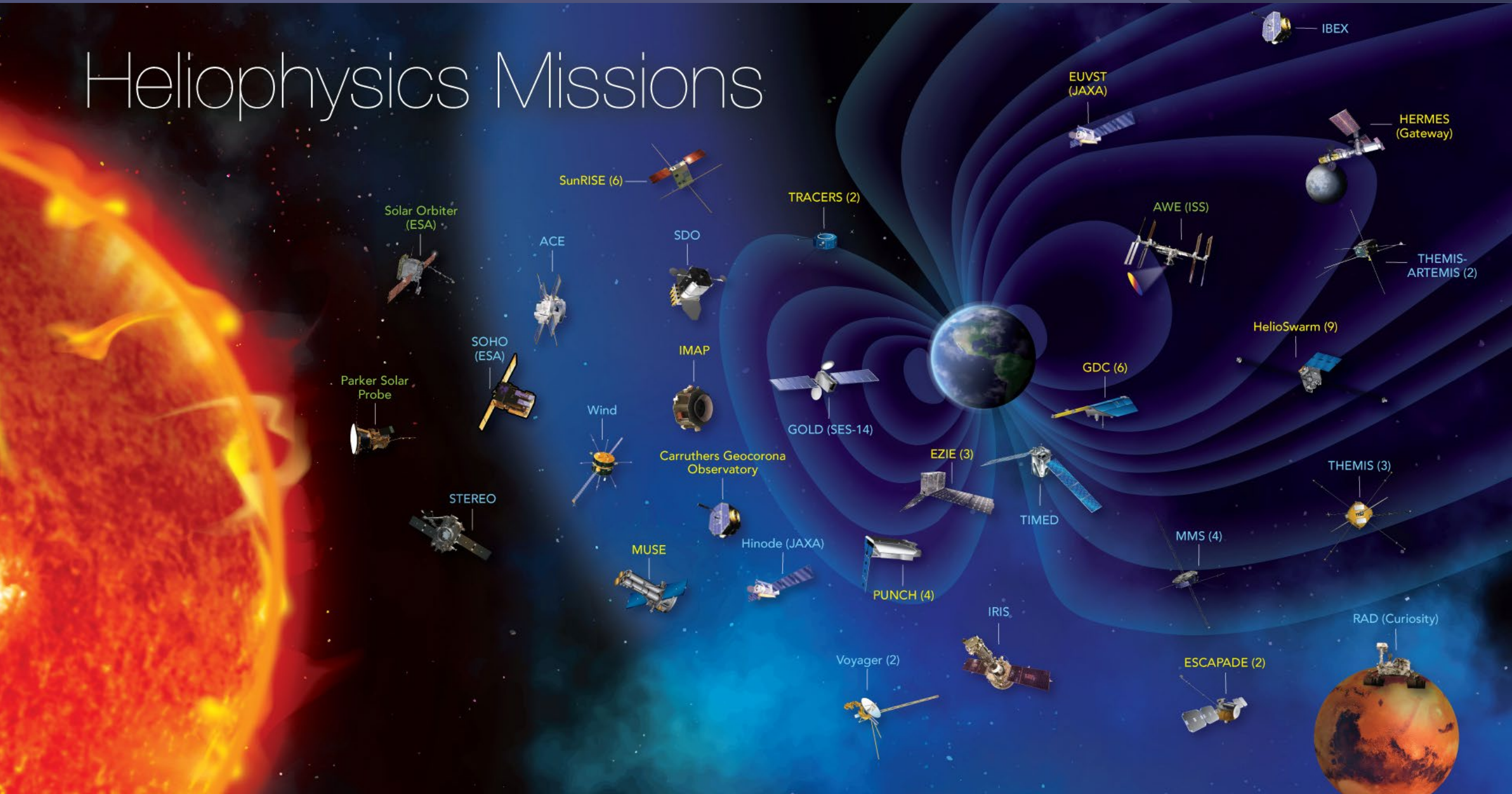
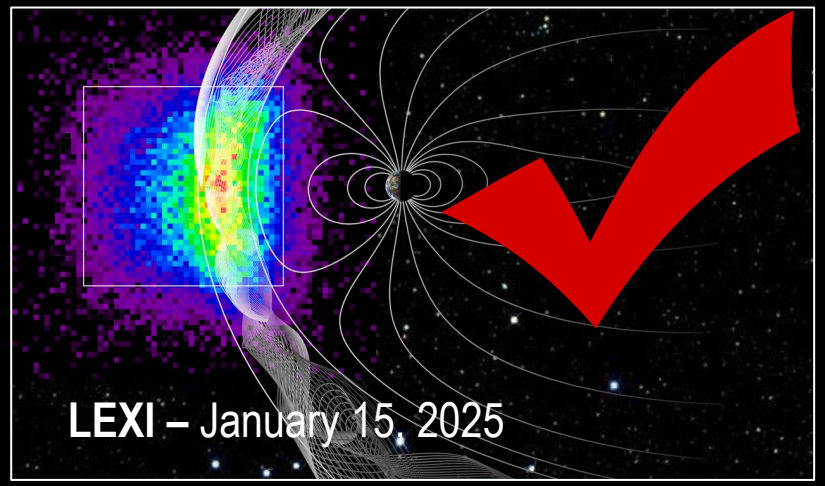
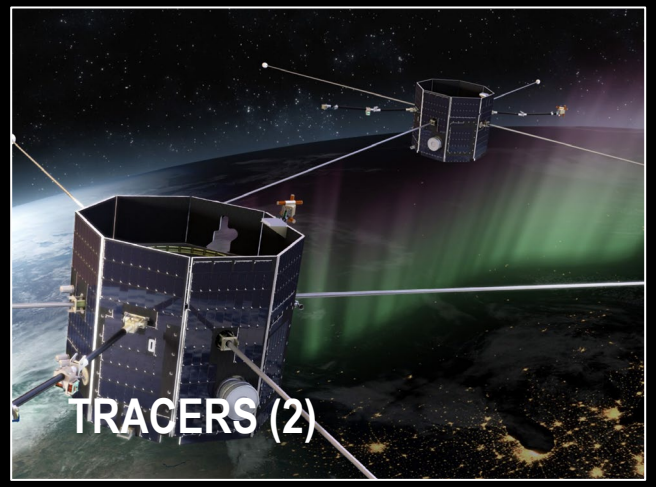
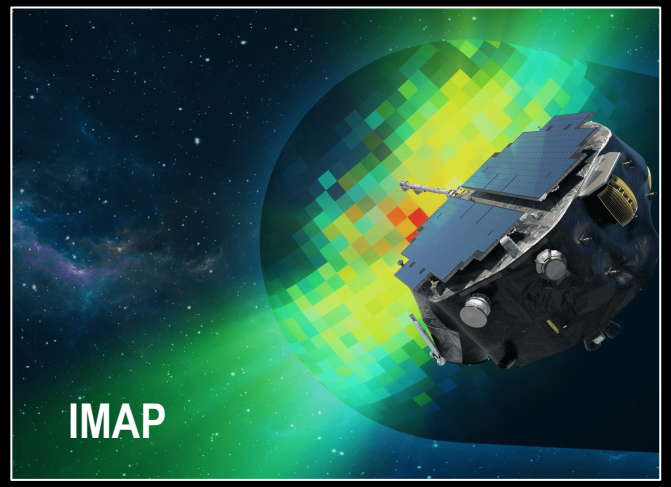
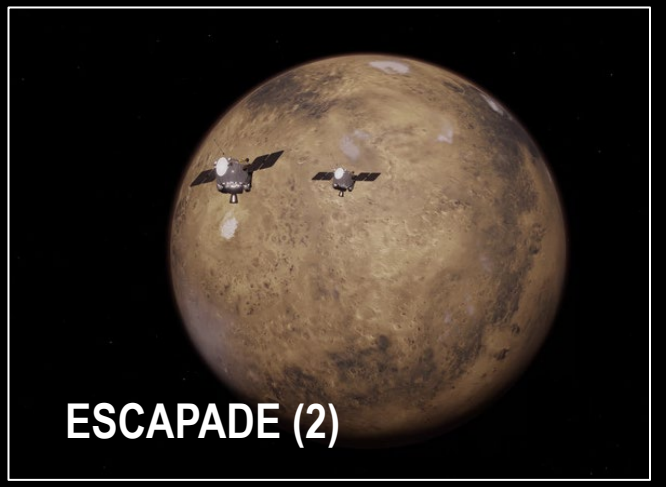

Heliophysics Missions
IBEX
EUVST (JAXA)
HERMES (Gateway)
SunRISE (6)
TRACERS (2)
AWE (ISS)
Solar Orbiter (ESA)
ACE
SDO
THEMIS-ARTEMIS (2)
SOHO (ESA)
IMAP
HelioSwarm (9)
Parker Solar Probe
Wind
GDC (6)
GOLD (SES-14)
Carruthers Geocorona Observatory
EZIE (3)
THEMIS (3)
STEREO
TIMED
MMS (4)
MUSE
Hinode (JAXA)
PUNCH (4)
IRIS
RAD (Curiosity)
Voyager (2)
ESCAPADE (2)

Heliophysics Mission Launches in 2025









LEXI

Lunar Environment Heliospheric X-ray Imager

In this visualization, the LEXI instrument is shown onboard Firefly Aerospace's Blue Ghost Mission 1

This is the first image captured by Firefly's Blue Ghost lander, delivering LEXI and nine other NASA instruments to the lunar surface.

PUNCH

Polarimeter to Unify the Corona and Heliosphere

PUNCH will make global, 3D observations of the Sun's corona and how it becomes the solar wind.

NASA's PUNCH mission launched from VSFB on March 11.

EZIE

Electrojet Zeeman Imaging Explorer

EZIE will be the first mission to image the magnetic fingerprint of auroral electrojet

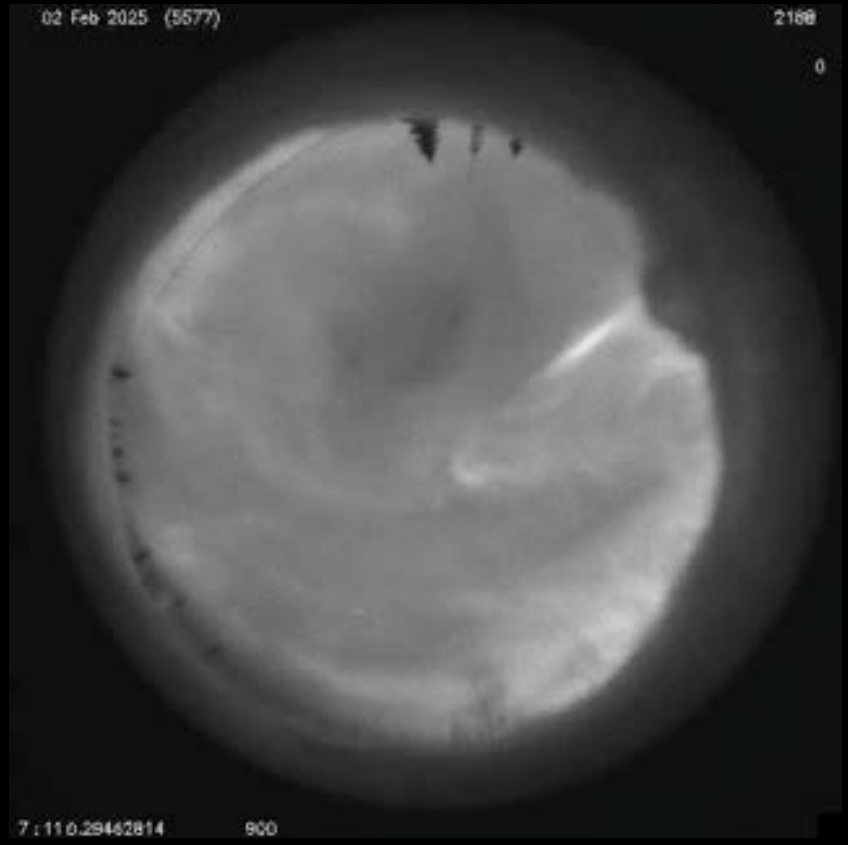
NASA's EZIE launched from VSFB March 14.
Credit: SpaceX

GIRAFF

Ground Imaging to Rocket Investigation Of Auroral Fast Features

Two GIRAFF payloads launched aboard two sounding rockets from Poker Flat Research Range in Alaska.

The first payload launched Feb. 1, and the second (pictured here) launched Feb. 8.



Pulsating aurora seen during two mins around apogee (x10 speed)

AWESOME

Auroral Waves Excited by Substorm Onset Magnetic Events

Launched!

Three NASA-funded rockets launched from Poker Flat Research Range in Fairbanks, Alaska, in an experiment that seeks to reveal how auroral substorms affect the behavior and composition of Earth's far upper atmosphere.

The experiment's outcome could upend a long-held theory about the aurora's interaction with the thermosphere and may improve space weather forecasting.

CODEX

Coronal Diagnostic Experiment

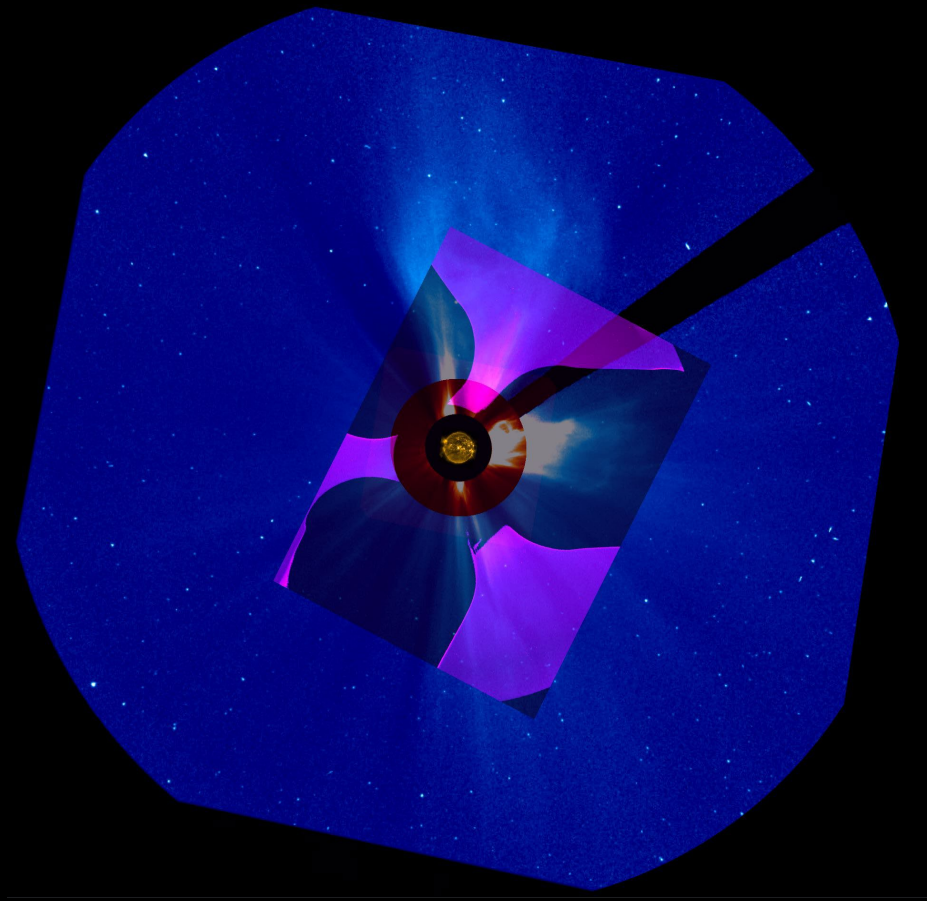
Operating on the International Space Station since November 2024, CODEX is an imaging solar coronagraph that produces images of the coronal electron temperature and radial speed as it transitions to solar wind.

CODEX Sees “First Light”

This image is an overlay of CODEX data (purple) with the Solar and Heliospheric Observatory Large Angle and Spectrometric Coronagraph (SOHO LASCO) (red and blue) and Solar Dynamics Observatory (gold).

This shows the solar corona on February 21, 2025, displaying streamers and a coronal mass ejection (CME) heading upwards.

CODEX data is used to measure the coronal electron density, temperature, and speed.



AWE

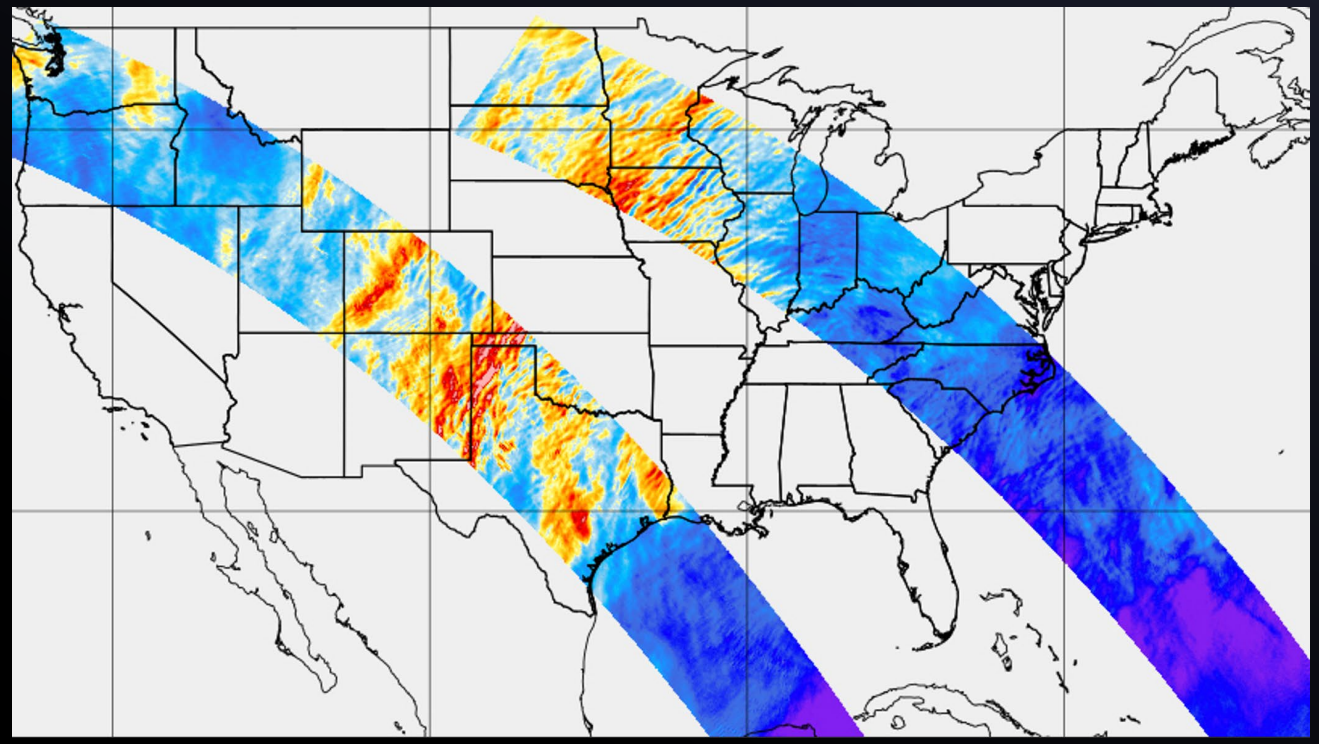
Atmospheric Waves Experiment

The first 3,000 orbits of data collected in space and transmitted back to Earth have been released.

This is a view of atmospheric gravity waves never captured before.

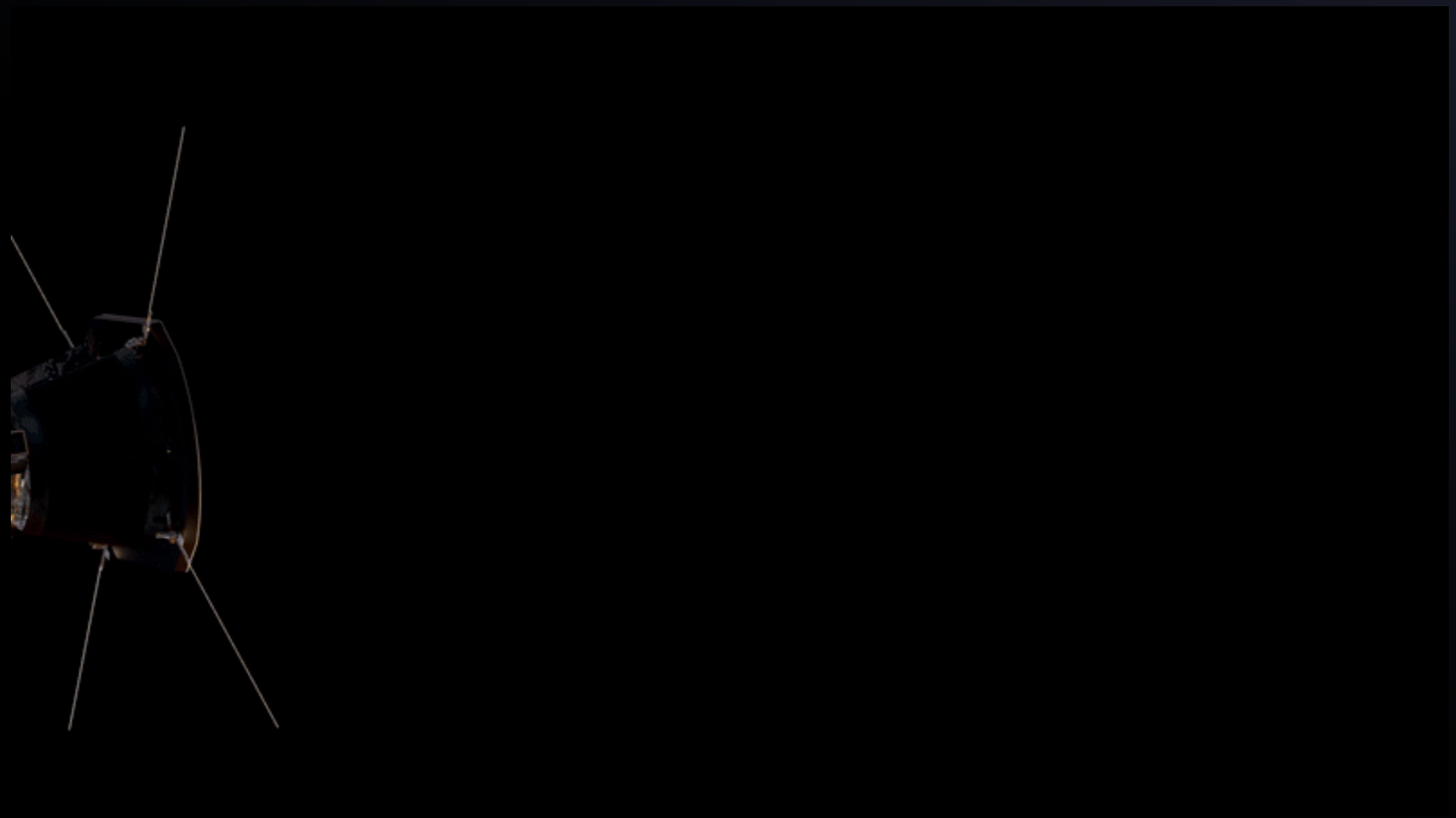
This image displays AWE data combined from two of the instrument's passes over the United States.

The red and orange wave structures show increases in brightness (or radiance) in infrared light produced by airglow in Earth's atmosphere.

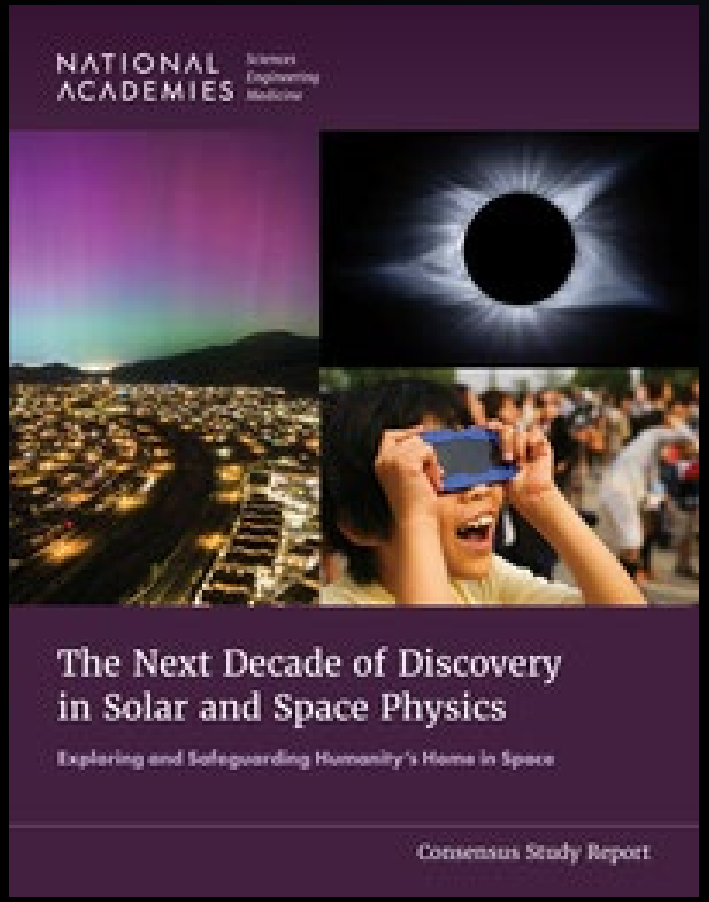


Parker Solar Probe

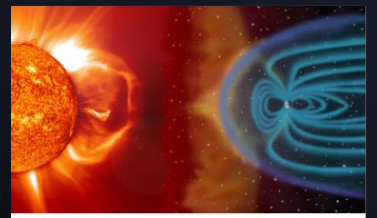
March 22: Parker zoomed through its 23rd science-gathering solar encounter, coming within 3.8 million miles of the Sun’s surface, matching its distance record.



Decadal Survey



Science Priorities for the Next Decade

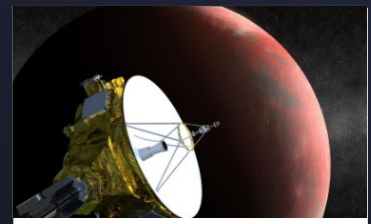


Sun-Earth-Space

Our local cosmos provides the opportunity to better understand the complex interactions amongst the different parts of heliosystems - vast reservoirs of plasmas, energetic particles, and electromagnetic fields, from deep in the Sun's interior to phenomena closer to Earth such as auroras.

A Laboratory in Space

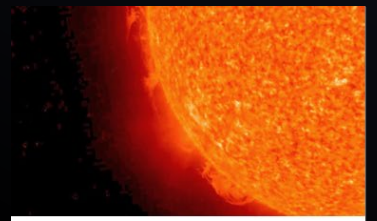
Our local cosmos hosts myriad physical processes, many of which remain poorly understood. These fundamental processes give rise to some of the most spectacular and intriguing phenomena in the solar system and present opportunities to advance understanding.



New Environments

Studying Earth's interaction with its space environment and our own system's heliosphere could enable us to better understand conditions in other planetary systems.

Understanding Space Weather and its Impacts



System-of-Systems Drivers of Space Weather

Understanding how the Sun's particles, plasmas, and fields travel outward, and how they interact and influence the background solar wind, Earth's magnetosphere, ionosphere, and atmosphere can help predict the state of the space environment from the atmosphere through interplanetary space.

Space Weather Responses of the Physical System

To protect assets on Earth, human life, and technological systems in space, we need to be able to predict the radiation environment from the upper atmosphere and LEO to the lunar environment and beyond.

Impacts on Infrastructure and Health Impacts

Variability in the space environment impacts technologies in space, in the air, and on the ground as well as communication systems between space and ground. It is critical to understand the impacts on specific systems and on humans onboard aircraft and in space.

Heliophysics of the Future

VISION: *To safeguard humanity's home in space and revolutionize exploration of the only known habitable star, our Sun, and all that it impacts.*

Drive innovation

Provide user-driven space weather research and applications

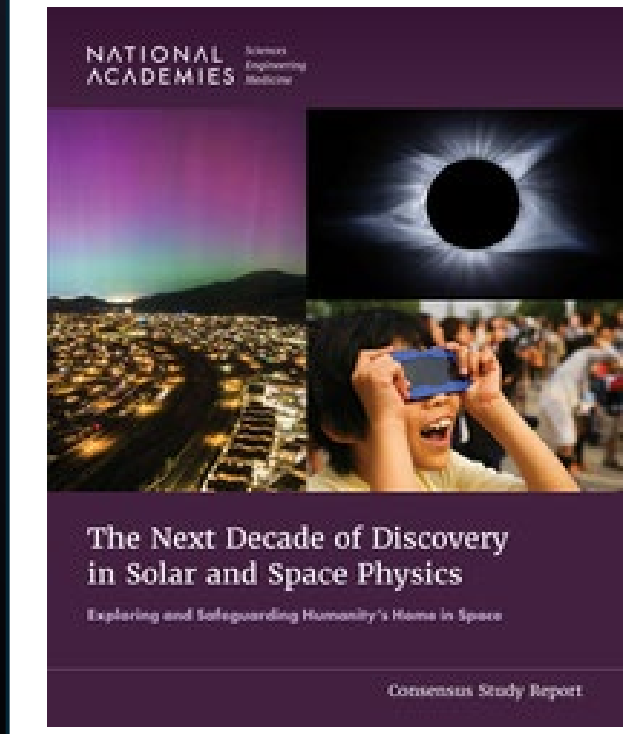
Prioritize societal benefit

Space Weather

Space Weather Program

Solar Max

User-Driven
Co-Production



2024 Decadal Survey
User Needs Survey

2024 Solar Super Storm (The “Gannon” Storm)

The May 2024 “Gannon” Storm (G5) was the largest geomagnetic storm in 20 years to hit Earth.

Aviation: Trans-oceanic flights rerouted due to high frequency radio loss, and precision landing and performance-based navigation system unavailable for ~15 hours.

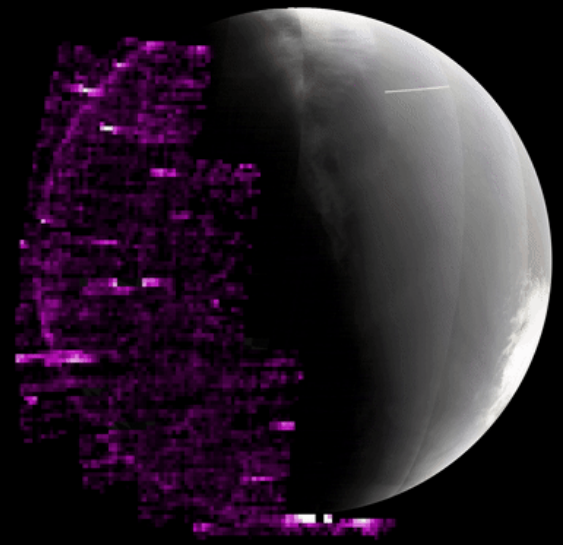
Agriculture: ~$500 million USD economic loss from precision GPS issues

Energy: High voltage lines tripped in northern Europe

Satellite Operations: Degraded Starlink service and ~5,000 satellites experienced increased drag, resulting in more frequent station-keeping burns and collision avoidance maneuvers.

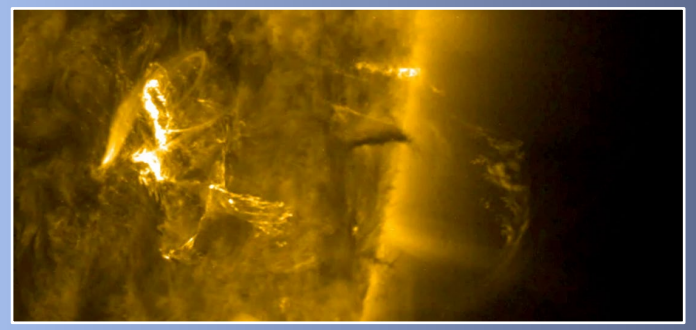
Mars Observations During May 2024 Solar Storm

Charged particles hitting the camera sensor on the NASA Curiosity Mars rover in May 2024



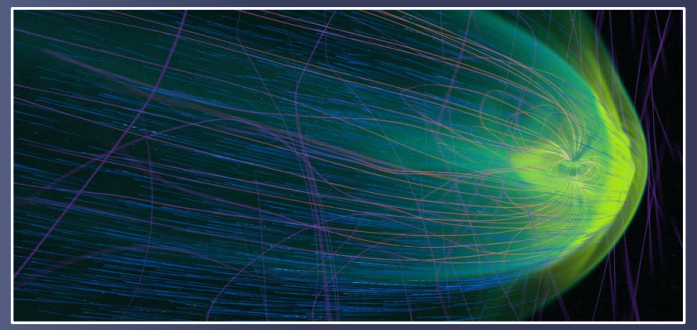
Aurora on Mars detected by the NASA MAVEN orbiter in May 2024

LIVING WITH A STAR (LWS)



Determining how the solar wind is generated and accelerated through the heliosphere

SPACE WEATHER PROGRAM (SWxP)



Developing predictive solar magnetic flux transport models using space and ground-based observations

Integrating physics-based prediction models with real-time heliospheric data to create visualizations used for operational forecasting by the NOAA Space Weather Prediction Center

LWS Concludes
SWxP Begins

BASIC RESEARCH → **APPLIED RESEARCH** → **APPLICATIONS**

Learning fundamental phenomena to understand and explain processes in the natural world

Directing scientific knowledge to a particular result and codifying knowledge in models and tools for predictive capabilities

Using data and information products to support forecasting, inform decisions, and guide actions of organizations

2024 Space Weather Program Accomplishments

Total Solar Eclipse Impacts

400+ NASA employees across 14 locations engaging with the public

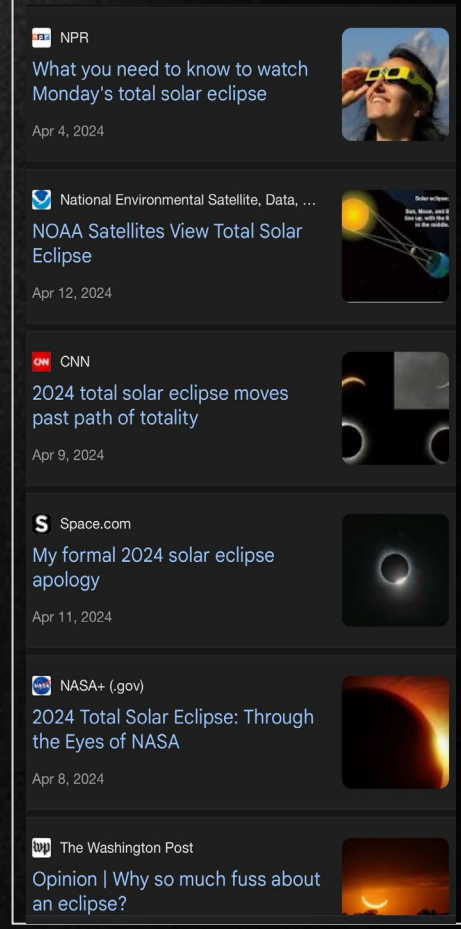
12,328,645
NASA Broadcast viewers – English

HD 1080p

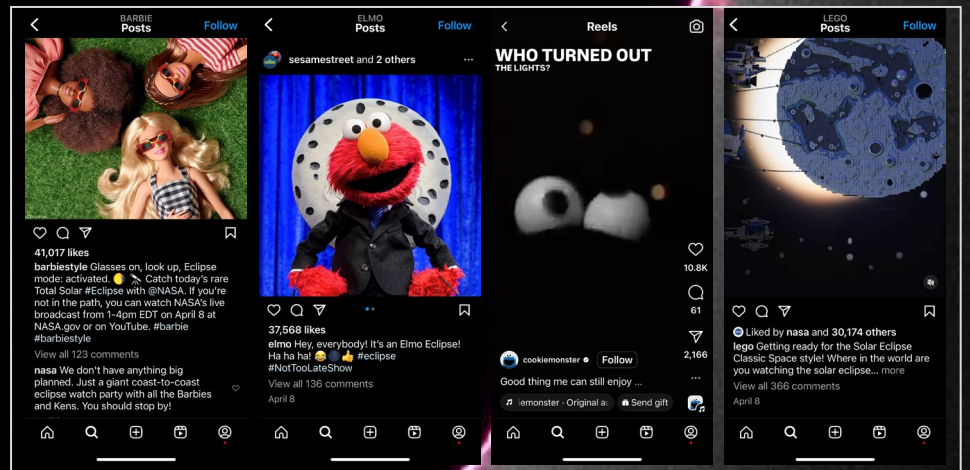
LIVE

4,603,238
NASA Broadcast viewers – Spanish

17,535
News stories generated



2M+
glasses distributed



Tens of Thousands
Of engagements with Barbie, Cookie Monster, Elmo, Snoopy, LEGO and more

2024 Space Weather Program Accomplishments

- Established Space Weather Centers of Excellence (Mar 2024)
- Participated in first multi-agency, end-to-end Space Weather Tabletop Exercise (May 2024)
- Launched NASA Space Weather Program Office at Langley (Oct 2024)

- Developed a new approach to the R2O2R Program Element based on prior successes and similar programs.
- Made selections for multiple research-to-operations-to-research (R2O2R) Transition projects.

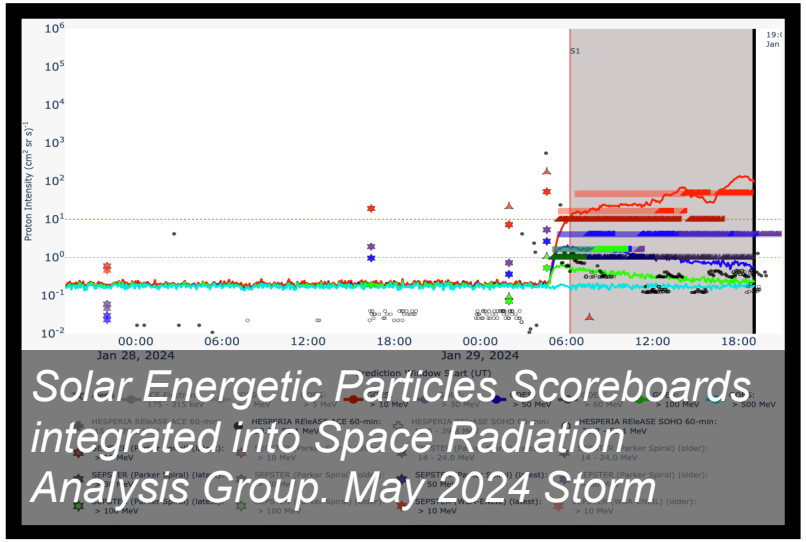
2024 Space Weather Accomplishments

Research & Analysis and Flight Portfolios

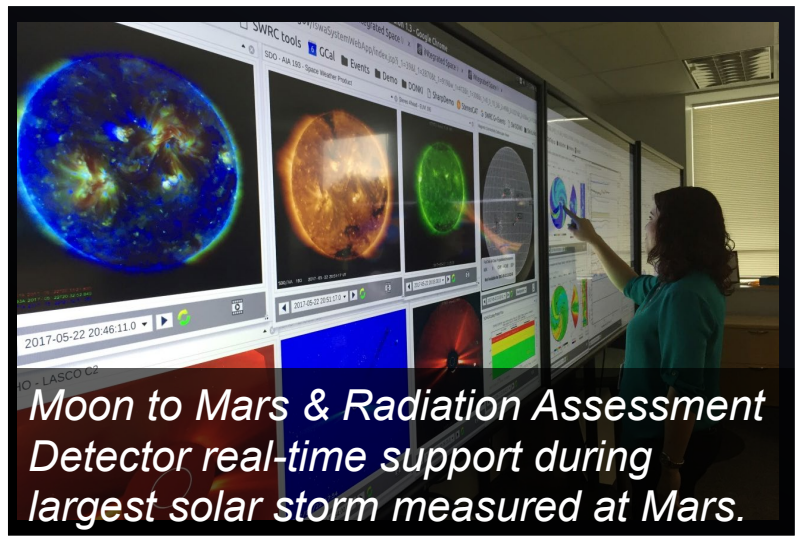
Community Coordinated Modeling Center's prioritization of open, community-based modeling

Small Business Innovation Research Balloon launched in Aug.

Successful qualification & delivery of the Heliophysics Environmental and Radiation Measurement Experiment Suite (HERMES).



Solar Energetic Particles Scoreboards integrated into Space Radiation Analysis Group. May 2024 Storm



Moon to Mars & Radiation Assessment Detector real-time support during largest solar storm measured at Mars.

Get Involved & Stay Informed!

Stay in touch and help us find new ways to highlight your work and keep you in the loop!

- Submit science highlights to us here: **https://go.nasa.gov/4gDha1S**

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QUESTIONS