



EXPLORE SOLAR SYSTEM&BEYOND

Committee on Solar and Space Physics November 2023

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NASA Headquarters

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NASA Heliophysics Division Leadership



Nicole (Nicki) Rayl
Associate Director for Flight



Peg Luce
Acting Division Director

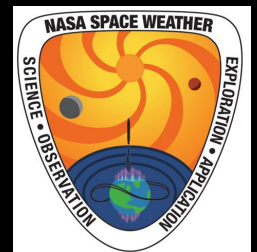


Therese Moretto Jorgensen
Acting Deputy Division Director

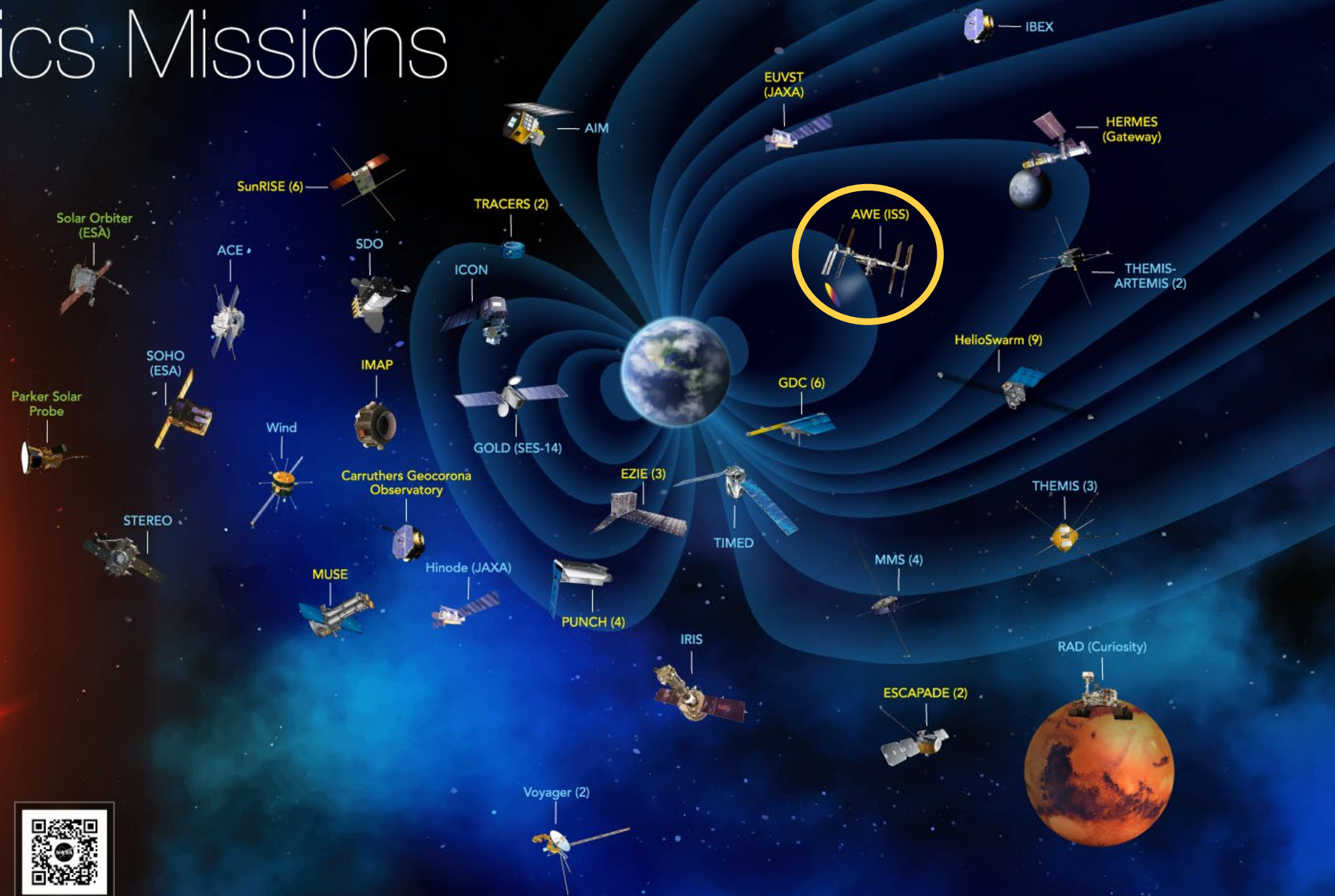
NASA HELIOPHYSICS OBJECTIVES

- Solve the **fundamental physics** mysteries of heliophysics: Explore and examine the physical processes in the space environment from the Sun to the Earth and throughout the solar system including the interface with the interstellar medium.
- Build the **knowledge to forecast space weather** throughout the heliosphere: Develop the knowledge and capability to detect and predict extreme conditions in space to protect life and society and to safeguard human and robotic explorers beyond Earth.
- Understand the **nature of our home in space**: Advance our understanding of the connections that link the sun, the Earth, planetary space environments, and the outer reaches of our solar system.

The NASA HQ Heliophysics Division



Heliophysics Missions



science.nasa.gov/heliophysics

*Objects Not to Scale

HELIO MISSION LAUNCH TIMELINE

AWE

ESCAPADE

Carruthers
Geocorona
Observatory

IMAP

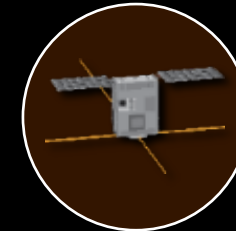
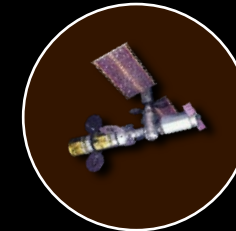
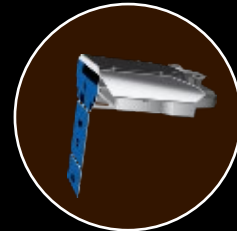
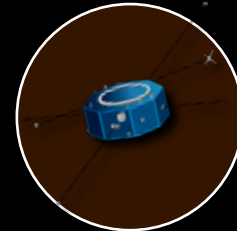
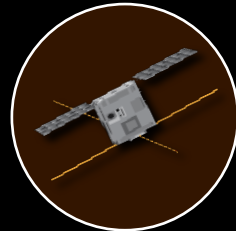
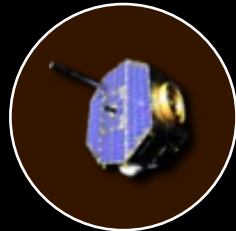
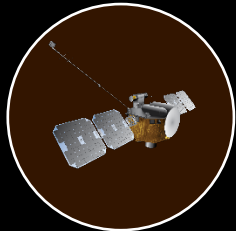
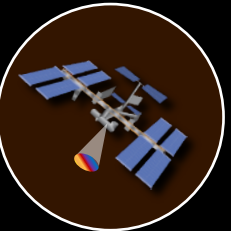
SunRISE

TRACERS

PUNCH

HERMES

EZIE



November 9
2023

~August
2024

~February
2025

~February
2025

~March
2025

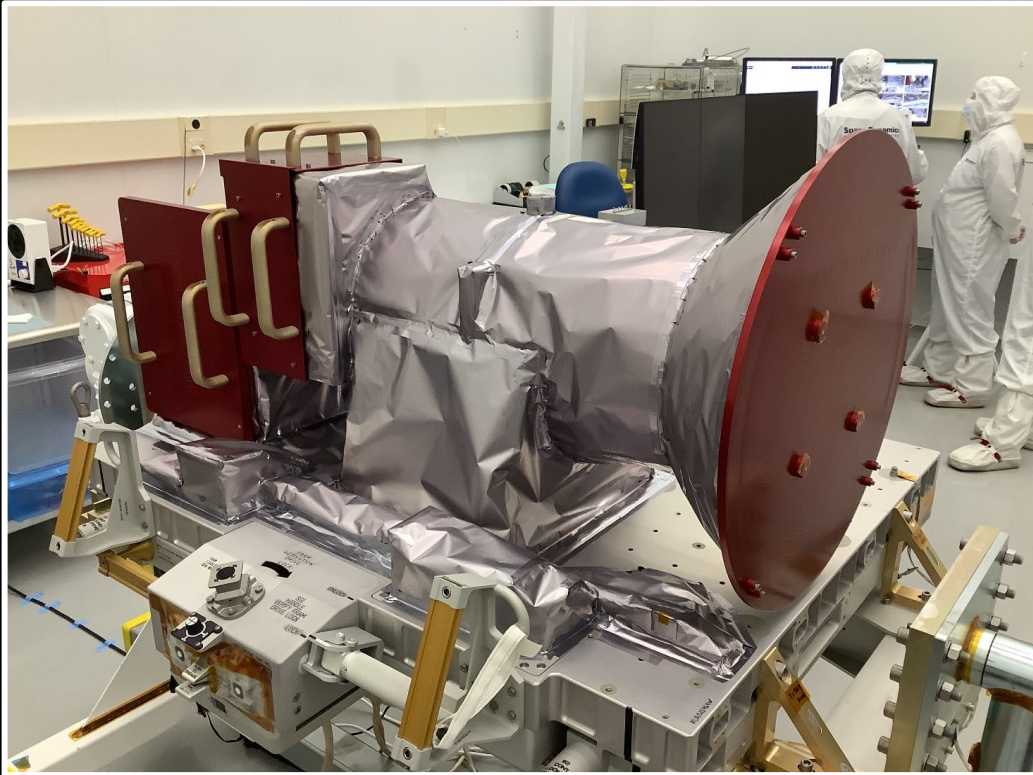
~April
2025

~April
2025

~October
2025

~March
2026

Atmospheric Waves Experiment (AWE)



Credit: Utah State University and Space Dynamics Lab

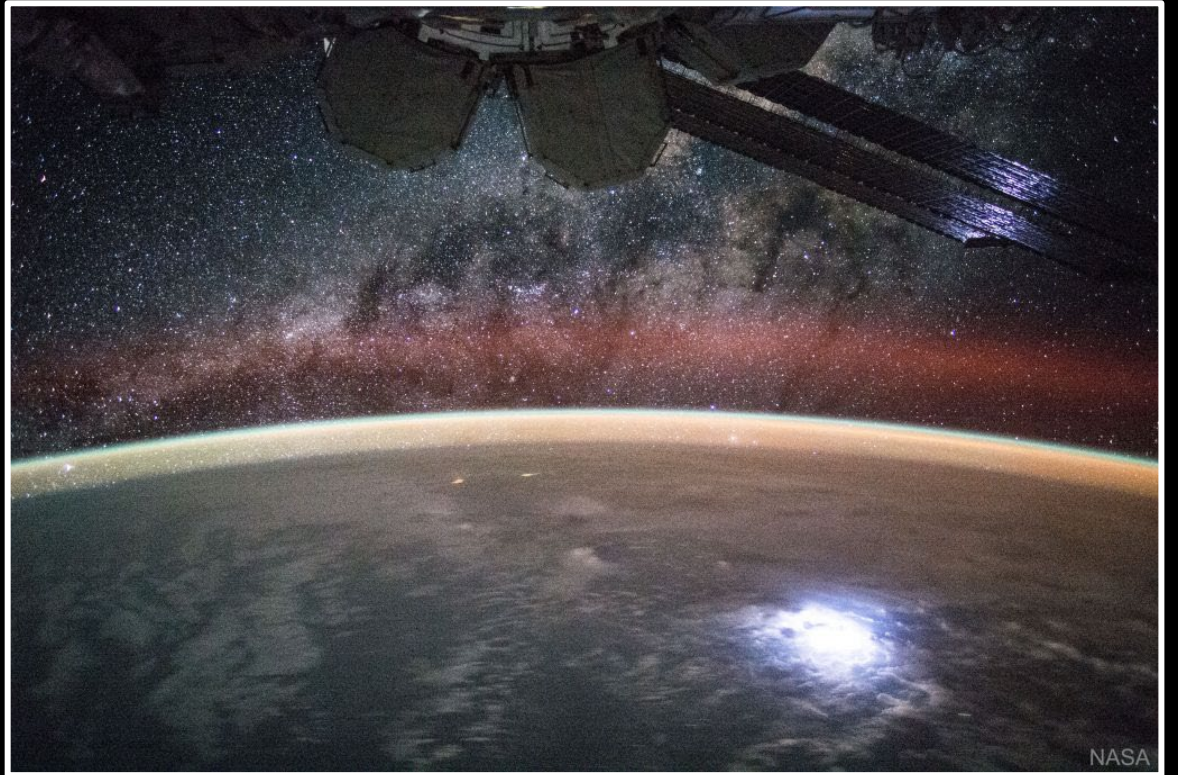


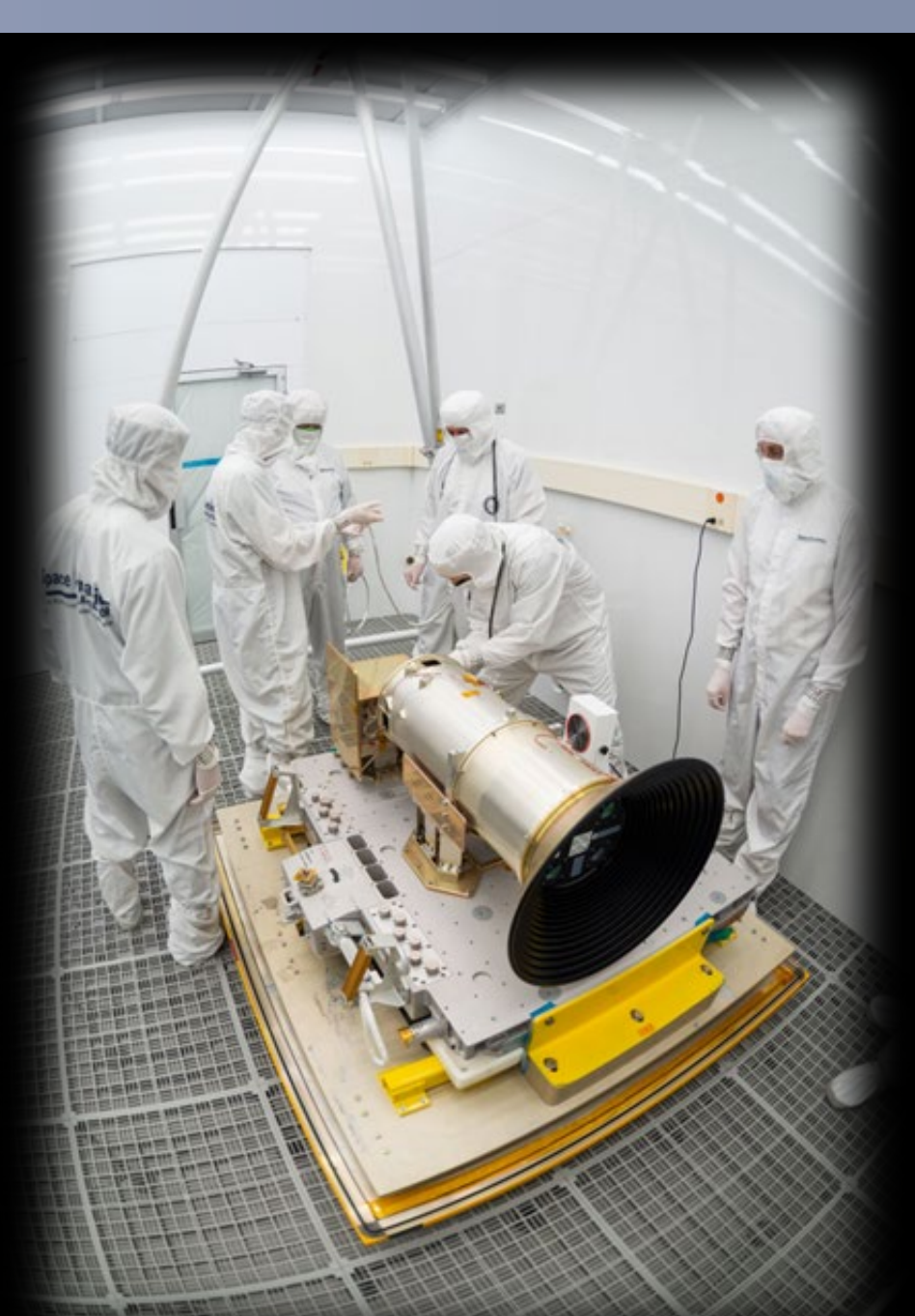
Image taken from the International Space Station shows swaths of airglow hovering in Earth's atmosphere | Credits: NASA



<https://blogs.nasa.gov/awe/>

AWE Launched to ISS on Nov 9

Atmospheric Waves Experiment



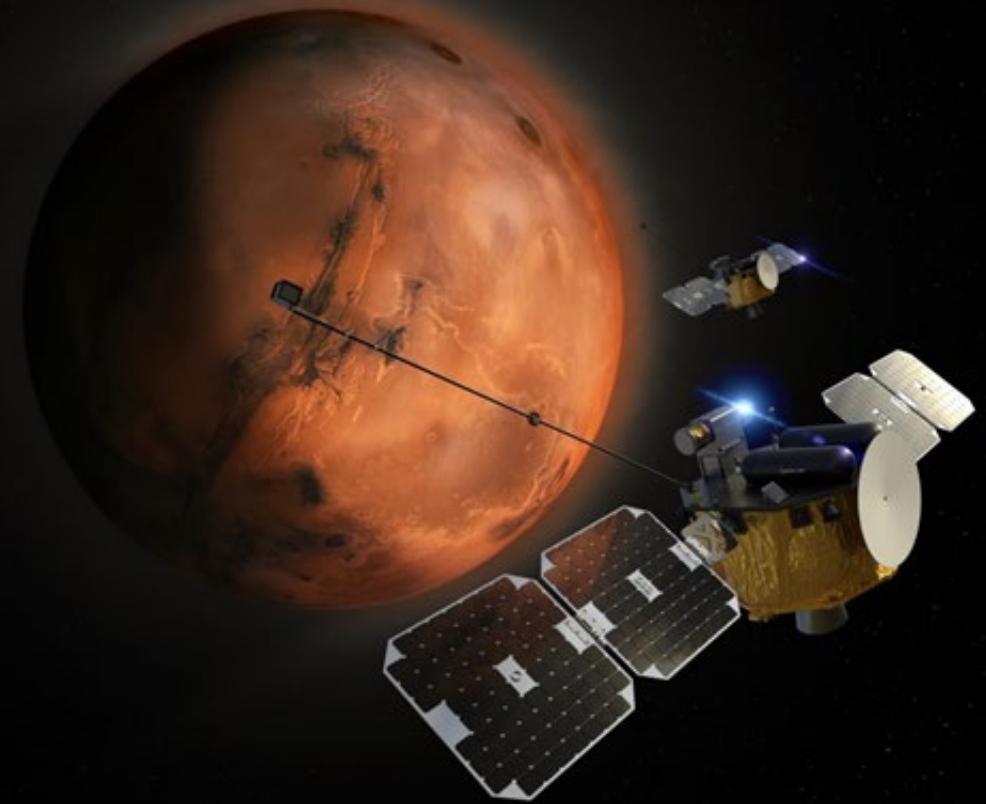
<https://blogs.nasa.gov/awe/>



ESCAPADE

Escape and Plasma Acceleration and Dynamics Explorers

- ESCAPADE will observe how energy and momentum are transported from the solar wind through Mars' magnetosphere.
- Launching NET August 2024
- Will arrive at Mars science orbit April 2026 for 11-month science mission.

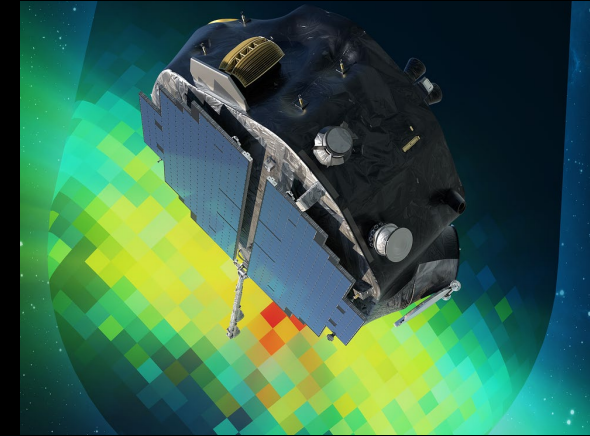


<https://blogs.nasa.gov/escapade/>

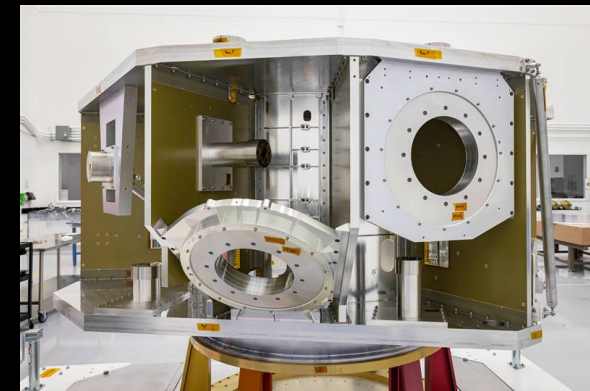
IMAP

Interstellar Mapping and Acceleration Probe

- IMAP, launching in 2025, will address fundamental scientific questions about the local interstellar medium, the boundaries that surround our solar system, and how particles are accelerated to high energies in space.
- Spacecraft integration and testing is ongoing and can be viewed [live here](#).



Credit: APL/Ed Whitman

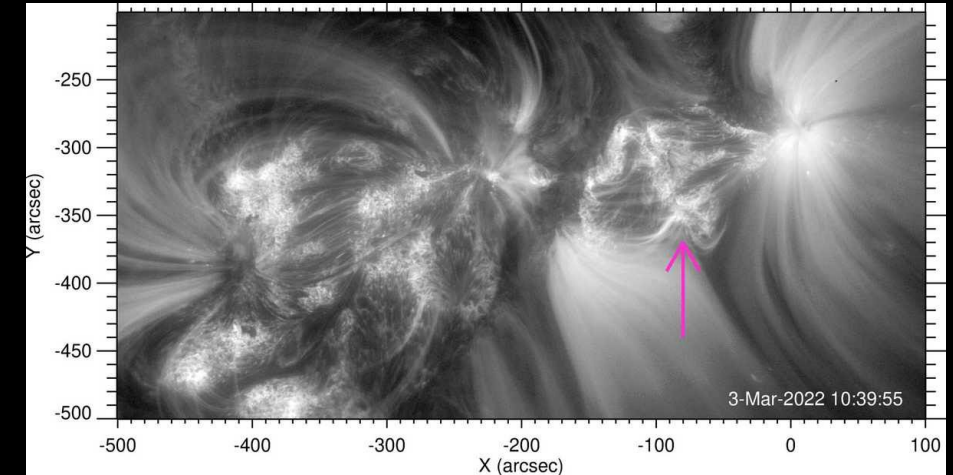


Credit APL/Ed Whitman

For more information, please visit: <https://www.nasa.gov/missions/imap>

SOLAR ORBITER

- **Close-Up Views of Energetic Particle Jets**
 - Solar Orbiter observed the first close-ups of a source of energetic particles expelled from the Sun in March 2022, viewing them from just 0.5 AU.
- **Wide-Angle Views of CMEs**
 - Image of a coronal mass ejection (CME) on April 21 observed by the SoloHI wide-field imager on Solar Orbiter.
 - This CME led to the most extreme space weather event so far in Solar Cycle 25 when it impacted Earth on April 23.
- Solar Orbiter completed perihelion October 7 at 0.29 AU from the Sun.



Close-Up Views of Energetic Particle Jets (image courtesy of SwRI)



2023-04-21 21:59:14

Wide-Angle Views of CMEs

PARKER SOLAR PROBE ORBIT 17 HIGHLIGHT

- This video shows stills, taken 5 minutes apart, from the WISPR Inner instrument during the period of Sept 26 to 29, including when Parker reached its closest ever perihelion of 11.4 Solar Radii (4.9M miles) on Sept 27 23:29
- Several CMEs can be observed, including 3 CME fronts in a row on Sept 28
- Parker Solar Probe's 5th Anniversary was Aug 12
- Reached Perihelion 17 on Sept 27 setting new records for both closest approach to the Sun and highest speeds



Geospace Dynamics Constellation (GDC) and Dynamical Neutral Atmosphere-Ionosphere Coupling (DYNAMIC)

GDC and DYNAMIC provide a whole-system study of upper atmospheric dynamics by combining their scientific and technical capabilities

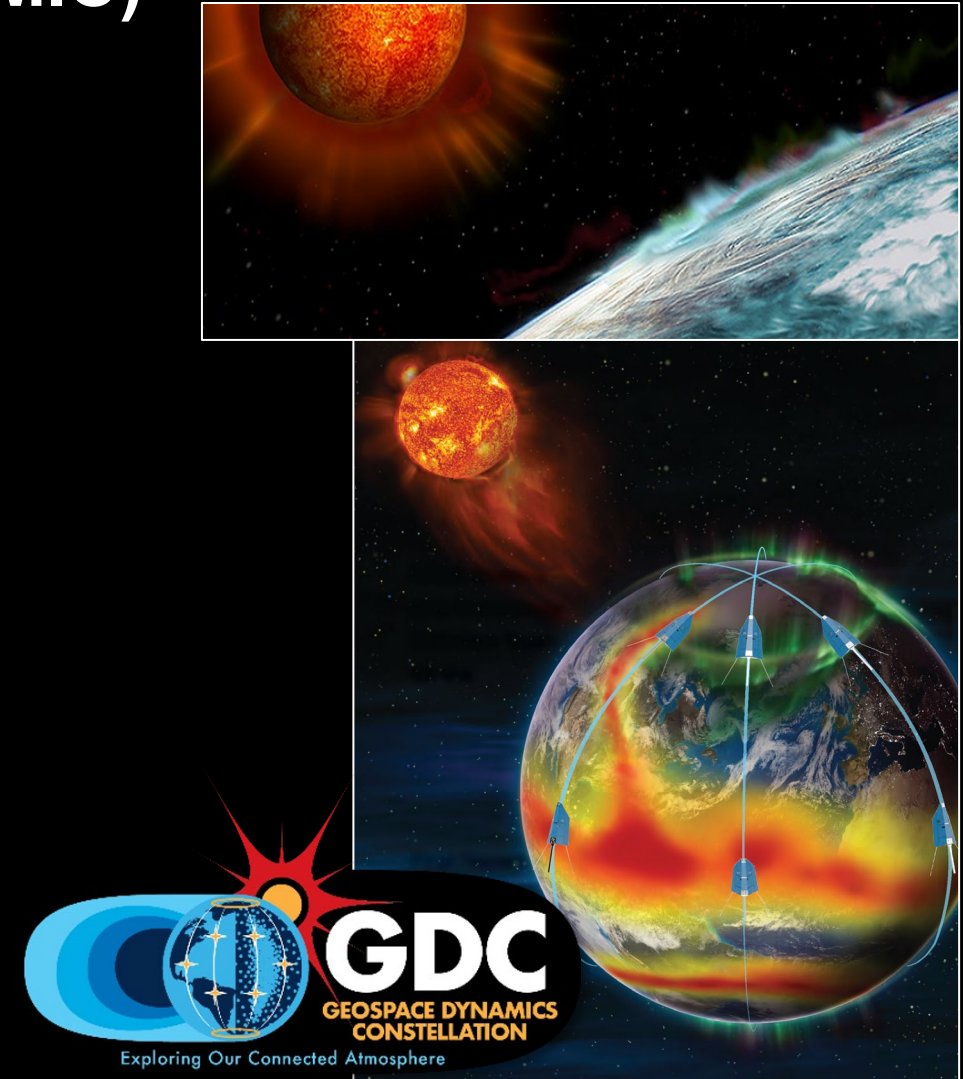
- In science...
 - GDC: Understand the upper atmosphere's internal processes and dynamics, and response to energy inputs from Earth's space environment (*energy from above*)
 - DYNAMIC: Understand the effect of lower atmosphere variability on the processes and dynamics of the upper atmosphere (*energy from below*)
- In architecture...
 - GDC: Provides in situ measurements of the upper atmosphere (above 300 km)
 - DYNAMIC: Provides altitude profiles of the upper atmosphere (below 300 km altitude), leverages GDC measurements

DYNAMIC

- AO allows proposals to assume observations required for DYNAMIC science will be provided by GDC instruments

GDC

- The 2024 President's Budget Request proposed a "pause" in GDC's development

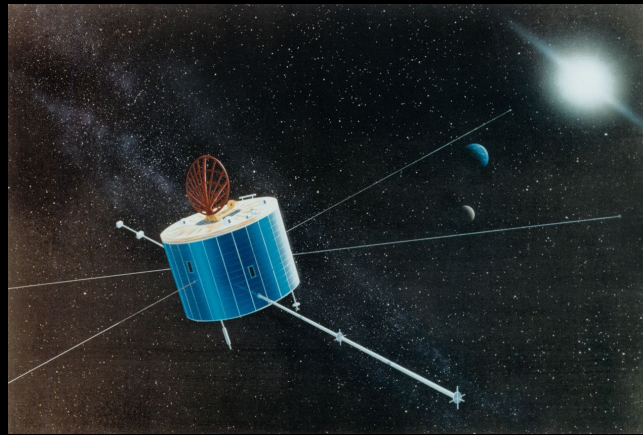


HELIOPHYSICS OPERATING MISSION MANAGEMENT

- Triennial Senior Review is used to evaluate all missions in extended operations
 - 2023 Senior Review was recently completed
 - All functional operating missions are continuing with only minor adjustments to budgets
 - AIM, GEOTAIL, and ICON completed their prime and extended science missions and returned incredible science.



AIM



Geotail



ICON

HELIOPHYSICS SYSTEM OBSERVATORY EXTENDED MISSION MANAGEMENT

- To manage the Heliophysics fleet as a system observatory and maximize science return, HPD modified the 2020 Senior Review Call For Proposals:
 - Separate evaluations for:
 - Project-funded science investigation
 - Project's enduring importance to the Heliophysics Science community
 - Created new category for missions with enduring value to the Science community but insufficient funds to continue to pursue new project-funded science investigations
- Objectives:
 1. Foster scientifically compelling measurement capabilities of long-term extended missions and make them available to broader community through R&A program
 2. Reduce triennial reporting requirements for the missions

PROGRAMMATIC UPDATES

Research and Analysis Update

- Heliophysics R&A Programs have grown significantly since DRIVE Initiative was recommended by 2013 Decadal Survey
- ROSES-2022 overall selection rates ~28%
 - 3 Space Weather Centers of Excellence selected
 - 3 DRIVE Science Centers selected in 2022 have kicked off Phase 2 activities
 - Eclipse 2024 element in ROSES 2022
- ROSES-2023 solicitation provides the greatest scope ever offered for NASA Heliophysics
 - New Technology Program and Space Weather Program
 - Growing number of Cross-Divisional programs

Space Weather Program

Three Space Weather Centers of Excellence selected in August

Space Weather Research to Operations / Operations to Research (R2O2R)

- ROSES-23 focused topics:
 - Data Assimilation for Neutral Density Forecasting
 - Open Call

HERMES & Gateway

- HERMES: Further understanding of the causes of space weather variability
 - Gateway LRD is NET November 2025

Space Weather Pipeline

- Developing four instruments, SPAN-E, SST, ECP-Lite, Faraday Cup for future flight opportunities

ESA Vigil Mission to L5

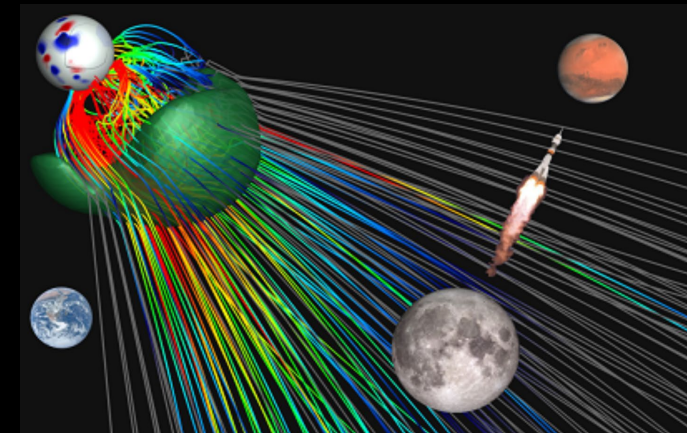
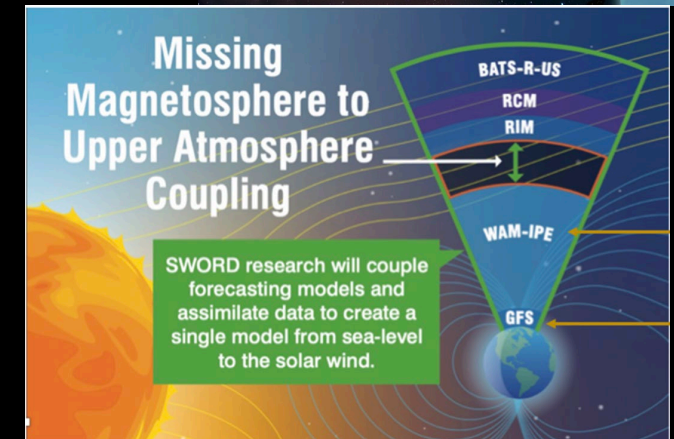
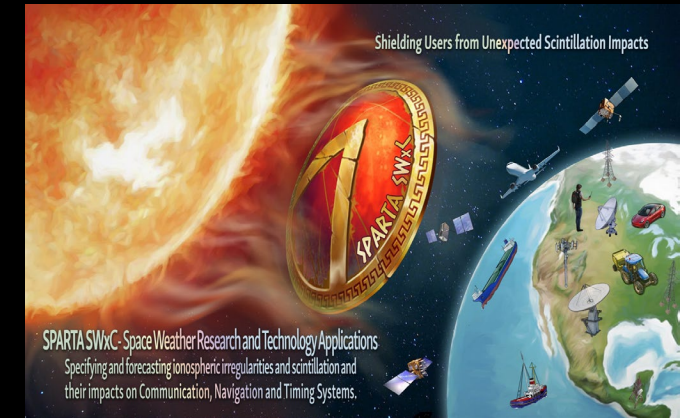
- Vigil AO released June 2023 for NASA contributed EUV imager
- Proposals under review



This photo was taken in the Shenandoah National Park, Virginia on November 5th. It uses a large aperture camera and long exposure time to capture the aurora (SAR arc) during a Kp 7 geomagnetic storm **Credits: Chris Fukuda/WUSA 9**

Space Weather Centers of Excellence

- **Space Weather Research and Technology Applications (SPARTA) Center of Excellence**
 - Principal Investigator: Keith Groves, Boston College
- **Space Weather Operational Readiness Development (SWORD) Center**
 - Principal Investigator: Thomas Berger, University of Colorado, Boulder
- **CLEAR: Center for All-Clear SEP Forecast**
 - Principal Investigator: Lulu Zhao, University of Michigan, Ann Arbor
- **Joint Selection - Center of Excellence for Advanced Forecasting of Drag for Enhanced, Sustainable, and Conscientious Space Operations**
 - Principal Investigator: Piyush Mehta, University of West Virginia, Morgantown



HEliophysics Strategic Technology Office (HESTO)

- In response to the Decadal Survey and a 2019 Congressional mandate, the Heliophysics Division established a Technology Program. The Heliophysics Technology Program strategically invests in the development and demonstration of instruments and technologies to enable infusion into future missions.
- In 2022, the Heliophysics Division created the Heliophysics Strategic Technology Office (HESTO) to help manage the Heliophysics technology program. HESTO will work closely with the [Sounding Rocket Program](#) and [Balloon program](#).

Recent Event

- [Held the first annual NASA Heliophysics Technology Symposium on October 18-19](#)



SMD: Transform to Open Science (TOPS)

NASA has designated 2023 as the Year of Open Science, a global community initiative to spark change and inspire open science engagement through events and activities that will shift the current paradigm.

- TOPS has three overarching goals:
 1. Increase understanding and adoption of open science principles and techniques in our Mission and Research Communities
 2. Accelerate major scientific discoveries through supporting the adoption of open science
 3. Broaden participation by historically excluded communities



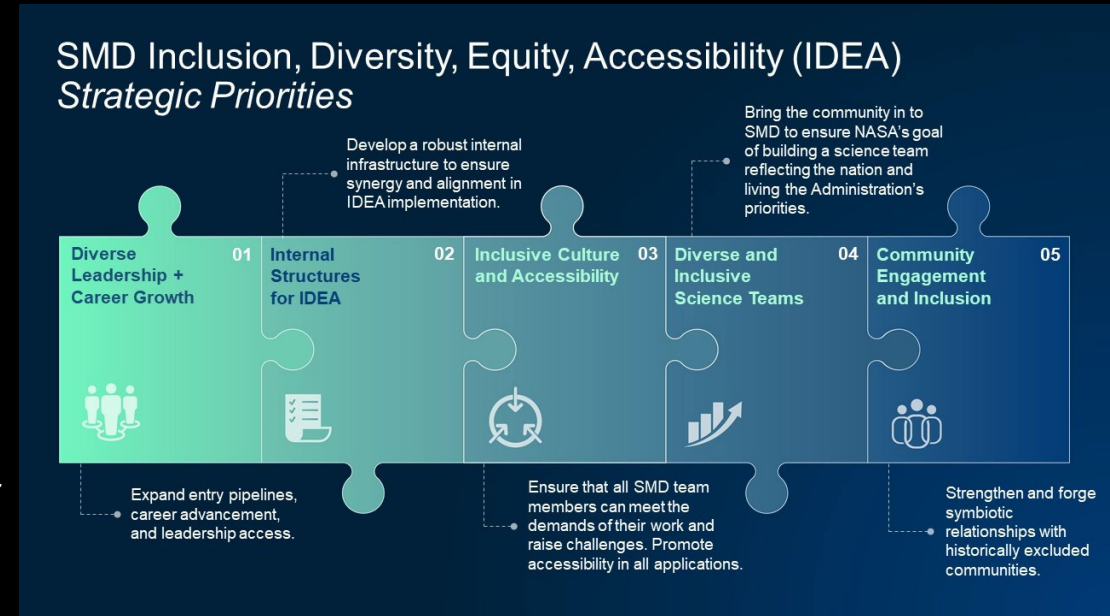
Join the TOPS email list: <https://science.nasa.gov/open-science/transform-to-open-science>

IDEA: Inclusion, Diversity, Equity, and Accessibility at SMD

SMD aims to create an environment where each team member is valued for their diversity of thought, unique background and whole selves. As indicated in the NASA Science Plan and reflecting NASA's Core Value of Inclusion, the Science Mission Directorate is committed to actualizing an environment where Inclusion, Diversity, Equity and Accessibility (IDEA) principles are ways of working and being.

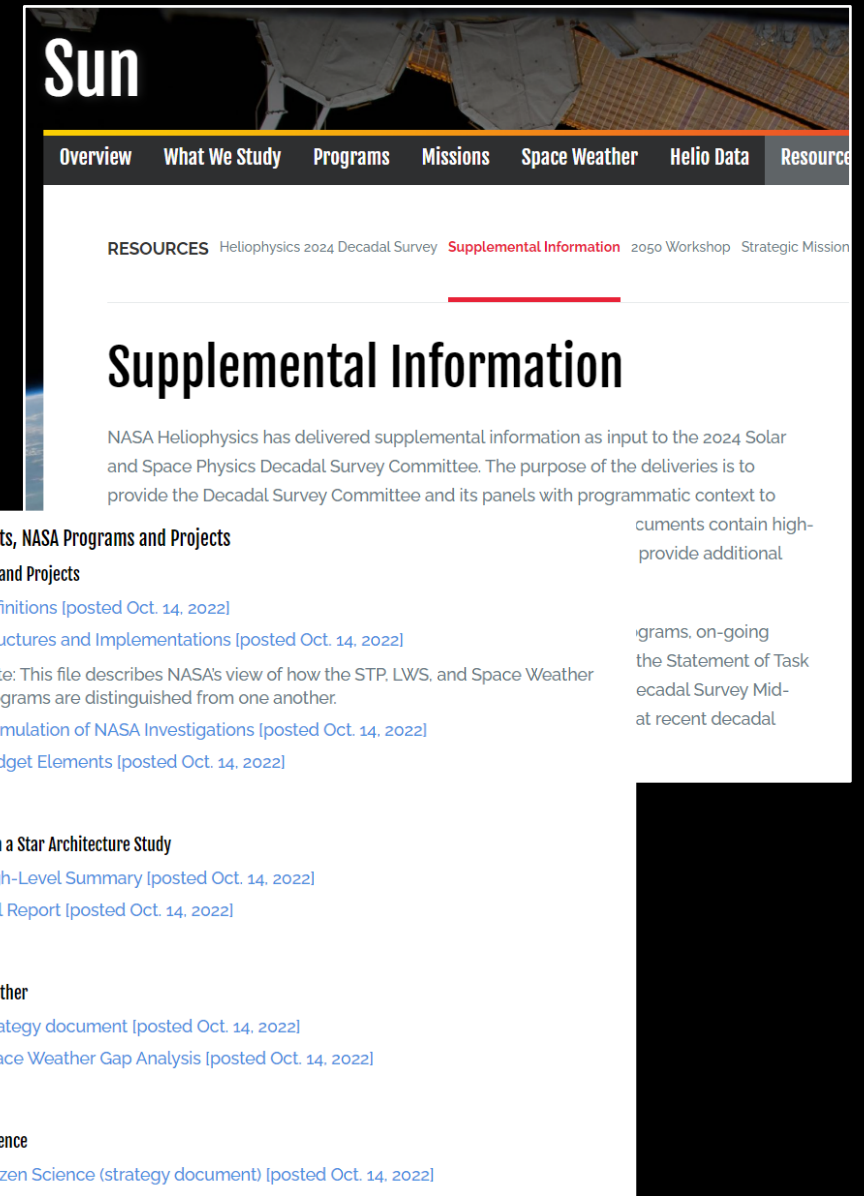
SMD Activities to Date:

- Launch of SMD Bridge Program to develop sustainable partnerships among institutions historically under-resourced
- Inclusion plan pilot and expansion
- PI Launchpad to support first-time proposers, the annual PI Launchpad workshop provides resources and insight into the proposal process.
- Adoption of dual-anonymous peer review for ROSES proposals to ensure that the review of proposals is performed in an equitable and fair manner.
- Development of a template code of conduct for mission teams
- Sponsoring and incentivizing enhanced and innovative outreach activities with IDEA focus
- Listening sessions with early career students and faculty to identify barriers for underrepresented groups
- Collection, evaluation, and publication of demographics of ROSES proposers and awardees

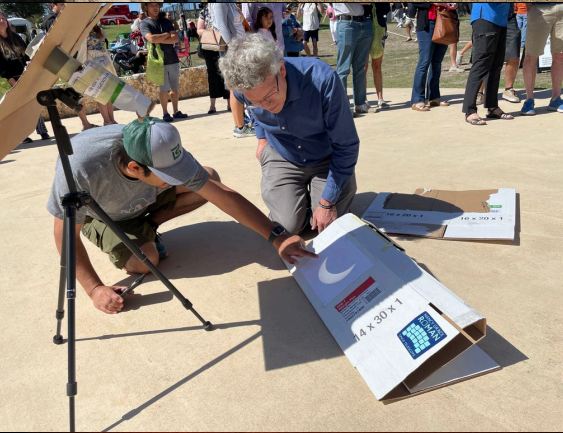


Decadal Survey Resources

- Visit the National Academy of Sciences' Decadal Survey website for the latest up-to-date information!
- Panel teleconferences ongoing
- NASEM website lists the latest announcements and upcoming events
- NASEM is the authoritative resource for the latest on the Decadal
- <https://www.nationalacademies.org/our-work/decadal-survey-for-solar-and-space-physics-heliophysics-2024-2033>
- **NASA Heliophysics Decadal Survey Website**
- Provides informational materials provided to NASEM
- <https://go.nasa.gov/HelioDecadal>







TOTAL SOLAR ECLIPSE



April 8, 2024



<https://science.nasa.gov/eclipses/>



PATH OF TOTALITY

2024 Total Solar Eclipse

12:20 PM CST

12:25 CST

12:30 CST

1:30 CDT

1:35 CDT

1:40 CDT

1:45 CDT

1:50 CDT

1:55 CDT

2:00 CDT

2:05 EDT

3:05 EDT

3:10 EDT

3:15 EDT

3:20 EDT

3:25 EDT

3:30 EDT

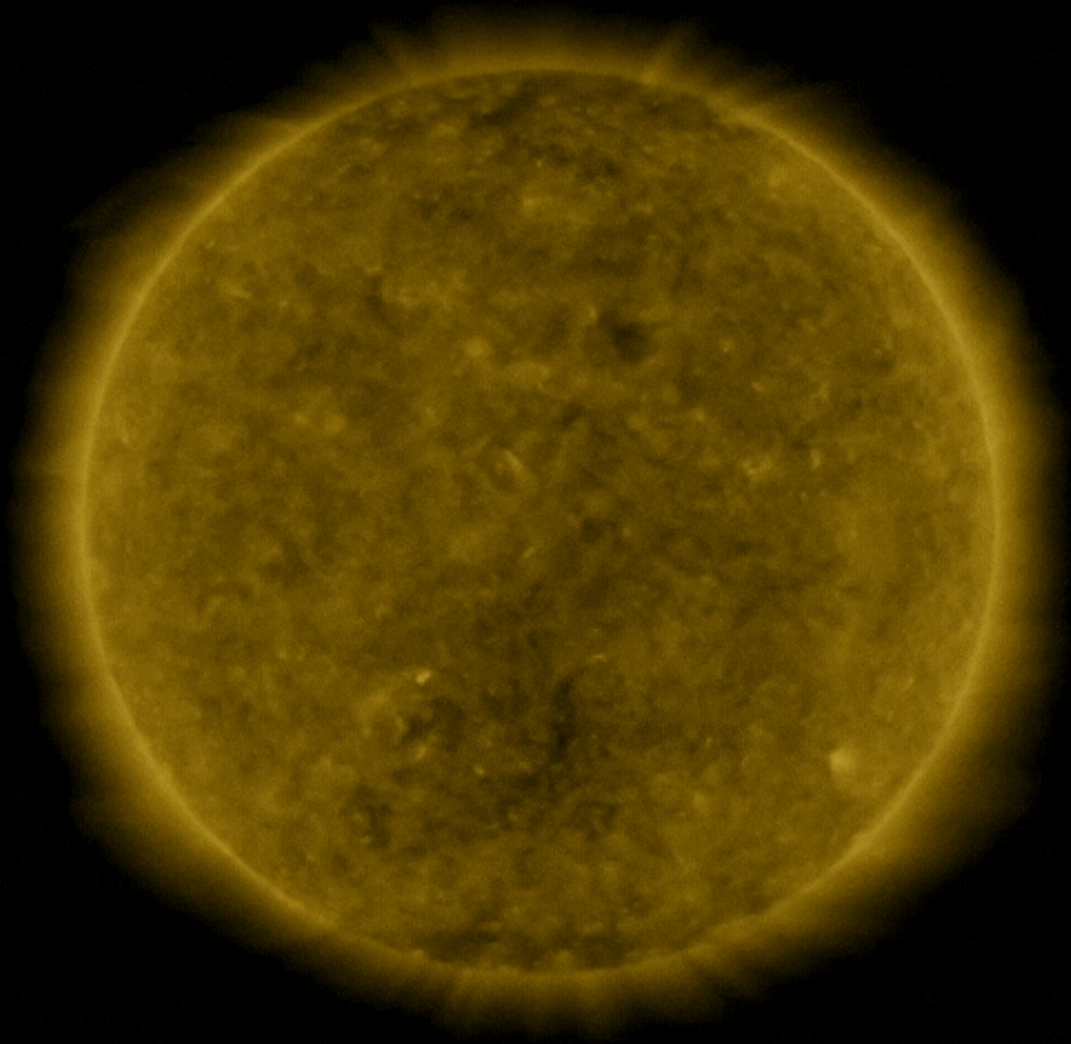
4:35 PM ADT

PARKER SOLAR PROBE MILESTONES & SCIENCE

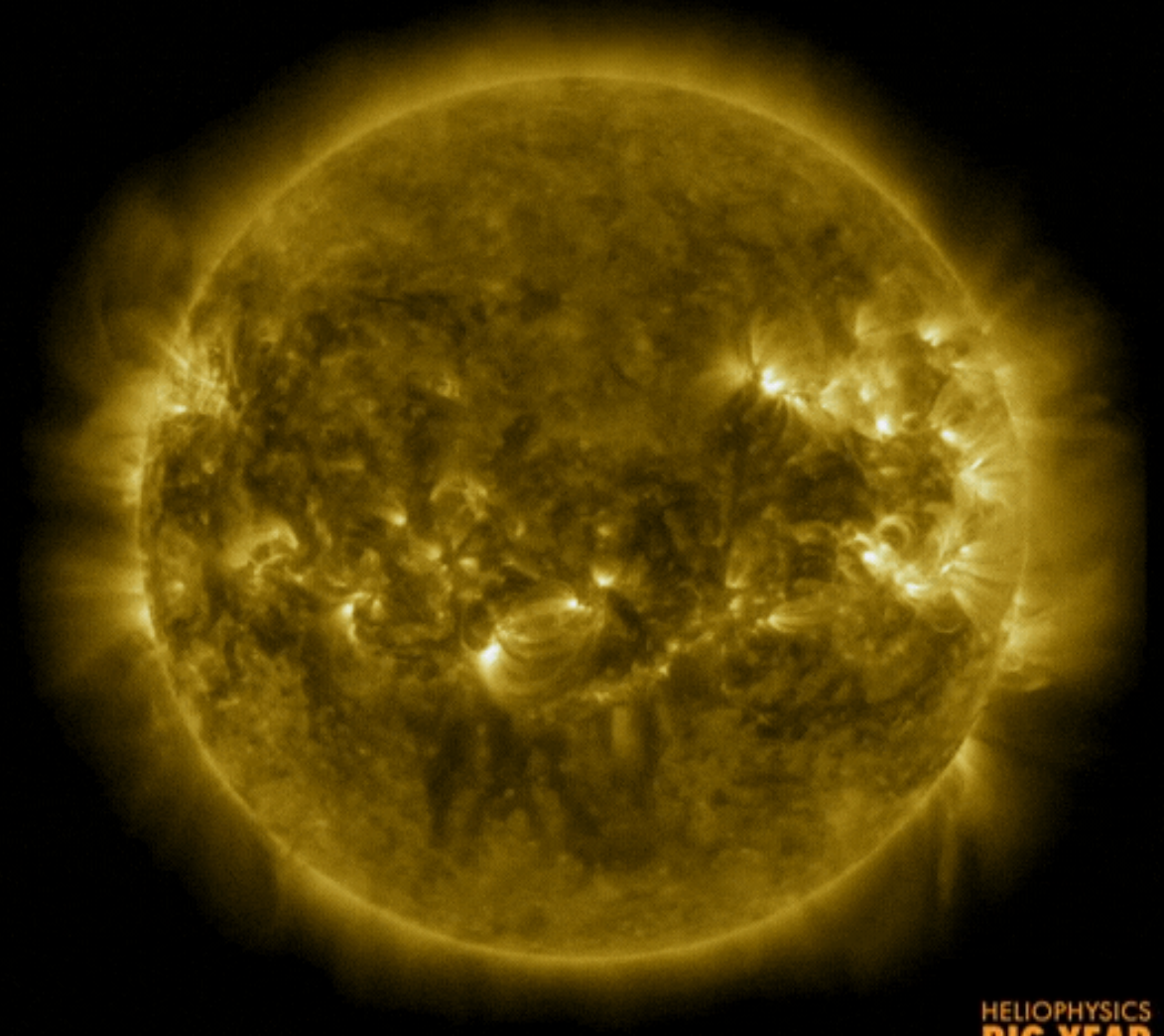


bit.ly/45oXnNX

SOLAR MINIMUM



SOLAR MAXIMUM



BACKUP