National Aeronautics and Space Administration

NASA

2024 NASA SCIENCE

NASA Heliophysics Division Update to HPAC

Dr. Joseph Westlake
Heliophysics Division Director
October 22, 2024

HPD Leadership

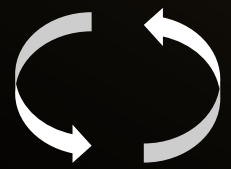
NASA Heliophysics Division Leadership

Dr. Joseph (Joe) Westlake
Division Director

Nicole (Nicki) Rayl
Deputy Division Director (Acting)

Dr. Therese Moretto Jorgensen
Director of Research

Brad Williams
Associate Director for Flight (Acting)

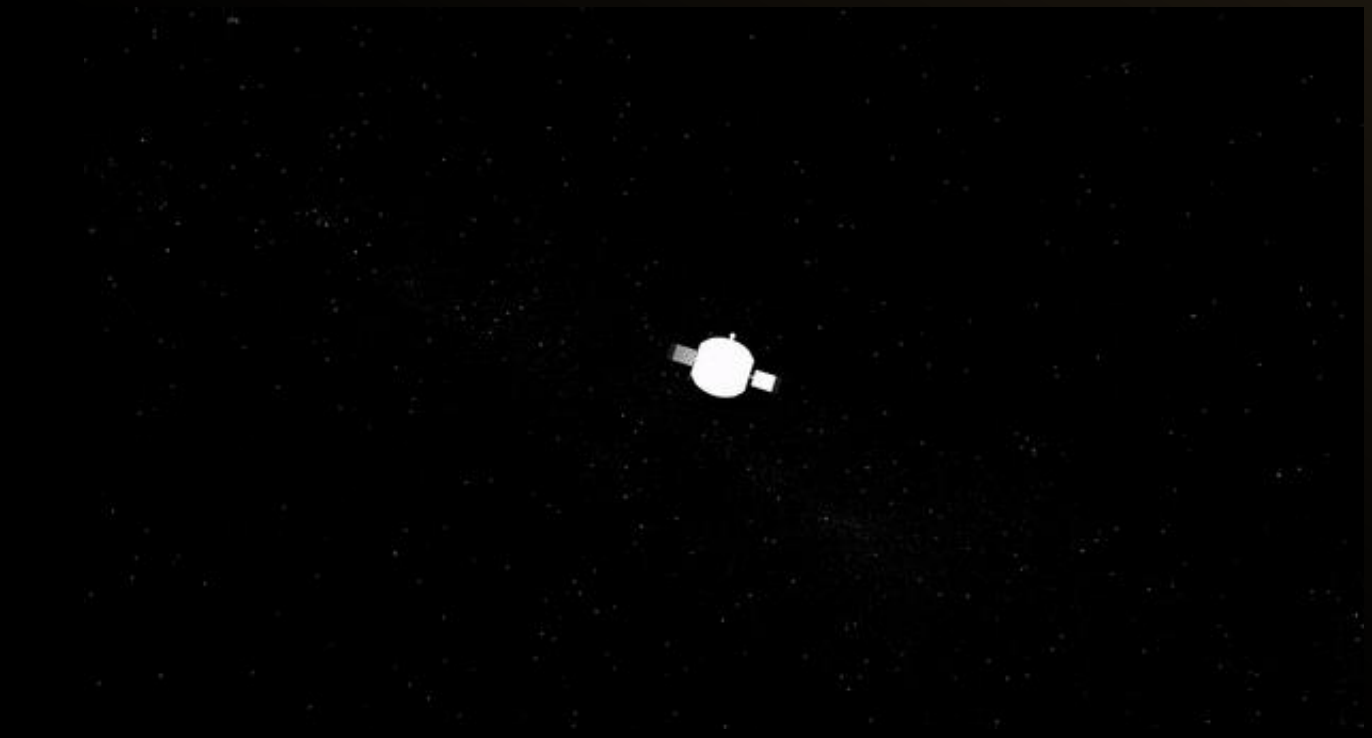


Acting Director/Deputy Roles Rotate

Dr. Asal Naseri
Deputy Associate Director for Flight (Acting)

Heliophysics Notable Events

Parker Solar Probe

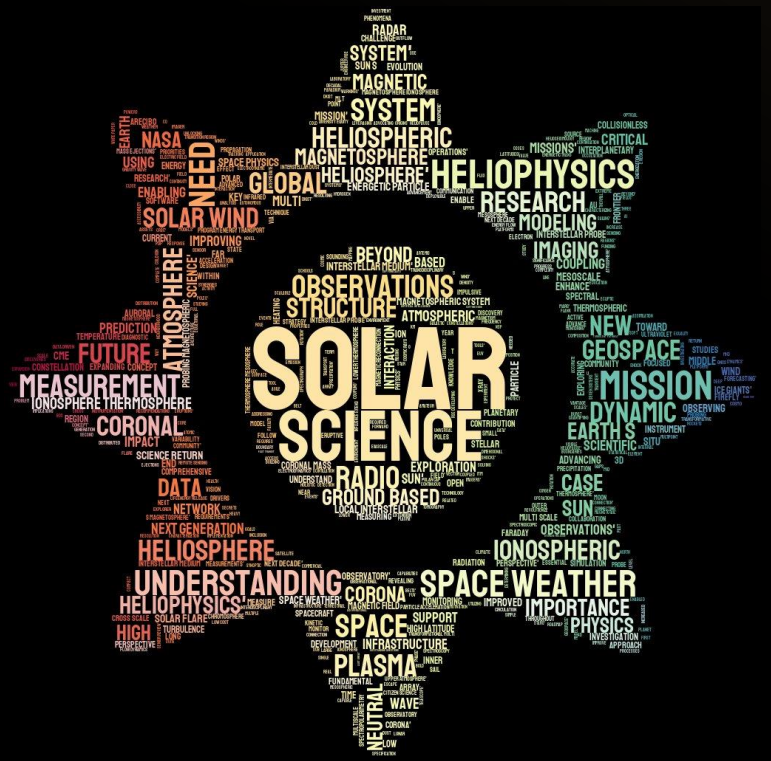


NASA’s Parker Solar Probe completed 20th close approach to the Sun!

On June 30, 2024, Parker Solar Probe matched its own distance record by coming about 4.51 million miles (7.26 million kilometers) from the solar surface.

2024 Decadal Survey is Coming Soon

250 white papers submitted!



Word cloud of the Heliophysics Decadal White Paper titles.
Credit: James Paul Mason

Expected late CY 2024

*The importance of the Decadal Survey cannot be overstated. This is **the** opportunity to set a vision for the next decade and beyond!*

For current information, visit the NAS website: https://nas.edu/ssphdecadal

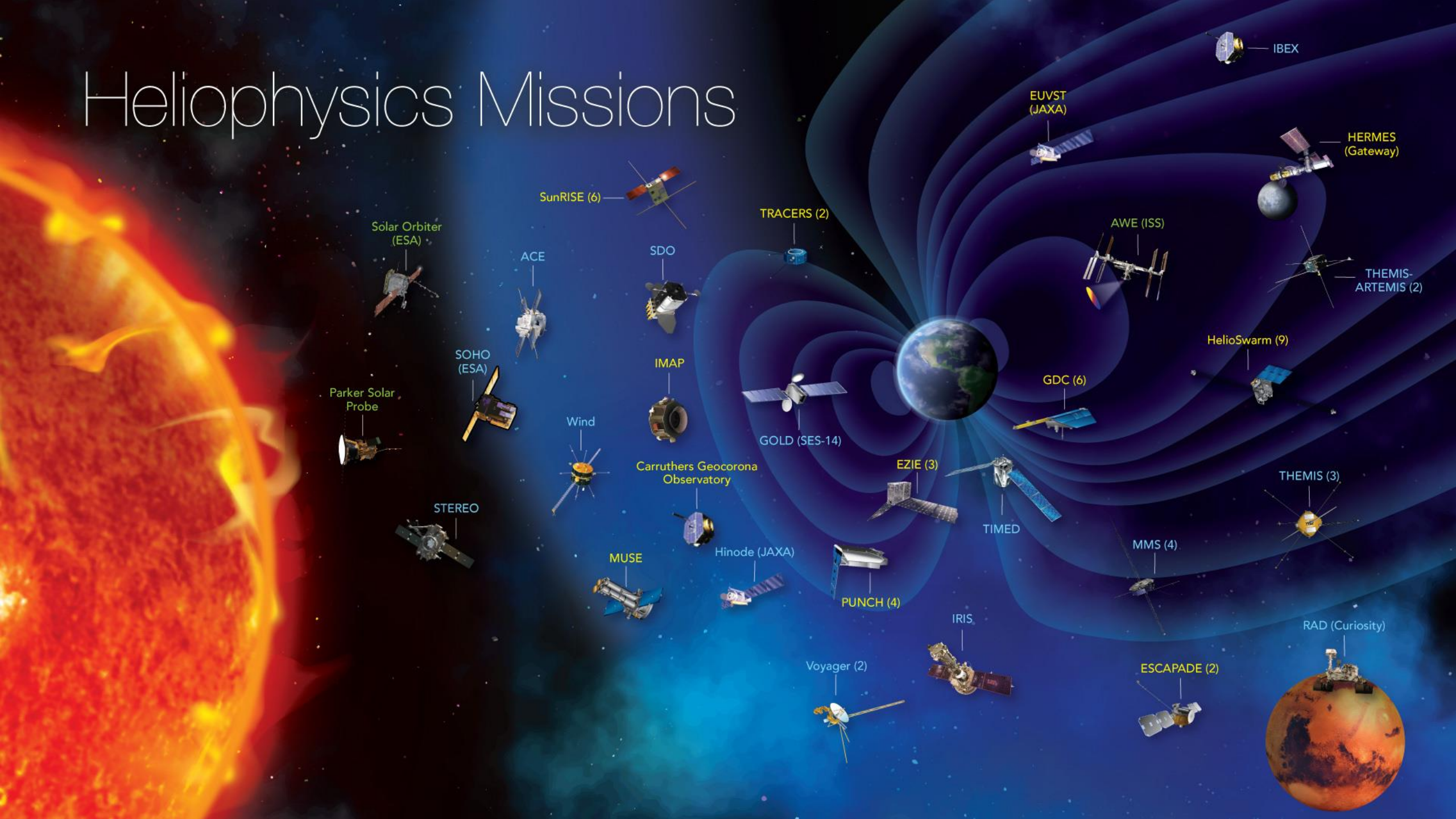
For supporting information delivered to the Decadal Survey, visit: https://go.nasa.gov/HelioDecadal (Resources → Supplemental Information)

NASA's initial response to the Decadal Survey planned for early 2025

Image credit: National Academies of Science website

Mission Highlights

Heliophysics Missions

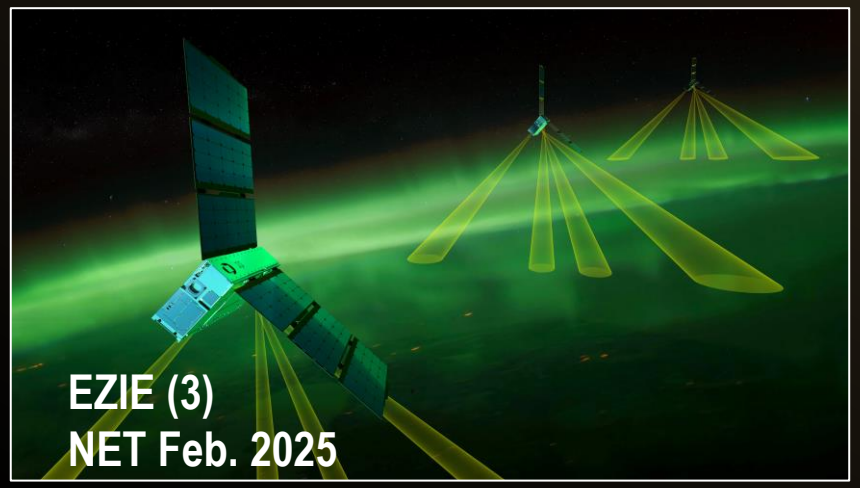


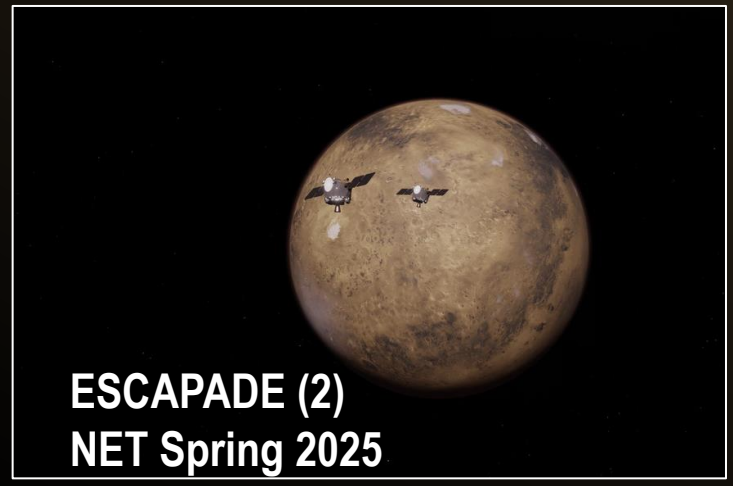
Happy (belated) 47th Birthday to Voyager!

Artist’s Concept of Voyager 2

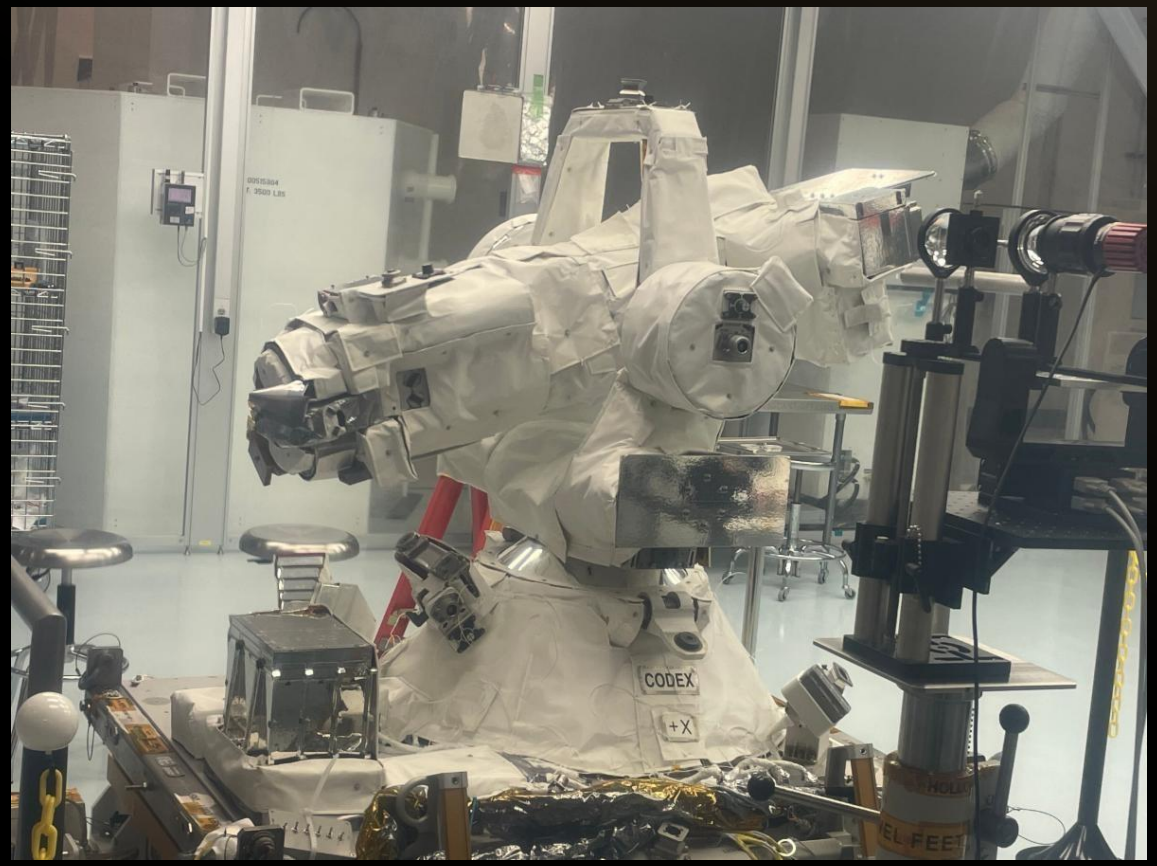
Artist's Concept of Wind

Upcoming Heliophysics Mission Launches





CODEX



COronal Diagnostic Experiment (CODEX) is a collaboration between NASA, the Korea Astronomy and Space Science Institute, and Italian National Institute for Astrophysics that will fly aboard the International Space Station.

This modern coronograph will use multiple filters to obtain simultaneous measurements of electron density, temperature, and velocity of the solar wind for the ***first time*** within a single instrument.

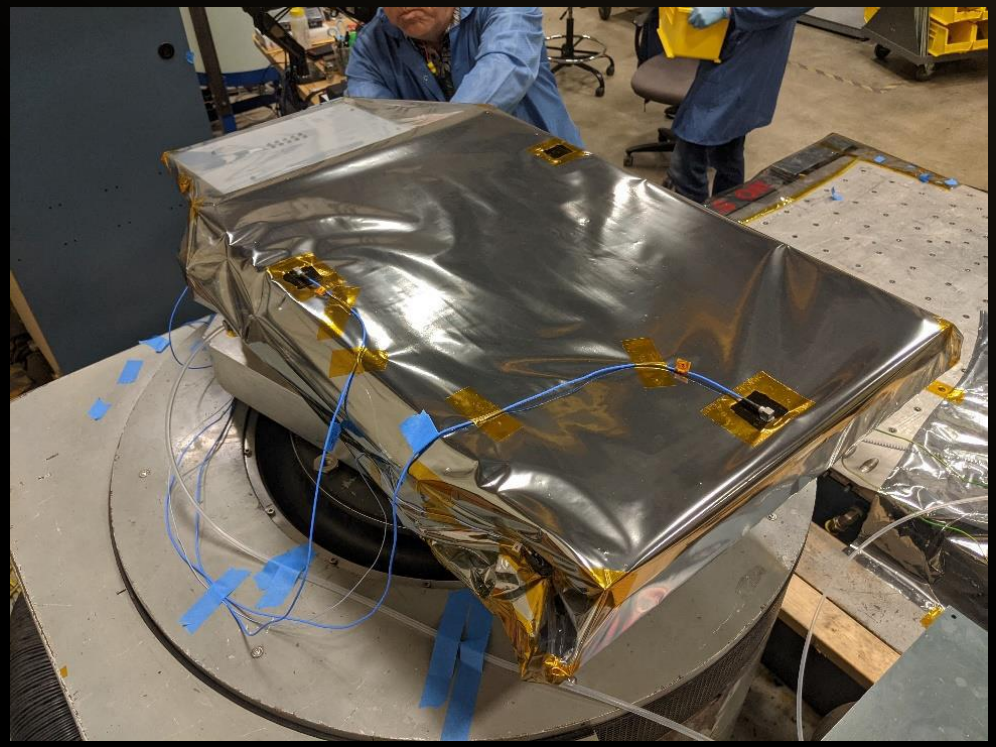
CODEX is scheduled to fly aboard SpaceX Falcon 9 CRS-31 from Kennedy Space Center later this year.

EZIE

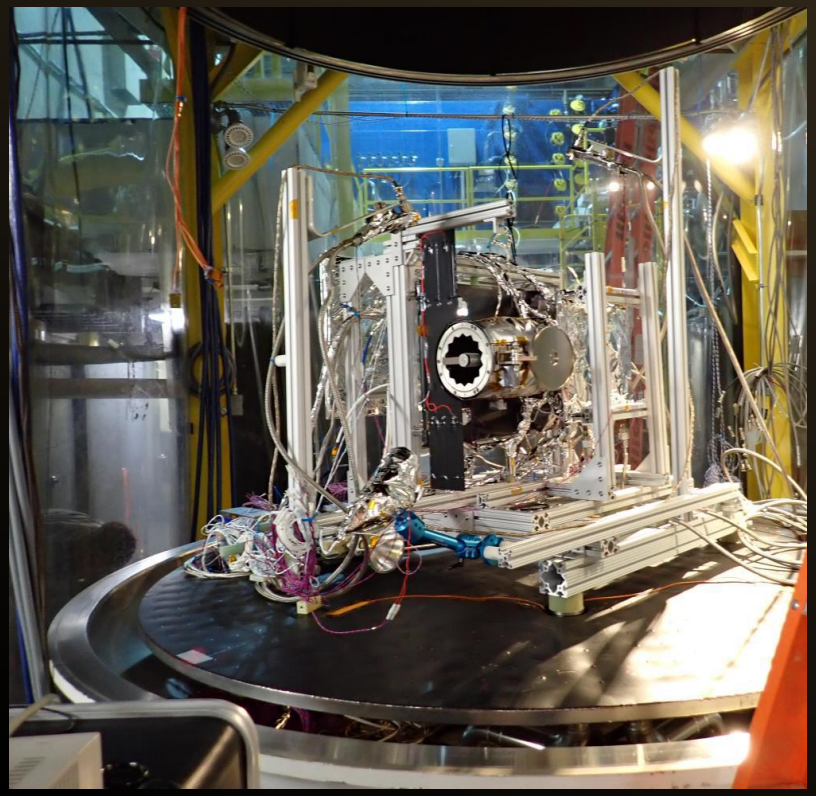
Blue Canyon Technologies (BCT) technicians Davy Hong and Dave Biancalana attach a solar array to the bus of the Electrojet Zeeman Imaging Explorer (EZIE) CubeSat. *Brooks Freehill, Blue Canyon Technologies*

Members of the Electrojet Zeeman Imaging Explorer (EZIE) team representing NASA, the Johns Hopkins Applied Physics Laboratory (APL) in Laurel, Maryland, Blue Canyon Technologies (BCT) in Boulder, Colorado, and Maverick Space Systems in San Luis Obispo, California, pose with the EZIE SV-B Space Vehicle after completing vibration testing. *Lauren Ransom, Blue Canyon Technologies*

PUNCH

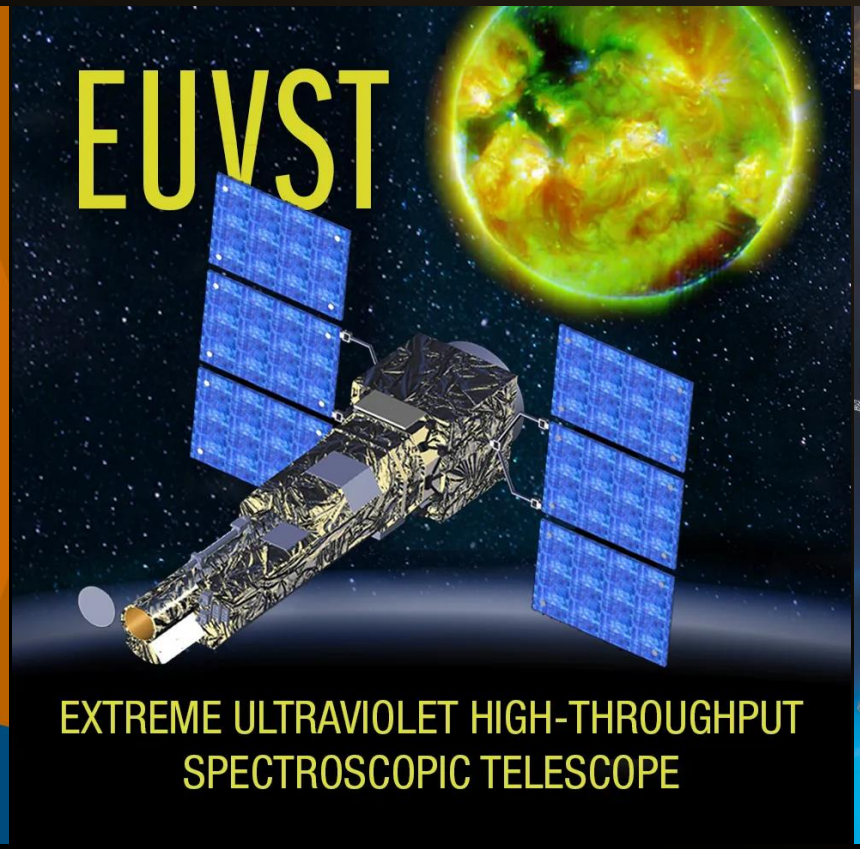


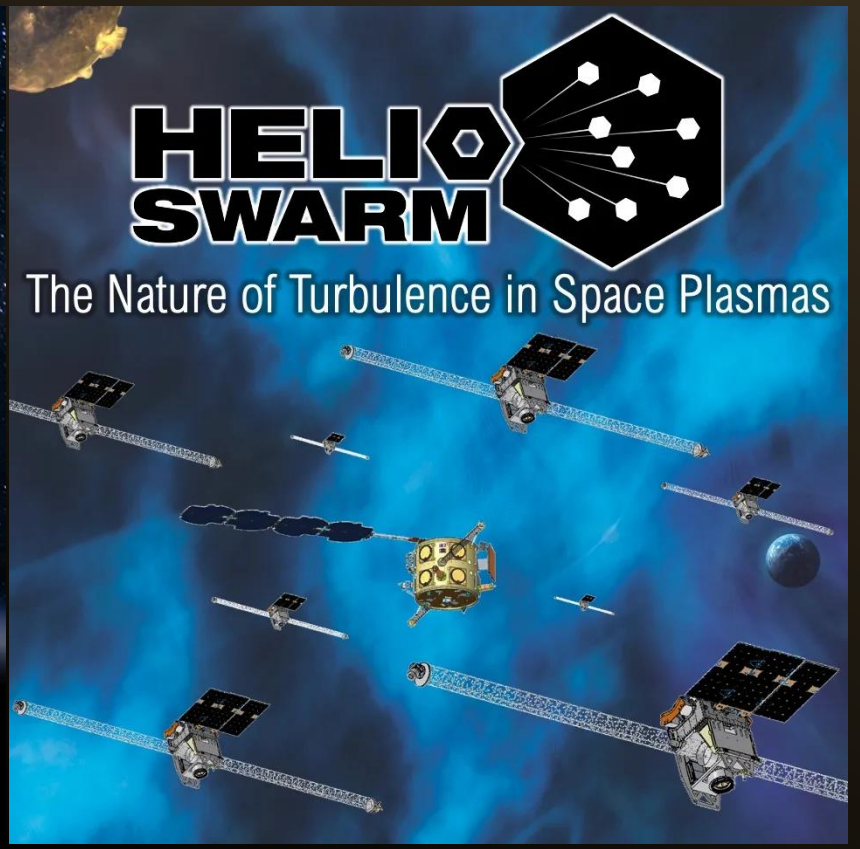
PUNCH Wide Field Imager undergoes vibration testing



PUNCH Near Field Imager undergoes thermal vacuum testing

Missions in Development





NASA's Sounding Rockets Program

- Current motor inventory is healthy
- FY24
  - 17 missions launched (4 missions moved to FY25)
  - 2 campaign deployments to Poker Flat (4 total launches)
  - Two eclipse campaigns = 6 total launches from White Sands and Wallops
  - Solar flare campaign from Poker Flat Research Range
  - First use of upgraded SPARCS (solar pointing system) with MaGIXS launch at White Sands (successful)
  - 2 student outreach launches from Wallops
- FY25
  - 18 missions total on manifest
  - Four campaign deployments (Norway, Poker-x2, Kwajalein)
  - May begin Peru site improvements
- FY26
  - Currently 12 missions total (updates expected)
  - Three campaign deployments (Norway, Poker, Kwajalein)

CAPTION: Recovery of the second flight of the Marshall Grazing Incidence X-ray Spectrometer (MaGIXS) at the White Sands Missile Range (PI: Amy Winebarger, MSFC). The payload is a technology development science demonstration that successfully captured soft X-ray spectra of resolved features within solar active regions. Pictured are instrument team members, sounding rocket engineers, and military range personnel.

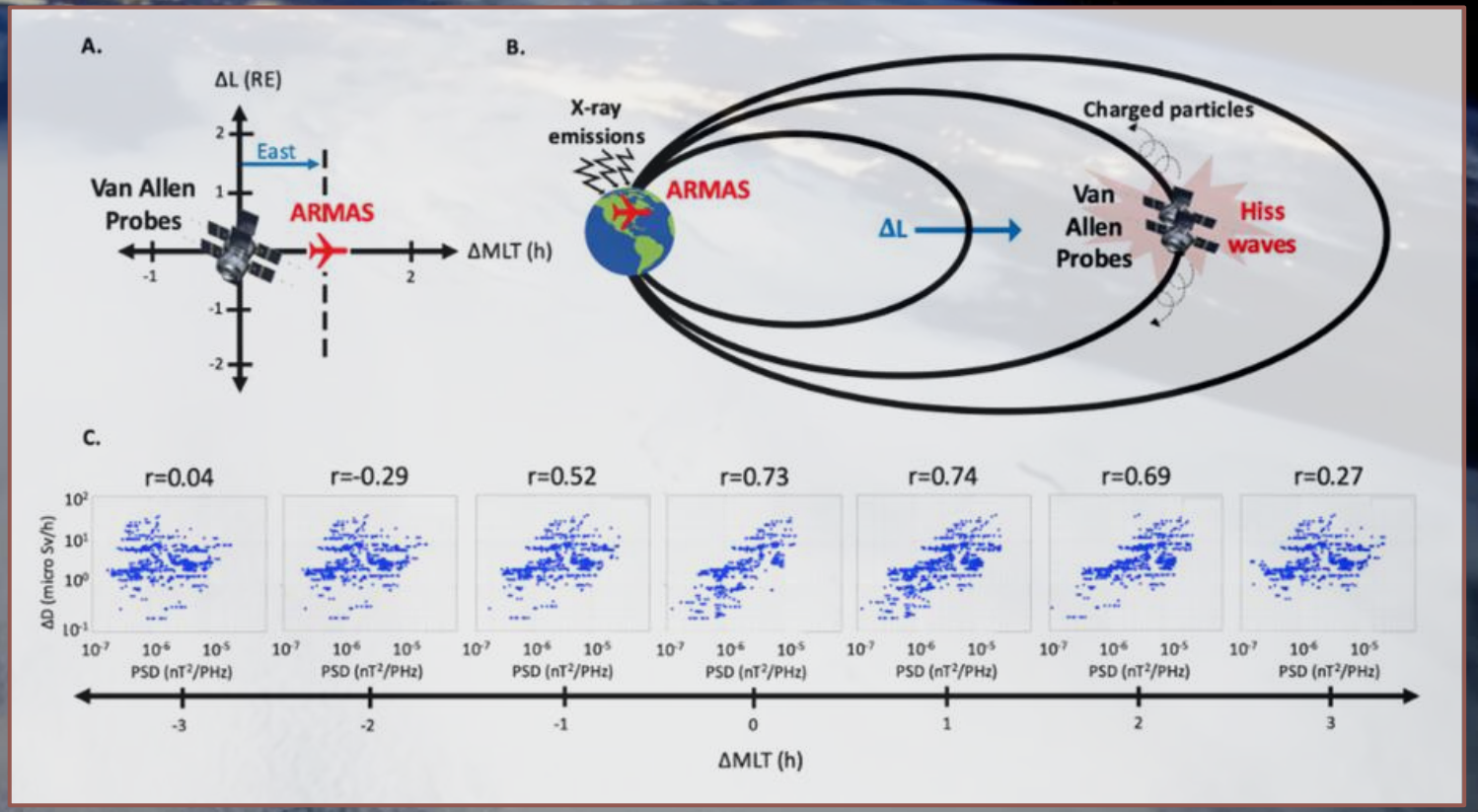
Heliophysics Community Science Nuggets

Electron Precipitation Causes X-Ray Enhancements on Commercial Flights

Electron precipitation driven by *plasmaspheric hiss waves* causes X-ray enhancements on commercial flights.

Connection observed between space weather from satellites to radiation exposure onboard flights

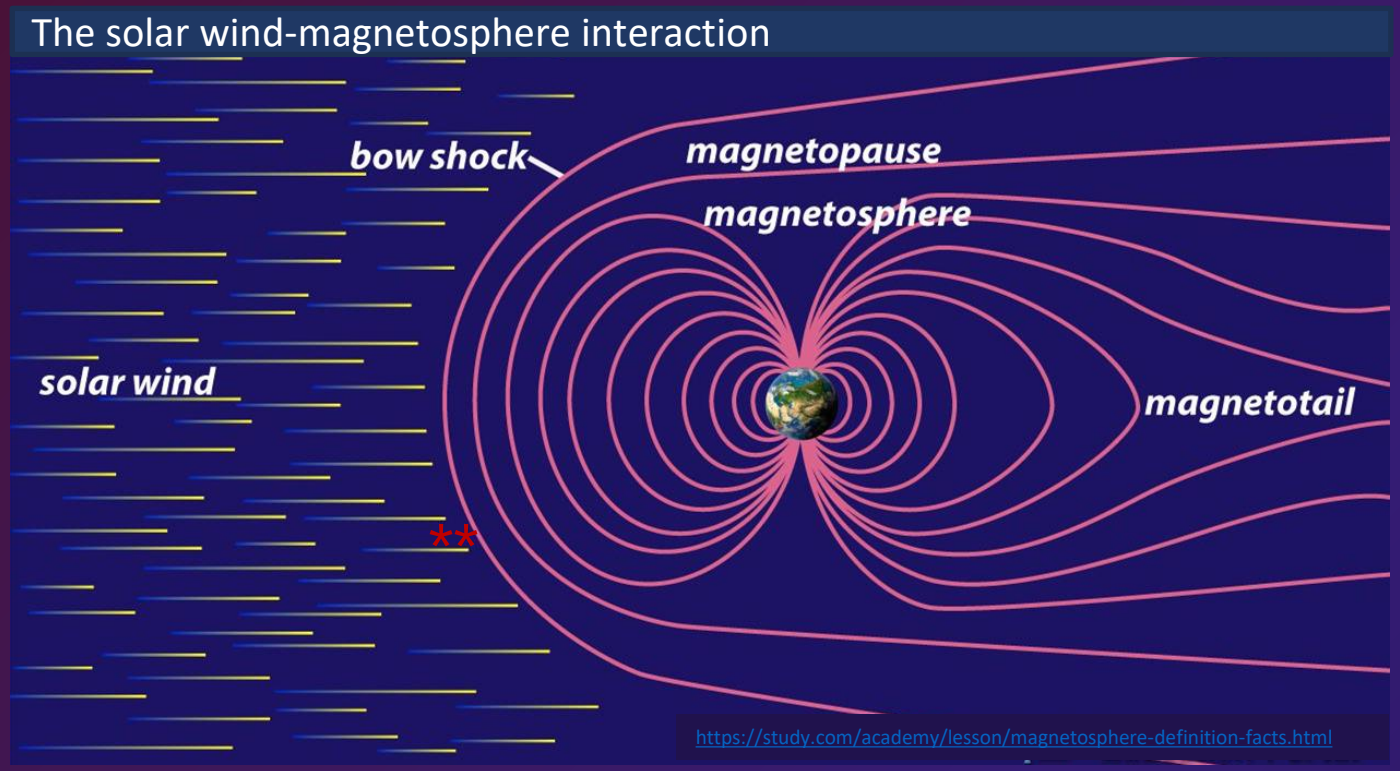
This helps in further protecting airline passengers and crew from excessive radiation during geomagnetic storms.

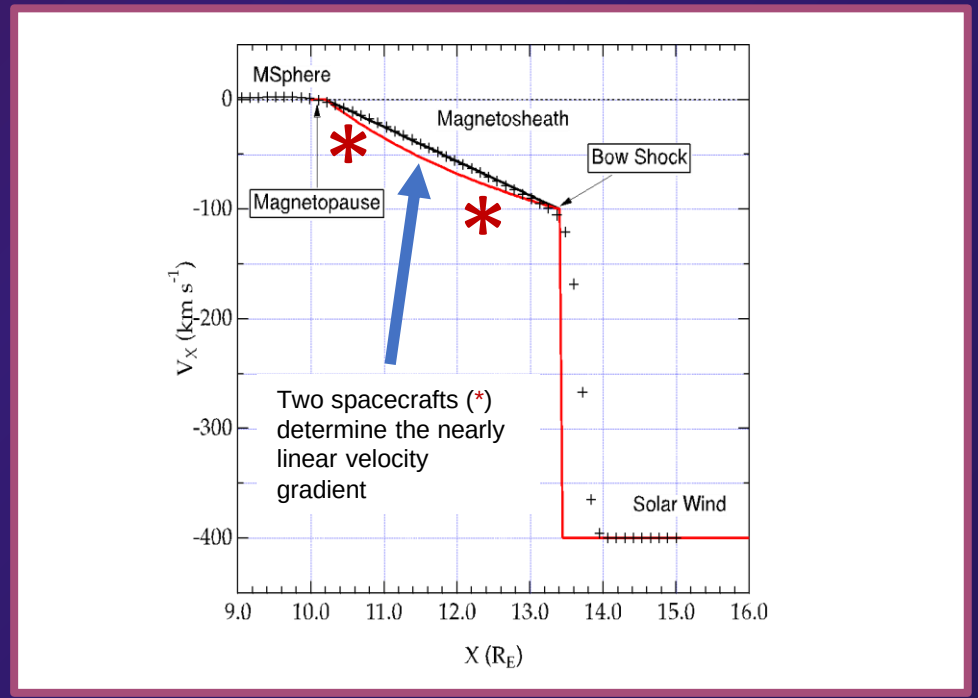


Plasmaspheric hiss waves are emissions of energy that scatter electrons into the atmosphere. They are like the space equivalent of static noise when tuning to a radio station.

PI: Bortnik, J. ROSES 2021

Multi-satellite Tracking of Bow Shock and Magnetopause Locations





Shocks occur when supersonic streams of charged particles (e.g. solar wind) encounter obstacles like the boundaries of the magnetosphere. The Earth's shock bends into a "bow" shape. The location and motion of both the bow shock and magnetopause provide crucial information on how the solar wind interacts with our magnetosphere.

- Multipoint THEMIS observations show that changes in the speed and direction of plasma can be used to track the magnetopause and bow shock locations remotely.
- Researchers can now continuously track magnetopause motion to distinguish between the two leading models for the solar wind-magnetosphere interaction: steady or bursty reconnection on the dayside magnetopause.
- This will guide the development of accurate first principle space weather forecast models.

PI: Sibeck, D. ROSES 2022

Programmatic Updates

Research & Analysis Update

RECENT ROSES-23 SELECTIONS

HSR 2023 (notified 10.20.23)	HGIO 2023 (notified 1.08.24)	HFOS 2023 (notified 1.25.24)	HTIDES 2023 (notified 1.25.24)	LWS 2023 (notified 5.01.24)
• 161 proposals received • 24 selected • 14% selection rate	• 82 proposals received • 19 selected • 23% selection rate	• 6 proposals received • 1 selected • 17% selection rate	• 26 proposals received • 6 selected • 23% selection rate	• 62 proposals received • 16 selected • 26% selection rate

ROSES-2023 solicitation provided the greatest scope ever offered for NASA Heliophysics

- New Technology Program and Space Weather Program
- Growing number of Cross-Divisional programs

Maintaining a robust R&A program through solicitation of 25 ROSES-24 elements

NASA DRIVE Science Centers

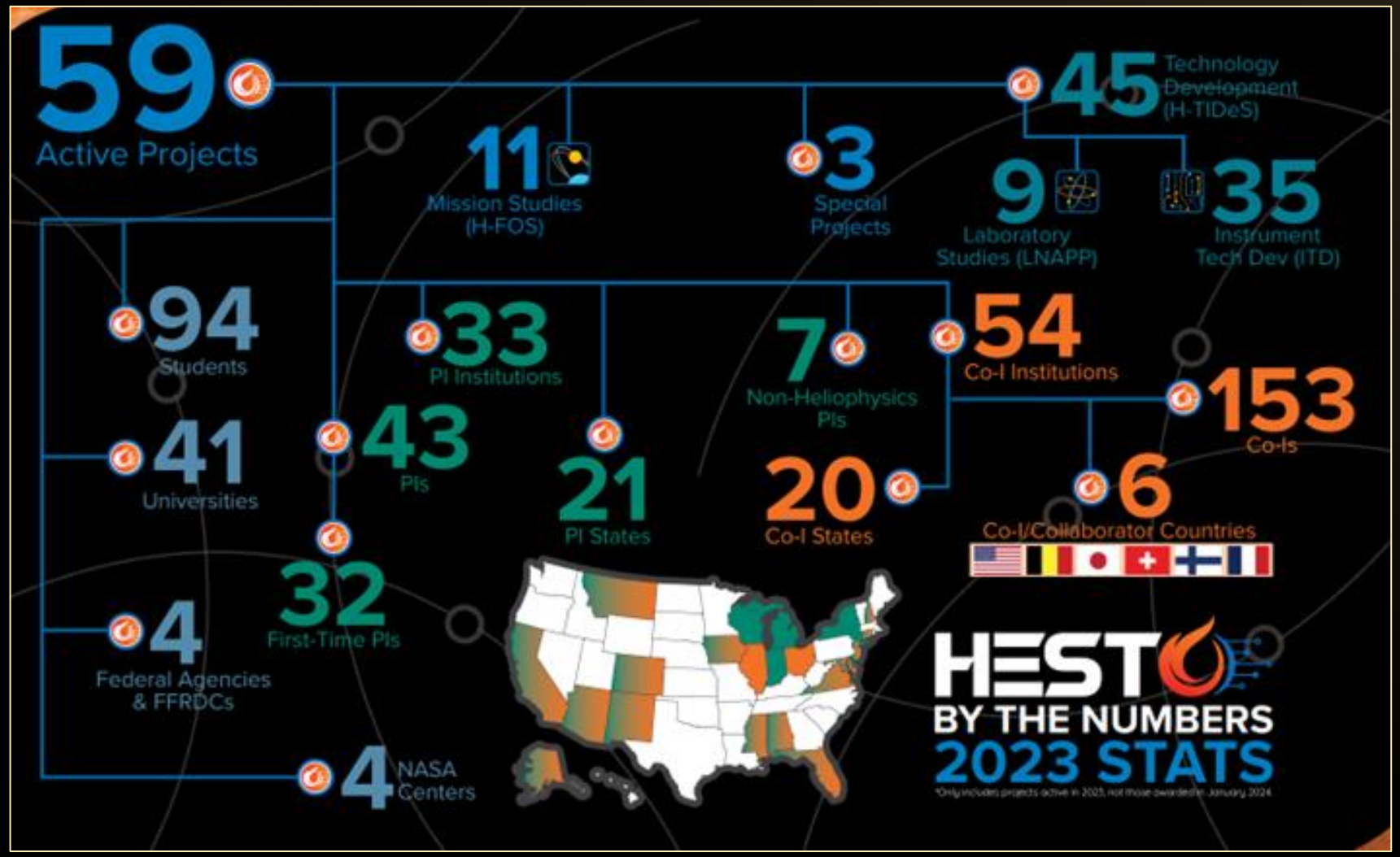
In response to the 2013 Heliophysics Decadal Survey, NASA established three DRIVE (Diversify, Realize, Integrate, Venture, Educate) Science Centers to create breakthrough science in heliophysics by integrating models from different domains and approaches.

COFFIES: Consequences of Fields and Flows in the Interior and Exterior of the Sun

CGS: Center for Geospace Storms

SHIELD: Solar wind with Hydrogen Ion charge Exchange and Large-Scale Dynamics

Heliophysics Strategic Technology Office (HESTO)

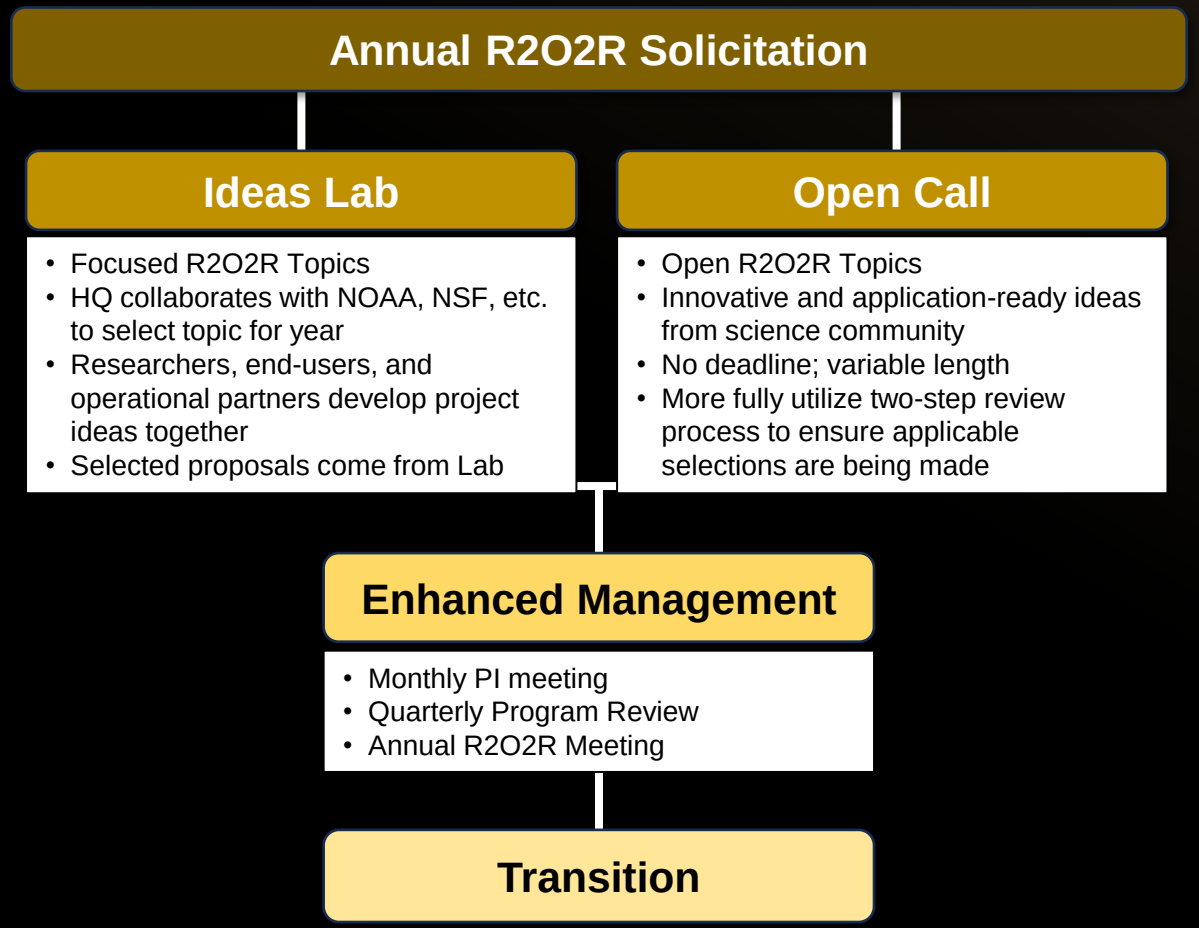


HESTO helps manage the Heliophysics technology program, which works closely with the Sounding Rocket Program and Balloon program.

Recent Accomplishments:

- Held the 2nd 2024 Heliophysics Technology Symposium on September 18-19, 2024 at the Wallops Flight Facility
- Launched the Heliophysics Technology website (hesto.smce.nasa.gov)
- Released the first annual Heliophysics Technology report (on HESTO website)

NASA Space Weather Program
R2O2R Program Element – New Approach



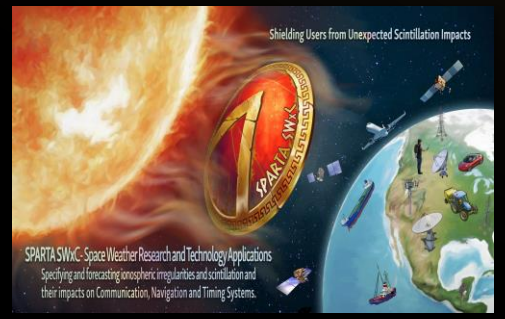
New approach **continues to meet NASA's responsibilities** as defined in PROSWIFT Act, National Space Weather Strategy & Action Plan, etc.

New approach **addresses issues & actions** identified by NASA, NOAA, NSF, DoD, and the science community. **Truly interagency approach**.

New **approach leverages successful pilot efforts and lessons learned** from similar programmatic activities (i.e., UK SWIMMR and NASA Applied Sciences)

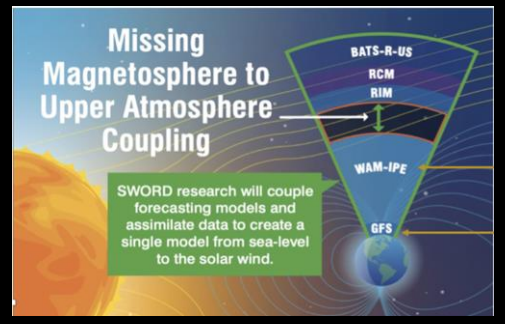
NASA Lead: Dr. Lisa Winter, Program Scientist (on detail from NSF)
NASA Deputy Lead: Dr. Esayas Shume, Program Scientist

Space Weather Centers of Excellence



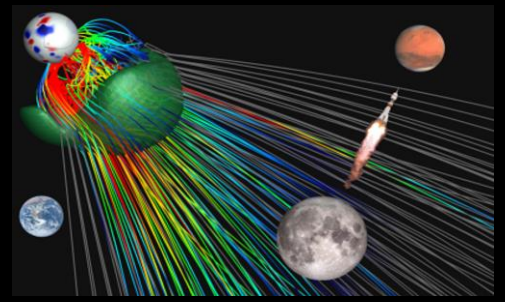
Space Weather Research and Technology Applications (SPARTA) Center of Excellence

- PI: Keith Groves, Boston College



Space Weather Operational Readiness Development (SWORD) Center

- PI: Thomas Berger, University of Colorado, Boulder



CLEAR: Center for All-Clear SEP Forecast

- PI: Lulu Zhao, University of Michigan, Ann Arbor

Joint Selection w/ Department of Commerce:

Center of Excellence for Advanced Forecasting of Drag for Enhanced, Sustainable, and Conscientious Space Operations

- PI: Piyush Mehta, West Virginia University, Morgantown

Moon to Mars Space Weather Analysis Office

The Moon to Mars (M2M) Space Weather Analysis Office was established to support NASA's Space Radiation Analysis Group (SRAG) with human space exploration activities by providing novel capabilities to characterize the space radiation environment.

M2M also supports NASA robotic missions with space weather assessments and anomaly analysis support.

Current M2M Space Weather Activities

Ongoing:
Real-time analysis of space weather activity, 7 days a week; 8am-4pm ET

Anomalies:
Analysis requested by mission

Artemis:
Real-time analysis 24/7

Artemis I

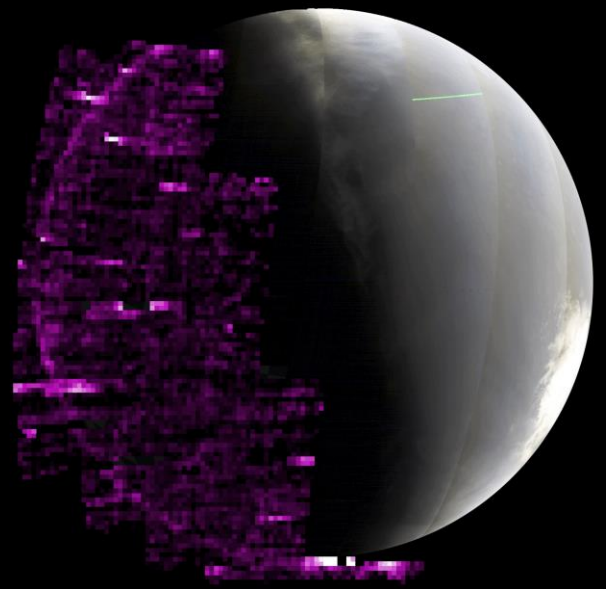
The M2M Space Weather Analysis Office supported the mission 24/7 during the 25.5 days of flight and worked closely with NASA SRAG and NOAA SWPC.

NOAA SWPC hosted a post-Artemis evaluation meeting between NASA SRAG, NASA M2M and NOAA SWPC.

Artemis I Flight Day 13: Orion, Earth, and Moon

Mars Observations During May 2024 Superstorm

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



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

Space Weather Council Request

HPD thanks the HPAC and the Space Weather Council for their work on the previous 6 tasks:

1. Advisory Group Coordination- No action requested.
2. Gap Analysis- No action requested.
3. Moon 2 Mars- No action until second SWC meeting in 2025.
4. Agency Coordination- No action requested.
5. R2O2R – No action requested until mid/late-2025
6. Scales- No action until scales released.
7. New- SWAG Users Survey

No action is requested on Tasks 1-6 at this time.

HPD Requested Task: SWAG User's Survey

Results from the First National Survey of Users Needs for Space Weather were released (Sep 2024) with recommendations in 3 broad categories:

1. Regionalization and Impacts
2. Education and Testbeds
3. Data Archives, Access, and Automation

For the February 2025 meeting of the Space Weather Council, HPD would like to request that the HPAC task the SWC with an analysis of the recommendations for NASA in this report. HPD would like to know:

1. What is the general priority for NASA to address the recommendation(low, medium, high)?
2. *What is the approximate timeframe that NASA could close the gap if focused efforts could be made for the recommendation? The recommendations should consider short term (< 1year,) mid-term (2-5 year), and longer term (5+ years) timeframes.*

   This analysis should include comparing the User's Survey Results to previous recommendations made by the SWC and the recommendations by the Decadal Survey.

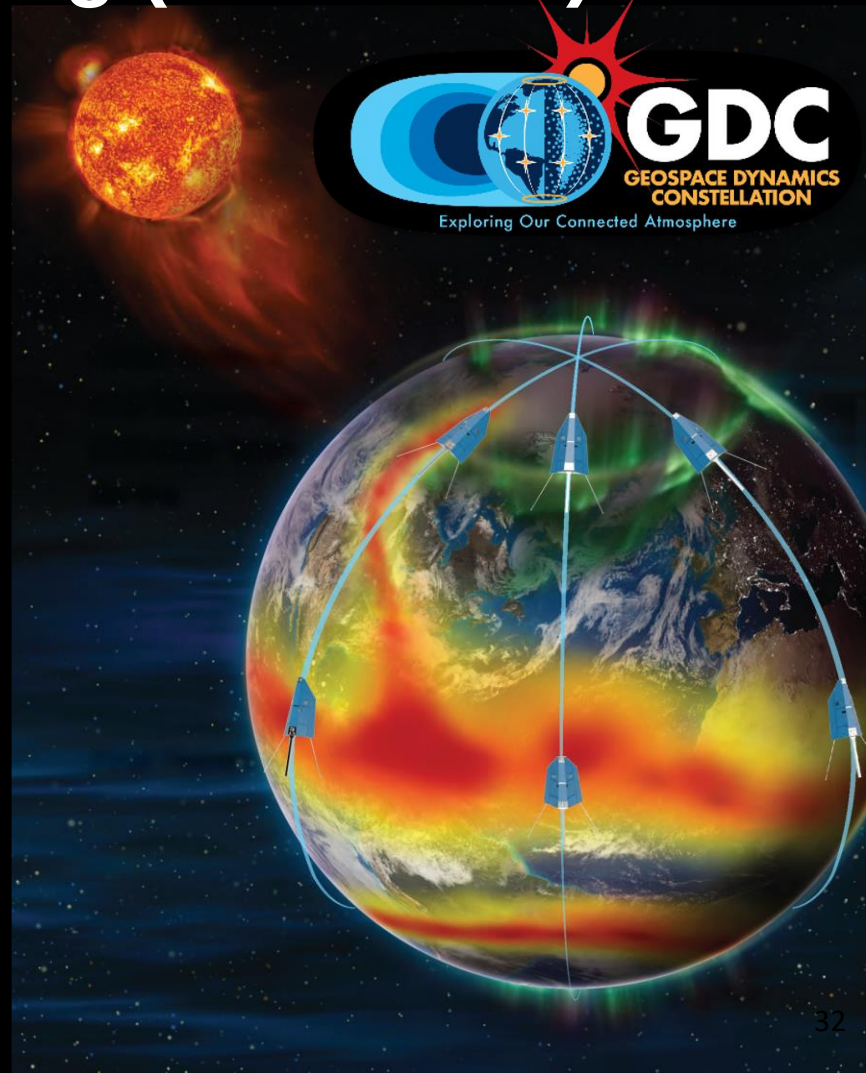
   Focus on the recommendations in Category 1: Regionalization and Category 2: Education and testbeds. Category 3 will be reserved for a meeting later in the year.

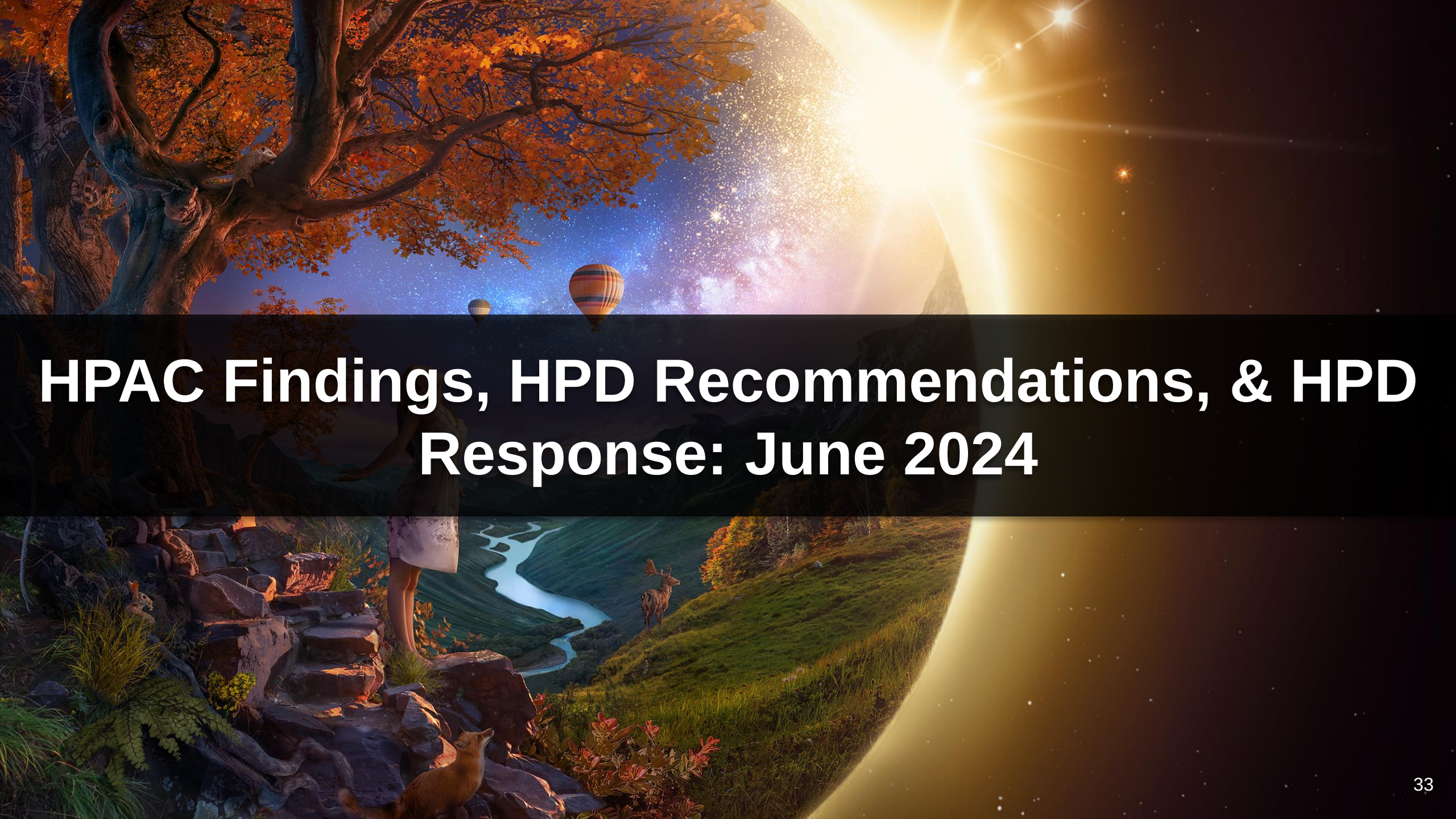
GDC & DYNAMIC

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

- **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*)
- **Architecture**
  - GDC: Provides in situ measurements above 300 km
  - DYNAMIC: Provides remote sensing of vertical profiles below 300 km altitude, leverages GDC measurements
- **DYNAMIC AO**
  - Three teams selected in June 2024 to conduct Phase A studies





HPAC Findings, HPD Recommendations, & HPD Response: June 2024

RESEARCH AND ANALYSIS (R&A) PROPOSAL PRESSURE (1/2)

HPAC Finding

We recognize the importance of HPD's effort to understand the origins of proposal pressure in Heliophysics 2023-2024 grant opportunities and identifying potential routes to mitigate this issue. We recognize there is no clear answer yet on how to definitively determine the origins of this proposal pressure increase and on how to mitigate it. We support HPD's commitment to ensure that any mitigation attempts are assessed carefully in order to continue the tradition of a fair and robust proposal process, to continue to prioritize funding high quality research, and to not introduce bias. We find that feedback to proposers is essential, especially to early-career proposers, particularly for proposals that are deemed non-compliant or have earned a low ranking by the panel.

HPD outlined a few options for how to mitigate proposal pressure and discussed merits and detriments of each. HPAC concurred that none of the options were without detriments, and we elaborate on our discussion below. We also include a discussion of having proposals with multiple due dates per year.

- No Due Dates or Multiple Due Dates Per Year:
  - Strength: Using multiple due dates may lower proposal pressure per due date.
  - Weakness: Rolling deadlines can present challenges to some potential proposers, as some of the urgency is removed. Having no deadlines could negatively impact the ability to find reviewers without COIs if the same panel members are retained for the whole ROSES cycle.

RESEARCH AND ANALYSIS (R&A) PROPOSAL PRESSURE (2/2)

HPAC Finding to HPD (Cont.)

- A Step-1 downselect:
  - HPD pointed out that a Step-1 downselect could be biased in favor of more experienced proposers. HPAC acknowledges that this is a valid concern (a weakness), but that the greater importance on Step-1 would motivate more complete responses from all proposers during that step (a strength).
  - Strength: It was pointed out that a Step-1 downselect could save time for proposers that are discouraged to submit to Step-2, because they do not have to write a full proposal.
  - Weakness: A downselect at Step-1 would increase the burden of finding reviewers to evaluate the proposals.
  - Weakness: Past experiments with Step-1 have had mixed results.
- Triage at Step-2:
  - Strength: Spending less panel time on proposals with a lower initial ranking would decrease the time investment of panel members.
  - Weakness: Proposers with lower ranking proposals would receive less feedback.
  - Weakness: Community members may question the validity of the decision process if some proposals are given less consideration than others.

HPD Response

NASA appreciates the input from the HPAC on ways to address the R&A proposal pressure. HPD is assessing these recommendations against future (ROSES-25) calls. HPD will update the HPAC on progress in the spring.

METRICS TO MEASURE THE HEALTH OF THE HELIOPHYSICS R&A PROGRAM (1/2)

HPAC Finding

Proposal selection rate is an imperfect measure of the health of the Heliophysics R&A program, as mentioned by HPD. Acknowledging that no single metric provides a perfect measure of the health of the R&A program, we support the desire to use additional metrics. Metrics might be considered across four categories (examples are included in parentheses):

- Level of support of the heliophysics community (e.g., selection rate, selection rate by adjectival rating, # of GS13 that could be fully supported by total R&A portfolio, # of FTE supported)
- Breadth of the portfolio (e.g., a sandchart diagram displaying funding by topic, i.e., solar vs. magnetospheric vs. IT)
- Demographics (e.g., % of early career scientists supported relative to total scientists supported, # of institutions, etc.)
- Success of awards (e.g., # of papers and presentations, press releases, perceived quality of work as indicated by citations, journal impact factor, etc.)

We acknowledge HPD's concern that sharing metrics can inadvertently dissuade early-career researchers to apply to particular opportunities. We commend HPD in considering these community effects and working to mitigate any such effects.

METRICS TO MEASURE THE HEALTH OF THE HELIOPHYSICS R&A PROGRAM (2/2)

HPAC Finding (Cont.)

Justifications for certain metrics previously requested by HPAC were requested, and are provided below:

1. The overall R&A budget and its trend with time in real year dollars and beyond, such as some representation of supported FTEs) - Indicates the extent to which HPD R&A allocations are supporting the heliophysics community.
2. The balance of the portfolio across different parts of the R&A program - Indicates whether the scientific subcommunities within HPD are being adequately supported.
3. Whether there are inequities in funding rates for community members from differing demographic categories - Indicates whether the funding to the community is being distributed in an equitable manner, and whether the future of the community (as indicated by early career scientists) is robust.
4. High-quality "proposal pressure" (i.e., fraction of non-selected, highly-rated proposals) – Already provided by HPD at this meeting. HPAC is grateful for the information.
5. Information about planned R&A funding allocation and distribution in future years - We retract this request.

HPD Response

NASA HPD appreciates HPAC's advice on this topic. HPD is very interested in assessing the health of the community and will continue to work to define the appropriate metrics and assess the community health. We intend to update HPAC on this after receipt of the Decadal Survey.

THE PROPOSED HELIOPHYSICS SYSTEM OBSERVATORY (HSO) EXTENDED MISSION FRAMEWORK

HPAC Finding

We find the proposed Heliophysics System Observatory (HSO) framework is a reasonable approach to enhance the systems-approach to mission science.

HPAC Recommendation to HPD

- We recommend that when communicating the HSO Extended Mission Framework RFI to the community, details about the "Transition Phase" should be provided for better community understanding and more informed feedback to HPD. Specifically, HPAC recommends that the "3 year" transition phase be replaced by a case-by-case, reasonable period that is primarily driven by synchronizing the extended mission to the Senior Review cycle cadence, ensuring a smooth transition of the mission to "mission management, operations, and data production."
- We recommend that HPD explicitly define what exactly is meant by, and included in, management, data, and operation.
- We recommend that HPD emphasize how the proposed structure provides opportunities analogous to programs in other divisions, such as Astrophysics MIDEX Guest Observers.
- We recommend that HPD encourage, cultivate, and support cross-mission collaboration to break down stovepipes during the Transition Phase to meet their stated objectives to increase cross-mission science efforts and campaigns during the Extended Mission phase.

HPD Response

NASA thanks HPAC for their recommendations and will use these in future communications about the HSO.

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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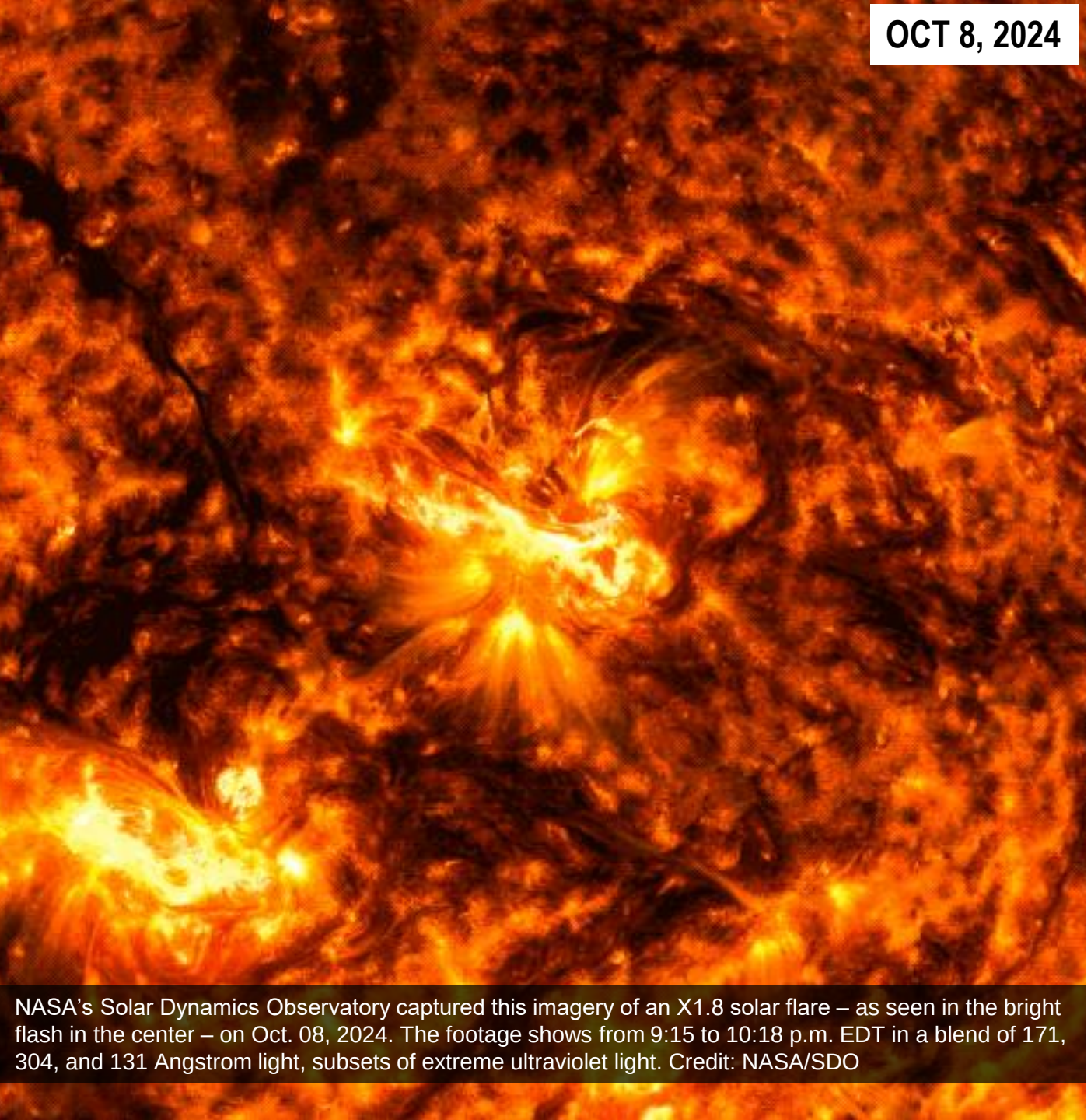
- blogs.nasa.gov/sunspot
- @NASASunScience
- @NASASun

Tune into our HPD Town Hall tomorrow, October 23 @ 12 PM ET for more updates on the following:

- State of the Union
- Heliophysics Recent Events
- Launch Updates
- Mission Milestones
- Solar Maximum
- Question & Answer Session

Join via the Town Hall WebEx Link



NASA’s Solar Dynamics Observatory captured this imagery of an X1.8 solar flare – as seen in the bright flash in the center – on Oct. 08, 2024. The footage shows from 9:15 to 10:18 p.m. EDT in a blend of 171, 304, and 131 Angstrom light, subsets of extreme ultraviolet light. Credit: NASA/SDO

Heliophysics Division team members captured the aurora on Oct. 10, 2024, in Stow, MA (top), Washington, D.C. (bottom left), and Bristow, VA (bottom right)

Questions & Answers

BACKUP