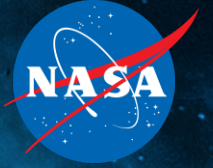


National Aeronautics and
Space Administration



Heliophysics Division

Heliophysics Advisory Committee Fall Meeting

Dr. Nicky Fox
Heliophysics Division Director
September 2022



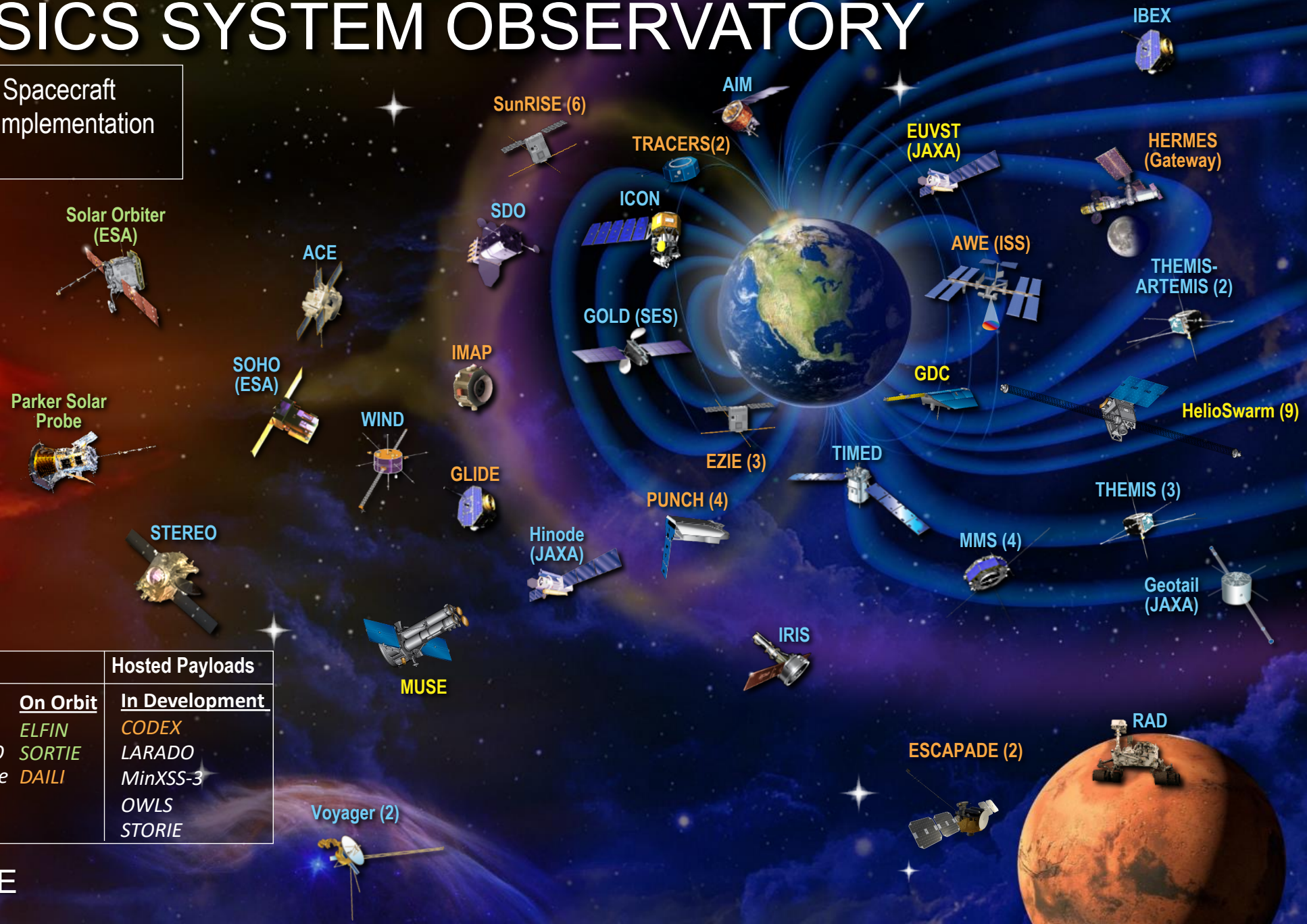
HELIOPHYSICS SYSTEM OBSERVATORY

- 20 Operating Missions with 27 Spacecraft
- 13 Missions in Formulation or Implementation
- 1 Under Study

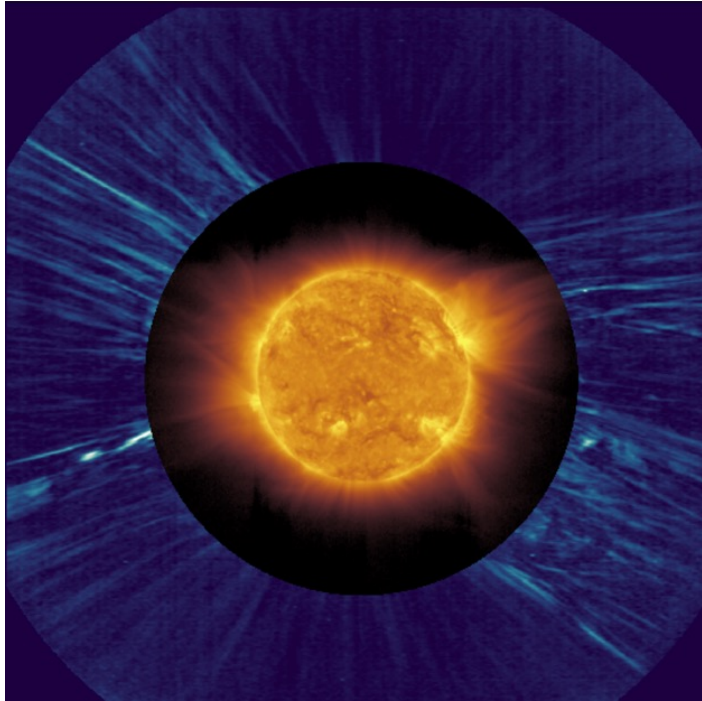
- FORMULATION
- IMPLEMENTATION
- PRIMARY OPS
- EXTENDED OPS

CubeSats				Hosted Payloads			
In Development				On Orbit			
AEPEX	Dione	CubIXSS	SunCET	ELFIN	CODEX		
AERO / VISTA	GTOsat	petitSat	DYNAGLO	SORTIE	LARADO		
CIRBE	ICOVEX	REAL	WindCube	DAILI	MinXSS-3		
CURIE	LAICE	SPORT			OWLS		
CuSP	LLITED	PADRE			STORIE		

OPERATING & FUTURE

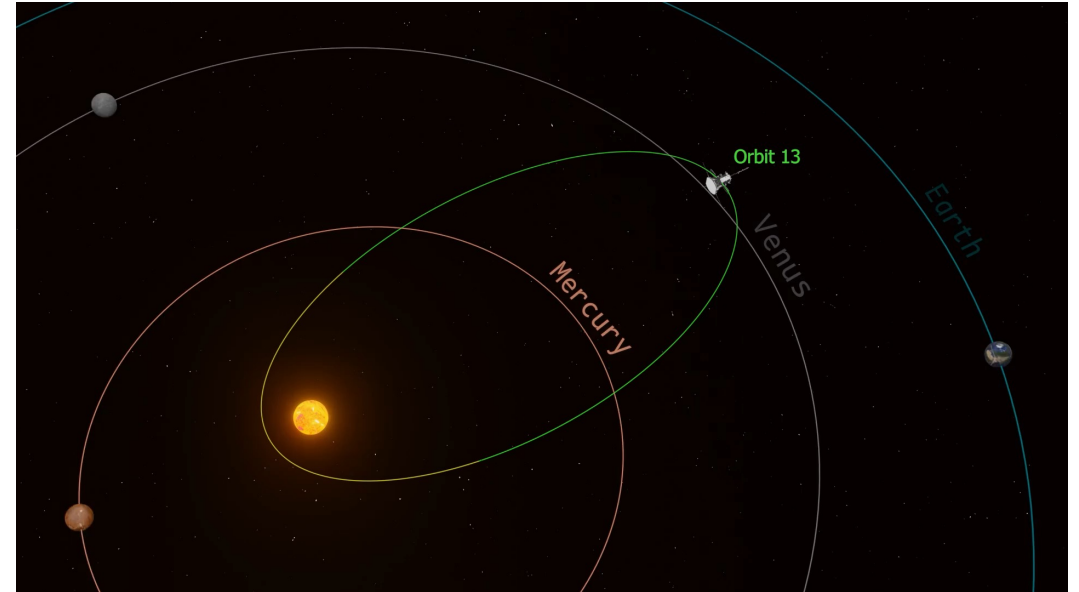


Solar Orbiter solves magnetic switchback mystery



Solar Orbiter has made the first ever remote sensing observation of an S-shaped 'switchback' magnetic feature in the solar wind by combining data from the EUI Telescope.

Parker Encounter #13



On Sept 6th, Parker Solar Probe reached perihelion #13, with its closest approach to the Sun reaching 5.3 million miles.

- Parker Solar Probe passed the Sun's Earth-facing side. Many opportunities for Earth-bound missions and other spacecraft to give us multiple viewpoints of solar events.

Congrats to Voyager, NASA's longest-lived mission on 45 years of discovery!



This archival image taken at NASA's Jet Propulsion Laboratory on March 23, 1977, shows engineers preparing the Voyager 2 spacecraft ahead of its launch later that year. *Credits: NASA/JPL-Caltech*



July 2022 Cover of Scientific American



Two 2022 Explorers Final Announcements of Opportunity Released

The Heliophysics Explorers Program conducts Principal Investigator (PI)-led space science investigations relevant to SMD's Heliophysics programs and manages both solicitations.

Heliophysics Explorers investigations must address NASA's strategic heliophysics science goals:

- Explore the physical processes in the space environment from the Sun to the Earth and throughout the solar system;
- Advance our understanding of the connections that link the Sun, the Earth, planetary space environments, and the outer reaches of our solar system; and
- 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.

Timeline and Due Dates

- AOs Release Date: September 7, 2022
- Pre-proposal Conference Date: September 30, 2022
- Required Notice(s) of Intent Due: October 24, 2022
- Proposal(s) Due: December 8, 2022

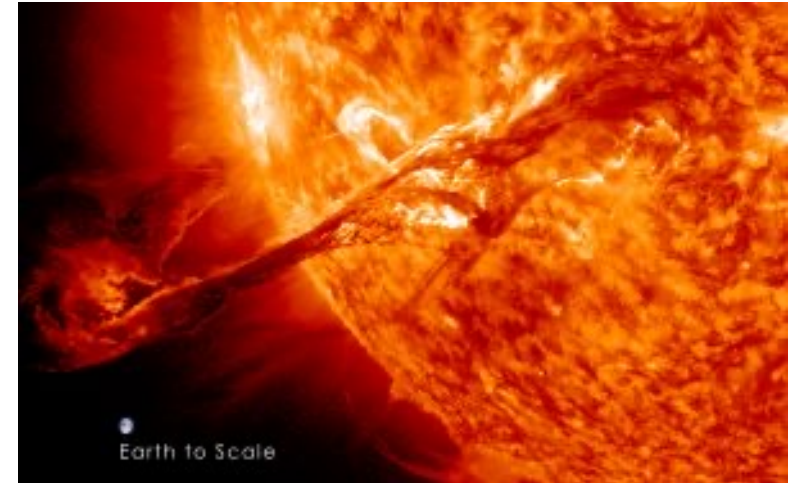
PUNCH announces Rideshare with SPHEREx

New Rideshare and Launch Date

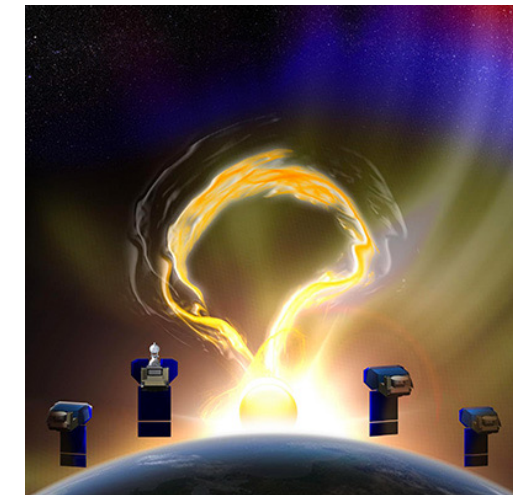
- NASA's Polarimeter to Unify the Corona and Heliosphere (PUNCH) mission will share a ride to space with NASA's Jet Propulsion Laboratory's Spectro-Photometer for the History of the Universe, Epoch of Re-ionization, and Ices Explorer (SPHEREx) mission.
- The missions will launch no earlier than April 2025 on a SpaceX Falcon 9. The contract with SpaceX was updated to include PUNCH and was awarded July 14, 2022.

PUNCH Overview

- PUNCH, which consists of four suitcase-sized satellites, will focus on the Sun's outer atmosphere (the corona) and how it generates the solar wind. The spacecraft also will track coronal mass ejections – large eruptions of solar material that can drive large space weather events near Earth – to better understand their evolution and develop new techniques for predicting such eruptions.
- The four satellites will spread out around Earth along the day-night line, which enables it to create a continuous, complete, view of the corona and inner solar system.



In this image, Earth is shown to scale with a coronal mass ejection that occurred on August 31, 2012. While Earth's size is shown to scale, its distance is not (Earth is much farther from the Sun than shown here). Credits: NASA/Goddard Space Flight Center

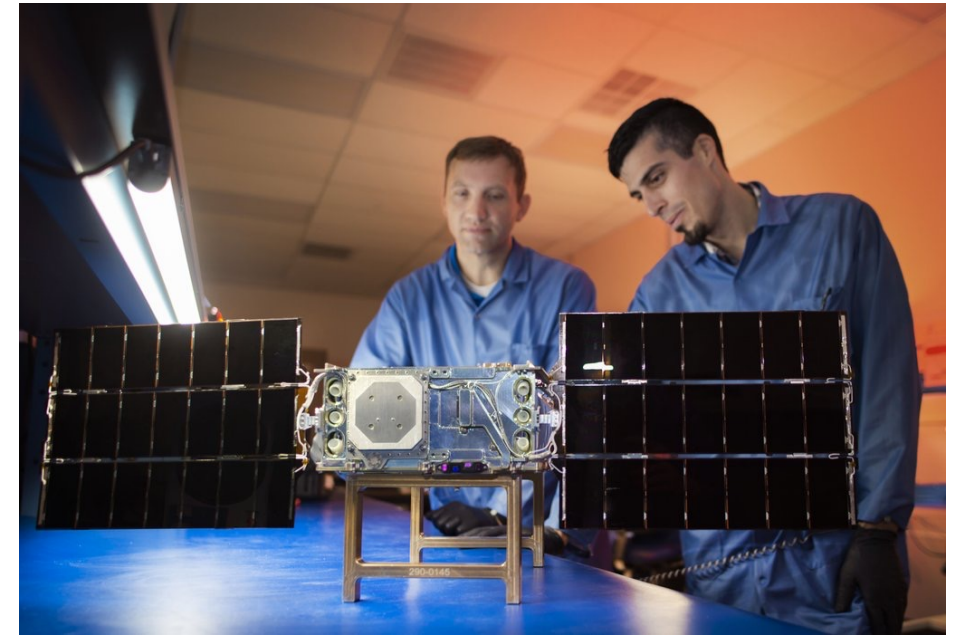


Credit: Southwest Research Institute

First of SunRISE SmallSats Rolls Off Production Line

Six of these small satellites will work together, creating the largest radio telescope ever launched to detect and track hazardous explosive space weather events.

- SunRISE will be a 6-mile-wide (10-kilometer-wide) radio telescope in orbit that will help deepen scientists' understanding of explosive space weather events.
- The first of those small satellites has already been completed at Utah State University Space Dynamics Laboratory (SDL) in Logan, Utah.
- Sun Radio Interferometer Space Experiment (SunRISE) is planning for a launch NET 2024.



Geospace Dynamics Constellation (GDC)

GDC uses the upper atmosphere as a “natural laboratory” for understanding our home and other worlds

1) Heliophysics Science

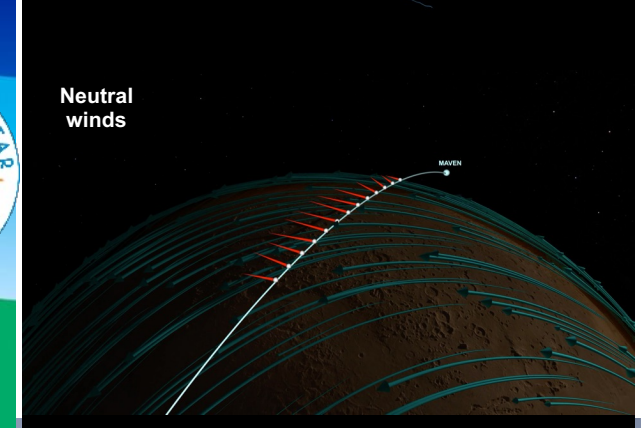
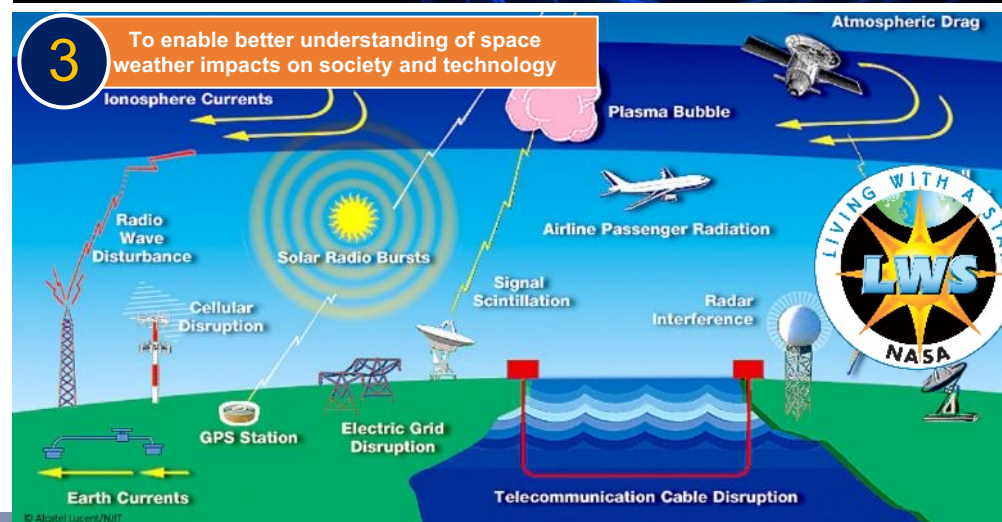
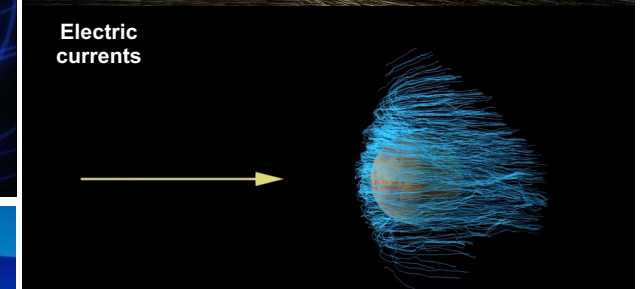
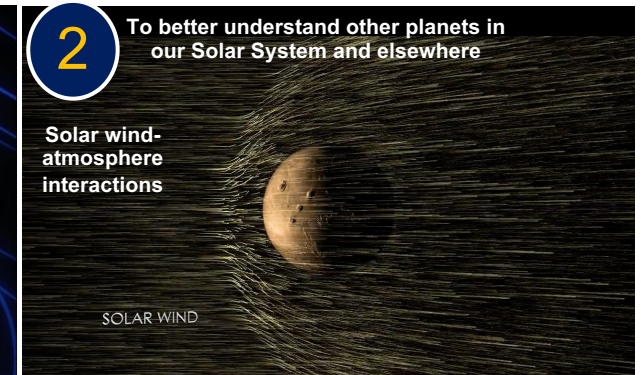
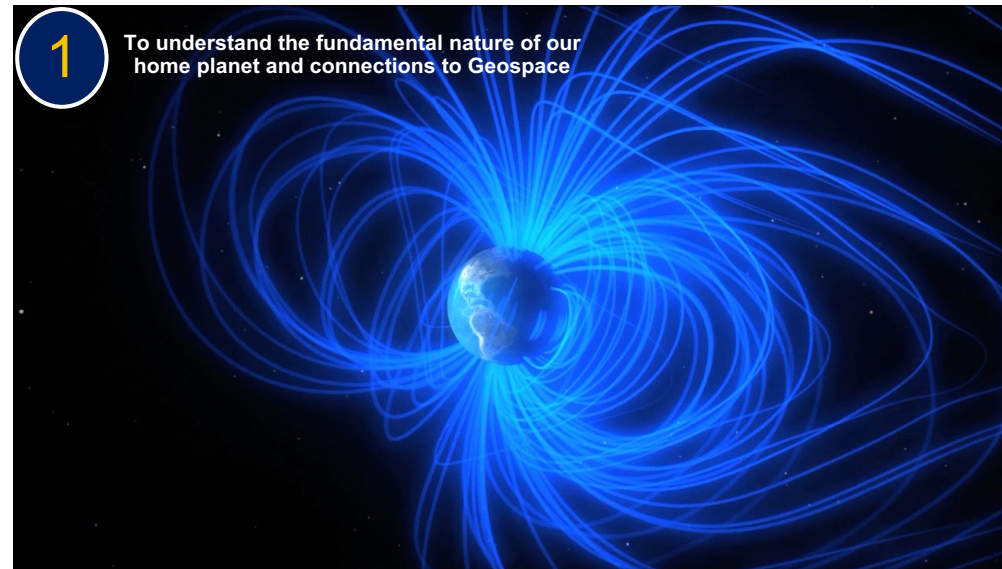
- Two-way magnetosphere-atmosphere coupling
- Universal physics of neutral gas + magnetized plasma (“natural laboratory”)

2) Comparative Planetology

- Solar wind – atmosphere interactions
- Ion-neutral interactions at other planets

3) Space Weather

- Cell, GPS, and other radio propagation
- Orbital drag
- Geoelectric current impacts on power grids



Dynamical Neutral Atmosphere-Ionosphere Coupling (DYNAMIC)

- DYNAMIC is a Solar Terrestrial Probes mission to resolve key science objectives about how lower atmosphere variability affects geospace, including
 - Day-to-day and longer-term variations of lower atmosphere forcing
 - Multi-scale upper atmosphere responses to energy inputs from below
 - Preconditioning the upper atmosphere to magnetospheric drivers
- DYNAMIC requires multi-point measurements across a range of latitudes
 - Disentangle and characterize the different atmospheric waves
 - Analyze a large range of temporal and spatial scales
 - Quantify the redistribution of energy and momentum of upward-propagating waves
- DYNAMIC has strong synergy with GDC, both scientifically and in terms of implementation details
 - Altitude profiles of the thermosphere and ionosphere (below 300 km altitude)
 - Provided by DYNAMIC
 - In situ measurements of thermosphere and ionosphere (above 300 km altitude)
 - Provided by GDC
- **Flying DYNAMIC and GDC together achieves high-priority science in a cost-effective manner**
- **DYNAMIC AO has been delayed, not cancelled. For more info see: <https://soma.larc.nasa.gov>**

NASA Space Weather Program (NSWx)

Recent Accomplishments

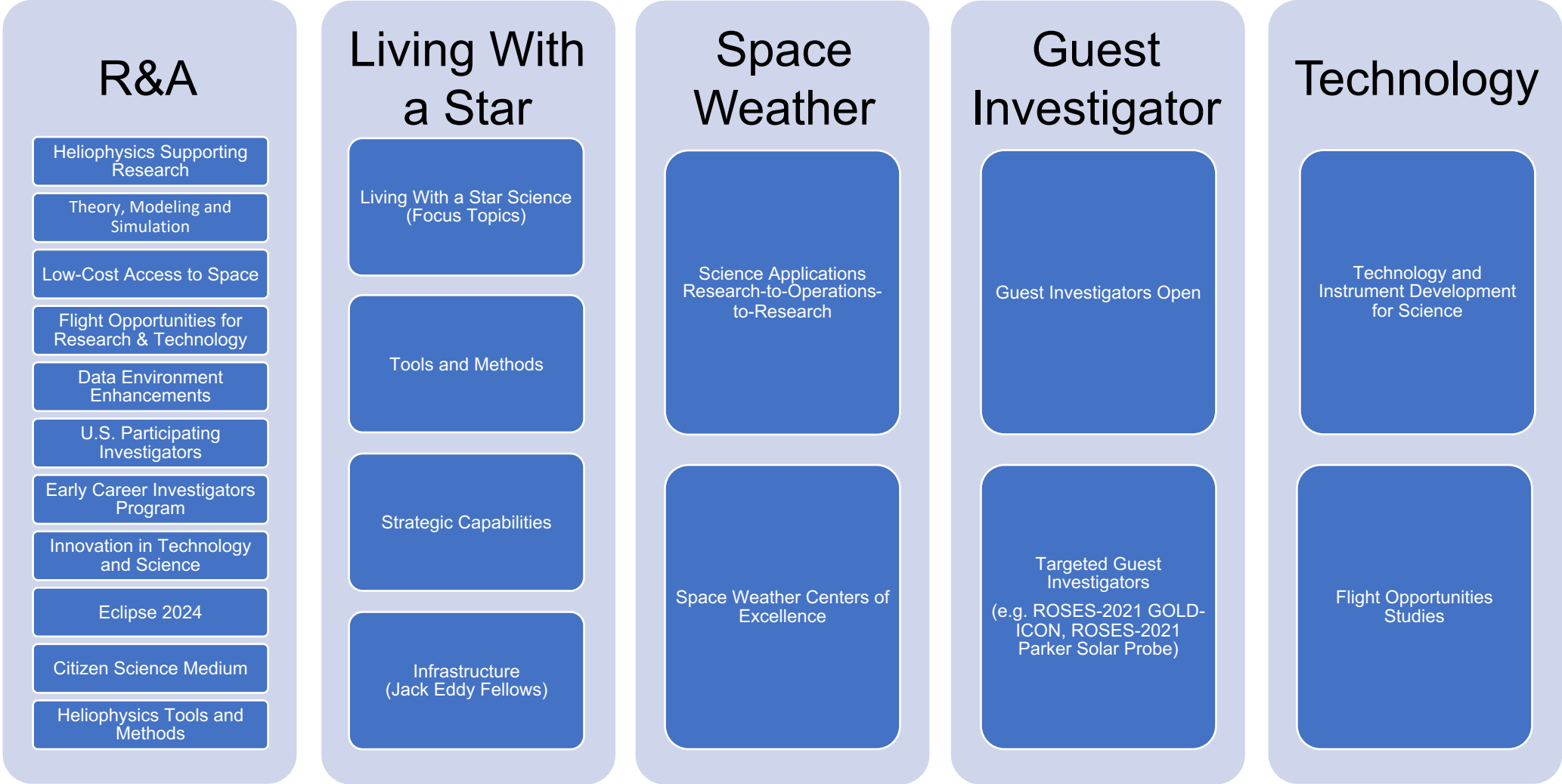
- Space Weather Council; meetings held March and August 2022
- HERMES passed KDP C in early 2022 and interdisciplinary scientists selected
- Developed a NOAA and DoD Framework to transition NASA research, techniques and technology relevant to space weather operations
- Supported the Research to Operations to Research (R2O2R) grant solicitation via Transition-Step for efforts that show promise to use in an operational space weather environment at NOAA or DoD
 - ROSES-22 focused topics:
 - High-Latitude Radiation Exposure
 - Downstream Updating of Solar Wind & CME Forecasts
 - Space Weather Centers of Excellence solicitation (ROSES-22)
- Four Space Weather CubeSats selected: CubIXXS/SwRI; DYNAGLO/UCBoulder; WindCube/UCAR; SunCET/APL

Looking Ahead

- PROSWIFT: continue with actions already underway to support interagency efforts, space weather observations, research, modeling, operational forecasting, and applications (SOHO, SWFO-L1, R2O2R)
- Develop space weather instrument pipeline for future opportunities
- Engage international partners on future collaborations: Vigil, ENLoTIS (ESA), AOM (CSA), SNIPE (KASI)



Heliophysics Competed Research (2022)



Inclusion, Diversity, Equity, and Accessibility (IDEA) in Heliophysics

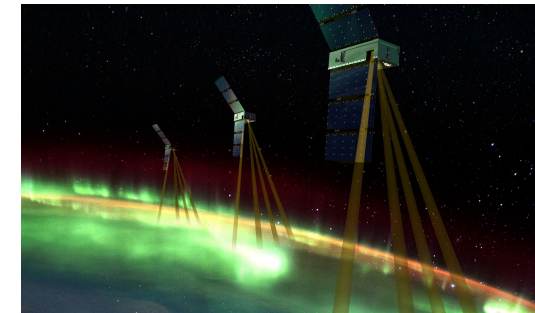
IDEA initiatives in Heliophysics recognized as a long-term effort, but immediate and mid-term action and problem solving will advance initiatives in parallel with systemic, enduring activity.

Ongoing and Exploratory Efforts

- Established a Heliophysics Division IDEA Working Group
 - Selected Co-chairs: Kelly Korreck and Denise Hill
- Sponsoring and incentivizing enhanced and innovative outreach activities with IDEA as a major focus
 - PUNCH, IMAP, GLIDE, EZIE
 - Newly selected Drive Centers
- Establishing a community-wide early- and mid-career support network pilot in partnership with other SMD Divisions, professional and scientific societies with a focus on providing mentors and mentees training and resources that consider the “whole” STEM individual
- Developing targeted and innovative R&A solicitations with an IDEA emphasis for FY22
- “Deepening the Pool” RockOn! and RockSat additional contributions
- Continue listening sessions with early career students and faculty to identify barriers for underrepresented groups

Additional Heliophysics Activities

- Members of HPD participating in various trainings and working groups across SMD to identify potential near-, mid-, and long-term Division IDEA actions
- Identifying Division and SMD leadership opportunities for staff
- Employing best practices for IDEA recruitment efforts, including hiring panels, reviewer panels and advisory boards
- Adopted inclusive R&A practices (e.g., code of conduct, dual-anonymous reviews)
- Coordinate with SciAct and OSTEM to expand engagement opportunities
- Advertise and solicit regular community input at meetings: AGU, GEM, CEDAR, SHINE etc.
- Implement some of the lessons learned from EC listening sessions and SMD led HBCU listening sessions



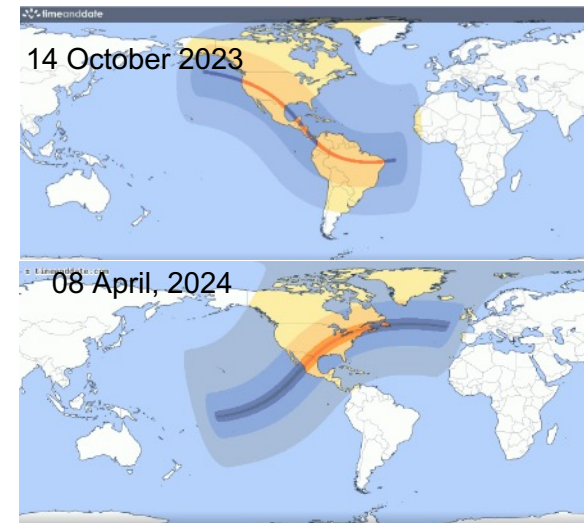
Heliophysics Big Year

What is the Heliophysics Big Year?

Ties together three major Heliophysics events in 2023-2025 (2 solar eclipses, solar maximum) to maximize participation in a coordinated incentivized citizen science campaign.

- NASA is developing a program to use these remarkable events to highlight and motivate solar system science
 - Two Solar Eclipses cross N. America (14 Oct 2023 and 8 April 2024)
 - The rising phase of the Solar Cycle 25 with Solar Maximum predicted to occur in 2025
- Look out for opportunities to be part of our Big Year
 - <https://science.nasa.gov/heliophysics/programs/citizen-science>

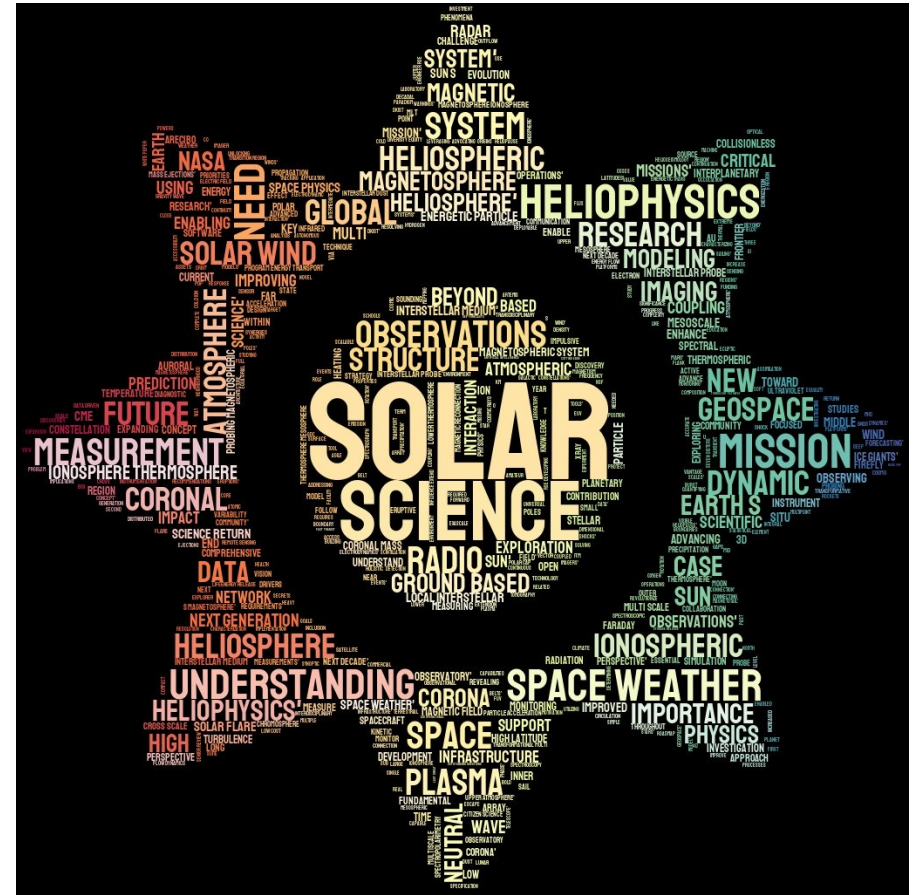
Helios Big Year is an opportunity to reach a **generation** for Heliophysics.



What is a “Big Year”? A big year is a birding term for maximizing a birder’s number of species.

2024 Decadal Survey is Underway

- Statement of Task and Study Approach (linked below the SoT) define scope and identify agency-specific guidance
 - <https://nas.edu/ssphdecadal>
- Steering Committee has been announced
 - Dr. Stephen Fuselier and Dr. Robyn M. Millan will serve as co-chairs
- Schedule
 - Kick-off meeting held on August 22 and 23
- White Papers
 - Due date was Sept 7 – **492 white papers submitted** which is a huge increase compared to previous decadal surveys
- NASA asking for ambitious but realistic science strategy
- Incorporates NASA programs as part of the strategy
 - https://science.nasa.gov/heliophysics/2024_decadal_survey/heliophysics-strategic-mission-programs



SpaceApps 2022: Join our Challenges!

What is the purpose of Space Apps?

Space Apps, which started in 2012, has now become the largest annual global hackathon in the world. While NASA provides awards to the top projects (see more below), Space Apps is all about collaboration! The mission is focused on the following objectives:

- To inspire collaboration, creativity, and critical thinking
- To foster interest in Earth and space science and exploration
- To raise awareness of NASA data around the world
- To encourage growth and diversity in the next generation of scientists, technologists, designers, engineers, and artists.

What is the theme of Space Apps for 2022?

- This year's event theme is Make SPACE, celebrating our motto of "there's always space for one more." At Space Apps, we strive to eliminate barriers of access to space and science opportunities. Space Apps is for anyone and everyone!



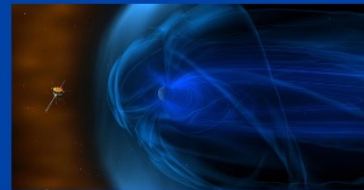
CALLING ALL RADIO ENTHUSIASTS!



CREATIVE DATA DISPLAY WITH THE PARKER SOLAR PROBE



ON THE WAY TO THE SUN



SAVE THE EARTH FROM ANOTHER CARRINGTON EVENT!

Register now and join us October 1-2 for events in person or virtually:

<https://www.spaceappschallenge.org/>

SMD: Transform to Open Science (TOPS)

From 2022 to 2027, TOPS will accelerate the engagement of the scientific community in open science practices through events and activities aimed at:

- Lowering barriers to entry for historically excluded communities
- Better understanding how people use NASA data and code to take advantage of our big data collections
- Increasing opportunities for collaboration while promoting scientific innovation, transparency, and reproducibility.

NASA is designating 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:
 - Increase understanding and adoption of open science principles and techniques in our Mission and Research Communities
 - Accelerate major scientific discoveries through supporting the adoption of open science
 - Broaden participation by historically excluded communities

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



Looking Ahead

Research & Analysis

- Continue support of three selected DRIVE Science Centers
- Invest in modernization of data facilities and archives
- Engage the public through “Heliophysics Big Year” which leverages three major Heliophysics events in 2023-2025 (two solar eclipses, solar maximum)

Operating Missions

- Provide support for 20 operating science missions
- Release call for 2023 Senior Review of operating missions

PI-led Missions

- Advance towards KDP-C: EUVST, MUSE and HelioSwarm
- Continued support for recently confirmed missions towards launch: AWE, IMAP, PUNCH, SunRISE, ESCAPEDE, GLIDE, HERMES, TRACERS/MAGIC, EZIE
- Maintain cadence of competitive Explorers program with the release of the AO for SMEX-22

Space Weather

- Release AO for US participation in ESA Vigil mission
- Select 1-2 Space Weather Centers of Excellence
- Support NASA-NOAA-NSF Research to Operations Framework
- Support OSTP initiatives in SSA/OD and continue instrument technology maturation and demonstration

Technology

- Technology Gap & Trend Analyses led by Heliophysics Strategic Technology Office (HESTO)

Other

- Implement IDEA actions and support Heliophysics IDEA Working Group
- Continue support of 2024 Decadal Survey with NASEM

Get Involved and Stay Informed!

We are continuing to work hard to grow the Heliophysics community. Stay in touch and help us find new ways to highlight your work and keep you in the loop!

Heliophysics virtual Town Hall is coming!

- When: October 24th
- More information to come!

Stay up to date with what's happening at Headquarters:

- <https://science.nasa.gov/researchers/virtual-townhall>

Let us know what you've been working on:

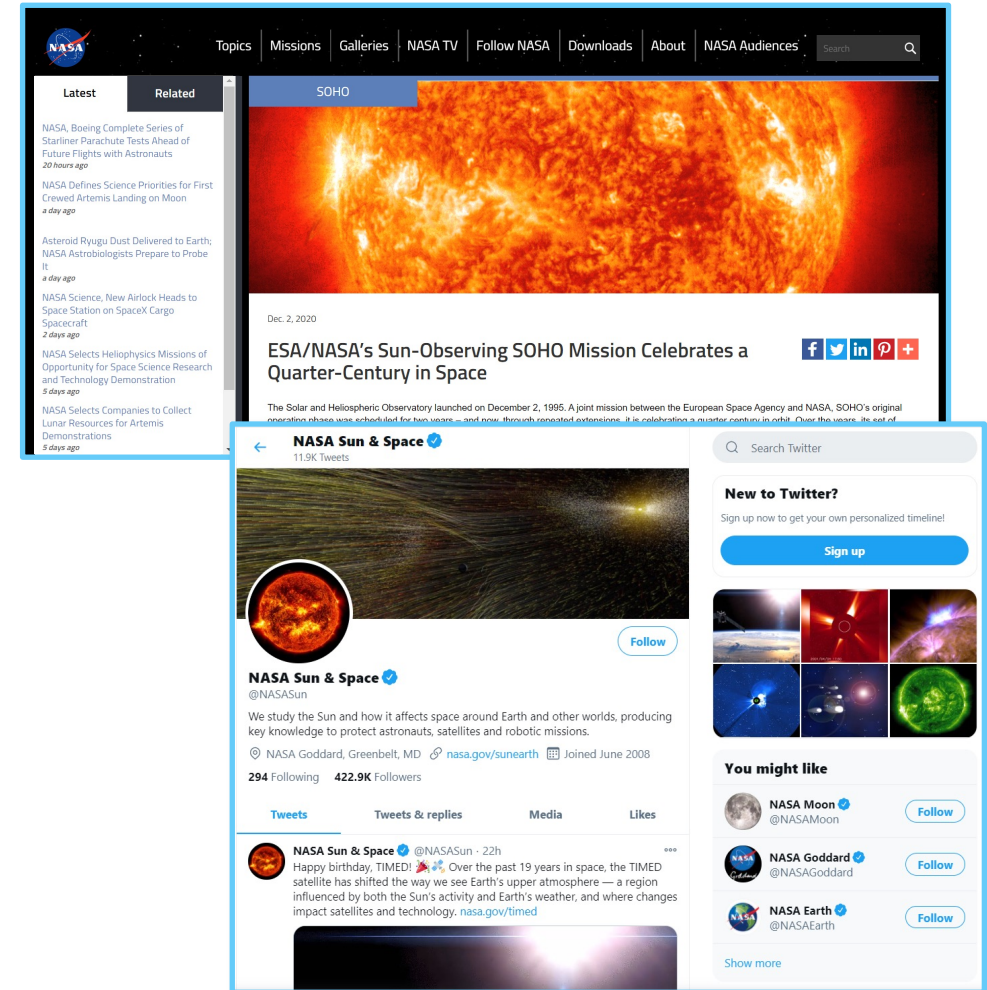
- <https://bit.ly/SubmitHelioScience>

Web and social media:

- NASA.gov/sunearth
- blogs.nasa.gov/sunspot
- [@NASASun](https://twitter.com/NASASun)
- facebook.com/NASASunScience

Volunteer for a panel:

- <https://science.nasa.gov/researchers/volunteer-review-panels>







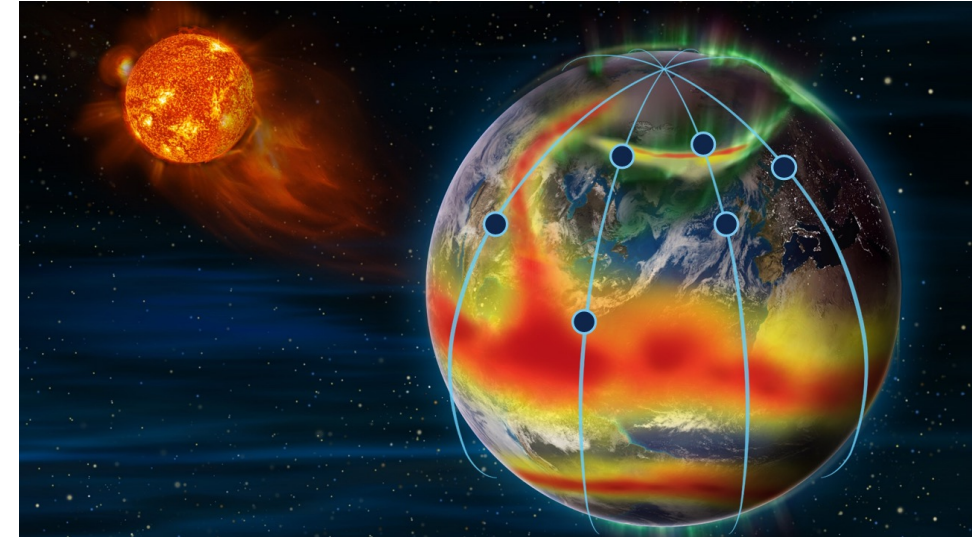
#HelioRocks!

International Collaborations

- Austria: THEMIS
- Belgium: ICON, Solar Orbiter, Parker Solar Probe
- Brazil: SPORT
- France: STEREO, MMS, Solar Orbiter, Parker Solar Probe, Space Environment Testbed (SET), SOHO, THEMIS, WIND
- European Space Agency: SOHO, Solar Orbiter, Vigil in coordination, CURIE in coordination, Lower Ionosphere Thermosphere Science (EN-LoTIS) in coordination
- Germany: Parker Solar Probe, Sounding Rockets, IMAP I-ALiRT in coordination
- Italy: CODEX
- Japan: Hinode, MMS, CLASP, Solar-C/EUVST
- Korea: MMS, Geomagnetic Storm Forecast Model, BITSE, CODEX, SNIPE, IMAP I-ALiRT
- Poland: GLOWS in IMAP
- Norway: Sounding Rockets, IRIS
- Russia: WIND
- Sweden: MMS
- Switzerland: STEREO, IMAP, Solar Orbiter
- United Kingdom: IMAP, Hinode, STEREO, Solar Orbiter, SET

Geospace Dynamics Constellation (GDC) Selections

- NASA is thrilled to announce the start of the GDC mission science team!
 - Interdisciplinary Scientists (selected Nov 2021)
 - Dr. Rebecca Bishop (The Aerospace Corp.)
 - Prof. Yue Deng (Univ. Texas, Arlington)
 - Prof. Jeffrey Thayer (CU Boulder)
 - Investigations, delivering science instruments (selected Apr 2022)
 - *MoSAIC*: Dr. Mehdi Benna (UMBC)
 - *CAPE*: Dr. Daniel Gershman (GSFC)
 - *AETHER*: Dr. Laila Andersson (CU Boulder)
- NASA has selected a competitive Phase A (down select circa Nov/Dec 2022)
 - *MAG*: Dr. Guan Le (GSFC)
 - *NEMISIS*: Prof. Mark Moldwin (Univ. Mich)
 - *MAG*: Prof. David Miles (Univ. Iowa)
 - *TPS*: Prof. Phil Anderson (Univ. Texas, Dallas)
 - *3DI*: Dr. Keiichi Ogasawra (SwRI)



Parker Solar Probe reaches Mission Success and enters the Solar Atmosphere for the first time

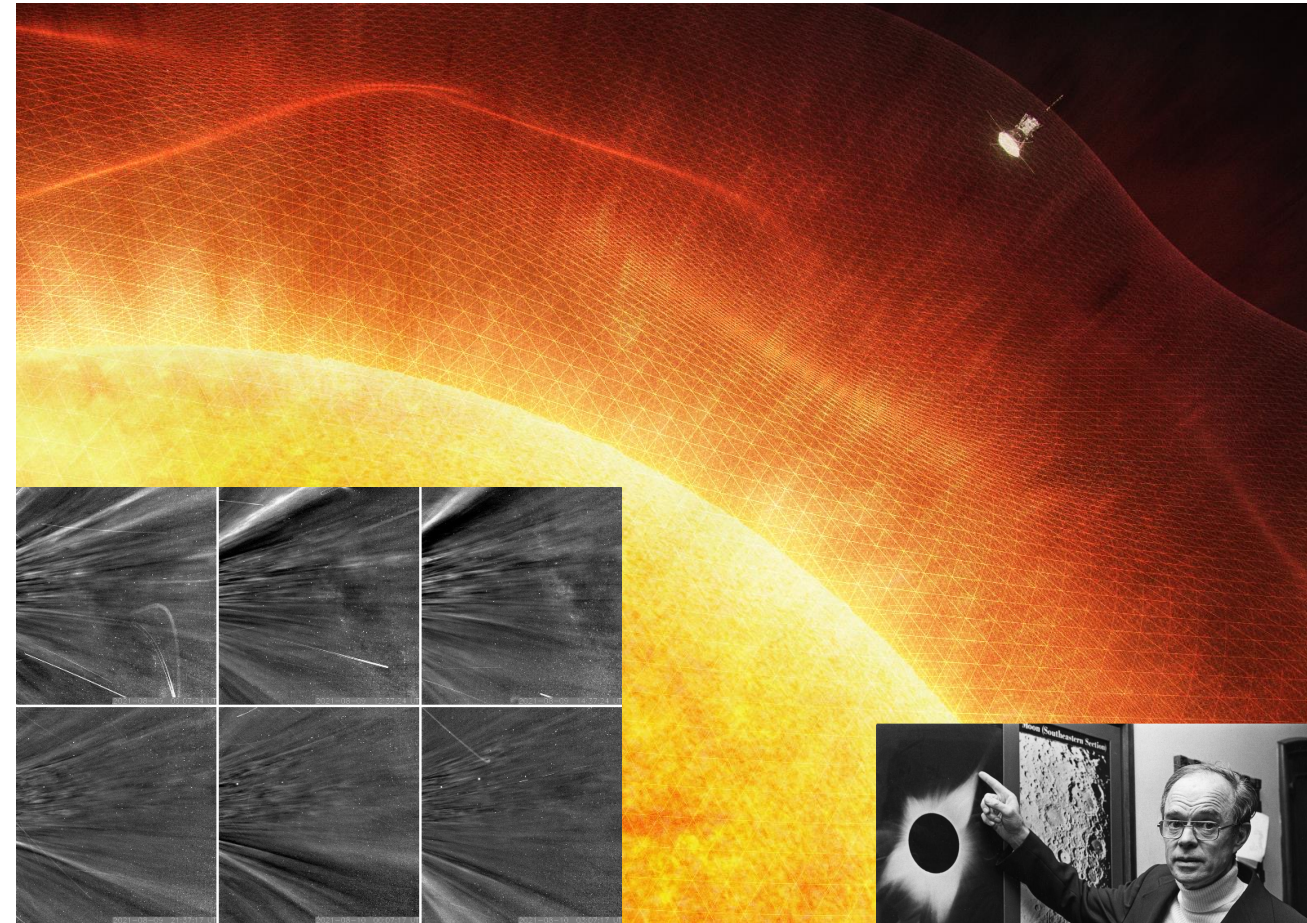
Parker has met Mission Success Criteria

Official memo signed by HPD Director Dr. Fox on Apr 26, 2022.

Parker enters bound solar atmosphere

Parker has entered an uncharted region where intertwined particles and fields are still bound to the Sun's atmosphere

Congratulations to the Parker Team on the International Academy of Astronautics Laurels Team Award!



NASA Space Weather Program (NSWx)

Space Weather Program Vision: Advance the science of space weather to empower a technological society safely thriving on Earth and expanding into space.

NASA plays a vital role in space weather research by providing unique, significant, and exploratory observations and data streams for theory, modeling, and data analysis research, and for operations.

NASA's Heliophysics Division is uniquely poised to support needs of the National and International space weather enterprise and the Agency's Artemis.

Various executive (NSW SAP) and legislative (PROSWIFT Act) mandates direct NASA to address research and application aspects of space weather which allows NASA to do what NASA does best – push the envelope by pursuing forward-leaning developmental activities.

Making use of NASA's unique capabilities and directly addressing the legislative mandate, HPD has established the new NASA Space Weather Program, a national resource to unify space weather research and drive our understanding of its risks, impacts and mechanisms into new realms.

