

National Aeronautics and
Space Administration



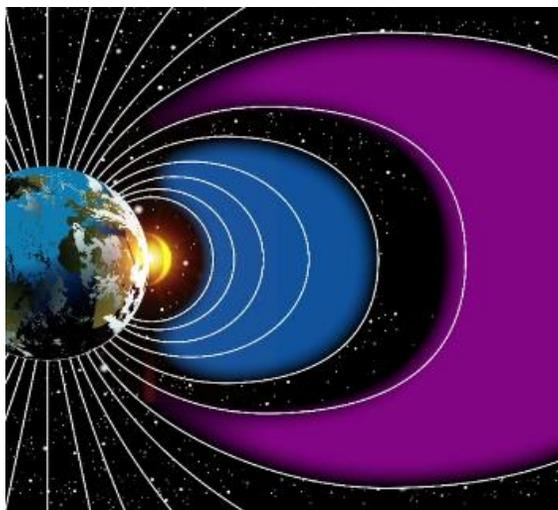
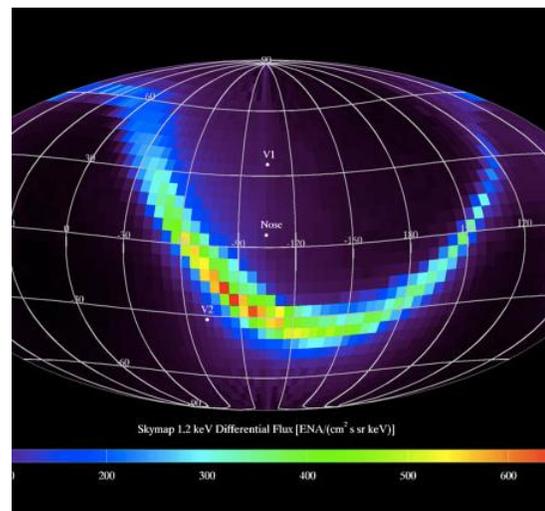
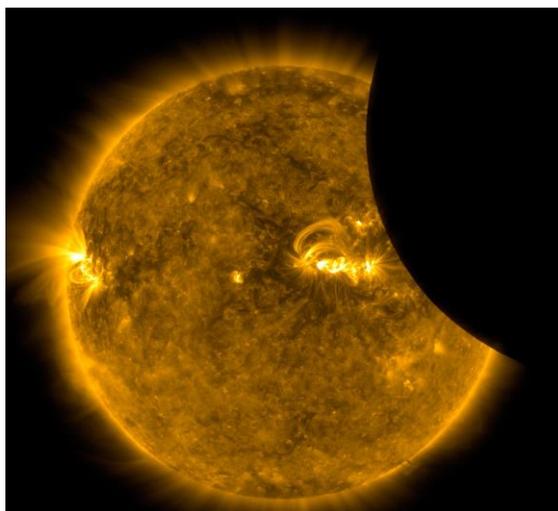
EXPLORES SCIENCE

NICKY FOX

Heliophysics Division Director

Heliophysics Advisory Committee

December 18, 2018



The Dawn of a New Era for Heliophysics

- Heliophysics Division, in collaboration with its partners, is poised like never before to:
 - Strategically advance understanding of solar and space physics, make amazing discoveries
 - Fulfill its role for the Nation enabling advances in space weather
 - Engage the public with science knowledge and citizen science
 - Develop the next generation of heliophysicists

A graphic on the left side of the slide depicts a space scene. It features a large, dark blue planet in the foreground, a smaller brown planet above it, and a ringed planet to the left. In the background, there's a bright yellow sun, a blue and green nebula, and a view of the Earth's horizon. The entire scene is framed by a white, curved, abstract shape that separates it from the rest of the slide.

Who is new at HQ?

Welcome to the Heliophysics Division!



Dr. Nicky Fox
Director



Dr. Simon Plunkett
Program Scientist



**Dr. Roshanak
Hakimzadeh**
Program Scientist



Dr. Patrick Koehn
Program Scientist – IPA

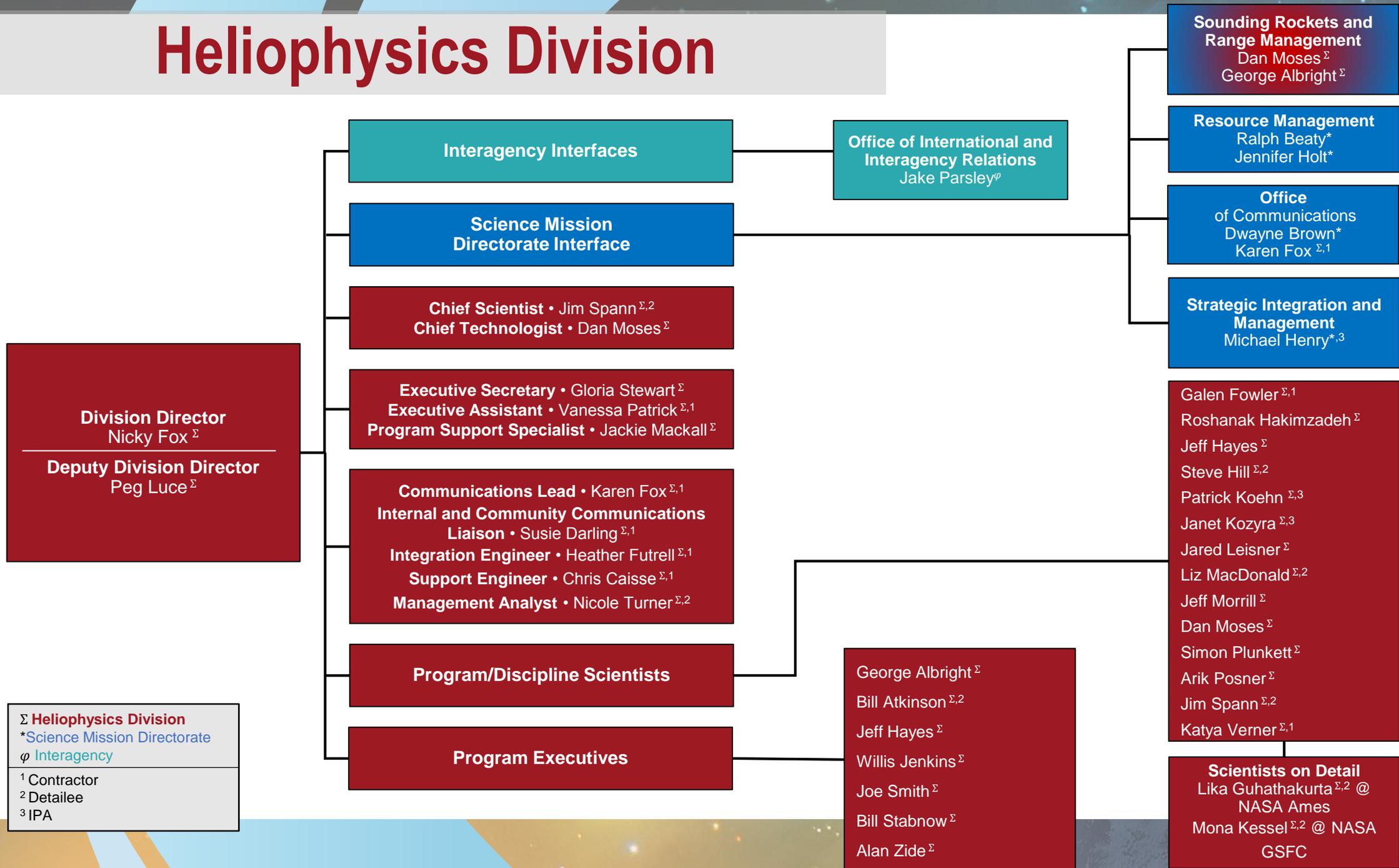


Nicole Turner
Management Analyst –
Detaillee from GSFC



Susie Darling
Outreach Coordinator and
Public Engagement Writer

Heliophysics Division



Σ Heliophysics Division
 *Science Mission Directorate
 φ Interagency

¹ Contractor
² Detailee
³ IPA

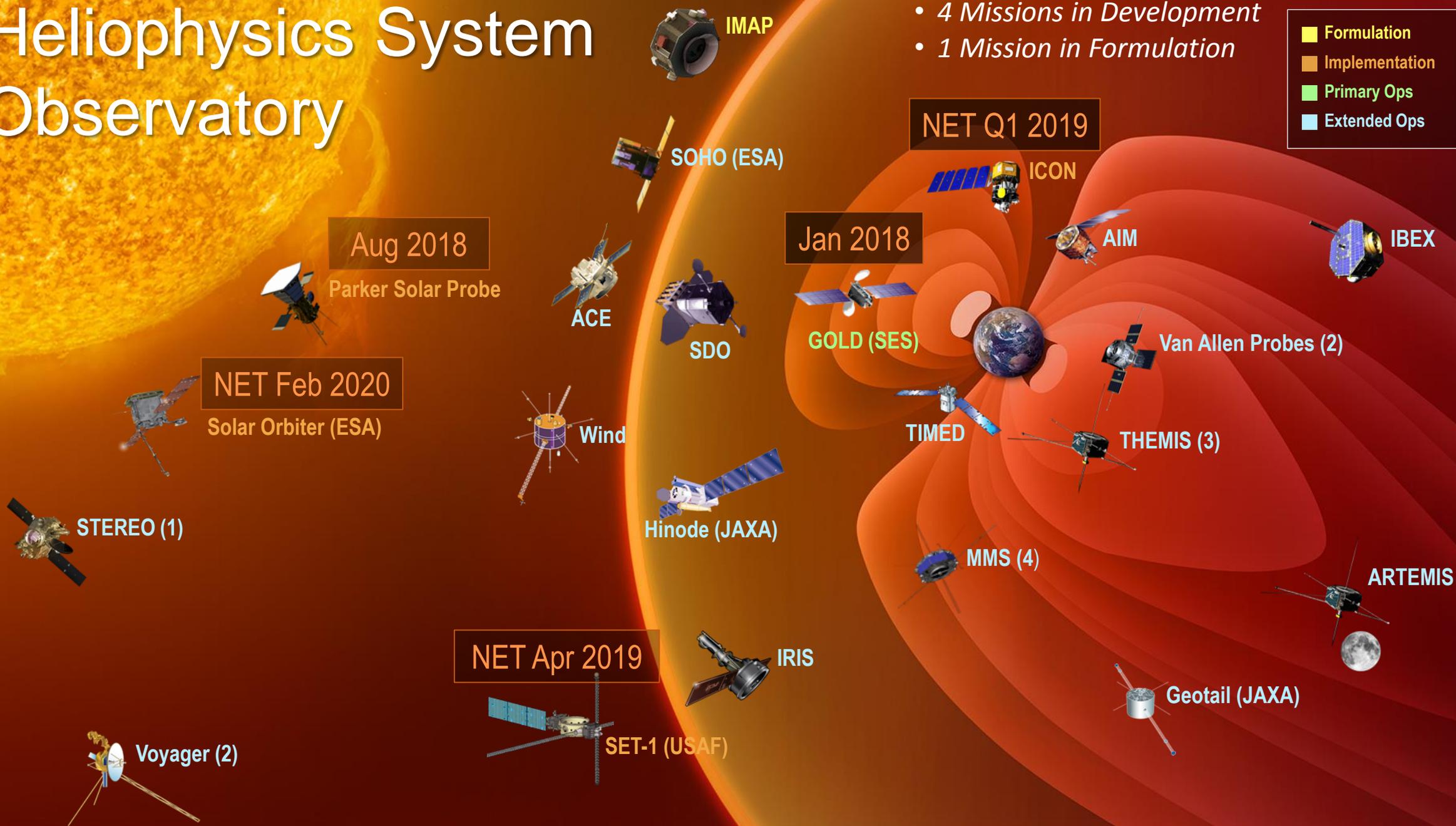


Heliophysics Missions & Highlights

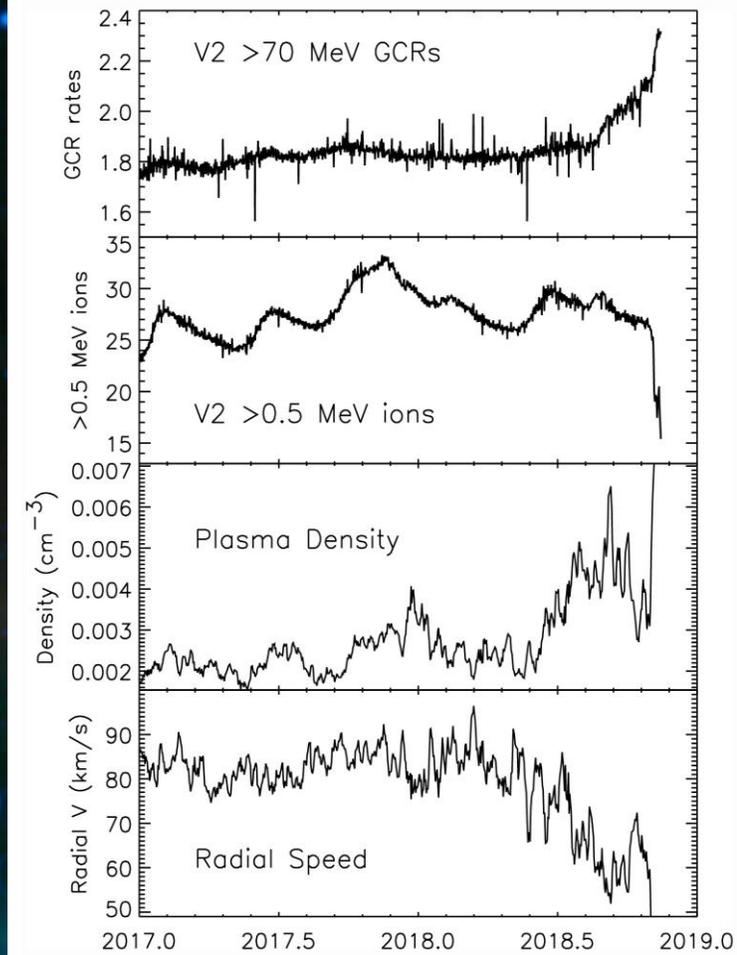
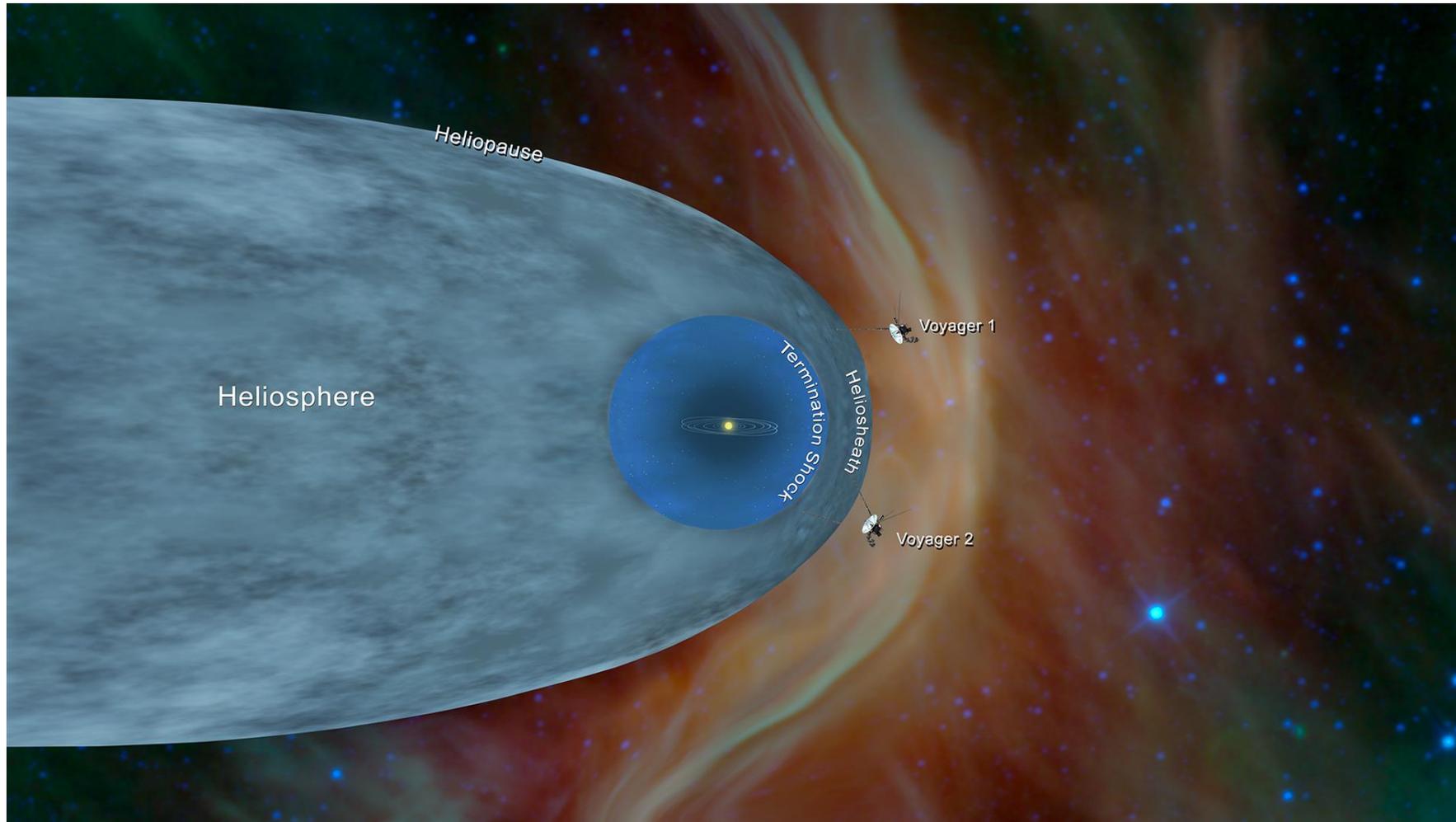
Heliophysics System Observatory

- 17 Operating Missions with 24 Spacecraft
- 4 Missions in Development
- 1 Mission in Formulation

■	Formulation
■	Implementation
■	Primary Ops
■	Extended Ops



The Voyagers are both out!!!!!!



Review of Progress Toward Implementing the Decadal Survey Vision in Solar and Space Physics: A Science for a Technological Society

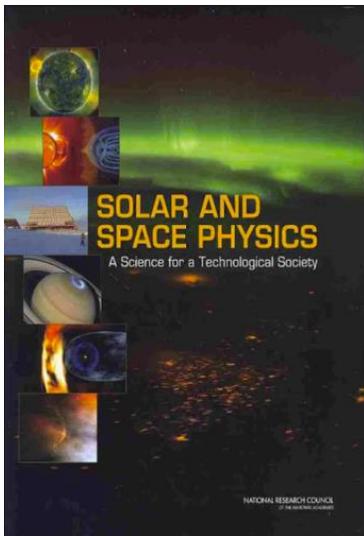
The National Academies of Sciences, Engineering, and Medicine shall convene an ad hoc committee to review the responses of NASA's Heliophysics program and NSF's Geospace program to the 2013 decadal survey, "Solar and Space Physics: A Science for a Technological Society."

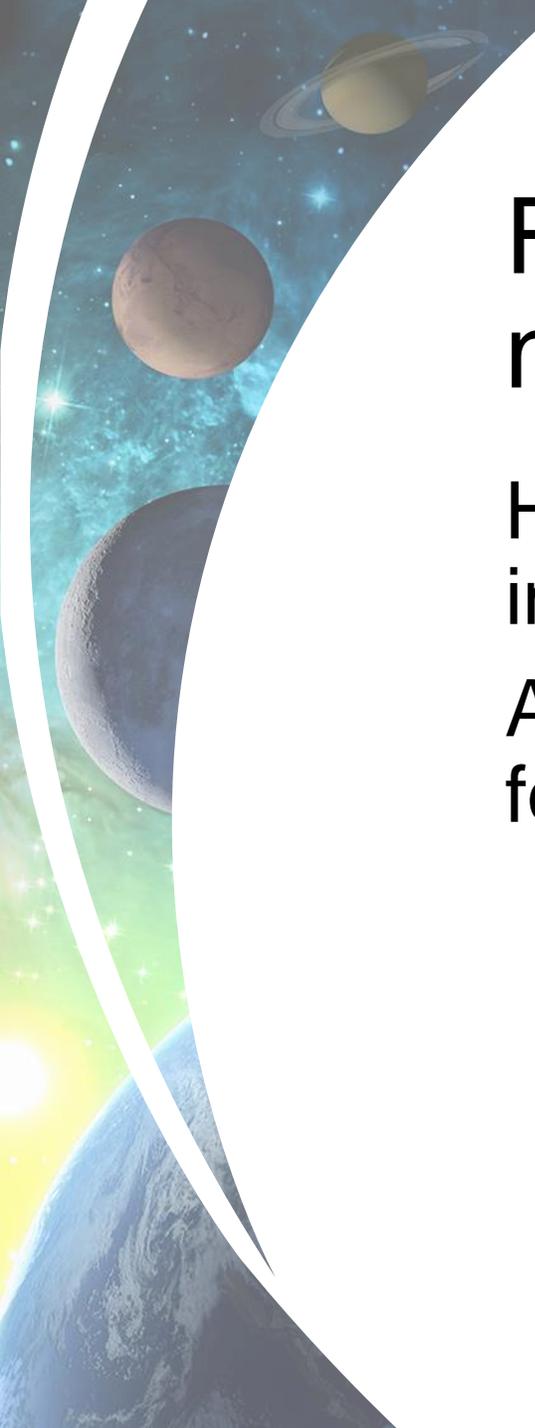
Committee has been appointed to develop mid-term report
Expected kick off meeting early in CY 2019

Assess the degree to which the Agencies' programs address the strategies, goals, and priorities in the current detail considering the national policy framework

Provide guidance about implementation of the recommended portfolio for the remaining years of the current decadal survey given actual funding levels

Recommend any actions that could be taken to optimize the science value of the Agencies' programs including how to take into account emergent discoveries and potential partnerships



A decorative graphic on the left side of the slide features a curved, semi-circular border. Inside this border, there is a vibrant space scene with a bright yellow sun at the bottom left, a blue and white Earth at the bottom, and several other celestial bodies including a brown planet, a grey planet, and a ringed planet (Saturn) against a starry blue and green background.

Future Opportunities to Participate in next Decadal

HPD is exploring ways the community can participate in the next Decadal

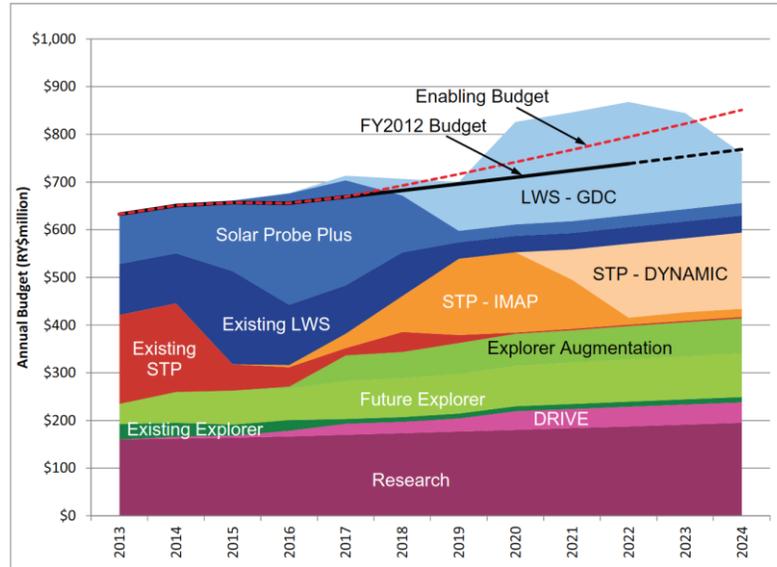
A possible and future brownbag would discuss the following:

- Recent and ongoing National Academies studies of interest to the Heliophysics science community

- HPD mid-term review

- Decadal process: planning and participation

Implementing the Decadal: Helio Budget 2013-2023



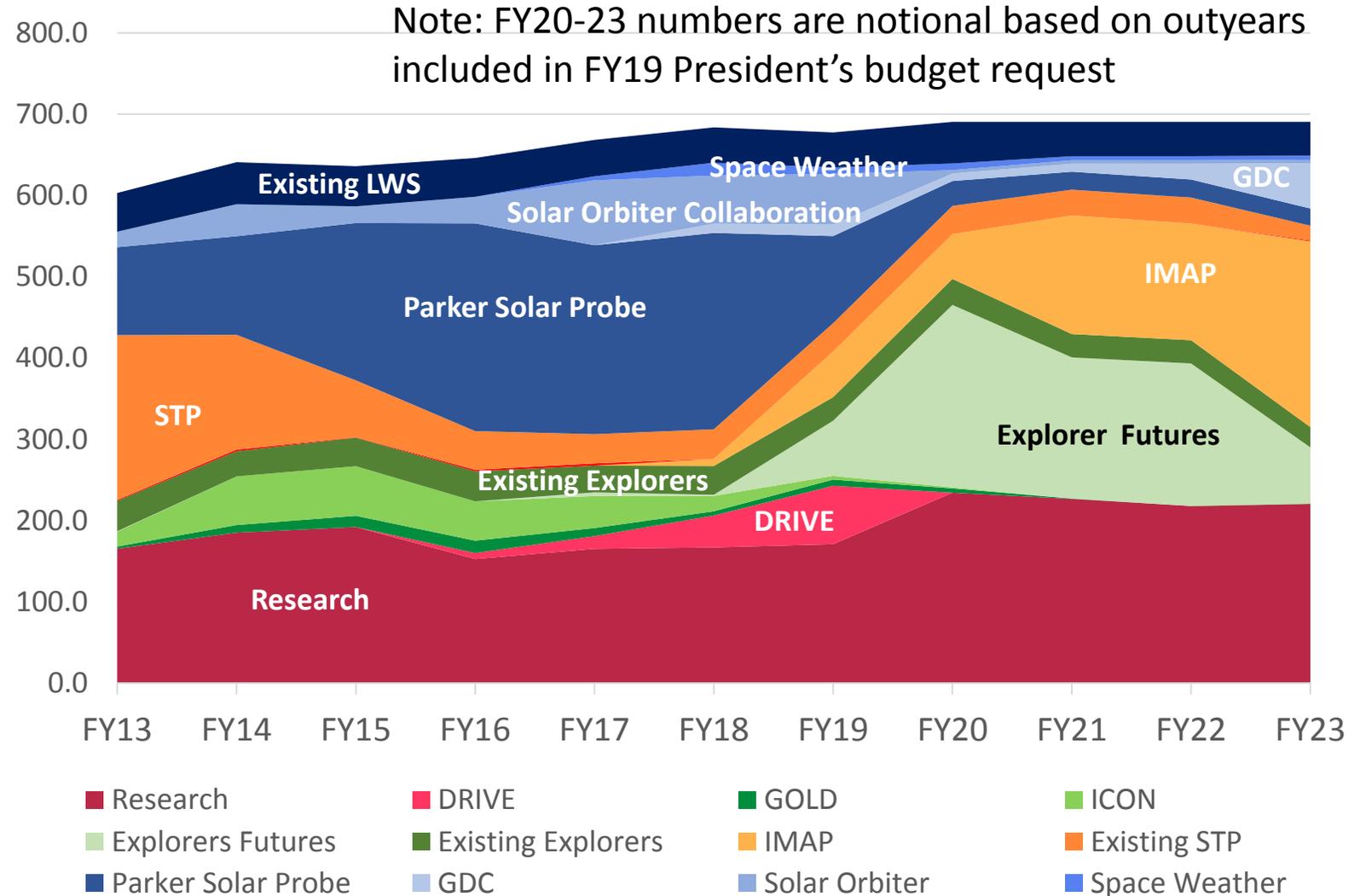
R0.0 Complete the current program

R1.0 Implement DRIVE (Diversify, Realize, Integrate, Venture, Educate)

R2.0 Accelerate and expand Heliophysics Explorer program

R3.0 Restructure STP as a moderate scale, PI-led flight program

R4.0 Implement a large LWS GDC-like mission



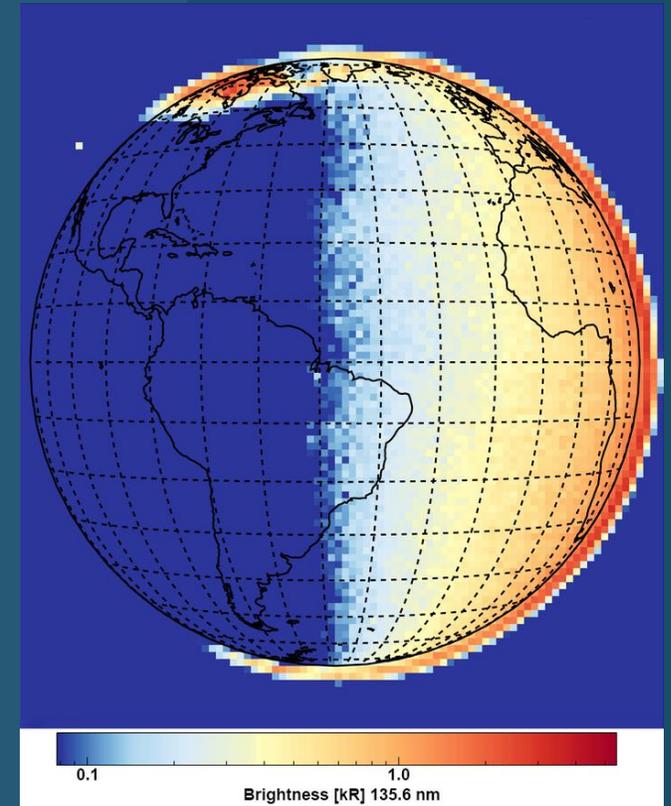
Alignment with Decadal Survey Recommendations

NASA FY19 President's Budget Request (PBR) and FY18 Appropriation Support:

R0.0 Complete the current program	Extended operations of current operating missions as recommended by the 2017 Senior Review; 5 missions currently in development, including two recently launched (GOLD and Parker), and ICON, SET, Solar Orbiter
R1.0 Implement DRIVE (Diversify, Realize, Integrate, Venture, Educate)	Implemented DRIVE initiative wedge in FY15; fully funded in FY18 and onwards
R2.0 Accelerate and expand Heliophysics Explorer program	Decadal recommendation of every 2-3 years; Explorer mission AO released in 2016; plan to release next draft Explorer AO in 2019. Notional mission cadence will continue to follow Decadal recommendation going forward. Increased frequency of Missions of Opportunity (MO), including rideshares on IMAP and Tech Demo MO.
R3.0 Restructure STP as a moderate scale, PI-led flight program	IMAP mission (STP-5) selected in 2018 as a PI-led mission with an LRD in 2024
R4.0 Implement a large LWS GDC-like mission	Start of mission formulation targeted for NET 2021. RFI call for innovative ideas yielded 65 responses – inputs provided to GDC STDT that started in 2018.

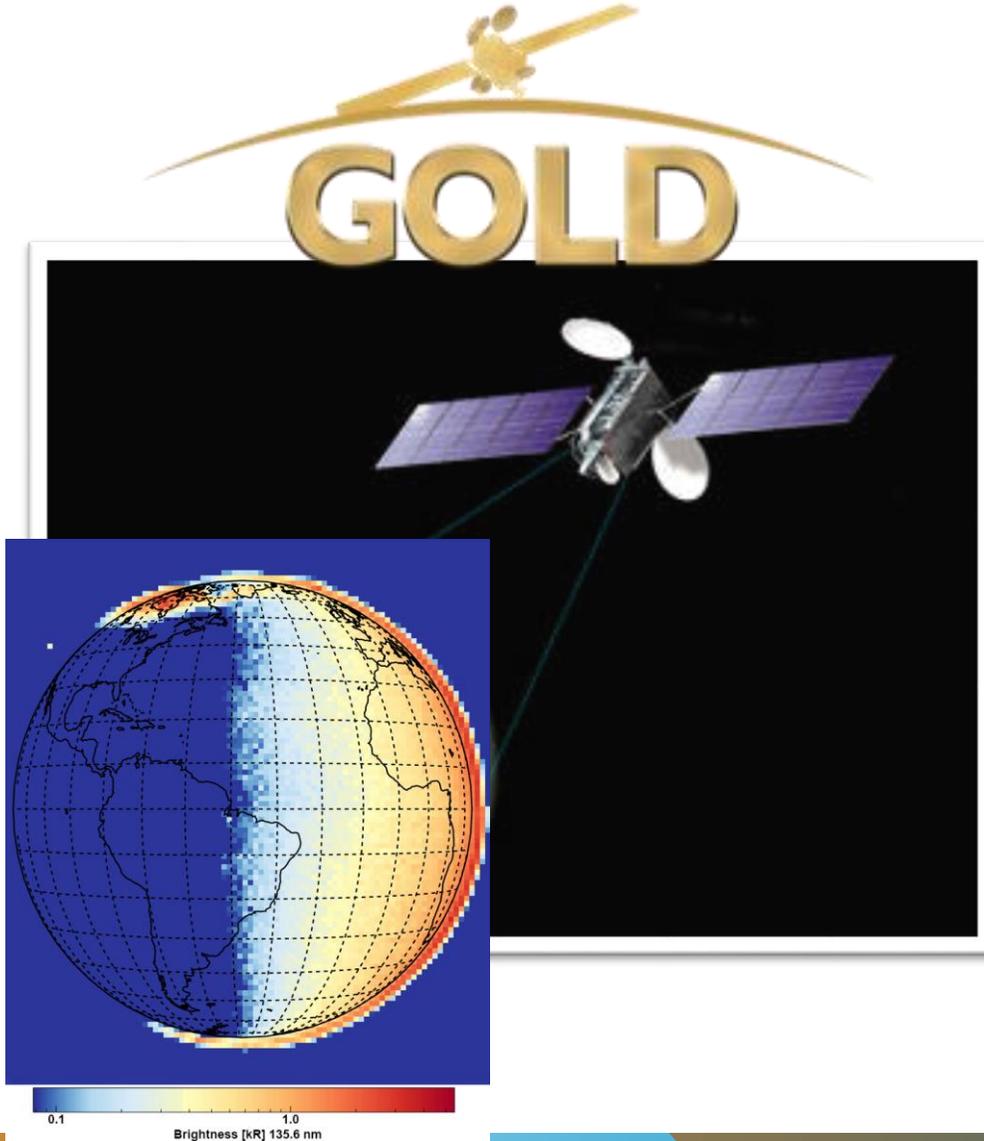


GOLD Launch



- *Gold launches from French Guiana on Jan 25 2018, Phase E operations started Oct 16*
- *Above: Gold first Light*

Global-scale Observations of the Limb and Disk (GOLD)



Mission Line: Solar Terrestrial Probes

Launch Vehicle: Ariane 5

Launch Site: French Guiana

Observatory: GOLD hosted payload on SES-14

Launched on Jan. 25, 2018, at 17:20 EST

GOLD Principal Investigator: Richard Estes

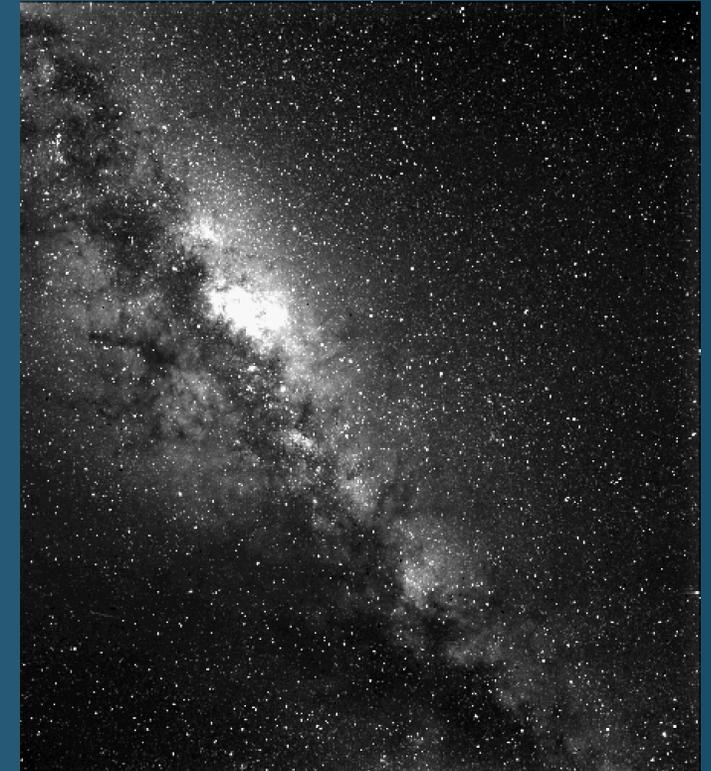
Description:

GOLD uses an ultraviolet imaging spectrometer to investigate the dynamic region where Earth's uppermost atmosphere meets near-Earth space.

GOLD is the first NASA science instrument to be hosted on a commercial spacecraft.

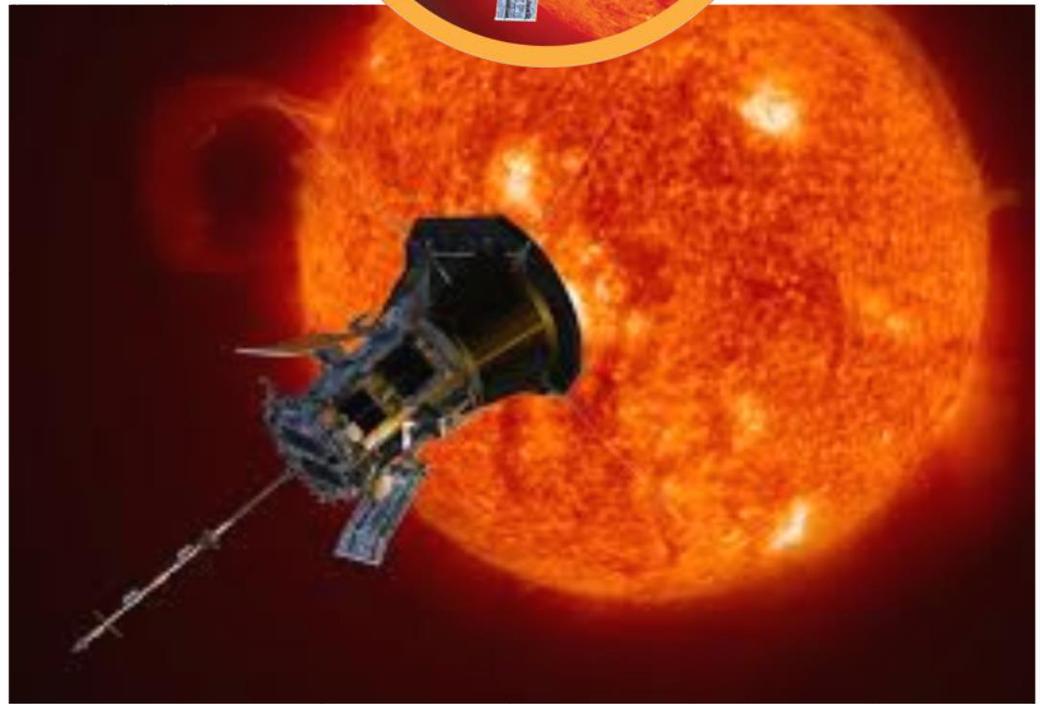
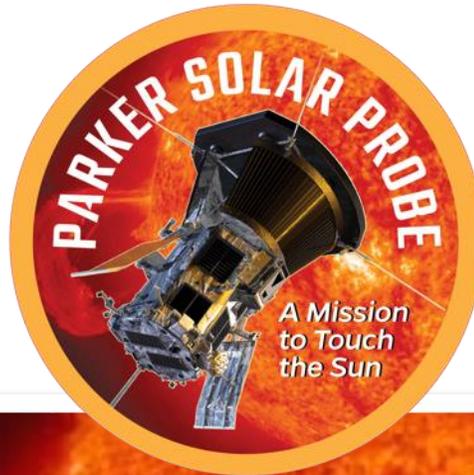
GOLD began Phase E on Oct. 18, 2018

Parker Solar Probe Launch



- *Parker Solar Probe launches from a Delta IV Heavy on Aug 12, 2018*
- *Above: Parker WISPR instrument doors open and first image downloaded, Sep10*

Parker Solar Probe



Mission Line: Living With a Star

Launch Vehicle: Delta IV-Heavy with Upper Stage

Launch Site: Cape Canaveral

Launched: Aug. 12, 2018

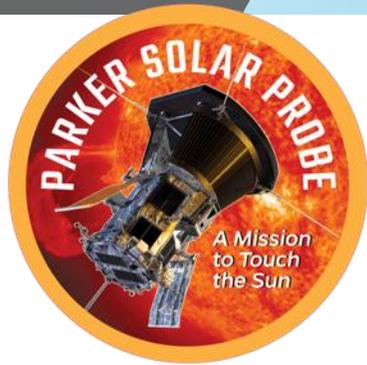
Parker Project Scientist: Nour Raouafi (APL)

Description:

Flying into the outermost part of the sun's corona for the first time, Parker Solar Probe will employ a combination of in situ measurements and imaging to revolutionize our understanding of the corona and expand our knowledge of the origin and evolution of the solar wind.

It will also make critical contributions to our ability to forecast changes in Earth's space environment that affect life and technology on Earth.

Next Step: *Parker completed its first Parker Venus gravity assist on Oct. 3, 2018*



Parker Solar Probe

- First Solar Encounter performed Oct. 31 – Nov. 11
 - Beacon tones beginning on Nov. 7 indicated that the spacecraft was nominal and instruments functioning
 - Minimum perihelion of $\sim .17$ AU occurred on Nov. 5, and max speed of 213,200 mph
- First data track received on Nov. 16 indicating:
 - Nominal spacecraft performance
 - Instrument data volume stored during encounter at the levels predicted
- Science data transmission from the first Parker Solar Probe solar encounter occurred Dec. 7 – 13.
- Trajectory control maneuver #6 on Dec. 9
- On Nov. 27, Popular Science reported that Parker Solar Probe was named "[the single greatest innovation of 2018.](#)"



Above: Members of the Parker Solar Probe mission team celebrate on Nov. 7, 2018, after receiving a beacon indicating the spacecraft is in good health following its first perihelion.

Credits: NASA/Johns Hopkins APL/Ed Whitman

Ionospheric Connection Explorer (ICON)



Mission Line: Explorers

Launch Vehicle: Pegasus XL rocket

Launch Site: Cape Canaveral

LRD: NET 1st quarter 2019

ICON Principal Investigator: Tom Immel (UC Berkeley)

Description:

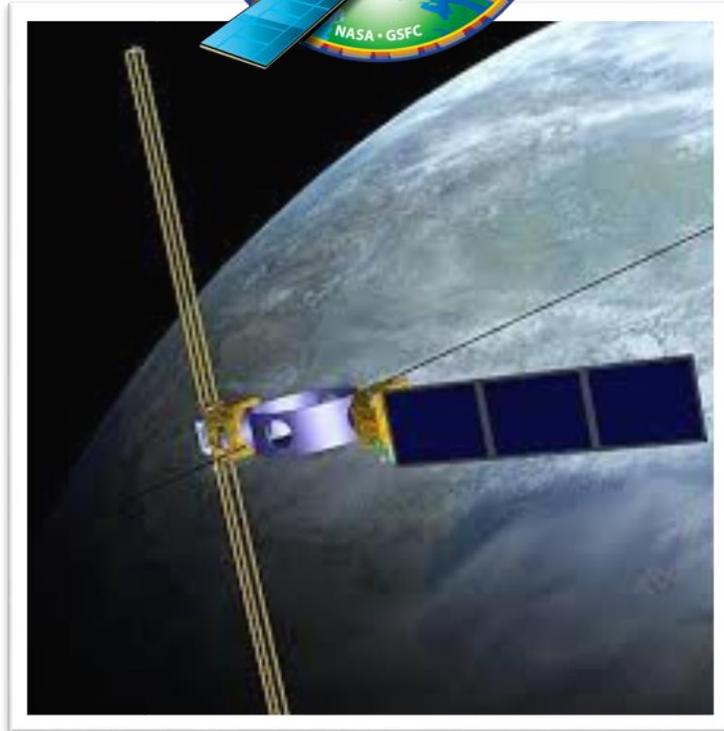
ICON will study the frontier of space: the dynamic zone high in our atmosphere where terrestrial weather from below meets space weather above.

In this region, the tenuous gases are anything but quiet, as a mix of neutral and charged particles travel through in giant winds.

These winds can change on a wide variety of time scales -- due to Earth's seasons, the day's heating and cooling, and incoming bursts of radiation from the sun.

Next Step: *Awaiting launch*

Space Environment Testbed (SET-1) Mission



Mission Line: Living With a Star

Launch Vehicle: Falcon 9 Heavy

Launch Site: Cape Canaveral

LRD: NET April 2019

SET Project Scientist: Mike Xapsos

Observatory: SET-1 hosted payload on Air Force Research Laboratory (AFRL) Demonstration and Science Experiments (DSX) spacecraft

Description:

Define the mechanisms for induced space environment and effects

Reduce uncertainties in the definitions of the induced environment and effects on spacecraft and their payloads

Improve design and operations guidelines and test protocols so that spacecraft anomalies and failures due to environmental effects during operations are reduced

Next Step: *Awaiting launch*

Solar Orbiter Collaboration



Mission Line: Living With Star

Launch Vehicle: U.S. Provided Atlas-V 411

Launch Site: Cape Canaveral

LRD: Feb. 2020

Solar Orbiter Collaboration Project Scientist: Chris St. Cyr

U.S. Provided Instruments:

HIS (Heavy Ion Sensor) part of SWA, SoloHI (Heliospheric Imager) have been delivered.

Description:

Solar Orbiter aims to make significant breakthroughs in our understanding both of how the inner heliosphere works, and of the effects of solar activity on it.

The spacecraft will take a unique combination of measurements: in situ measurements will be used alongside remote sensing close to the Sun to relate these measurements back to their source regions and structures on the Sun's surface.

Next Step: *Thermal Vacuum Testing ongoing*

HPD Operating Missions

Mission	Launch	Phase	Extension	M-3	M-2	M-1	Cur. M.	Remarks
Geotail	7/24/1992	Extended	9/30/2021					
STEREO	10/25/2006	Extended	9/30/2021					
THEMIS+Artemis	2/17/2007	Extended	9/30/2021					
AIM	4/25/2007	Extended	9/30/2021					
Hinode	9/23/2006	Extended	9/30/2021					
ACE	8/27/1997	Extended	9/30/2021					
SOHO	12/2/1995	Extended	9/30/2024					
TIMED	12/7/2001	Extended	9/30/2021					
Voyager 1 + 2	8/20/1977	Extended	9/30/2021					Voyager 2 crossed heliopause... Parkes now receiving data.
TWINS A	6/1/2006	Phase F						Phase F budget received. No concerns.
IBEX	10/19/2008	Extended	9/30/2021					
Wind	11/1/1994	Extended	9/30/2021					
SDO	2/11/2010	Extended	9/30/2021					
Van Allen	8/30/2012	Extended	9/30/2021					
IRIS	6/27/2013	Extended	9/30/2021					Issue with star tracker on 10/27. Continues in coarse mode.
MMS	3/12/2015	Extended	9/30/2021					
GOLD	1/25/2018	Prime	10/17/2020					



Mission proceeding to meet science requirements



Area of concern - possible reduction in capability



Significant problem – possible or probable loss of mission

Fully Funded DRIVE Program



- FY19 Budget Request: \$175M, DRIVE Elements include:
 - HTIDeS:
 - Low Cost Access To Space (LCAS): Sub-orbital and CubeSats
 - Instrument Technology Development (ITD) and LNAPP
 - Guest Investigator
 - Open and Mission Focused
 - Supporting Research
 - Grand Challenge Research
 - Including Heliophysics Science Centers
 - Early Career Investigator Program
 - LWS Science
 - Including Space Weather Research

Sounding Rocket Highlights



Focusing Optics X-ray Solar Imager (FOXSI-3) launched Sep 7, 2018, White Sands Missile Range, PI Glesener



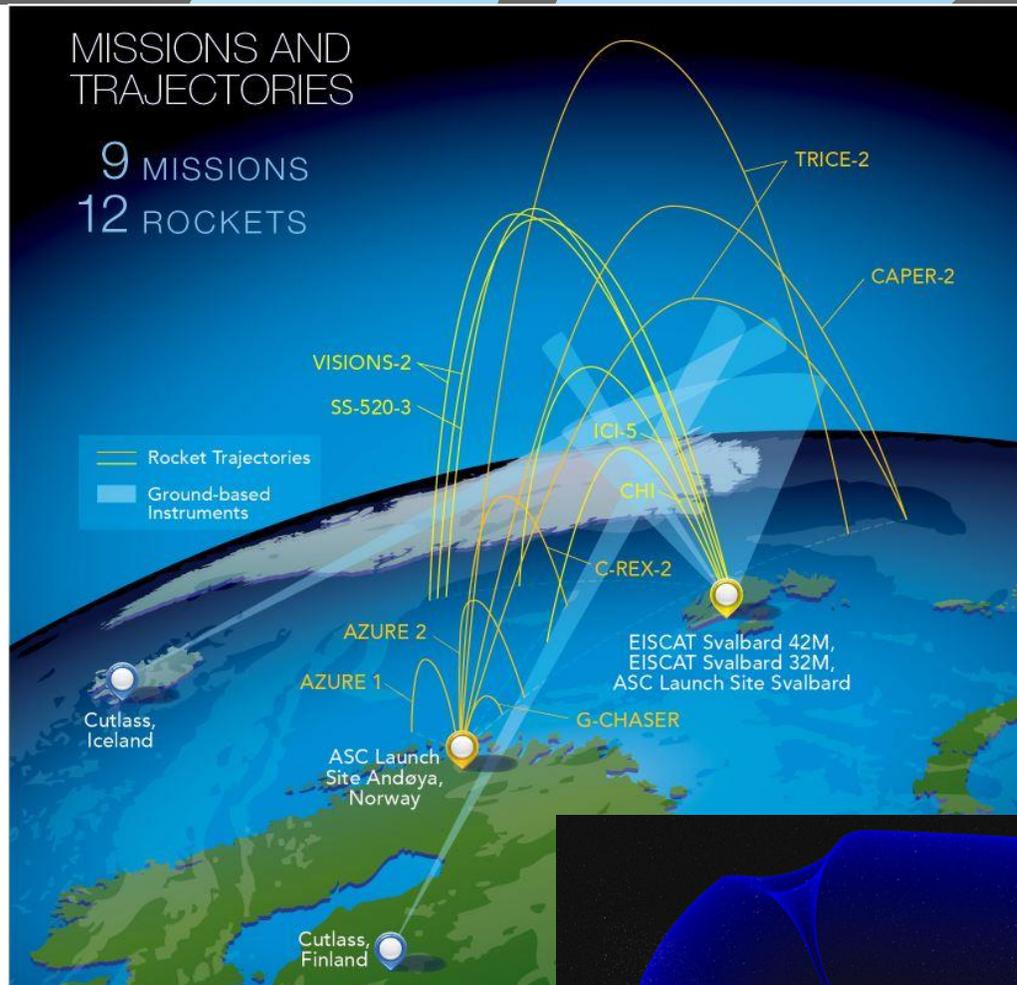
High-Resolution Coronal imager (Hi-C) launched May 29, 2018, White Sands Missile Range, PI Winebarger



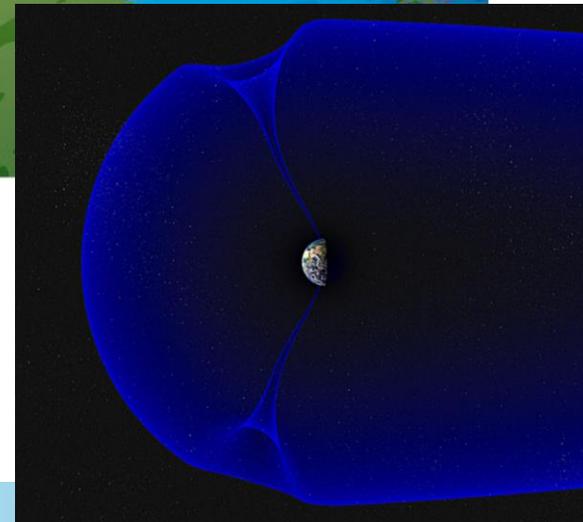
AESOP (Anti-Electron Sub Orbital Payload)-Lite, launched May 15, 2018, Sweden, PI Clem

- HPD Suborbital Program
- 22 NASA missions + 4 reimbursable missions launched in 2018
- 15 HPD Suborbital (13 Sounding Rockets, 2 Balloons) selected in 2018

Grand Challenge



Right: Earth's magnetosphere, showing the northern and southern polar cusps. (Credits: Andøya Space Center/Trond Abrahamsen)



- The **2018/2019 Grand Challenge Initiative** began this December and runs through December 2019.
- U.S. Principal Investigators (PI) are participating in 7 of the 9 missions, and the NASA Wallops Flight Facility is supporting launch activities.
- The first missions for the U.S. were VISualizing Ion Outflow via Neutral atom Sensing-2 (VISIONS-2) and Twin Rockets to Investigate Cusp Electrodynamics II (TRICE-2).
 - The purpose of VISIONS-2 is to study the nature and extent of low altitude ion outflow (>10 eV) from the cusp.
 - PI: Doug Rowland from GSFC
 - Launch December 7, 2018, from Svalbard, Norway.
 - The purpose of TRICE-2 is to measure cusp signatures of reconnection occurring at the magnetopause during steady IMF Bz southward conditions.
 - PI: Craig Kletzing from the University of Iowa
 - Launch December 8, 2018, from Andøya, Norway.

CubeSats Highlights



ELFIN-STAR

Credit: UCLA EPSS



MinXSS II

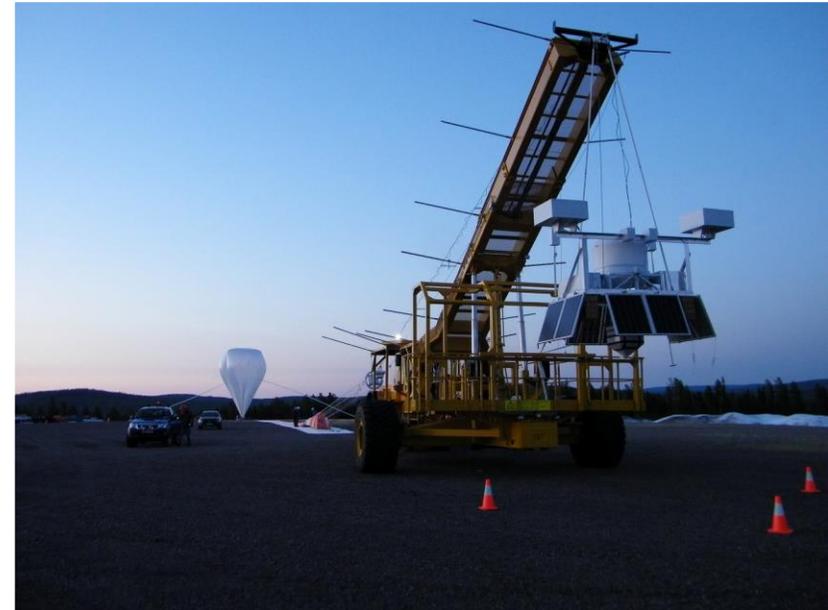
Credit: LASP

2018 HPD CubeSat Investigations

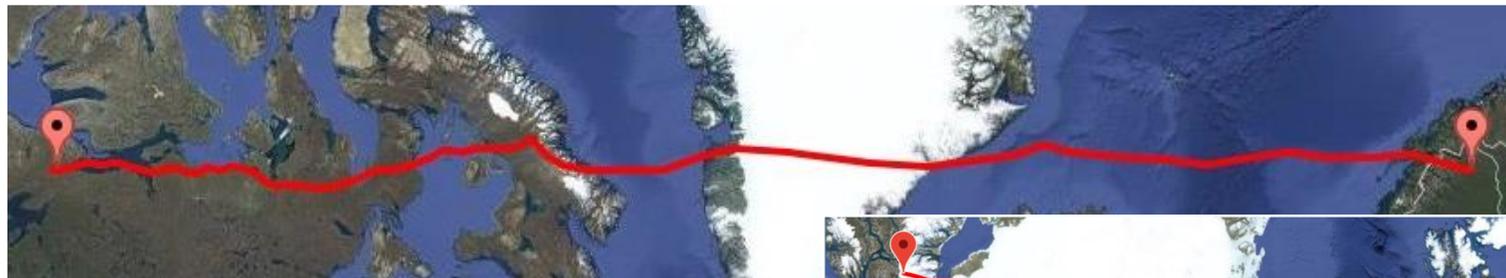
- Electron Loss and Fields Investigation with Spatio-Temporal Ambiguity Resolving (ELFIN-STAR) space weather CubeSats A and B launched on ICESat-2 launch, September 15, 2018
- Miniature X-ray Solar Spectrometer II (MinXSS-2) launched on December 3, 2018, with SSO-A SSO-A SmallSat Express aboard a SpaceX Falcon 9
- Compact Radiation Belt Explorer (CeREs) launched on Dec 16, 2018 aboard Rocket Labs Electron Rocket
 - First NASA Venture Class Launch Initiative – VCLI
- Five HPD CubeSats selected in 2018
- 18 Total HPD CubeSat investigations have been selected to date

FY18 Norway Balloon Campaign Highlights

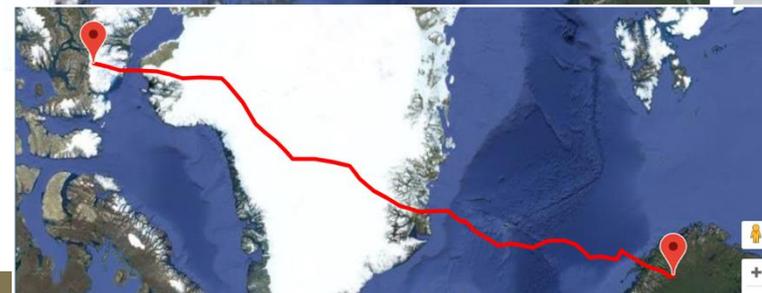
Launch Date	Experiment	Principal Investigator	Institution
May 15, 2018	AESOP (Anti-Electron Sub Orbital Payload)-Lite	Dr. John Clem	University of Delaware
June 24, 2018	HiWind (High-altitude Interferometer WIND Experiment)	Dr. Qian Wu	National Center for Atmospheric Research
July 8, 2018	PMC-Turbo (Polar mesospheric clouds)	Dr. Dave Fritts	GATS-Boulder



Leaving from Sweden,
Top:
ASEOP
Bottom:
PMC-Turbo



Above: HiWind balloon track, PMC-Turbo balloon track similar
Right: AESOP balloon track





Students working on RockSat-X payload



FDL 2018 team

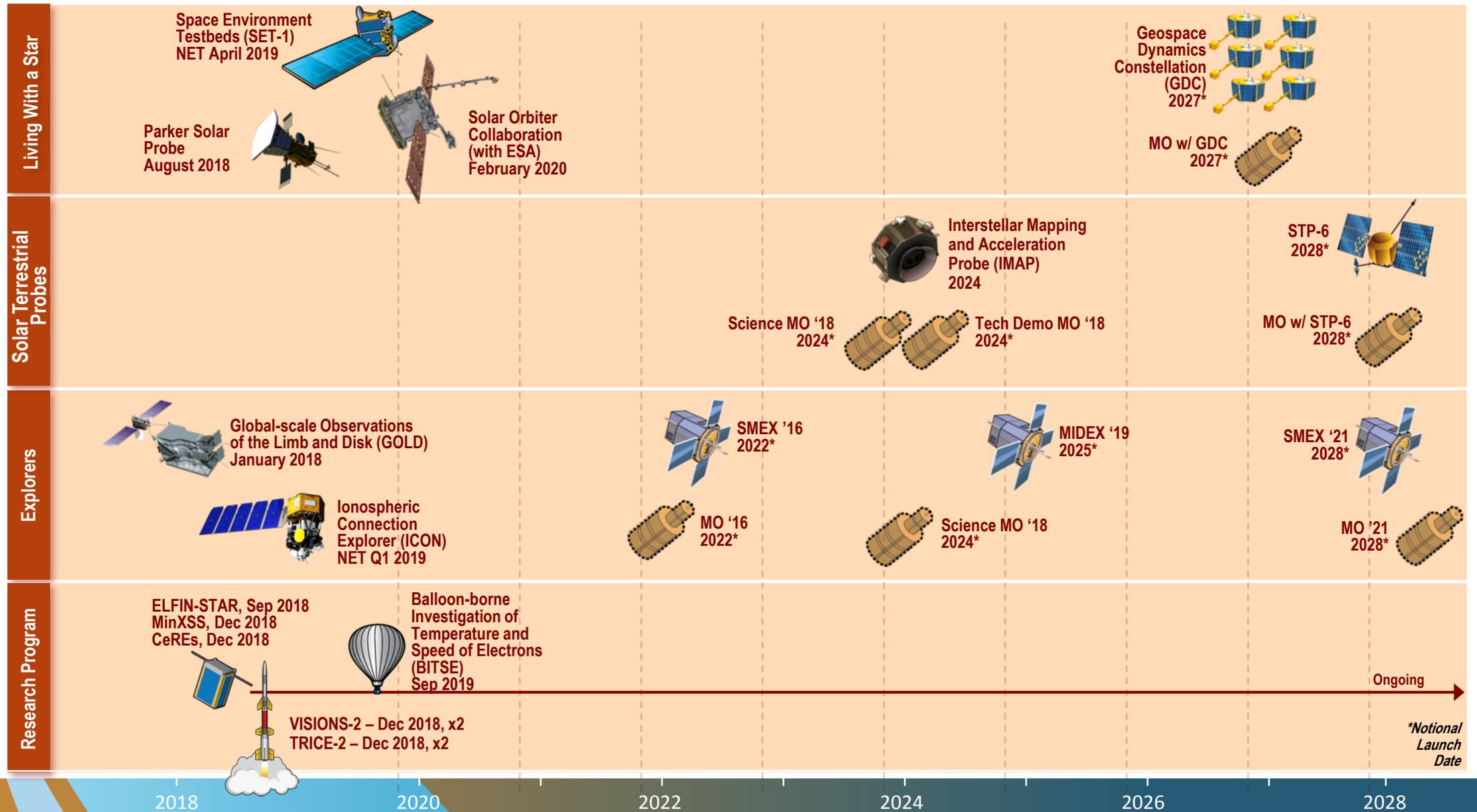
Investments in Future Heliophysics Leaders

- **Early Career Investigator Program (ECIP)**
 - First year of pilot implementation
 - Anticipated awards Q2 FY19
- **Fellowships**
 - 6 current Jack Eddy Fellows
 - 12 NASA Earth and Space Science Fellowship (NESSF) in 2018
 - Future Investigators in NASA Earth and Space Science and Technology (FINESST) replaces the 2019 NESSF call
- **Heliophysics Summer School**
 - 33 students participated in 2018
- **RockSat-X sounding rocket**
 - 100+ student participated; launched August 13, 2018
- **Frontier Development Lab**
 - In 2018, 8 Students/early career

A graphic on the left side of the slide depicts a space scene. It features a large, dark blue sphere (resembling the Moon) in the center, a smaller brown sphere (resembling Mars) above it, and a ringed planet (resembling Saturn) to the left. The background is a vibrant, multi-colored nebula with shades of blue, green, and yellow, filled with numerous bright stars. At the bottom, the curved horizon of the Earth is visible, showing blue oceans and brown landmasses. The entire graphic is framed by a white, curved border that separates it from the text on the right.

Missions in Formulation and Decadal Recommendations

Heliophysics Programs (2018-2028)



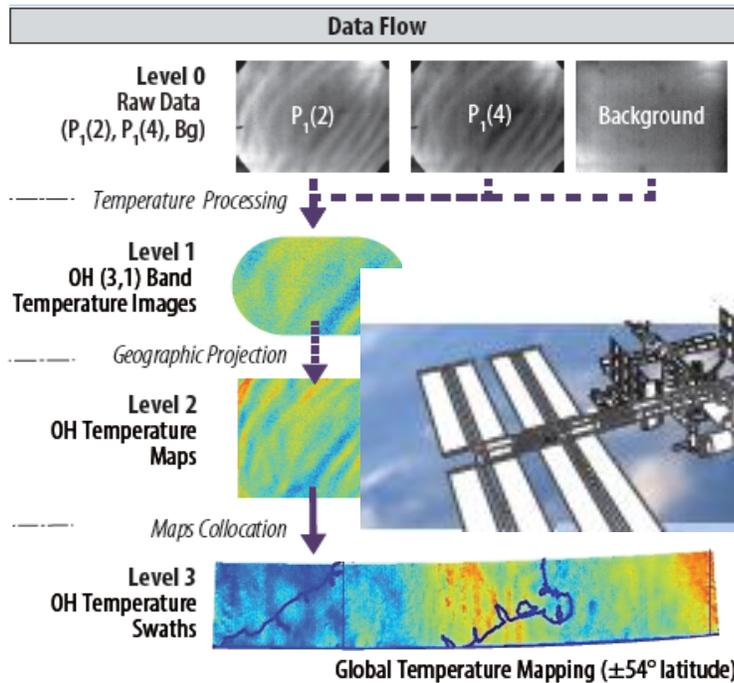
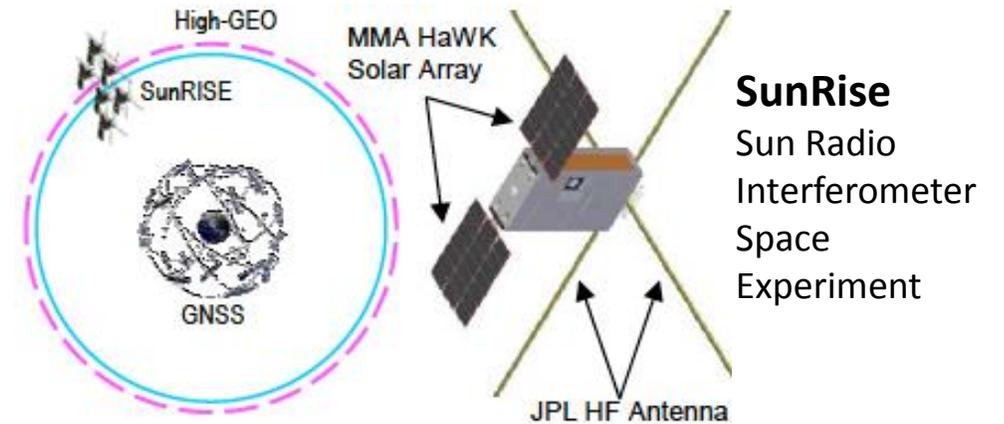
*Notional Launch Date



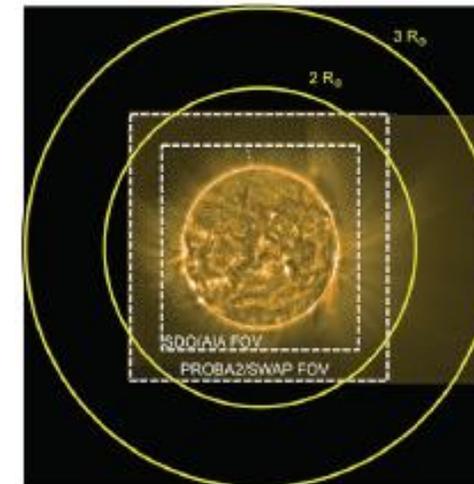
Explorers 2016 Missions of Opportunity

Two MO missions in Phase A down-select competition: SunRISE & AWE

One Cat 3 MO in technology development effort: COSIE



AWE
Atmospheric Waves Experiment



COSIE
Coronal Spectrographic Imager in the EUV



Explorers AO 2016 SMEX Selections

Five SMEX missions in Phase A down-select competition:

MEME-X, FOXSI, MUSE, TRACERS, PUNCH

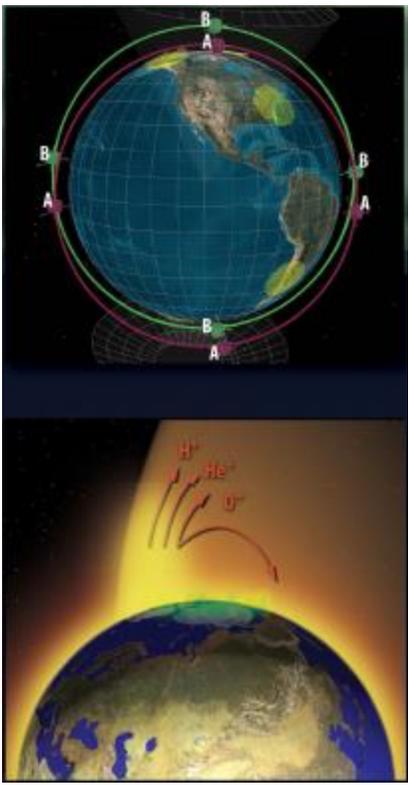
LRD ~2022

TRACERS
Tandem Reconnection and Cusp Electrodynamics Reconnaissance Satellites

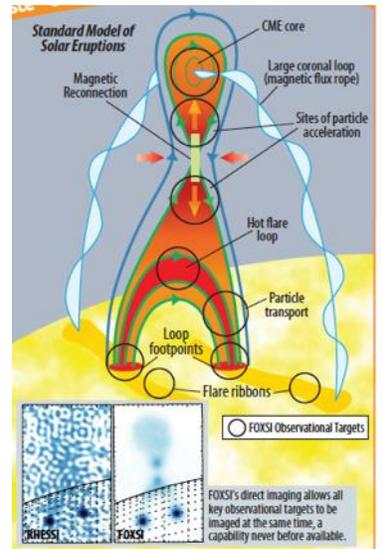
Key Spacecraft Characteristics

T1 & T2 Satellites

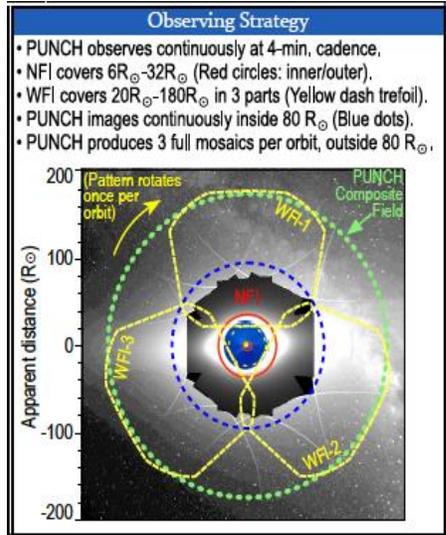
- Passive spin stabilization enables simple instrument modes & operations
- Power, RF, thermal-positive in all attitudes
- Spacecraft bus design uses strong WFOV/Altair heritage and leverages legacy industry components for Low Earth Orbit
- Self-equilibrating hydrazine system merges heritage components via Millennium's WFOV existing integration processes
- Booms have direct THEMIS heritage



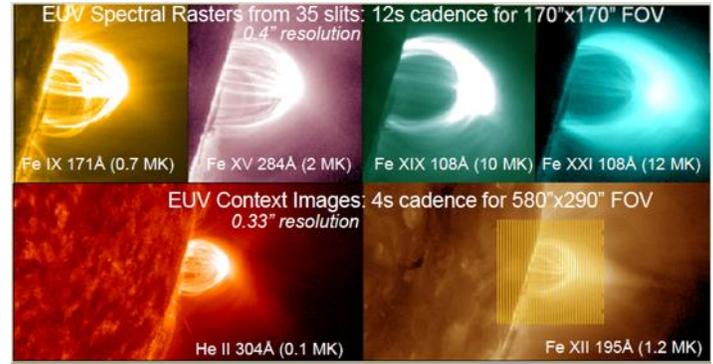
MEME-X
Mechanisms of Energetic Mass Ejection eXplorer



FOXSI
Focusing Optics X-ray Solar Imager



PUNCH
Polarimeter to Unify the Corona and Heliosphere



MUSE
Multi-slit Solar Explorer

Interstellar Mapping and Acceleration Probe (IMAP)

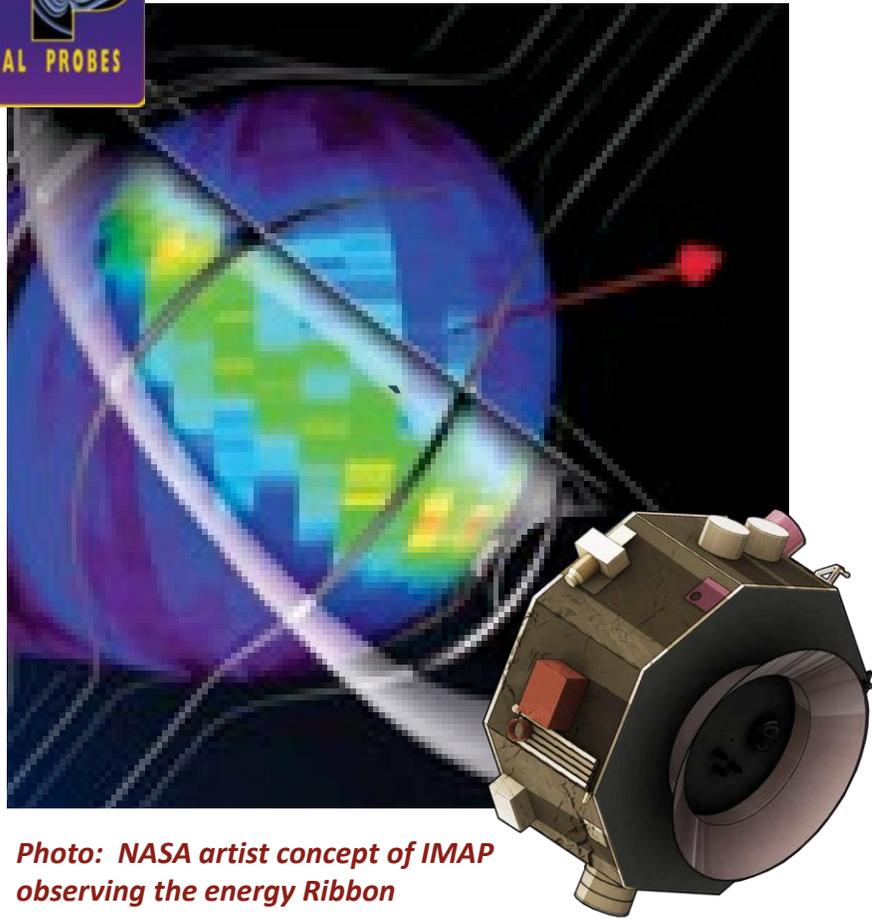


Photo: NASA artist concept of IMAP observing the energy Ribbon

- IMAP and the ESPA Grande - Selected: Jun 1, 2018
 - LRD: Oct 1, 2024
 - PI David McComas of Princeton University
 - Project Management and Mission Operations Center at Johns Hopkins University's Applied Physics Laboratory in Laurel, Maryland
 - Science Operations Center at LASP/University of Colorado
- Orbit: L1 Lagrangian point
- Description:
 - Sample, analyze, and map particles streaming to Earth from the edge of interstellar space.
 - Investigate the generation of cosmic rays in the heliosphere and beyond.
 - 10 scientific instruments
- Rideshare opportunities on the ESPA
 - Competitive Missions of Opportunity including Tech Demo
 - NOAA Space Weather Follow-On



2018 Heliophysics Opportunities

SALMON AO released

- Proposals received November 30
 - Science MO cost cap \$55M
 - Science MO small complete mission (SCM) cost cap \$75M to ride on ESPA ring
 - Technology Demonstration MO SCM cost cap \$65M to ride on ESPA ring
 - Anticipated Launch Readiness Date: October 2024
- Note:** Combined opportunity as announced at 2017 AGU

ROSES Science Centers

- Comments received from Draft Phase 1 DRIVE Science Centers on September 21
- Final call released
 - Step 1 proposal due date: February 1, 2019
 - Step 2 proposal due date: April 5, 2019

A large, stylized graphic on the left side of the slide depicts a space scene. It features a bright sun in the lower left, a blue and white Earth in the bottom foreground, a large grey moon in the center, and several other planets including Saturn with its rings and a reddish planet. The background is a vibrant nebula with shades of blue, green, and yellow, filled with stars.

Explorers Future Missions

Explorers mission cadence every 2-3 years; in-line with current Decadal Survey

MIDEX 19

- Draft AO release date: January 2019
- Final AO release date: June 2019
- PI managed Cost Cap: \$250M
- Launch Vehicle: Medium Class
- Launch Readiness Date: NLT February 2026

A graphic on the left side of the slide depicts a space scene. It features a large, dark blue planet in the foreground, a smaller brown planet above it, and a ringed planet to the left. The background is filled with stars and a nebula. A white curved line separates this graphic from the text on the right.

Research and Technology

Heliophysics Research

ROSES 17

- **Awarded/Selected Elements:**
 - Supporting Research
 - Technology and Instrument Development for Science
 - Guest Investigators Open
 - Data Environment Enhancement
 - Magnetospheric Multiscale Guest Investigators
 - Space Weather Operations to Research
 - Living With a Star

ROSES 18

- **Awarded/Selected Elements:**
 - Technology and Instrument Development for Science*
 - Guest Investigator
 - Space Weather Operations to Research (1)
 - Data Environment Enhancement
- **Awaiting Selection:**
 - Supporting Research
 - Early Career Investigator Program
- **Open Solicitations:**
 - Living With a Star
 - DRIVE Science Centers
 - Space Weather Operations to Research (2)



Technology Development: ROSES18 HTIDeS restructured



- LNAPP and ITD elements expanded selections via DRIVE
- Research and Technology (R&T) Flight Program; in-line with NPR7120.8
 - Total Flight 39 proposals
 - Split LCAS:
 - CubeSats 18 total proposals
 - LCAS (all sub-orbitals) 21 total proposals
 - R&T Prime (Greater than \$3.5M total cost)
 - Mandatory formulation study with down-select
 - Total 14 proposals
 - 1 Suborbital
 - 13 Cubesat/Orbital

Space Weather Science Applications Program

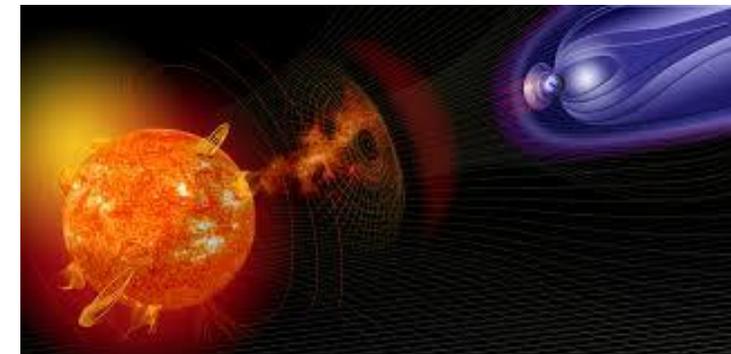
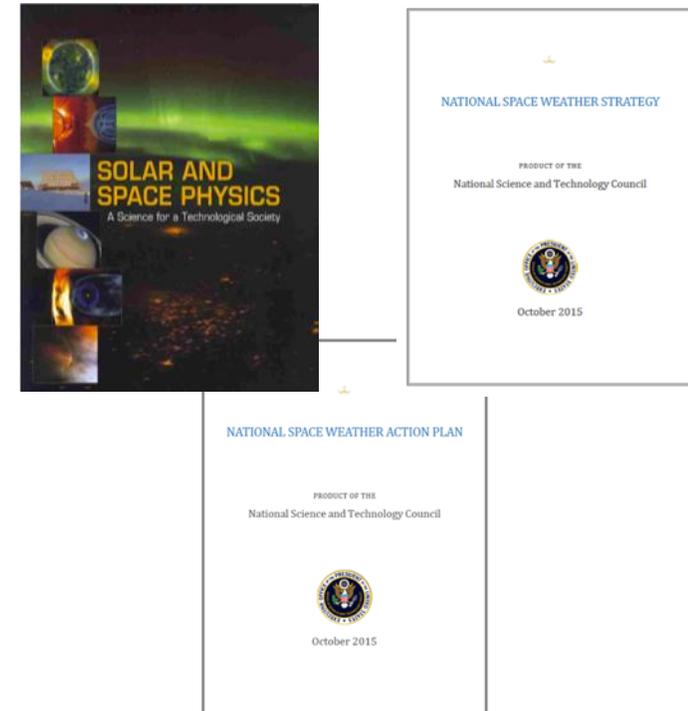
Establishes an expanded role for NASA in space weather science under single budget element

Consistent with recommendation of the NRC Decadal Survey and the OSTP National Space Weather Strategy

Competes ideas and products, leverages existing agency capabilities, collaborates with other agencies, and partners with user communities

Three main areas of the Space Weather Science Applications Program are:

- Collaboration
- Competed Elements
- Directed Components



Space Weather Science Applications Program (1)

3 calls were made between ROSES 2017 and ROSES 2018 in Space Weather Operations-to-Research (SWO2R)

8 selections made for ROSES 2017 SWO2R

Focus: Improve predictions of background solar wind, solar wind structures, and CMEs

9 selections made for ROSES 2018 (1) SWO2R

Focus: Improve specifications and forecasts of the energetic particle and plasma encountered by spacecraft

ROSES 2018 (2) SWO2R selections upcoming:

Focus: Improve forecasts of solar energetic particles and heavy ions

Step 1 proposals due 2/1/19; Step 2 proposals due 4/5/19

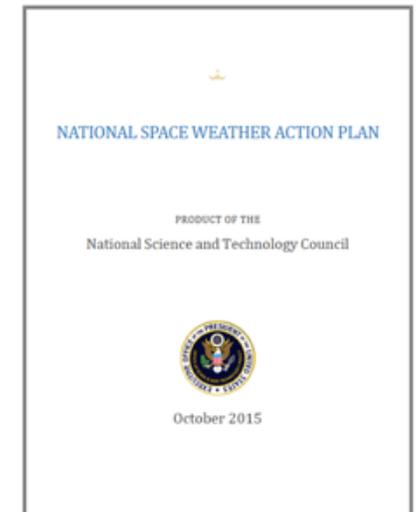
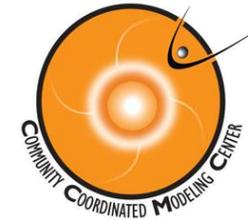
Small Business Innovation Research (SBIR) Program

Selected two space weather proposals for 2018; continued participation in 2019 SBIR Program



Space Weather Science Applications Program (2)

- Investments in improving Infrastructure
 - CCMC enhancement for model assessment and transition
 - High-End Computing capability to enable large scale predictive modeling development
- Next Steps Benchmarking Activity beginning
 - Community input to the update of the Space Weather Action Plan Benchmarks (Winter)
 - Geoff Reeves (LANL) will chair community steering group
 - Overseen by the Science and Technology Policy Institute, supported by NSF funding
 - Logistics provided by NASA
 - Workshop hosted spring/summer where draft document created
 - Town Hall in Fall 2019 for final document release



A graphic on the left side of the slide depicts a space scene. It features a bright yellow sun in the lower-left, a large blue and white Earth in the lower-right, and several other celestial bodies including a reddish planet, a ringed planet, and a grey moon. The background is a dark blue space filled with stars and a nebula. A white curved line separates this graphic from the text on the right.

Heliophysics Committees



Heliophysics Committees

4/5-6 HPAC Meeting

2017 Senior Review Recommendations were briefed

7/31 – 8/3: GDC Science and Technology Definition Team
2nd Meeting

10/22-23: HPAC Meeting
GPRAMA Review

10/22-23: LWS Program Analysis Group meeting in College Park, MD
Draft ROSES 19 focus science topics
Discussing future strategic capability
TRT metrics

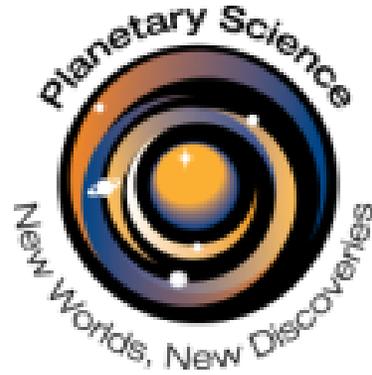
11/27-30: GDC Science and Technology Definition Team
3rd Meeting

12/18-20: HPAC Meeting

A graphic on the left side of the slide depicts a space scene. It includes a large, dark blue planet with a prominent ring system, a smaller reddish-brown planet, and a bright yellow sun. The Earth's horizon is visible at the bottom. The background is a vibrant, multi-colored nebula with shades of blue, green, and yellow, filled with numerous stars. A white, curved line separates this graphic from the main text area.

Partnerships

Intra- and Interagency Partners



Planetary:

Co-selected LWS grants; joint ROSES Juno Participating Scientist Program

Astrophysics:

Joint “Impact of Stellar Properties on the Habitability of Exoplanets” research opportunity

NASA-NOAA (MOU):

Collaboration between CCMC and NOAA/SWPC on space weather modeling capability

Co-funding O2R proposals

Accommodation for SWFO mission on IMAP launch

NASA-NSF:

Coordinating ICON & GOLD opportunities (joint NASA mission GI and NSF CEDAR solicitations)

Co-funding Living With a Star Strategic Capabilities, Science Centers, CCMC

New opportunity focused on Computational Aspects of Space Weather

NASA-NSF-NOAA:

Pilot O2R research activity, MOU signed

NASA-USGS

NASA collaborating with USGS to enable Magneto-Telluric Survey in southwest

International Partners



ESA (Europe):

Solar Orbiter

KASI (Korea):

Development towards prototype coronagraph (BITSE) for balloon flight in 2019

Van Allen downlink and SDO data archiving

KASI Geomagnetic Storm Forecast Model

AEB (Brazil):

SPORT CubeSat Mission, LRD 2020

ISRO (India):

Three sub-working groups established

Aditya-1 mission collaboration, space weather modeling, long-term strategic collaboration focus areas

JAXA (Japan):

Working with JAXA on approach for Next Generation Solar Physics Mission (NGSPM)

Cooperation on Hinode and sounding rockets (CLASP and the upcoming CLASP2)



A graphic on the left side of the slide depicts a space scene. It features a bright yellow sun in the lower-left, a large blue and white Earth in the lower-right, and several other celestial bodies including a reddish planet, a ringed planet, and a grey moon-like sphere. The background is a dark blue space filled with stars and nebulae. A white curved line separates this graphic from the text on the right.

Heliophysics New Initiatives

For Community Comment



“Whole Helio” campaign

- Unique opportunity in Heliophysics allowing coordination in a way we have never done before
- Benchmark for integrated knowledge and assessment of knowledge gaps throughout the system
- Truly “interdisciplinary”

Whole Helio Month (1/2)

Coordinated observation and theory-modeling program covering full breadth of Heliophysics **across agencies** and **interdisciplinary**

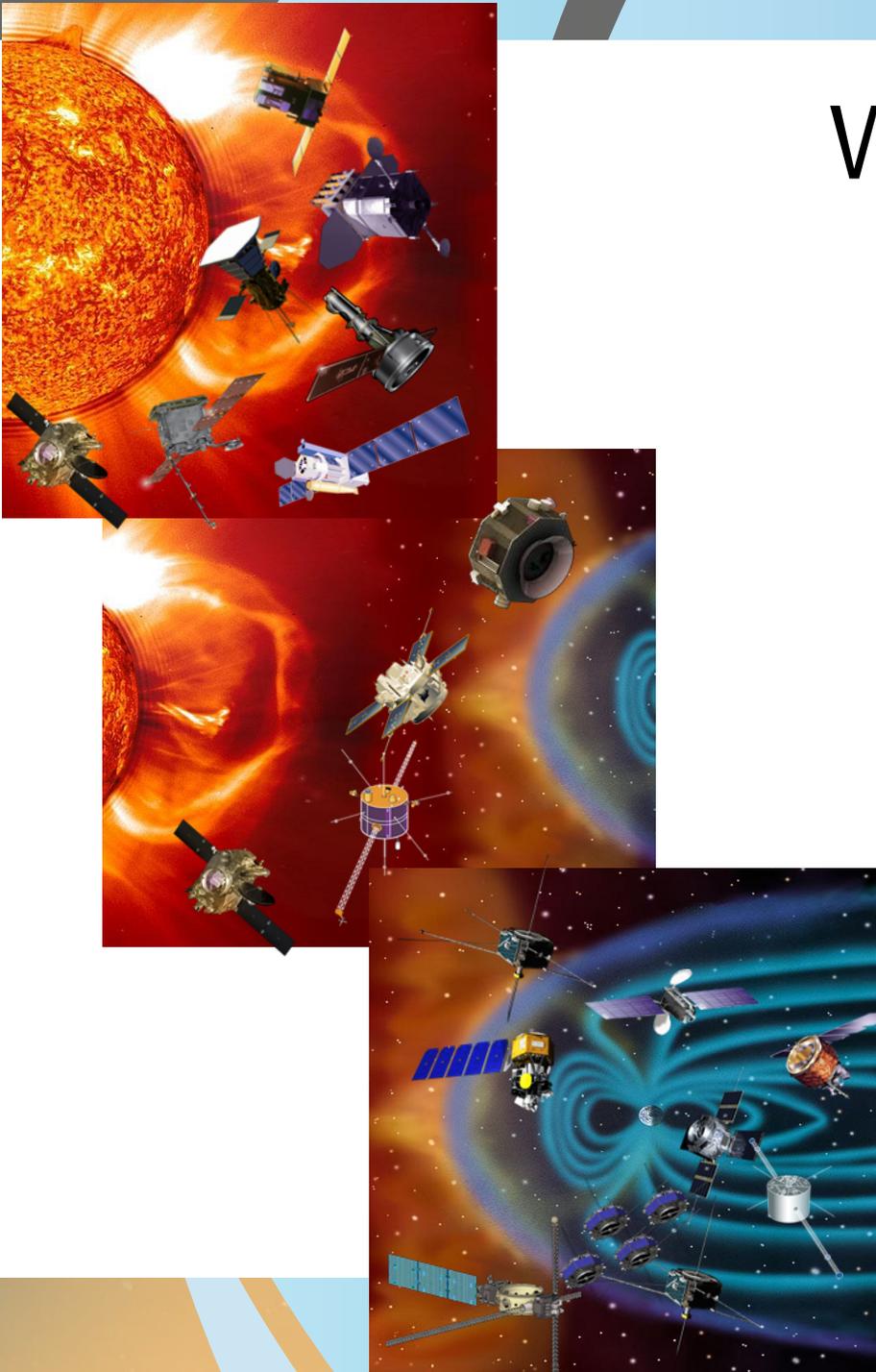
Centered on perihelion passes for Parker which are visible from Earth or other planets

Coordinate Parker, DKIST, SoO, & other space, suborbital & ground-based assets

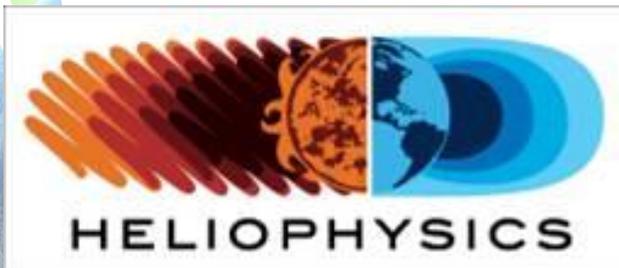
Track the transit of features through interplanetary space

Observe and characterize the geospace response

Integration of Theory and Modeling throughout solar system and beyond



Whole Helio Month (2/2)



- "Test Run" this summer centered on Solar Minimum called Whole Heliosphere and Planetary Interactions led by Sarah Gibson and Barbara Thompson (<https://whpi.hao.ucar.edu/>)
- Novel interdisciplinary scientist program to drive connected research and discovery
 - Large scale IDS teams led by a PI
 - Grants for individual contributors who will provide their data and conduct independent research.
- Follow up workshop after first observing period
 - Collaboration after campaign plus planning meeting for the next campaign.
- Workshops would continue to be scheduled at a regular cadence – organized by IDS teams



**Ability to take
advantage of any future
ride opportunity**

HPD Rideshare

SMD has embraced Rideshare opportunities as a standard practice to maximize mass to orbit

Enabling additional opportunities for science community

SMD has formed a rideshare policy team to develop standard rideshare processes

The first HPD rideshare opportunity is using a standard (non-propulsive) ESPA Grande

Releasing RFI to capture private sector capability and interest in ESPA integration.

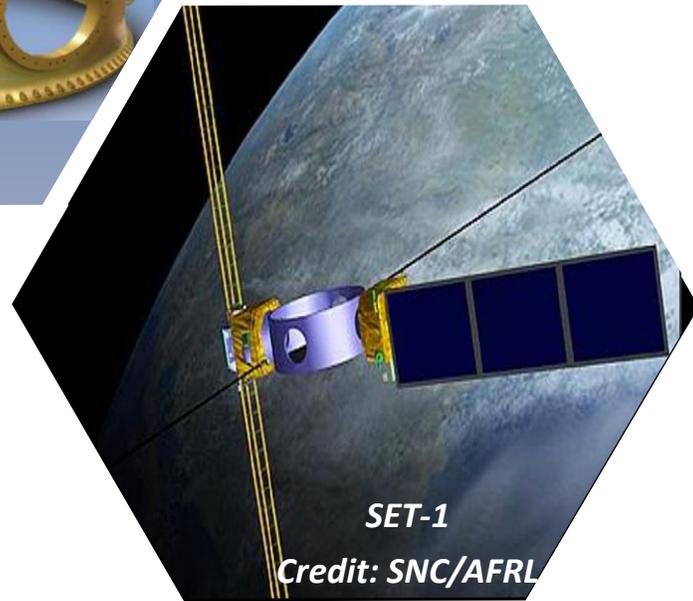
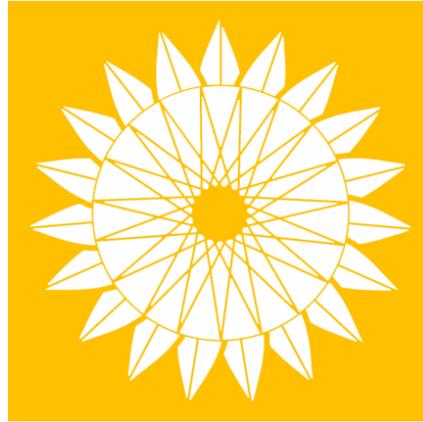
Rideshare opportunities on IMAP ESPA

Science MO SCM; Technology Demonstration MO SCM

NOAA Space Weather Forward Observatory

If there are open ESPA ports after the above missions are accommodated, they will be offered to other SMD investigations under new Rideshare Policy.

In support of rideshare, HPD is developing a mission-unique ESPA Systems Interface Specification



Expanded Rideshare Program



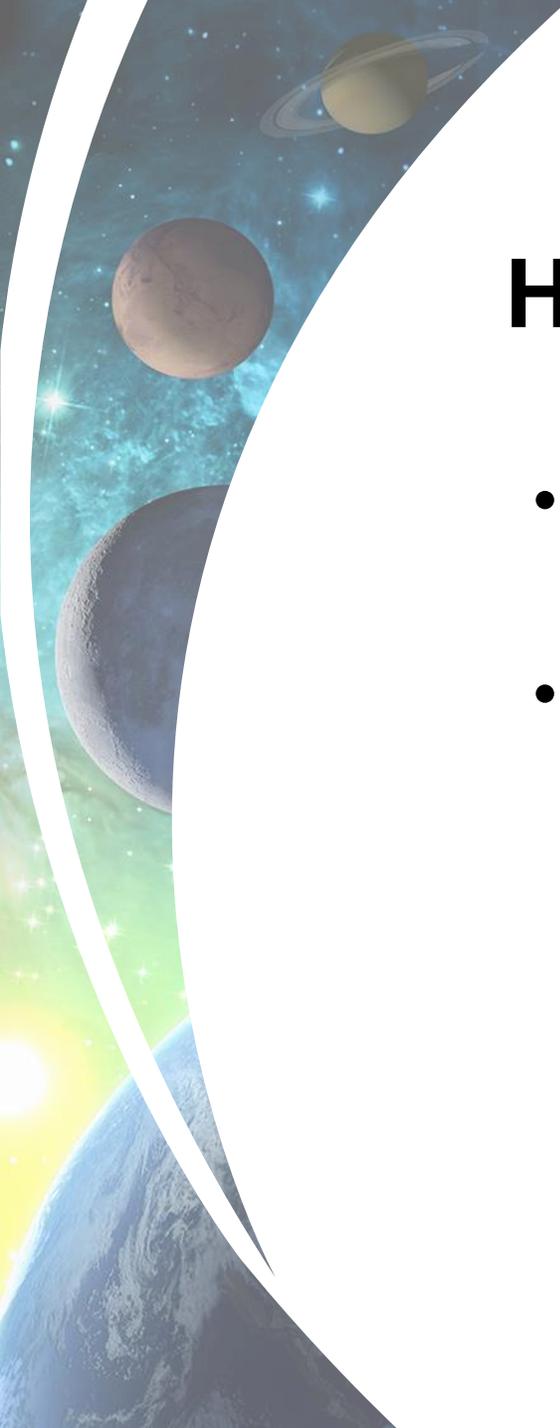
Industry

Goal: Implement innovative selection process to allow agility to respond to any given ride opportunity

Similar to Planetary Science Division call for instrument packages for lunar landers

Solicit high TRL investigations to create HPD portfolio which could be quickly integrated

Possibly fund through investigation CDR then hold until ride is available?



Heliophysics and the Lunar Gateway

- Use a new platform for Geospace studies (including SpWx observations) and for prototype telescopes
- Staging and deployment of multi-spacecraft missions



Summary

HELIO CONNECTS through Science

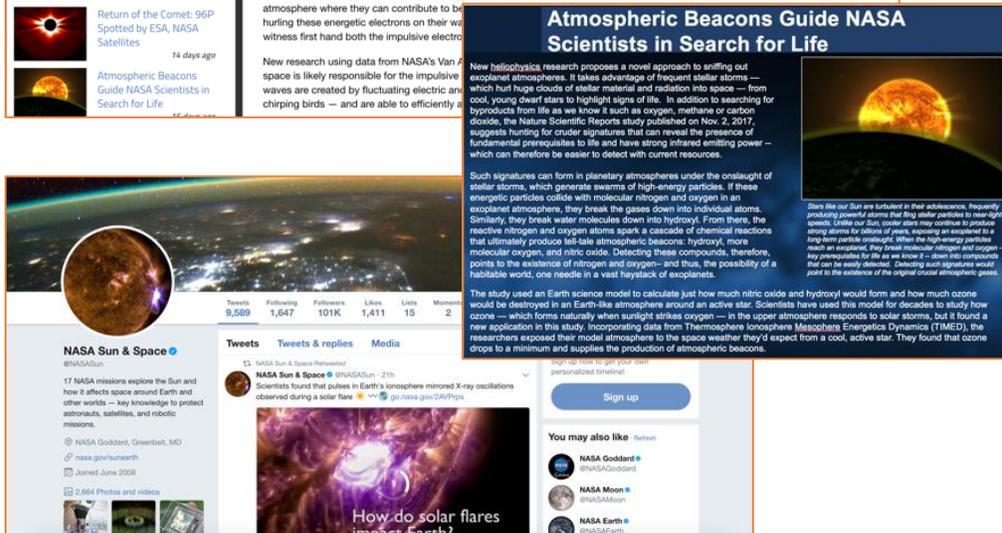
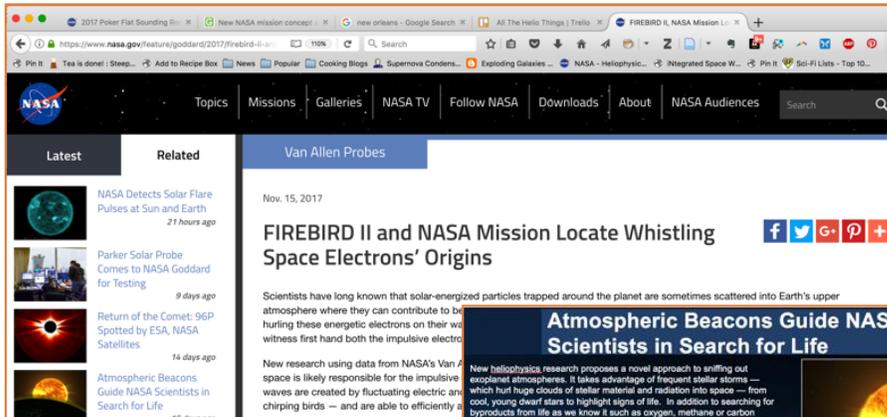
We want to know about your research and other news from your field!

- Paper accepted
- Mission milestones
- Outreach events: Educational, Press, Social media, Stakeholder audiences, Etc.

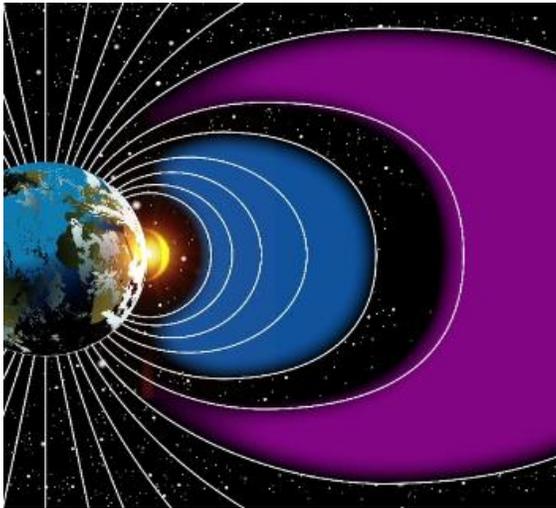
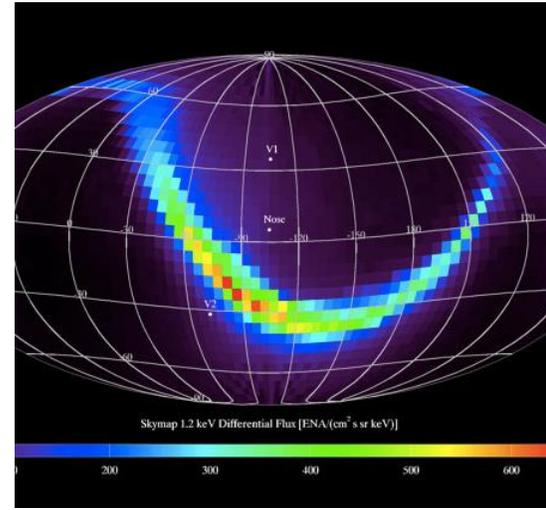
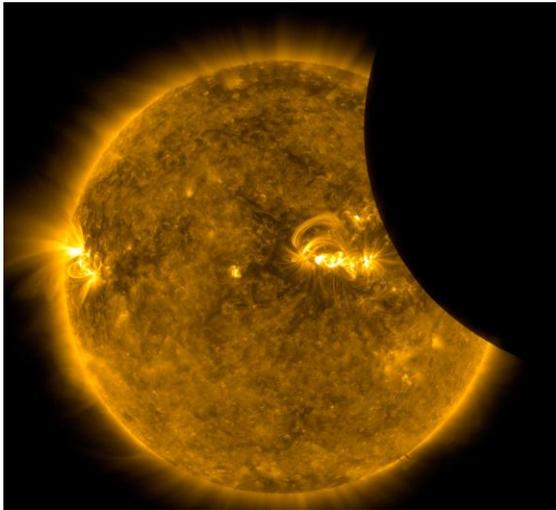
We feature your research via numerous outlets:

- Internet: [NASA.gov/sunearth](https://www.nasa.gov/sunearth) and blogs.nasa.gov/sunspot
- Social media: Twitter, Snap Chat, Facebook Live
- Imagery: Videos, visualizations, infographics
- Highlights to NASA leadership: Monthly Science Review
- Media: press briefings and releases

Let us know at: bit.ly/SubmitHelioScience



It is a Great Time to be a Heliophysicist!



- Launched its most ambitious mission ever to touch the Sun (Parker), and the first NASA instrument aboard a commercial satellite (GOLD)
 - both within budget and on schedule
- Established the genesis of a Space Weather Science Application Program in collaboration with sister federal agencies, academia, and industry
- Fully funded Decadal DRIVE initiative with provisions for early career, technology, diverse elements
 - Equals a very healthy R&A program!
- Instituted a strategic approach following the Decadal Survey recommendations
- Unique opportunity to study the Sun and its effects throughout the Heliosphere



Back up

Acronyms [1/4]

AA	Associate Administrator
ABC	Agency Baseline Commitment
ACE	Advanced Composition Explorer
AFRL	Air Force Research Laboratory
AIA	Atmospheric Imaging Assembly
AIM	Aeronomy of Ice in the Mesosphere
AO(s)	Announcement of Opportunity (Opportunities)
APL	Applied Physics Laboratory
APMC	Agency Program Management Council
ARTEMIS	Acceleration, Reconnection, Turbulence and Electrodynamics of the Moon's Interaction with the Sun
AWE	Atmospheric Waves Experiment
BPR	Baseline Performance Review
Cat	Category
CCMC	Community Coordinated Modeling Center
CDF	Common Data Format
CEDAR	Coupling, Energetics, and Dynamics of Atmospheric Regions
CGMS	Coordinated Group for Meteorological Satellites
CINDI	Coupled Ion-Neutral Dynamics Investigations
CMC	Center Management Council
CME	Coronal Mass Ejection
COSIE	Coronal Spectrographic Imager in the EUV
COSPAR	Committee on Space Research
DEE	Data Environment Enhancements
DOE	Department of Energy
DPMC	Mission Directorate Program Management Council
DRIVE	Diversify, Realize, Integrate, Venture, Educate
DSX	Demonstration and Science Experiments
DXL	Diffuse X-rays from the Local Galaxy
ECIP	Early Career Investigator Program
EELV	Evolved Expendable Launch Vehicle

EPD	Energetic Particle Detector
ESA	European Space Agency
ESPA	EELV Secondary Payload Adapter
EUI	Extreme Ultraviolet Imager
EUV	Extreme Ultra-Violet
EVM	Earned Value Management
FACA	Federal Advisory Committee Act
FAST	Fast Auroral SnapshoT Explorer
FIELDS	Fields Experiment
FITS	Flexible Image Transport System
FOV	Field of View
FOXI	Focusing Optics X-Ray Solar Imager
FRR	Flight Readiness Review
FUV	Far Ultra-Violet
FY	Fiscal Year
GCR	Grand Challenge Research
GDC	Geospace Dynamics Constellation
GEM	Geospace Environment Modeling
GI	Guest Investigator
GOLD	Global-scale Observations of the Limb
GPRA	Government Performance and Results Act
GPRAMA	Government Performance and Results Act Modernization Act
GRC	Glenn Research Center
GSFC	Goddard Space Flight Center
H-TiDeS	Heliophysics Technology and Instrument Development for Science
HEC	High End Computing
HEK	Heliophysics Events Knowledgebase
HIS	Heavy Ion Sensor
HPAC	Heliophysics Advisory Committee
HPD	Heliophysics Division

Acronyms [2/4]

HQ	Headquarters
HSCs	Heliophysics Science Centers
IAG	International Astronomical Union
IAGA	International Association of Geomagnetism and Aeronomy
IAMAS	International Association of Meteorology and Atmospheric Sciences
IAU	International Astronomical Union
IBEX	Interstellar Boundary Explorer
ICAO	International Civil Aviation Organization
ICAO	Committee on Earth Observing Satellites
ICON	Ionospheric Connection Explorer
IDL	Interactive Data Language
IMAP	Interstellar Mapping and Acceleration Probe
IOC-UNESCO	Intergovernmental Oceanographic Commission - United Nations Educational, Scientific and Cultural Organization
IPA	Intergovernmental Personnel Act
IRIS	Interface Region Imaging Spectrograph
IS \odot IS	Integrated Science Investigation of the sun
ISCU	International Council for Science
ISES	International Space Environment Service
ISFM	Internal Scientist Funding Model
ISRO	Indian Space Research Organization
ISWI	International Space Weather Initiative
ITD	Instrument and Technology Development
ITM	Ionosphere-Thermosphere-Mesosphere
IUGG	International Union of Geodesy and Geophysics
IUPAP	International Union of Pure and Applied Physics
IVM	Ion Velocity Meter
JAXA	Japan Aerospace Exploration Agency
JCL	Joint confidence level
JPL	Jet Propulsion Laboratory

JSC	Johnson Space Center
KASI	Korean Astronomy and Space Science Institute
KDP	Key Decision Point
KSC	Kennedy Space Center
LASP	Laboratory for Atmospheric and Space Physics
LCAS	Low Cost Access to Space
LCC	Life-Cycle Cost
LNAPP	Laboratory Nuclear, Atomic, and Plasma Physics
LPAG	LWS Program Analysis Group
LRD	Launch Readiness Date
LVRR	Launch Vehicle Readiness Review
LWS	Living With a Star Program
Mag	Magnetosphere
MAVEN	Mars Atmosphere and Volatile Evolution Mission
MDAA	Mission Directorate Associate Administrator
MEME-X	Mechanisms of Energetic Mass Ejection eXplorer
MIDEX	Medium-Class Explorers
MIGHTI	Michelson Interferometer for Global High-resolution Thermospheric Imaging
MMS	Magnetospheric Multiscale
MMS	Magnetospheric Multiscale Guest Investigators
MO&DA	Mission Operations and Data Analysis
MoO (MO)	Mission of Opportunity
MOU	Memorandum of Understanding
MSFC	Marshall Space Flight Center
MUSE	Multi-slit Solar Explorer
NAC	National Advisory Committee
NAIRAS	Nowcast of Atmospheric Ionizing Radiation System
NAS	The National Academy of Sciences
NASA	National Aeronautics and Space Administration
NCEI	National Centers for Environmental Information

Acronyms [3/4]

NESSF	NASA Earth and Space Science Fellowship
NET	No Early Than
NGSPM	Next Generation Solar Physics Mission
NOAA	National Oceanic and Atmospheric Administration
NRA	NASA Research Announcement
NRC	National Research Council
NRL	Naval Research Laboratory
NSAC	National Science Advisory Committee
NSF	National Science Foundation
NSROC	NASA Sounding Rocket Operations Contract
NSRP	NASA Sounding Rocket Program
NSTC	National Science and Technology Council
O2R	Operations to Research
OATK	Orbital ATK
Ops	Operations
ORNL	Oak Ridge National Laboratory
ORR	Operational Readiness Review
OSTP	Office of Science and Technology Policy
PBR	President's Budget Request
PCA	Program Commitment agreement
PDR	Preliminary Design Review
PE	Program Executive
PFRR	Poker Flats Research Range
PHI	Polarimetric and Helioseismic Imager
PI	Principal Investigator
PIR	Program Implementation Review
PP	Program Plan
PPBE	Planning, Programming, Budgeting, and Execution
PS	Program Scientist
PSP	Participating Scientists Program
PSR	Pre-Ship Review

PUNCH	Polarimeter to Unify the Corona and Heliosphere
R&A	Research and Analysis
R&T	Research and Technology
R2O	Research to Operations
RAPTOR	Research and Analysis Program Tracking of Resources
RFI	Request for Information
RHESSI	Reuven Ramaty High Energy Solar Spectroscopic Imager
ROSES	Research Opportunities in Earth and Space Science
RPW	Radio and Plasma Waves
R _s	Solar Radii
SAMPEX	Solar Anomalous and Magnetospheric Particle Explorer
SBIR	Small Business Innovation Research
SBTT	Small Business Technology Transfer
SC	Science Committee
SCAR	Scientific Committee on Antarctic Research
SCOSTEP	Scientific Committee on Solar Terrestrial Physics
SDAC	Solar Data Analysis Center
SDO	Solar Dynamic Observatory
SDP	Science Data Package
SET	Space Environment Testbeds
SHINE	Solar, Heliosphere and INterplanetary Environment
SIR	System Integration Review
SIS	Suprathermal Ion Spectrograp
SMD	Science Mission Directorate
SME	Subject Matter Expert
SMEX	Small Explorers
SNOE	Student Nitric Oxide Explorer
SOC	Solar Orbiter Collaboration
SOHO	Solar and Heliospheric Observatory
SoloHi	Heliospheric Imager

Acronyms [4/4]

SPASE	Space Physics Archive Search and Extract
SPDF	Space Physics Data Facility
SPICE	Spectral Imaging of the Coronal Environment
SR	Senior Review
SR	Supporting Research
SRPO	Sounding Rocket Program Office
STDT	Science and Technology Definition Team
STEREO	Solar Terrestrial Relations Observatory
STIX	X-ray Spectrometer/Telescope
STMD	Space Technology Mission Directorate
STP	Solar Terrestrial Probes
SunRISE	Sun Radio Interferometer Space Experiment
SW	Space Weather
SWA	Solar Wind Plasma Analyser
SWAP	Space Weather Action Plan
SWEAP	Solar Wind Electrons Alphas and Protons
SWORM	Space Weather Operations, Research, and Mitigation
SWPC	Space Weather Prediction Center
SWRC	Space Weather Research Center
SwRI	Southwest Research Institute
TBC	To Be Confirmed
Tech	Technology
THEMIS	Time History of Events and Macroscale Interactions during Substorms
THOR	Turbulence Heating Observer
TIDeS	Technology and Instrument Development for Science
TIMED	Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics
TMS	Theory, Modelling and Simulations
ToF	Time of Flight
TPS	Thermal Protection System

TRACERS	Tandem Reconnection and Cusp Electrodynamics Reconnaissance Satellites
TRL	Technology Readiness Level
TWINS	Two Wide-angle Imaging Neutral-atom Spectrometers
UCB	University of California - Berkeley
UFE	Unallocated Future Expenses
ULA	United Launch Alliance
UM	University of Michigan
UNCOPUOS	United Nations Committee on Peaceful Use of OuterSpace
UNH	University of New Hampshire
URSI	International Union of Radio Science
USPI	United States Participating Investigator
UT	Universal time
VAP	Van Allen Probes
VSO	Virtual Solar Observatory
VxOs	Virtual x Observatory
WBS	Work breakdown structure
WFF	Wallops Flight Facility
WIGOS	WMO Integrated Global Observing System
WISPR	Wide-field Imager for Solar PRobe
WMO	World Meteorological Organization
WSMR	White Sands Missile Range