Heliophysics Division Overview

Committee on Solar and Space Physics

Dr. Nicky Fox, Director, Heliophysics

October 19, 2020

Heliophysics Missions: COVID-19 Impacts

Formulation

- Impacts related to inefficiencies stemming from telework and reduced staffing are creating some schedule impacts, but missions have sufficient funding and schedule margin.
- Project teams are tracking possible impacts if delays occur with ordering parts that require long lead times, and are communicating with HQ regularly.

Operational

- Space Science Missions Operations (SSMO) management and HPD continue to monitor mission operations – many operations centers have reduced staffing and are working under mandatory telework.
- Multiple sounding rocket missions have been postponed.

ROSES COVID-19 Impacts

SMD-wide

- NASA has instituted a number of grant administration flexibilities to ease the burden on grant recipients during the COVID-19 emergency
- SMD's policy on late proposals will be applied leniently on a case-by-case basis
- Encouraging all to continue to pay graduate students, post-docs, and lab staff
- **Call for Augmentations**
  - SMD will be accepting requests for funded extensions and augmentations to existing awards to help make up for increased costs directly attributable to the COVID-19 pandemic.
  - SMD's priorities for funding extensions and augmentations, in the likely case that demand exceeds available funding, are in an SMD policy document, "Augmentations and Funded Extensions in Response to COVID-19."

Heliophysics Division R&A

- Minimal impact so far. All panels are now virtual. Some Step-1 and Step-2 dates for ROSES-20 were delayed by a few weeks in response to community requests.

Coronavirus (COVID-19) Response – Stay Updated

- Everyone's safety is our priority
- This is a new and unprecedented situation
- We recognize everyone's personal and professional challenges at this time
- As the situation evolves, we will continue to communicate with all of you, whether through Town Halls, NSPIRES notices, or other modes
- In the meantime, please continue to follow agency updates:
  - Web: **nasa.gov** and **nasapeople.nasa.gov/coronavirus**
  - Twitter: **@NASA, @JimBridenstine, @Dr_ThomasZ**
- **SMD Town Hall Meetings**
  - March, May, July, September, November (TBC)
  - **https://science.nasa.gov/researchers/virtual-townhall-2020**

Heliophysics Highlights

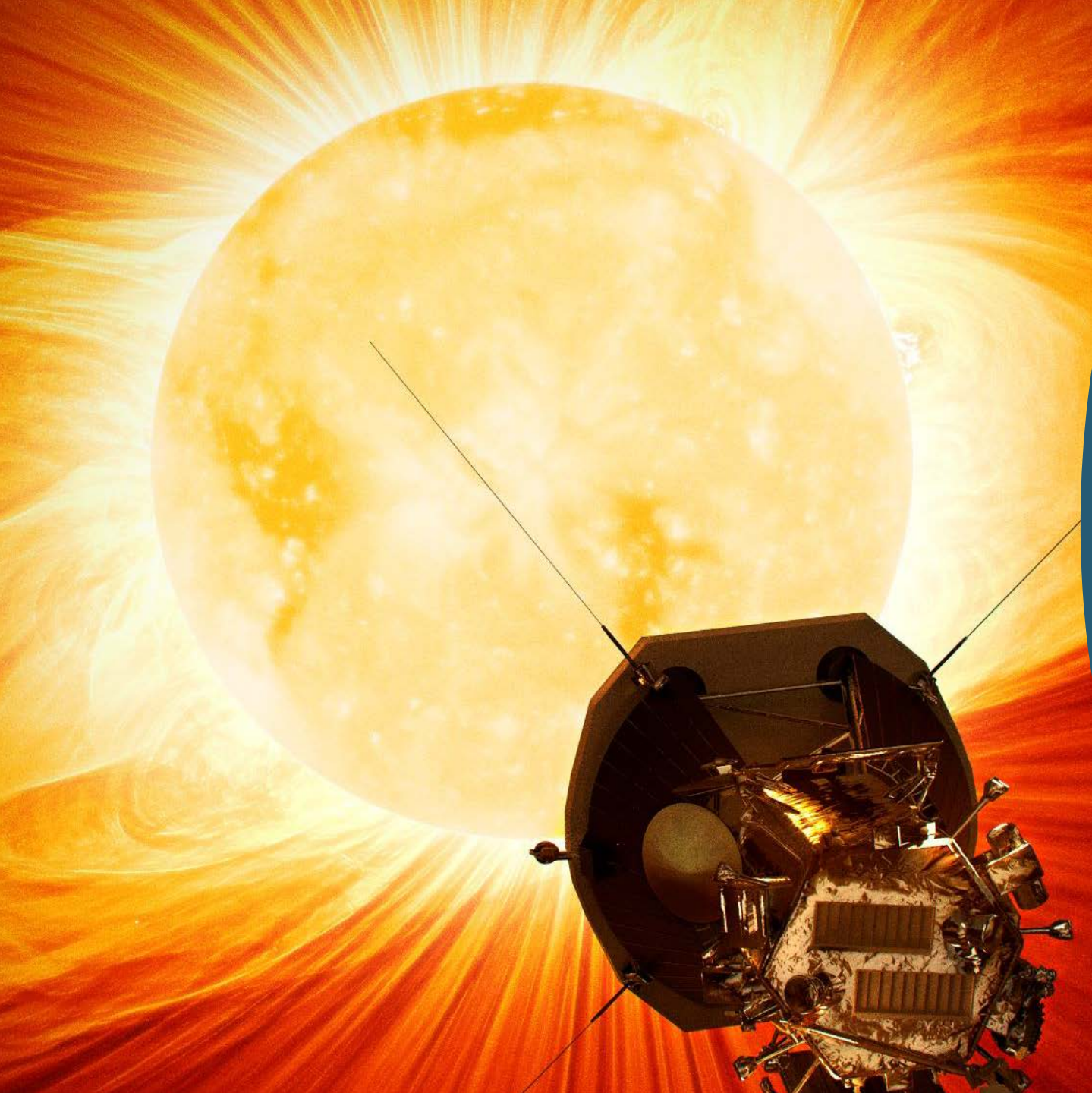
Progress and Plans Towards 2013 Decadal Survey Recommendations

2013 Decadal Recommendations and Progress	
R0.0 Complete the current program	Extended operations of current operating missions as recommended by the 2017 Senior Review, 2020 review pending; Van Allen Probes (decommissioned in 2019); 5 recently launched and now in primary or extended operations (GOLD, Parker, SET, ICON, 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 (SMEX); 2018 (MOO) and 2019 (MIDEX) (Step-1 selections, Aug. 2020). Plan for SMEX 2021 and MIDEX 2023
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 NET 2024. PDR in May 2021. Rideshare MOO (Science and Tech Demo) Next STP mission: DYNAMIC
R4.0 Implement a large LWS GDC-like mission	GDC STDT report delivered to HPAC in October 2019. Initiated formulation activities for GDC in FY20 (directed). KDP-A, 9/8.

2013 Decadal Midterm Assessment

- NASEM convened an ad hoc committee to review the responses from NASA's Heliophysics program and the National Science Foundation to the 2013 decadal survey, "Solar and Space Physics: A Science for a Technological Society" in Fall 2018
- Midterm assessment delivered to the Heliophysics Division in January 2020
- The Heliophysics Division formally submitted its response to the Space Studies Board (SSB) Chair, and the relevant SSB staff at NASEM in April 2020
- HPAC concurred on midterm findings and HPD's responses in July 2020
- **Decadal Midterm panel recommendations**
  - **3.4:** NASA should take the steps necessary to release an Announcement of Opportunity for a **DYNAMIC-like** mission as the next Solar-Terrestrial Probes mission.
  - **3.5:** "In order to proceed toward meeting the top-level decadal survey Living With a Star mission recommendation, NASA should take the steps necessary to define a specific mission architecture formulation and implementation scheme for the GDC mission within the next 3 years."

"With all long-term plans, the landscape changes and opportunities evolve in ways that the original planners could not foresee. Some changes accelerate progress, but many tend to complicate, slow down, or challenge implementation of the original plans. This has been the case over the some 6 years since publication of the decadal survey report. *Despite these challenges, the majority of the 2013 decadal survey recommendations have been implemented or are in progress towards being implemented over the next few years." –* ***2013 Heliophysics Decadal Midterm Assessment***

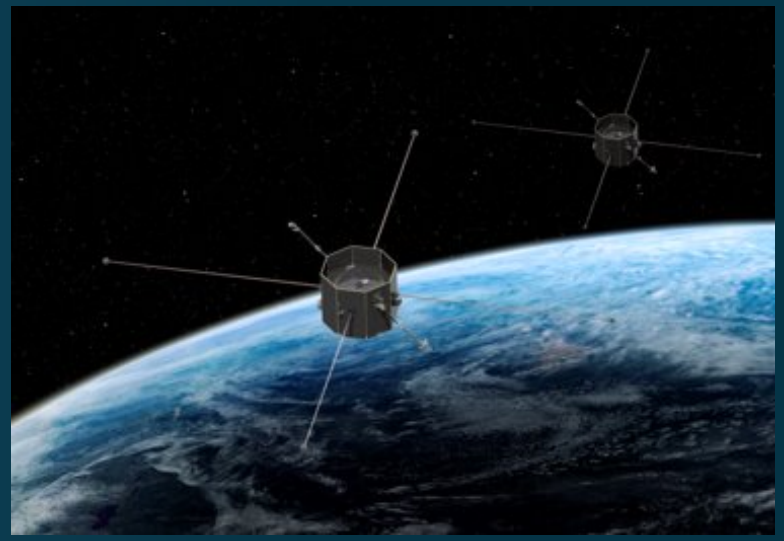


Parker Solar Probe

- **5th Encounter (Jun. 1-6)**
  - Distance: within 11.6 million miles of the Sun's surface
  - Top speed: 244,225 miles per hour
- **3rd Venus Gravity Assist (Jul. 11)**
  - Passed approximately 516 miles above the surface
- **Data Release (Sep. 15)**
  - Data released from 4th encounter
- **6th Encounter (Sep. 21-27)**
  - Distance: within 8.4 million miles of the Sun’s surface
  - Top speed: 289,927 miles per hour

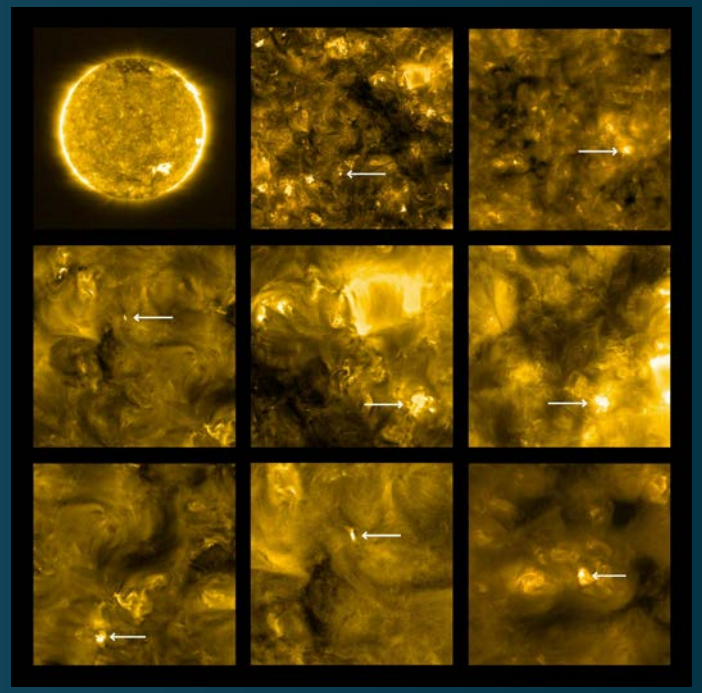
TRACERS and MAGIC

- **Tandem Reconnection And Cusp Electrodynamics Reconnaissance Satellites (TRACERS)** and a Technology Demonstration Opportunity, MAGnetometers for Innovation and Capability (MAGIC): Proceeded into Phase B Preliminary Design following the successful completion of an Extended Phase A study on April 24.

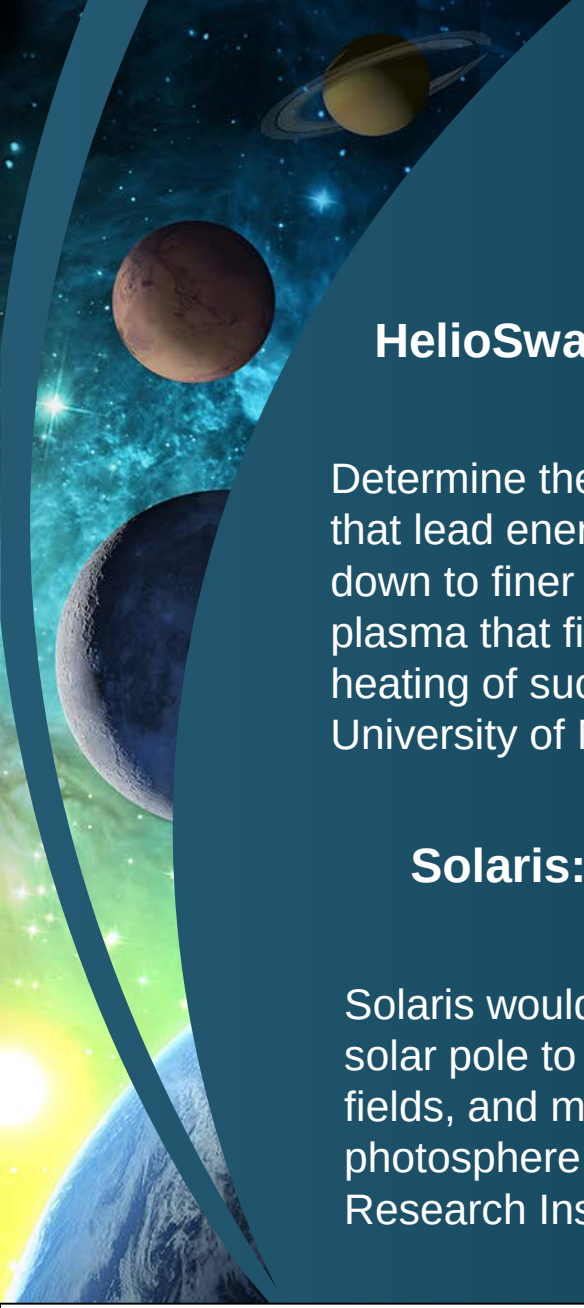


Solar Orbiter

- In July 2020, Solar Orbiter returned its first data, including the closest images of the Sun ever captured.
- Images will help scientists piece together the Sun's atmospheric layers, which is important for understanding how it drives space weather near the Earth and throughout the solar system.



Left: Solar Orbiter spots 'campfires' on the Sun. Locations of campfires are annotated with white arrows. Credits: Solar Orbiter/EUI Team (ESA & NASA); CSL, IAS, MPS, PMOD/WRC, ROB, UCL/MSSL



5 MIDEX-19 Proposals Selected

HelioSwarm: The Nature of Turbulence in Space Plasmas

Determine the fundamental space physics processes that lead energy from large-scale motion to cascade down to finer scales of particle movement within the plasma that fills space, a process that leads to the heating of such plasma. **PI:** Harlan Spence at the University of New Hampshire in Durham.

Solaris: Revealing the Mysteries of the Sun's Poles

Solaris would observe three solar rotations over each solar pole to obtain observations of light, magnetic fields, and movement in the Sun's surface, the photosphere. **PI:** Donald Hassler at the Southwest Research Institute in Boulder, Colorado.

Solar-Terrestrial Observer for the Response of the Magnetosphere (STORM)

First-ever global view of our vast space weather system. **PI:** David Sibeck at GSFC in Greenbelt, Maryland.

Multi-slit Solar Explorer (MUSE)

Provide high-cadence observations of the mechanisms driving an array of processes and events in the corona. **PI:** Bart De Pontieu at Lockheed Martin in Palo Alto, California.

Auroral Reconstruction CubeSwarm (ARCS)

ARCS would explore the processes that contribute to aurora at size scales that have been rarely studied. **PI:** Kristina Lynch at Dartmouth University in Hanover, New Hampshire.

Each proposal will conduct a 9-month mission concept study. Following the study period, NASA will choose up to two proposals for launch.

Geospace Dynamics Constellation (GDC)

Proceeded into Phase A, Sept. 8, 2020

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

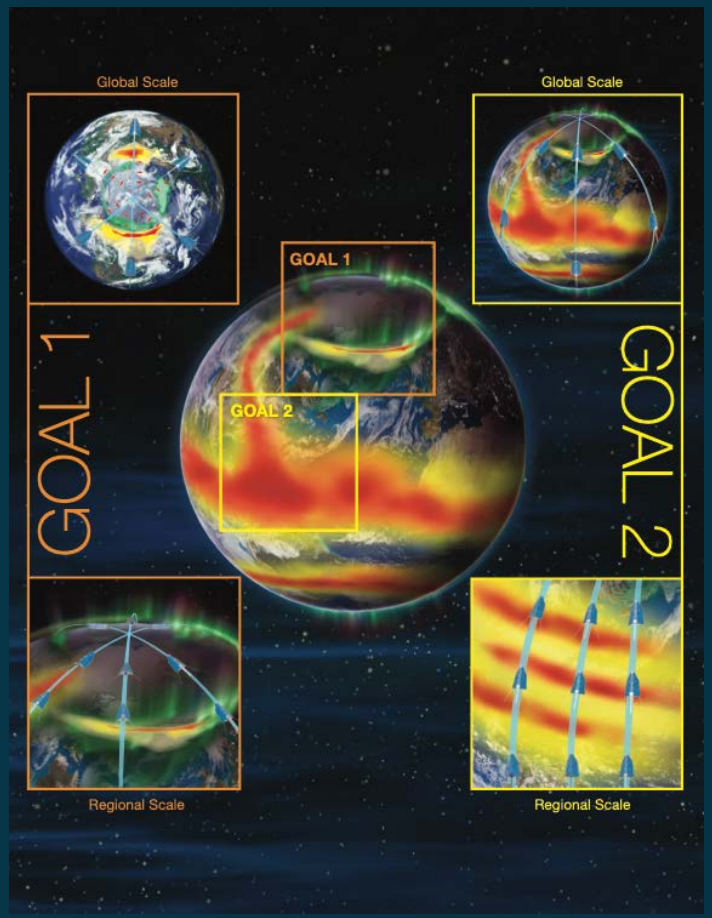
1. **Heliophysics Science**
   - Two-way magnetosphere-atmosphere coupling
   - Universal physics of neutral gas + magnetized plasma (”natural laboratory”)
2. **Comparative Planetology**
   - Solar wind – atmosphere interactions
   - Ion-neutral interactions at other planets
3. **Space Weather**
   - Cell, GPS, and other radio propagation
   - Orbital drag
   - Geoelectric current impacts on power grids

GDC Goal 1

Understand how the high latitude ionosphere-thermosphere system responds to variable solar wind/magnetosphere forcing.

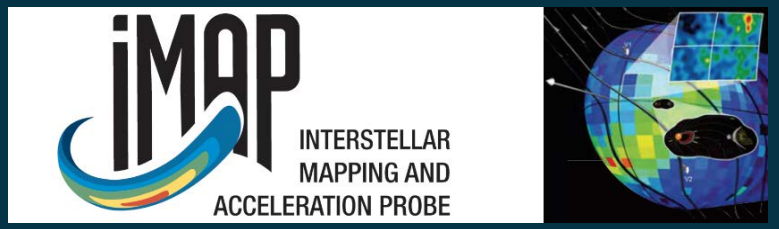
GDC Goal 2

Understand how internal processes in the global ionosphere-thermosphere system redistribute mass, momentum, and energy.



Interstellar Mapping and Acceleration Probe (IMAP)

Launch Services Contract for IMAP Awarded to SpaceX, Sep. 2020

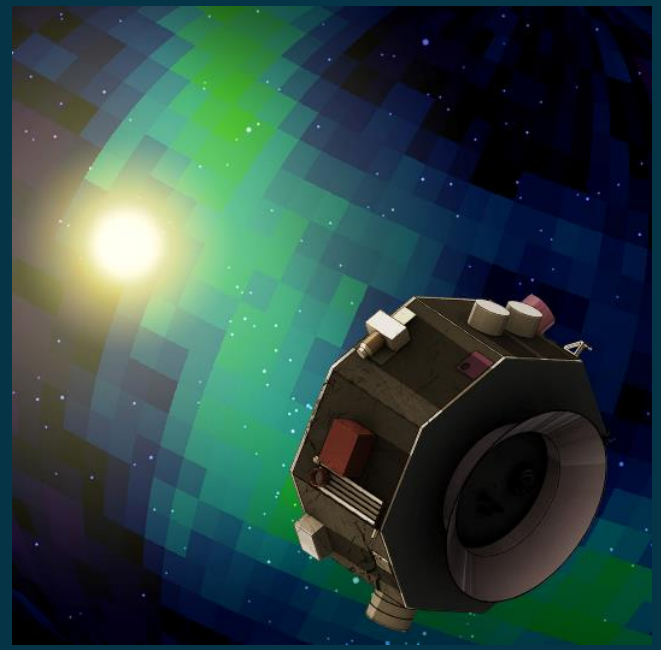


Milestones:

- Key Decision Point B, Jan. 2020
- Preliminary Design Review, May 2021
- Confirmation Review, NET Jun. 2021
- Launch Readiness Date, NET Fall 2024

Rideshare opportunities on the ESPA Grande:

- Competitive Tech Demo and Science MOs
- NOAA Space Weather Follow-On at L1 (SWFO-L1)



IMAP will simultaneously investigate the acceleration of energetic particles and interaction of the solar wind with the interstellar medium.

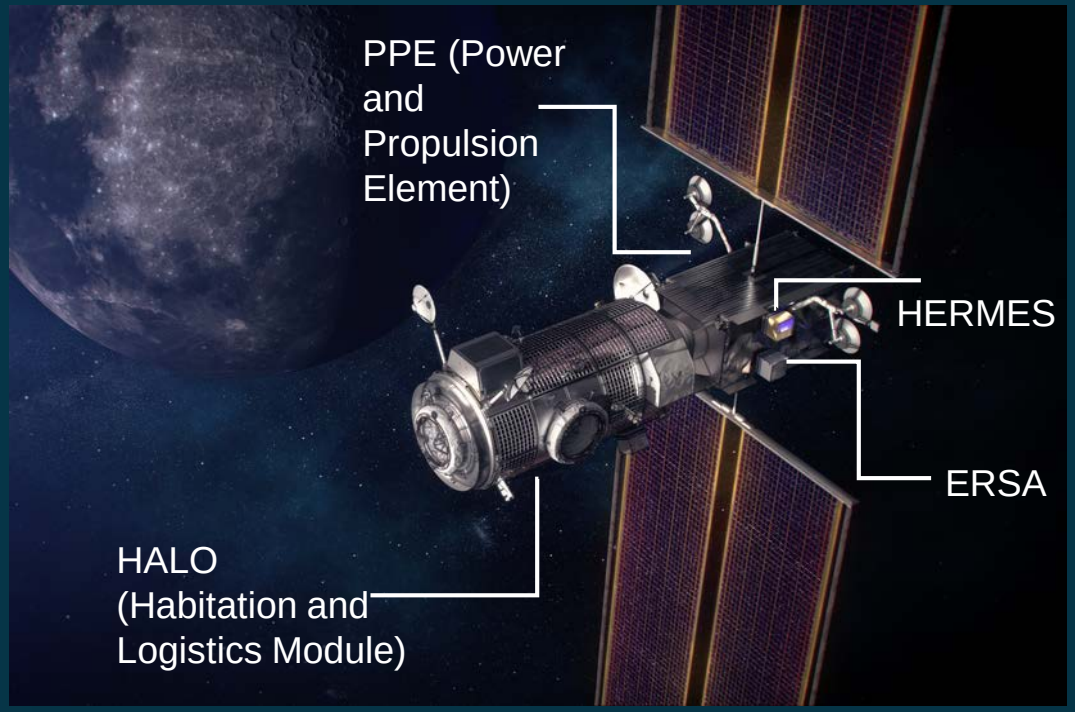
- **PI:** David McComas of Princeton University

HERMES (Heliophysics Environmental and Radiation Measurement Experiment Suite)

- HERMES concentrates on understanding the causes of space-weather variability as driven by the Sun and modulated by the magnetosphere.
- In coordination with the Heliophysics two-spacecraft mission THEMIS/ARTEMIS already in lunar orbit, the Gateway observations will initiate a heliophysics lunar constellation to conduct science investigations into what drives change in our near-Earth space environment that have never before been possible.
- Science team will be competed

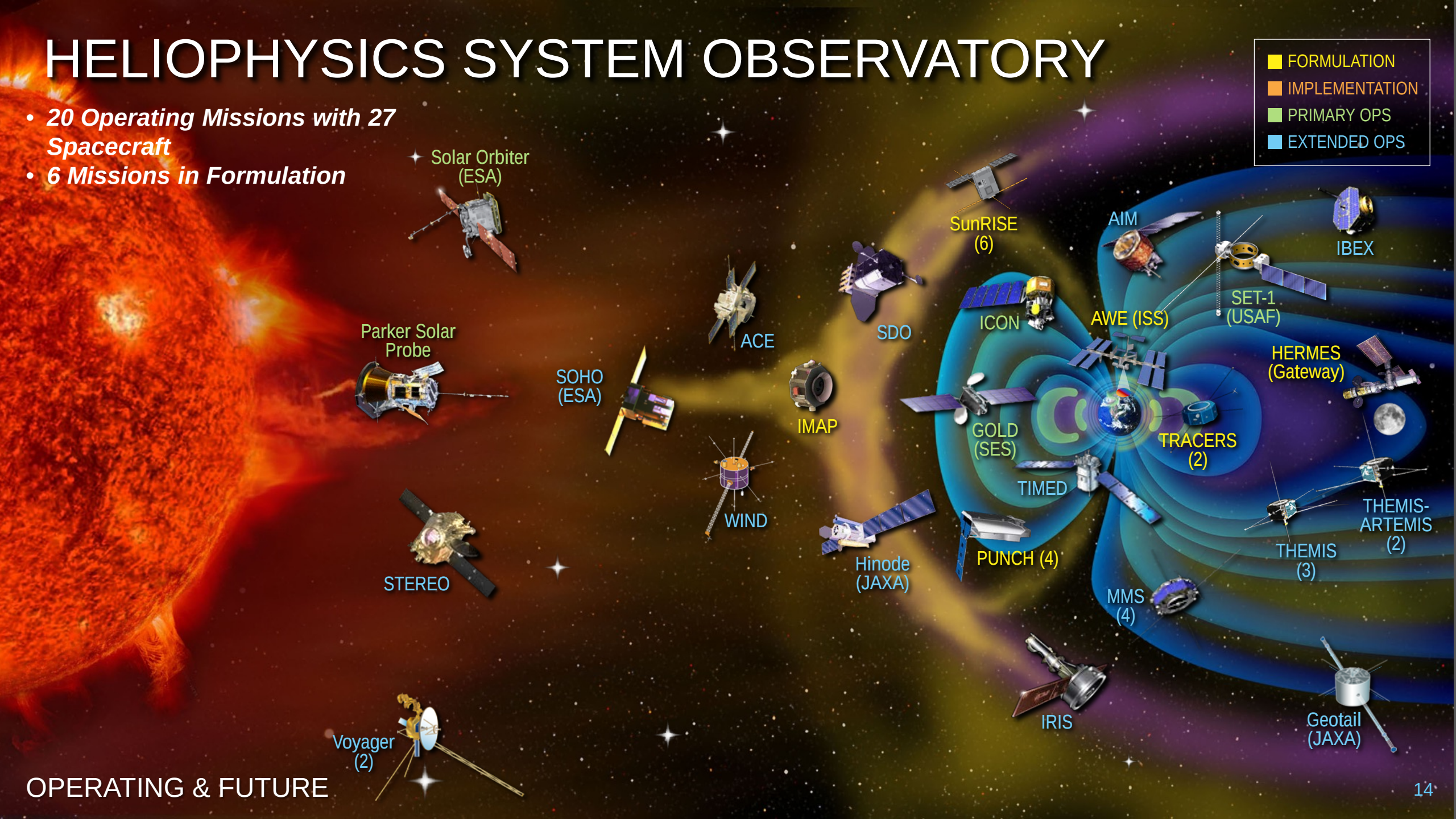
Milestones

- Instrument Concept Reviews: Summer 2020 - Complete
- KDP-C: December 2020
- Delivery to Maxar/NG: July 2022



HELIOPHYSICS SYSTEM OBSERVATORY

- ***20 Operating Missions with 27 Spacecraft***
- ***6 Missions in Formulation***



Missions in Formulation

2018 STP Science MOs to ride with IMAP

Two missions selected (Aug 13, 2019) for nine-month concept studies.

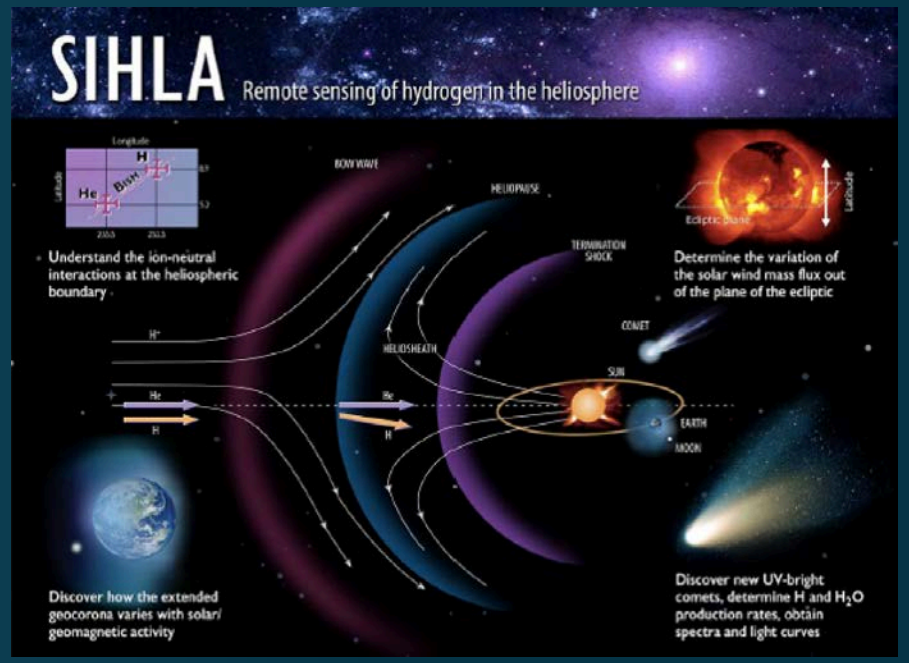
Spatial/Spectral Imaging of Heliospheric Lyman Alpha (SIHLA)

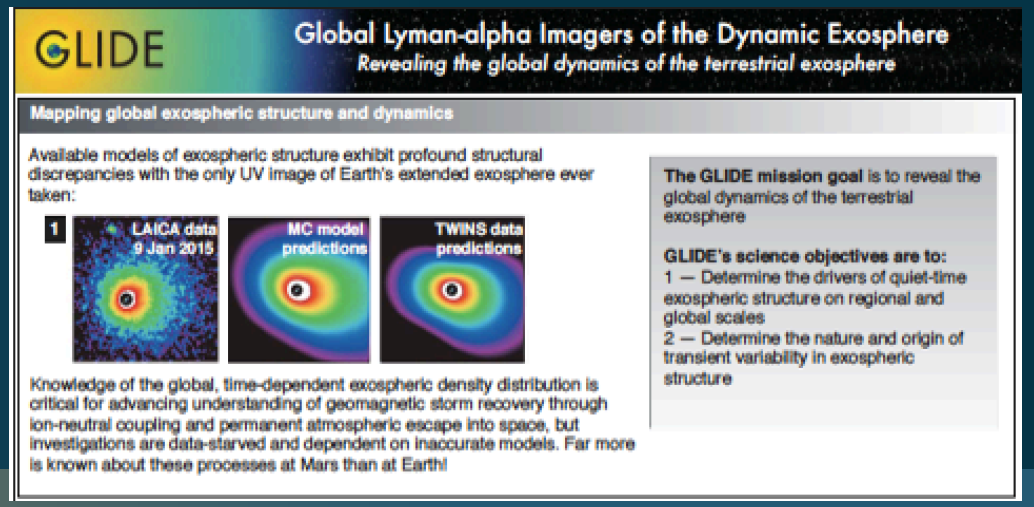
- would focus on mapping the velocity and distribution of the solar wind helping to resolve our understanding of what drives structure in the solar wind and heliopause.
- **Principal Investigator:** Larry Paxton at the Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland.

Global Lyman-alpha Imagers of the Dynamic Exosphere (GLIDE)

- would gather ultraviolet light emitted from hydrogen at a high rate, with a view of the entire exosphere.
- **Principal Investigator:** Lara Waldrop at the University of Illinois at Urbana-Champaign

LRD Oct 2024



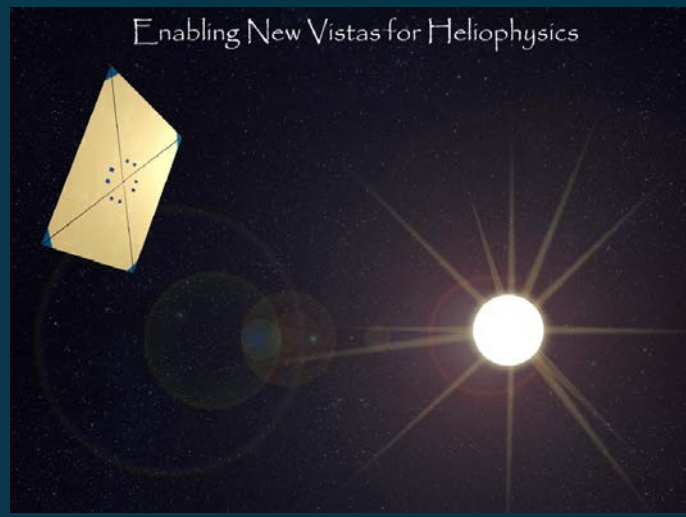


2018 STP Technology Demonstration MOs

Two missions selected (Aug 15, 2019) for nine-month concept studies.

Science-Enabling Technologies for Heliophysics (SETH)

- would demonstrate technologies in two areas:
  1. Deep space small satellite optical communications, and
  2. Solar energetic neutral atom (ENA) detector that also detects X-rays and energetic charged particles.
- **Principal Investigator:** Antti Pulkkinen at NASA's Goddard Space Flight Center in Greenbelt, Maryland



Solar Cruiser

- designed to mature solar sail technologies and demonstrate a novel solar coronagraph for SmallSat applications.
- 1666m^2 solar sail would be the largest ever flown
- **Principal Investigator:** Les Johnson at NASA's Marshall Space Flight Center in Huntsville, Alabama

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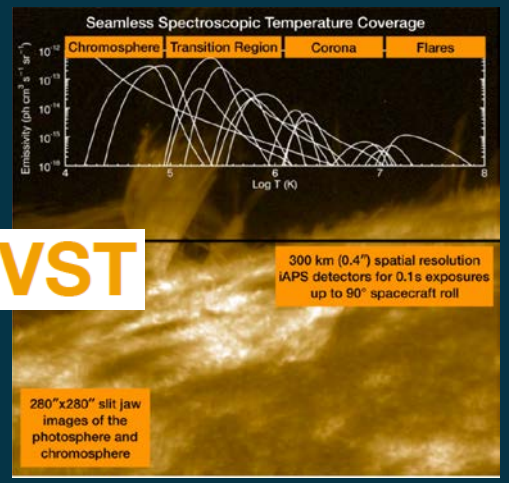
Explorers Missions of Opportunity

Three missions selected (Sep 3, 2019) for nine-month concept studies;



Extreme Ultraviolet High-Throughput Spectroscopic Telescope (EUVST) Epsilon Mission

- EUVST would observe simultaneously, for the first time and over a wide range of the lower solar atmosphere, how magnetic fields and plasma interact.
- Instrument to fly on JAXA's Solar-C mission
- **Principal Investigator:** Clarence Korendyke at the U.S. Naval Research Laboratory in Washington, D.C.

Aeronomy at Earth: Tools for Heliophysics Exploration and Research (AETHER)

- AETHER would explore the ionosphere-thermosphere system and its response to geomagnetic storms from a position aboard the International Space Station.
- **Principal Investigator:** James Clemmons at the University of New Hampshire in Durham.

Electrojet Zeeman Imaging Explorer (EZIE)

- EZIE would focus on an electric current known as the auroral electrojet, which circles through the atmosphere around 60 to 90 miles above Earth, near the poles.
- **Principal Investigator:** Jeng-Hwa Yee at the Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland.

Escape, Plasma Acceleration and Dynamics Explorers (ESCAPADE) Under Study

Principal Investigator: Robert Lillis, University of California, Berkeley

Instruments: EscaPADE Magnetometer (EMAG), EscaPADE Electrostatic Analyzer (EESA), EscaPADE Langmuir Probe (ELP)

With unprecedented two-point plasma measurements, ESCAPADE will untangle temporal from spatial variability and definitively map out the transfer of energy and momentum that leads to ion and sputtering escape, enabling a much more reliable extrapolation of escape rates to early Mars.

- The mission is of high value to the HPD mission portfolio and supports not only heliophysics science but also space weather and the Artemis mission.

ESCAPADE was demanifested from Psyche because design changes required to meet higher energy launch would require a longer schedule.

Suborbital Update

Suborbital Update

Low Cost Access to Space (LCAS)

- **Sounding Rockets**
  - 10 missions launched in FY19, 3 in FY20 before COVID-19 impact (Geospace and Solar and Heliospheric).
  - Multiple sounding rocket missions in 2020 delayed or cancelled due to COVID-19. Rescheduling based on PI and team availability, science window, range availability, science priorities, and SRPO support availability.

Flight Opportunities for Research (H-FORT)

- **CubeSats**
  - 3 on orbit
    - ELFIN, launched: Sep. 2018
    - Tbex, launched: Jun. 2019
    - SORTIE, launched: Dec. 2019
  - 16 in development
- **ISS attached payload (CODEX)**

DUST-2 Sounding Rocket

- **DUST-2 (Astro)**, the first sounding rocket to launch during COVID-19 restrictions, launched successfully on September 8 from WSMR.
  - This is our first sounding rocket launch since the beginning of COVID in the United States. Many 2020 launches were postponed.
  - Determining Unknown yet Significant Traits-2 (DUST-2) is a collaboration between NASA and the Japan Aerospace Exploration Agency and follows up on the DUST mission launched in October 2019.
  - The team dedicated this launch to Frank Lau who recently passed away.

Heliophysics Sounding Rockets (2018-2021)

Ongoing

Sounding Rockets

Hi-C 5/29/2018
FOXI-3 9/7/2018
CLASP-2 4/11/2019
EVE 6/18/2019
ESIS 9/30/2019
ICI-5I 11/26/2019
EUNIS 12/21/2020
HERSCHEL 2/23/2021
EVE 4/27/2021
SHIELDS 4/19/2021
Super Soaker 1/26/2018
Visions 2 GCI-2 Rockets 12/7/2018
CAPER-2 GCI 1/4/2019
TOOWINDY 2 Rockets 6/19/2019
CHI 12/10/2019
DYNAMO-2 6/2021
C-REX-2 11/2021
Trice2 GCI-2 Rockets 12/8/2018
AZURE GCI-2 Rockets 3/5/2019
PolarNOx 1/26/2020
KiNET-X 2/11/2021
VIPER 2/19/2021
USIP-2 3/25/2018
RockSat 8/14/2018
G-CHASER GCI 1/13/2019
RockOn 6/20/2019
RockSat-X 8/12/2019
RockOn-3 6/24/2021
RockSat-X 8/2021
ASPIRE 2nd Flt (JPL) 3/31/2018
ASPIRE 3rd Flt (JPL) 9/7/2018
SUBTEC-8 10/24/2019
DXL 1/19/2018
WRX-R 4/4/2018
Micro-X 7/22/2018
Micro-X 8/2021
CIBER-2 2/15/2021
CHESS 4/16/2018
DEUCE 12/18/2018
SISTINE 8/11/2019
FORTIS 10/28/2019
DEUCE 11/2/2020
XQC 2021
SISTINE 2021
LAMP 12/2021
AFE 9/18/2019
SOFE-1 12/9/2020
ABFT 3/1/2021
DUST 10/7/2019
DUST-2 9/8/2020

LEGEND

Solar	Tech Development	Education
Geospace	High Energy Astrophysics	Reimbursable
Solar and Heliophysics	UV Optical Astrophysics	Lab Astrophysics

2018 2019 2020 2021

*Launches resumed in September; multiple launches pushed to 2021 due to COVID-19 impacts.

HPD CubeSat Portfolio Highlights

ELFIN - Electron Losses and Fields Investigation

- Launched: 9/15/2018
- Published an article entitled “The ELFIN Mission” in Space Science Reviews on July 30, 2020: https://link.springer.com/article/10.1007/s11214-020-00721-7

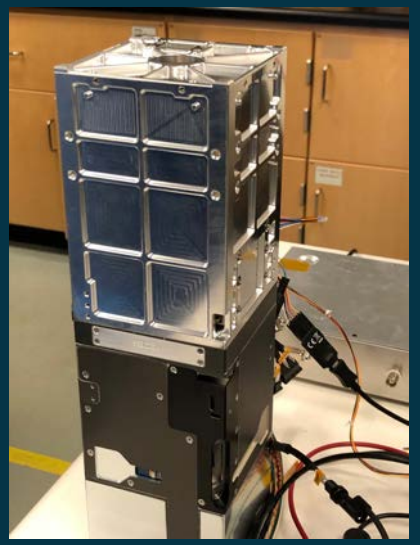
SORTIE - Scintillation Observations and Response of the Ionosphere to Electrodynamics

- Deployed from ISS: 2/19/2020
- Submitted a paper and presentation to the 2020 Small Satellite Conference held in August 2020 https://digitalcommons.usu.edu/smallsat/2020/all2020/48
- Submitted a presentation to the CEDAR 2020 Workshop held in June 2020

CIRBE - CubeSat: Inner Radiation Belt Experiment

- Successfully completed Mission CDR on Aug 12, 2020

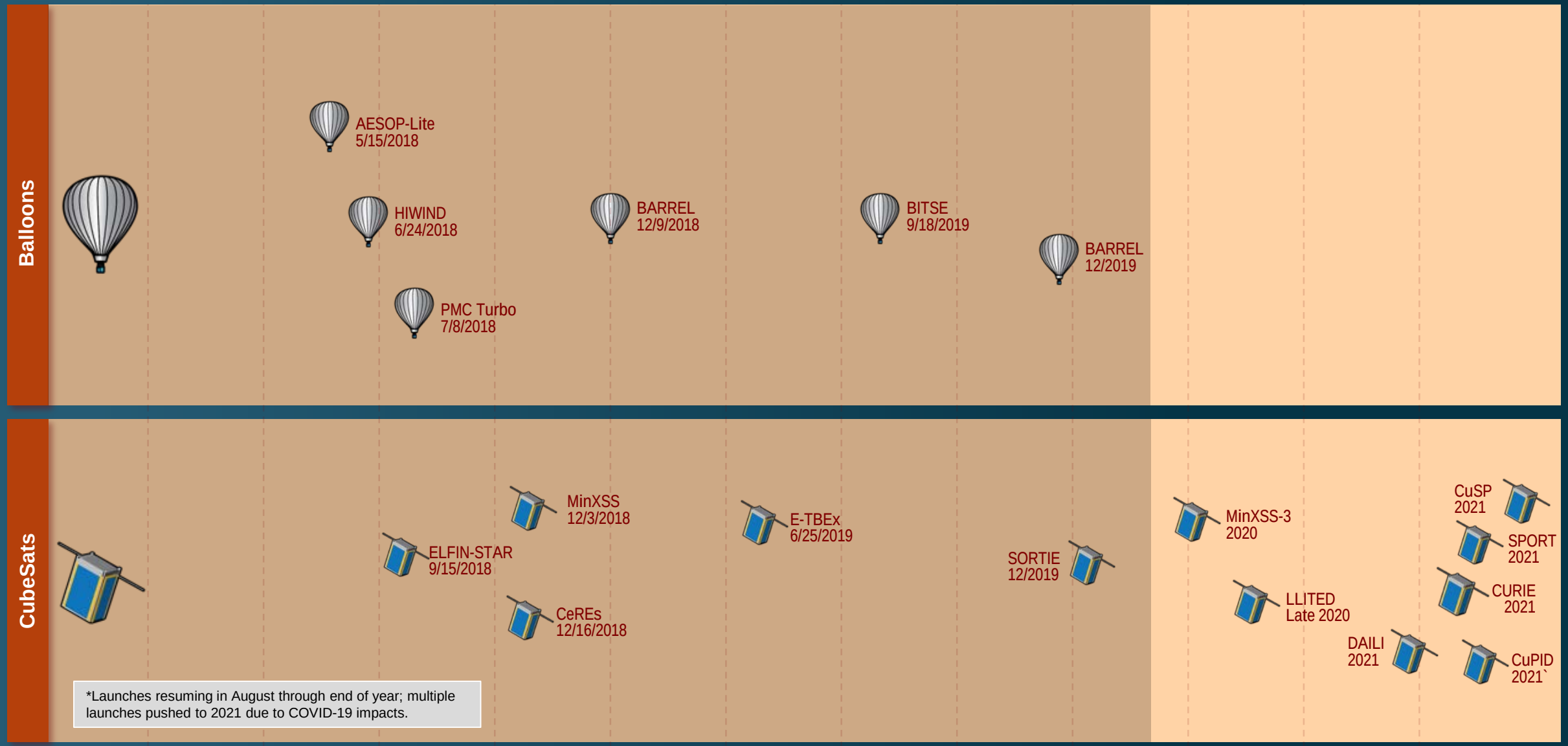
SORTIE @ SmallSat 2020



CIRBE Spacecraft EDU

Heliophysics Suborbital & CubeSats (2018-2021)

Ongoing



Research and Analysis

Research and Analysis Update

- Maintaining healthy R&A Programs
- Completing recommendations in the 2013 Decadal and midterm: maintain DRIVE initiative
- Implementing initiatives to coordinate observation and theory-modeling programs covering full breadth of Heliophysics across agencies and disciplines (HSO Connect)
- ECIP cadence every 2 years
- Future initiatives include: AI/ML program (cross-Divisional)
- Engaging in efforts to increase diversity in research
  - Dual anonymous, high risk high reward
  - July 2020 HPAC report provided specific recommendations on efforts to increase diversity

Research and Analysis Program Elements

- HLCAS: Low Cost Access to Space
- HFOS: Flight Opportunity Studies
- HFORT: Flight Opportunities for Research and Technology
- HTIDS: Technology and Instrument Development for Science
- Guest Investigator
  - Open and mission focused
- Supporting Research
- Heliophysics Science Centers
- Theory, Modeling and Simulation
- Early Career Investigator Program & FINESST
- Living With a Star (LWS) Science
- Space Weather O2R
- Data Environment Emphasis

ROSES-19

	ROSES Element		Proposal Due Date	Notify Date	# Proposals received	# Proposals selected	% selected	# New PI	% New PI
2019	HDEE	Data Environment Emphasis	6/20/2019	10/21/2019	15	11	73%	11	100%
	HGIO	Guest Investigators Open	7/17/2019	2/3/2020	128	30	23%	24	80%
	HSODS	Heliophysics System Observatory Data Support	8/15/2019	9/30/2019	6	4	67%	4	100%
	HTIDS	Technology and Instrument Development for Science	8/28/2019	4/2/2020	31	12	39%	9	75
	HSR	Supporting Research	10/18/2019	6/16/2020	122	30	25%	19	63%
	HFORT	Flight Opportunities for Research and Technology	11/8/2019	7/14/2020	42	15	36		
	TMS	Theory, Modeling, Simulation	12/3/2019	6/19/2020	54	14	25%	10	71%
	OHGI	Outer Heliosphere Guest Investigator	12/10/2019	3/5/2020	16	5	31%	3	60%
	SWO2R	Space Weather Applications Operations 2 Research	2/13/2020	6/29/2020	48	13	48%	12	92%
	LWS Science	Living With a Star Science	2/27/2020	7/31/2020	65	26	40%	17	65%
	HSO Connect	Heliophysics System Observatory Connect	3/13/2020	6/23/2020	14	4	29%	4	100%

Heliophysics Division ROSES Initiatives

Innovative Elements
ROSES-18
• SW02R: Space Weather Operations to Research
• ECIP: Early Career Investigator Program
• Phase 1 DRIVE Centers
ROSES-19
• OHGI: Outer Heliosphere Guest Investigator
• HSO: Heliophysics System Observatory Connect
ROSES-20
• Parker Solar Probe Guest Investigator
• GIGI: GOLD-ICON Guest Investigators

Technology-specific Elements
ROSES-18
• HTIDS: Technology and Instrument Development for Science
ROSES-19
• HTIDS: Technology and Instrument Development for Science
• HFORT: Flight Opportunities for Research and Technology
ROSES-20
• HTIDS: Technology and Instrument Development for Science
• HLCAS: Low Cost Access to Space
• HFOS: Flight Opportunity Studies
• HFORT: Flight Opportunities for Research and Technology

ROSES (Research Opportunities in Space and Earth Science)

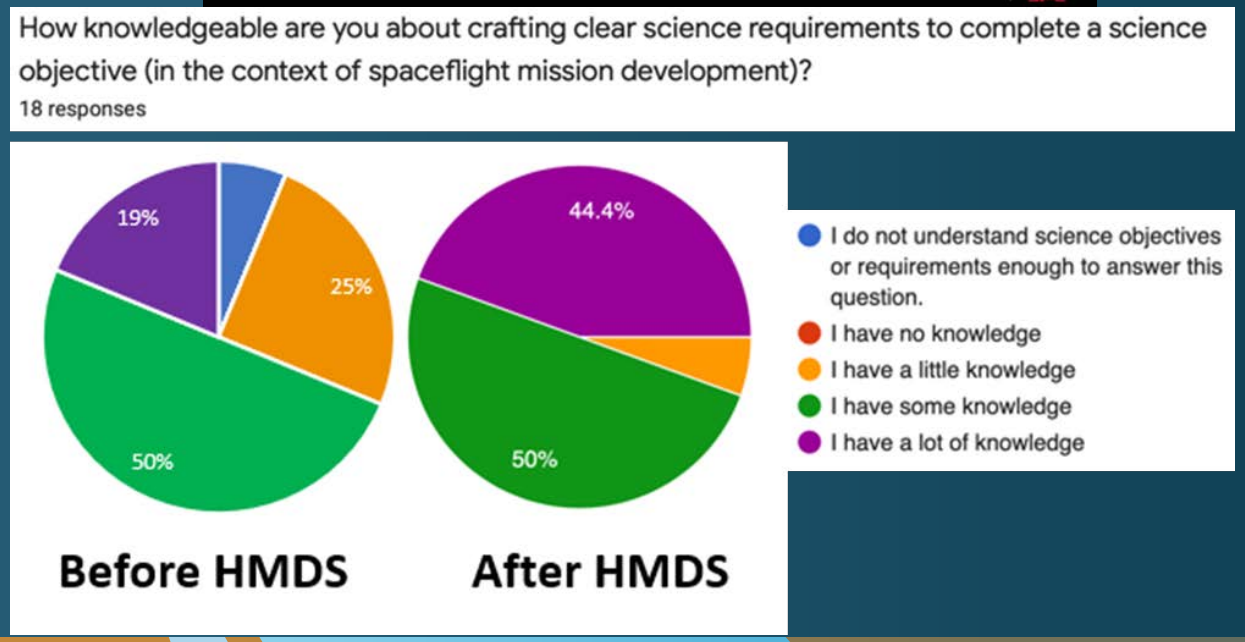
Living With a Star (LWS) Science

- ROSES opportunities – **Focus Science Topics (FSTs) - 2020**
  - Modeling and Validation of Ionospheric Irregularities and Scintillations
  - Understanding and Predicting Radiation Belt Loss in the Coupled Magnetosphere
  - The Origin and Consequences of Suprathermal Particles that Seed Solar Energetic Particles
  - Long Term Variability and Predictability of the Sun-Climate System
- ROSES opportunities – **Strategic Capabilities (ITM)**
  - Develop model(s) of the global ion/neutral density in the thermosphere, ionosphere and plasmasphere and its variation with time and geomagnetic conditions
- Revised Strategic Science Areas (SSAs) – used as guidelines for FSTs, etc.
- LWS Program Analysis Group (LPAG) – replaces the LWS Steering Committee
  - Virtual meeting held in July 2020

Expanding the Heliophysics Community

- Recent activities sponsored by the LWS Program
  - Frontier Development Laboratory (FDL) – AI/ML programs to provide an innovation forum to address and accelerate solutions to Heliophysics Scientific Problems
  - High End Computing (HEC) resources to support Strategic Capability modeling
  - Heliophysics Summer Schools – training the next generation interdisciplinary scientists
  - Jack Eddy Post Doctoral Fellowships, 34 in total, the next generation heliophysicists
  - LWS Institutes –bridging the gap between science and application
- These programs provide resources necessary to train the next generation of Heliophysicists and sponsor specific topical focus of relevance to science and society to current members of the Heliophysics Community
- All these LWS activities, Missions, Science and Community support, provide direction to new missions

NASA Heliophysics Mission Design School (HMDS)



- JPL ran a pilot session of a Heliophysics-oriented mission design school experience based on the Planetary Science Summer Seminar (PSSS)
- Emphasis on Science-driven mission formulation and requirements
- Applicants:
  - 42 applicants (26M, 16F)
  - Representing US and 10 other countries
  - 17 Doctoral Candidates, 19 Post-docs and recent PhDs, 6 “Other”
- Admitted:
  - 18 attendees (11M, 7F)
  - 7 Doctoral Candidates, 10 Post-docs and recent PhDs, 1 Faculty member

Headquarters Updates

HPD Strategic Working Groups

To drive innovation within the upcoming Heliophysics Division's (HPD) Decadal Survey strategy, HPD formed eight strategic working groups (SWG). The SWGs have outlined their high-level strategic objectives below. Across the working groups, three key themes have emerged as priorities for HPD: maximize the impact of HPD missions and research, ensure the sustainable management and innovative expansion of HPD science, democratize the science access, and diversify the future of the science community.

Archives

- Assess, restructure, and modernize the HPD Archives
- **Lead**: Jeff Hayes
- **Deputy:** Patrick Koehn, Heather Futrell

Citizen Science

- Develop and implement the HPD Citizen Science policy and strategy
- **Lead**: Liz MacDonald
- **Deputy:** Janet Kozyra

Comms.

- Enhance coordination between HPD, the science community, and the public
- **Lead:** Karen Fox

Mission Size Mix

- Assess the optimal mix of future mission sizes in the HPD portfolio
- **Lead**: Simon Plunkett

Research & Analysis

- Assess the R&A program's strategic balance and effectiveness in supporting the HPD community
- **Lead:** Mona Kessel

STP and LWS

- Better define and distinguish the goals and objectives of STP and LWS mission lines
- **Lead**: Jared Leisner

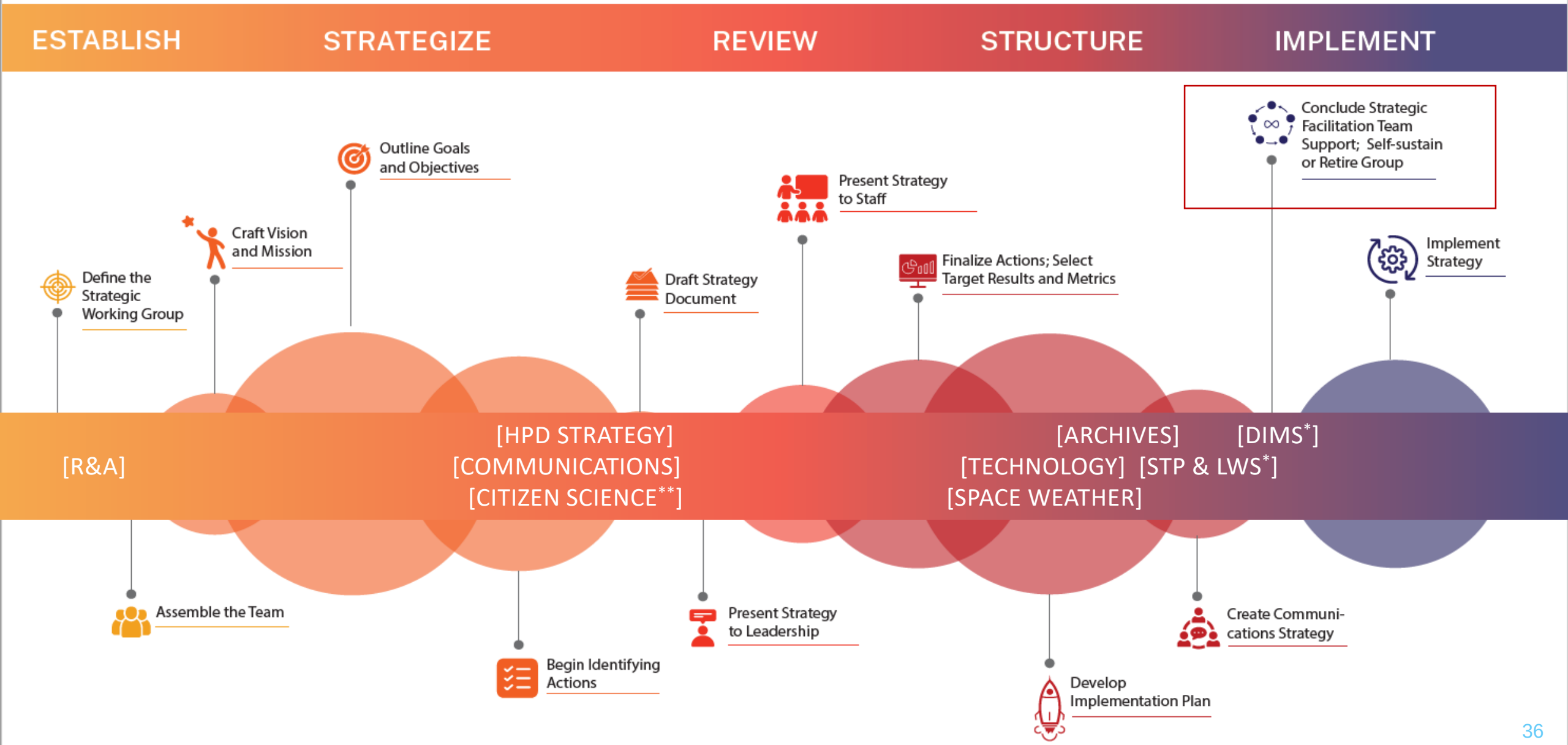
Space Weather

- Define overarching strategy for the Heliophysics Space Weather and science applications program
- **Lead**: Jim Spann

Technology

- Define technology strategy to enable advances in Heliophysics science
- **Lead**: Roshanak Hakimzadeh

NASA Strategic Working Group Milestone Map



Data Archives Strategy

Vision: Democratize the Data & Science of Heliophysics

Background

- All science disciplines have seen an explosion of data holdings over the last decade. This has been driven by inexpensive computing and digital storage, and the digital collection of data.
- HPD is participating in the SMD Strategic Data Management Working Group to develop a 5- year strategy with three overall goals:
  - Leverage best practices to improve discovery and access
  - Identify large-scale and cross-disciplinary science users and use cases to inform future science data system capabilities
  - Develop set of recommendations to modernize science data systems and promote development of new technology

Heliophysics Strategic Working Group

- **Mission:** In line with U.S. government strategy, the HPD Archives are committed to being the premier resource for all NASA HPD data needs.
- Moving beyond a traditional repository and toward a functional, collaborative data library, the HPD archives will maximize the utility of the data of the Heliophysics System Observatory (HSO), sustainability of the archives, and access for the public to these data.

1. Develop

- Provide the infrastructure for a functional HPD data library (HDL)

2. Unify

- Identify, connect, and unify support for data providers

3. Curate

- Curate integrated Heliophysics data

4. Operate

- Serve the Public as a working Data Library

5. Optimize

- Maximize the Utility of the data

6. Grow

- Expand the field's engagement with NASA HPD data

NASA Space Weather Strategy

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

Mission: Establish a preeminent space weather capability that supports robotic and human space exploration and meets national, international, and societal needs by advancing measurement and analysis techniques, and by expanding knowledge and understanding for transitioning into improved operational space weather forecasts and nowcasts.

NASA is in the process of developing an implementation plan.

1. Observe
- Advance observation techniques, technology, and capability

2. Analyze
- Advance research, analysis and modeling capability

3. Predict
- Improve space weather forecast and nowcast capabilities

4. Transition
- Transition capabilities to operational environments

5. Support
- Support Robotic and Human Exploration

6. Partner
- Meet National, International, and societal needs consistent with Government directives

Full briefing to follow.

Heliophysics Technology Strategy

Vision:

To enable New Realms of Heliophysics Knowledge and Capability

Mission:

Enable novel and transformative capabilities and mission concepts. Advance science by expanding the limits of what is measurable, observable and achievable in Heliophysics. Set the tone for the future of the field, enabling science and missions that are not conceivable or achievable today.

1. Advance

- ***Advance*** technology to expand heliophysics science

2. Improve

- ***Improve*** likelihood of technological and scientific success

3. Optimize

- ***Optimize*** the return of technology investment

Full briefing to follow.

Heliophysics Citizen Science Strategy

Vision

- Leverage public participation in Heliophysics to help drive innovation and diversity in science, society, and education.

Mission

- Build a robust, dynamic, and engaging Heliophysics citizen science portfolio that fuses natural phenomena, mission opportunities, and the power of people's diverse viewpoints to fuel collective innovation.

The Citizen Science Seed Funding Program (CSSFP) Element of ROSES

Aims to support scientists and other experts to develop citizen science projects relevant to NASA's Astrophysics, Heliophysics and Planetary Science Research Programs and proposals relevant to Biological and Physical Sciences will also be considered on a case by case basis.

Proposals are due December 11, 2020

1. Grow
- Broaden the reach and scope of Heliophysics and the vitality of the field through CS

2. Execute
- Create and regularly update a robust citizen science portfolio

3. Innovate
- Discover new aspects of Heliophysics - including those that impact life, society, and the process of doing science

4. Communicate
- Internal & external communication to foster support for & engagement with citizen science

5. Optimize
- Best practices, methodologies, data integrity, and technology infrastructures

6. Partner
- Foster mutually beneficial engagement with partners & stakeholders

Senior Review 2020

Objectives

- Maximize the science return (from missions and from the HSO)
- Ensure data is archived, usable, and useful
- Treat the archives as an aspect of the HSO concept
- Reduce the burden on the missions and for NASA in assessing continued operations
- Give NASA stakeholders a better insight into our decision processes

Major Changes

- Missions may propose either a science investigation or to move into HSO infrastructure
- Project Data Management Plan vs. Mission Archive Plan
- Proposals must present plans to move to open source code
- In-depth evaluation of proposer data archives in Space Physics Data Facility (SPDF) and Solar Data Analysis Center (SDAC)
- No longer use non-NASA data archives

Timeline – UPDATED

- Final Call for Proposals issued
  - **February 7, 2020**
- Senior Review Proposals due
  - **June 3, 2020**
- Senior Review panel met:
  - Week of **August 17, 2020 &**
  - Week of **August 31, 2020**
- NASA receipt of panel's report
  - **September 28, 2020**
- Senior Review results to projects
  - **NET early November 2020**

SMD Rideshare Office

Rideshare Office with Permanent SMD Rideshare Lead established March 2020 under the management of the Heliophysics Division

Goals:

- foster the maximizing of science, exploration, and technology return on investment by enabling rideshare or accommodation opportunities for secondary payloads on SMD primary mission launches
- serve as the single point of contact in SMD for coordinating the Rideshare opportunities between compatible payloads and the SMD launch opportunities
- pave the way for rideshare opportunities for Centers, Agency, and the broader NASA organization by working to build out processes, documentation, and guidelines to follow.
- Close collaboration with the Deputy Associate Administrator for Research to review and modify AO solicitation language associated with Rideshare payloads. Provided a tailored 2020 SMD ESPA Rideshare Users Guide for each of the ESD Earth Venture Mission-3, APD Pioneers, and APD MIDEX Mission of Opportunity announcements to provide consistent guidelines and standardized SMD Do No Harm (DNH) requirements for secondary payloads
- Established an HPD Program Office DNH management process for the Interstellar Mapping and Acceleration Probe (IMAP) mission to manage the compliance of DNH requirements and minimize risk to the primary mission, and all the secondary payloads
- Created a NASA-wide collaborative SharePoint site to share, inform, and provide guidance to NASA missions delving into the rideshare world
- Monthly interagency discussion with USSF for rideshare collaboration on mutual opportunities. Presenting rideshare at upcoming Tri-Agency Architecture & Strategy Workshop (NASA, NOAA & USSF)

NASA Science Plan Released

- Science 2020-2024: A Vision for Scientific Excellence released May 28, 2020 at science.nasa.gov/about-us/science-strategy
- Through close collaboration with the entire Science Mission Directorate leadership team and NASA Center Directors, laid out ambitious program over next five years to build on current activities and drive change in high-priority areas where we can have the greatest impact
- Demonstrated commitment to excellence across SMD portfolio through leadership and strategic engagement with partners
- Consulted with the NAC Science Committee and Space Studies Board ad hoc committee to validate approach
  - Thank you to Jeff Dozier (Chair), Victoria Hamilton (Vice Chair), and members of the ad hoc committee
- Will continually assess progress for transparency and accountability

Collaborations on Missions with International Partners

- NASA establishes partnerships with international space agencies to advance its strategic objectives in science
- PI proposed partnerships have not been an effective manner of establishing NASA contributions to partner-led missions
  - These are “Partner Mission of Opportunity” (PMO) proposals
  - We have concluded that the PMO process is not a successful or efficient process for establishing partnerships
- SMD will no longer solicit PMO proposals
  - SMD will still allow PI-led Explorers missions to be proposed that include a partner contribution, generally limited to be <1/3 of the mission per the AO
- SMD will continue to seek community input on potential partnerships

Welcome New Helio Staff!

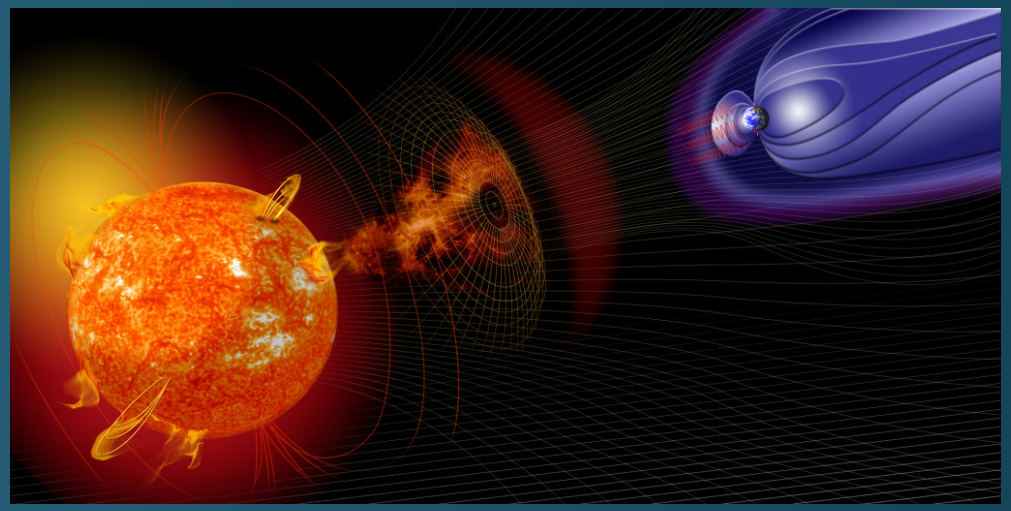
- Amy Winebarger—Program Scientist (Detail in Place)
- David Cheney—Program Executive
- Doug Lenhardt—Program Executive (Detail in Place)
- Reiner Friedel—Program Scientist (IPA)

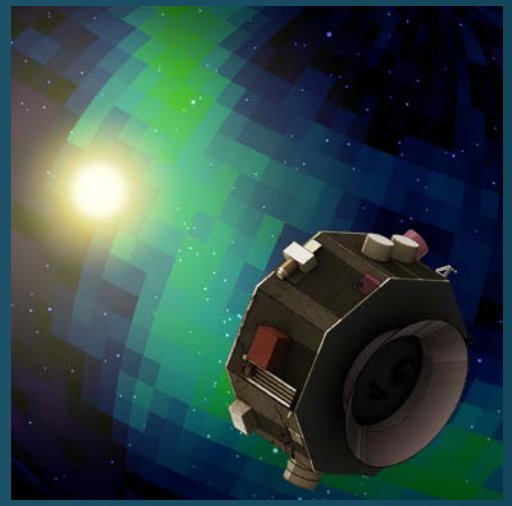
Additional Program Scientists and Program Executives to join HPD in early 2021.

Heliophysics Summer Interns

- **Kaylen Woods:** Assessed and provided recommendations on the layout and content for a Science Mission Directorate Rideshare User's Guide. (Mentor: Alan Zide)
- **Jacob Smith and Becker Han:** Created recommendations on how to increase awareness and interest in the study of nuclear power and propulsion. (Mentor: Joe Smith)
- **Aubrey Donohue:** Analyzed the evolving demographics of research proposers over time. (Mentor: Mona Kessel)
- **Kinga Wrobel:** Parker Solar Probe systems engineering. (Mentor: Joe Smith)

It is a Great Time to be a Heliophysicist!





Heliophysics Division is poised like never before to:

- Capitalize on our unique opportunity to study the Sun and its effects throughout the Heliosphere
- Augment the Heliophysics fleet with new, innovative missions, a robust suborbital program, and an enhanced ride share program
- Make research and technology investments to enable science, e.g. interstellar probe, solar sails
- Develop the next generation of Heliophysicists and engage the public with science knowledge
- Fulfill our responsibility for the Nation enabling advances in space weather
- Play a critical role in Exploration supporting the Artemis mission
- Lean forward for success in the next decade

#HelioRocks

Back-up

GOLD/ICON Guest Investigators (GIGI)

SCOPE:

The Global-scale Observations of the Limb and Disk (GOLD) and the Ionospheric Connection Explorer (ICON) Guest Investigators program (GIGI) is intended to maximize the scientific return from these missions by providing support for research beyond the scope of work of the mission science teams. It also allows scientists who are not associated with a mission team to participate in the mission science

OBJECTIVES AND QUESTIONS:

GOLD Science objectives are the following:

- Determine how geomagnetic storms alter the temperature and composition of Earth's thermosphere
- Analyze the global-scale response of the thermosphere to solar extreme ultra violet variability
- Investigate the significance of atmospheric waves and tides propagating from
- below on the temperature structure of the thermosphere
- Resolve how the structure of the equatorial ionosphere influences the formation and evolution of equatorial plasma density irregularities

ICON Science questions are the following:

- What causes changes in the ionosphere, other than geomagnetic effects?
- How do large-scale atmospheric waves control the ionosphere at low latitudes?
- How do ion-neutral coupling processes respond to increases in solar forcing and geomagnetic activity?

Major Meetings

HPAC Meetings

- **June**
  - Division Director Nicky Fox provided overview of HPD activities
  - Further updates on Space Weather, DRIVE Science Centers and Decadal planning were presented
- **September**
  - HPAC met on September 21 to review GPRAMA material. The committee agreed on unanimous green ratings for the relevant Performance Goals.

OMB

FY 2022 budget submit was presented on September 24th