

National Aeronautics and
Space Administration



Heliophysics Division

Committee on Solar and Space Physics

Dr. Nicky Fox
Heliophysics Division Director
October 12, 2021

Heliophysics Bottom Line Up Front (BLUF)



Poised to complete recommendations outlined in the 2013 Decadal and mid-term assessment

- IMAP, PUNCH, and SunRISE confirmed in 2021
- Geospace Dynamics Constellation (GDC) passed KDP-A in Sep 2020 and instrument solicitations received Sep. 2021
- 5 Medium Class Explorers (MIDEX-19) step-1 selections announced in Aug 2020: STORM, HelioSwarm, MUSE, ARCS, and Solaris
- Initiated planning for DYNAMIC mission as a PI-led MoO

Enhancing and expanding the Heliophysics System Observatory with new, innovative missions, a robust suborbital program, and leveraging creative rideshare strategies

- 12 missions in formulation or development and another 6 under study
- TRACERS (w/MAGIC, a tech demo) proceeded into formulation and is preparing for KDP-C
- Missions of Opportunity selected in Dec 2020: EUVST (JAXA partner mission) and EZIE
- ESCAPADE confirmed in Aug. 2021
- 14 CubeSats in development, 4 on orbit

Investing in research and technology to enable enhanced return on science

- Solar Cruiser (MSFC tech demo) and GLIDE Missions of Opportunity selected in Dec 2020 (IMAP rideshares via ESPA ring)
- Space Situational Awareness/Orbital Debris coordination and technology maturation

As a result of these actions NASA has the largest and most vibrant Heliophysics System Observatory in its history.

Progress and Plans Towards 2013 Decadal Survey Recommendations

Summary of Top-Level Decadal Survey Research Recommendations as of October 2021

R0.0 Complete the current program	<ul style="list-style-type: none">• Launched Parker, GOLD, ICON, SET, Solar Orbiter• 2020 Senior Review for 20 operating missions successfully completed
R1.0 Implement DRIVE (Diversify, Realize, Integrate, Venture, Educate)	<ul style="list-style-type: none">• Fully implemented DRIVE which is now included in the R&A baseline, representing an overall sustained increase in R&A budget• Preparing for selection of Phase 2 DRIVE Science Centers in early 2022
R2.0 Accelerate and expand Heliophysics Explorer program	<ul style="list-style-type: none">• Decadal recommendation of every 2-3 years:<ul style="list-style-type: none">• Explorer mission AOs released in 2016 (SMEX), 2018 (MoO), and 2019 (MIDEX) (Step-1 selections, Aug. 2020)• Plan for SMEX 2022 and MIDEX 2025• Explorers program contributes to overall resurgence in Helio flight program (12 missions in formulation or development and another 6 under study) to support future HSO
R3.0 Restructure STP as a moderate scale, PI-led flight program	<ul style="list-style-type: none">• IMAP mission (STP-5) passed KDP-C in July 2021 with an LRD in 2025. Expanded scope of PI-led STP missions to include Solar Cruiser (Tech Demo) and GLIDE selected as Rideshare MoOs• Initiated planning for a PI-led DYNAMIC AO
R4.0 Implement a large LWS GDC-like mission	<ul style="list-style-type: none">• GDC passed KDP A in September 2020; instrument solicitations received Sep. 2021

- 20 Operating Missions with 27 Spacecraft
- 12 Missions in Formulation or Development
- 6 Under Study

- FORMULATION
- IMPLEMENTATION
- PRIMARY OPS
- EXTENDED OPS

CubeSats			On Orbit
<u>In Development</u>			
AEPEX	CuSP	LLITED	ELFIN
AERO / VISTA	DAILI	MinXSS-3	SORTIE
CIRBE	Dione	petitSat	CuPID
CODEX	GTOsSat	REAL	
CURIE	LAICE	SPORT	

HELIOPHYSICS SYSTEM OBSERVATORY

- 20 Operating Missions with 27 Spacecraft
- 12 Missions in Formulation or Development
- 6 Under Study

Legend:

- FORMULATION
- IMPLEMENTATION
- PRIMARY OPS
- EXTENDED OPS

CubeSats

In Development			On Orbit
AEPEX	CuSP	LLITED	ELFIN
AERO / VISTA	DAILI	MinXSS-3	SORTIE
CIRBE	Dione	petitSat	CuPID
CODEX	GTOSat	REAL	
CURIE	LAICE	SPORT	

OPERATING & FUTURE

Mission Highlights

Missions in Implementation:

- IMAP completed KDP C 7/12/21
- PUNCH completed KDP C 7/23/21
- ESCAPADE completed KDP C 8/17/21
- SunRISE completed KDP C 9/8/21



Operating Missions:

- Parker Solar Probe completed perihelion 9 at 15.9 Rs on August 9
- Solar Orbiter completed its second Venus flyby on August 9 and we have new images from the SoloHI instrument

08-07 18:24:09

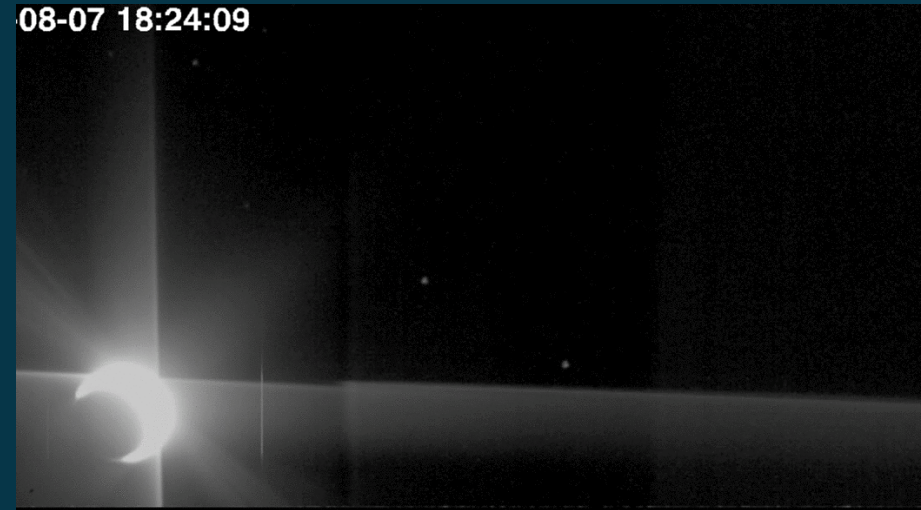


Image: Footage of Venus captured by the Solar Orbiter Heliospheric
Credits: ESA/NASA/NRL/SoloHI/Phillip Hess

NASA Space Weather



Recent Accomplishments

- NOAA and DoD Framework to transition NASA research, techniques and technology relevant to space weather operations
- Joint NSF-NASA Space Weather Quantification of Uncertainty (SWQU) grant solicitation
- Research to Operations to Research (R2O2R) grant solicitation: Additional Transition Step for efforts that show promise to use in an operational space weather environment at NOAA or DoD
 - Recently announced selections for SWO2R-20
 - Preparing to make selections for SWR2O2R-21:
 - Topic 1: Solar Flare Activity Prediction
 - Topic 2: Cis-lunar Space Environment Forecast

Looking Ahead

- HERMES Payload Single Design Review (PDR level) to be held October 26-28, 2021
- 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 (ESAL5, CSA AOM, Daedalus, SNIPE)
- Continue transitioning Radiation Assessment Detector (RAD) instrument on Curiosity rover on Mars from Planetary Science Division to the Heliophysics Division to engage space weather community supporting forecasting research at Mars



Research and Analysis Update

Overall

- Maintaining healthy R&A Program
- Maintaining DRIVE initiative – Phase II proposals due soon!
- Establishing ECIP cadence every 2 years
- Engaging in efforts to increase diversity in research
 - Dual anonymous, diversity and inclusion-specific solicitations
- Cross-Divisional programs:
 - E.3 Exoplanets (2 selections in 2021)
- AI/ML – strong emphasis in H-TMS in ROSES 2022
- New ROSES elements responding to Open Data and Open Science initiatives
- Eclipse 2024 element in ROSES 2022
- Space Weather Centers of Excellence



Citizen Science (new NASA HPD strategy, POC Liz MacDonald)

- **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
- **Planning for Heliophysics Big Year (2023-2024)**
 - Focus on two solar eclipses and solar max
- 4 selections in 2021 from Citizen Science Seed Funding Program, 1 selection in SWO2R
- Upcoming Citizen Science Seed Funding Program (CSSFP) F.9 due Dec. 15, 2021 with Amendment pending
- GSFC SMD/CISTO EPSCoR Rapid Research Response (R3) AI/ML CAN Appendix F features Supporting Heliophysics Citizen Science Goals through Data Partnerships (fall 2020)

Sounding Rockets Program

Recent Successes



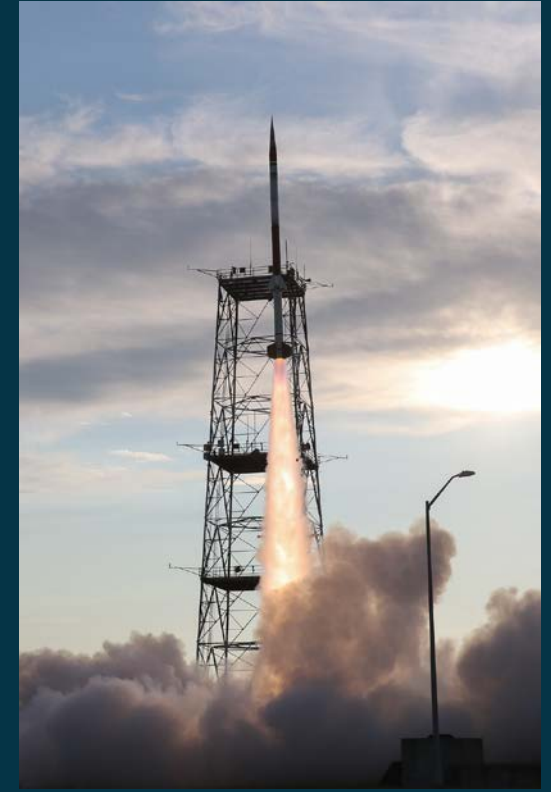
MaGIXS/Winebarger
30 July 2021
WSMR



RockSatX/Koehler
19 August 2021
WFF



SDO EVE/Woods
9 September 2021
WSMR



HOTShot/Leathe
11 September 2021
WFF

Press Release from Australian Trade Minister Celebrates the Sounding Rocket Launches in Australia

From the Press Release:

- On September 24, a NASA team ended quarantine and began work on a ground-breaking campaign to launch three sub-orbital sounding rockets from the Arnhem Space Centre in the Australia Northern Territory.
- Minister for Trade, Tourism and Investment Dan Tehan said the historic collaboration was a big win for Australia's expanding space sector.
 - "We've been working with governments, businesses and the sector to ensure Australia is best placed to take advantage of the growing opportunities in space," Mr. Tehan said. "The Morrison Government is committed to expanding the civil space sector as part of its plan to grow the sector to \$12 billion and create the jobs of the future."



Minister for Trade, Tourism and Investment

The Hon Dan Tehan MP

One giant leap for Australia's space sector



The Wallops Range and sounding rocket teams are in Australia building up the launch site where we'll launch three sub-orbital sounding rockets in mid-2022.

Planning for the next Decadal

- **Heliophysics 2050 Workshop held in early May 2021**
 - NASA- and NSF-enabled, community-led workshop
 - Developed short-, medium-, and long-term science objectives, including capability needs
 - Discipline-specific science, fundamental physics, interdisciplinary and inter-Agency sessions
 - Over 1,150 domestic and international registrants with approximately 425 to 650 engaged each day
 - “Heliophysics as a Community in 2050” considered how to strengthen inclusion, diversity, equity, and access (IDEA) within the community as well as developing and sustaining healthy, multi-generational approaches for teaming
 - Enabled cross- and interdisciplinary connections
 - “Expanding the Frontiers” session brought together different heliophysics disciplines, planetary science, and astrophysics to discuss how and where the scope of heliophysics can grow
- **Mission concept studies for decadal survey white papers**
- **Statement of Task is being finalized among sponsoring agencies in coordination with NASEM**
 - Decadal preparation, community insight/involvement
 - Defining decadal survey scope, focus
 - NASEM and HPD coordinated community webinars underway





Early-mid Career Roundtables

Past activities:

- Held 5 early-mid career roundtable sessions
- Briefed SMD leadership on key takeaways
- Addressed various community wide issues raised in the roundtables (decadal webinar, mentoring program)

Current:

- Expanded the roundtables to include mid-career participants
- Roundtables include a mix of new and returning participants

Topics include:


- Long-term COVID impacts on the job market
- Work/life balance in a virtual environment
- Building successful relationships with colleagues in the age of virtual conferences
- Inclusion, Diversity, Equity, and Accessibility initiatives
- Leading/Supervising others through the pandemic
- Ideas or needs for hybrid work scenarios (meetings, conferences, telework)

MENTORING365™



- AGU, AAS, and ASGSR are joining forces to support early career researchers and students through a mentoring opportunity that will provide connectivity and access to a community of Earth and space scientists around the globe with a goal of fostering a robust, diverse, equitable and inclusive workforce.
- Focused on increasing participation and opportunities for individuals within the ESS community by helping to help fill gaps in resources.
- **Program focuses:**
 - Lack of community
 - Lack of career advice
 - Decreased job opportunities and access to financial support
 - Unsafe virtual spaces
- **Participants:**
 - **Mentees:** Current undergraduate, graduate and postdoctoral students and early career professionals
 - **Mentors:** Mentors can range in career stage from post docs to senior scientists

https://mentoring365.chronus.com/p/p1/membership_requests/new



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

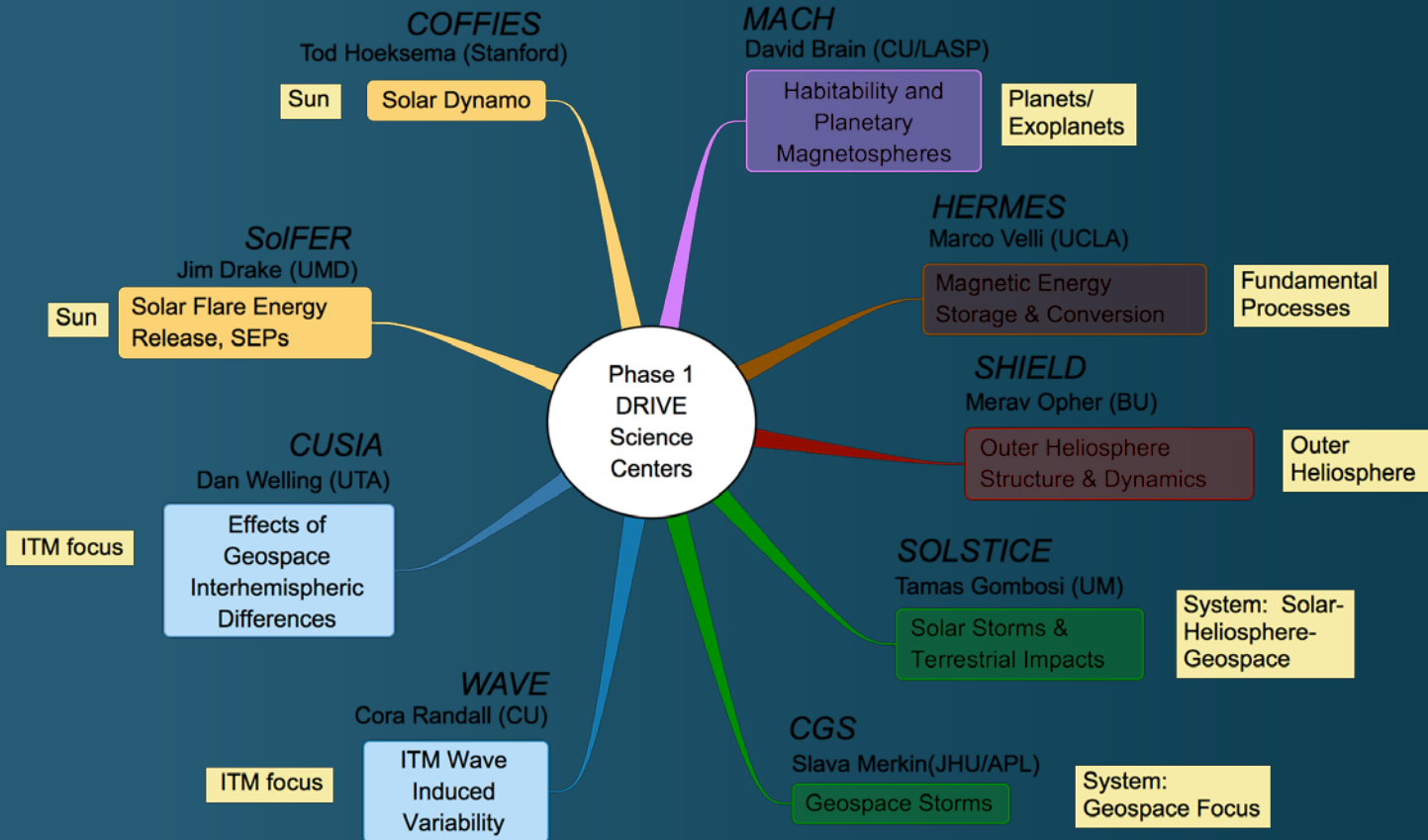
IDEA initiatives in Helio recognized as a long-term effort, but immediate and mid-term action and problem solving will advance initiatives in parallel with systemic, enduring activity.

Funded Ongoing and Exploratory Efforts

- Incentivized newly selected mission teams to expand their traditional communications plans to include outreach targeting minority groups to inspire and to increase diversity of future Heliophysicists.
 - The wide-reaching projects target nontraditional audiences as well as rural & underserved populations with hands-on hardware experiences for a variety of age groups.
- PUNCH, IMAP, and IMAP student collaboration
- Implemented new grant programs to energize the community & enhance diversity and inclusion
 - Heliophysics Innovations for Technology & Science (HITS) program which solicits proposals for innovative & novel ideas to advance Heliophysics research which currently fall outside the traditional grant solicitations
 - Developing targeted and innovative R&A solicitations with an IDEA emphasis for FY22
 - Inclusion of language that broaden and incentivize diverse participation on investigation teams and improve accessibility to mission science.
- Exploring options for current in-development missions including broadening the impact of Participating Scientists and Interdisciplinary Scientists solicitations
- HPD heard from early career individuals during the summer roundtables who expressed a strong desire that IDEA training should be a critical part of being a PI, student training, and more broadly, for those in positions of power. Heliophysics Division Program Scientists are exploring whether these efforts could be tied to specific ROSES solicitations.
- Coordinating with SciAct and OSTEM to expand engagement opportunities

DRIVE Science Centers and IDEA

Many DRIVE Science Centers are currently engaged in initiatives to increase diversity and inclusion and developing plans for future pilots, all of which will help to develop the future STEM workforce, in addition to impacts in breakthrough science.



- Engagement programs at HBCUs to train STEM educators (two workshops held)
- Diversity & inclusion team workshops on gender bias and under-represented scientists' experiences
- Pilot programs to identify early career researchers to lead critical team science or management tasks
- Webinar and video series to bring diverse voices to science
- Team participation in training focused on improving the workplace experience of employees who are LGBTQIA+
- Webinar series highlighting personal stories on how discoveries are made, skills needed for success, diverse career paths and viewpoints
- Piloting partnerships which pair undergrads with middle school students in an informal afterschool STEM learning program that includes solar and heliospheric science



Archives Modernization

HPD is planning to release an RFI to the community in the coming weeks.

- This RFI seeks community input and feedback on the current and future needs for NASA's Heliophysics data, and associated archives, tools, models, and resources.
- The Heliophysics Division manages mission data in the Heliophysics Data Environment (HPDE). This consists of the following archives, and their associated data portal and tools:
 - Solar Data Analysis Center (SDAC); and
 - Space Physics Data Facility (SPDF).
- The Heliophysics Data Archives Strategic Working Group is focusing on the modernization of HPD's archives to maximize the utility of the data of the Heliophysics System Observatory (HSO), sustainability of the archives, and access for the public to these data.
- RFI responses will be used to inform NASA's restructuring, expansion, and evolution of the Heliophysics data archiving infrastructure in accordance with the mission and strategy of the HPD Data Archives Strategic Working Group.

HPD Staffing Updates

WELCOME!



Susanna Finn has joined HPD via IPA detail as a Program Scientist from the University of Massachusetts Lowell.



Esayas Shume has joined HPD as a Program Scientist from the University of La Verne in California.



Shannon Fitzpatrick has joined HPD as a Program Executive from her role as Range Chief at Wallops Flight Facility.

Get Involved and Stay Informed!

We are continuing to work hard to grow the Heliophysics community, especially at a time where we find ourselves so separated. Stay in touch and help us find new ways to highlight your work and keep you in the loop!

Check out our “Nicky Notes” email!

- Sign up for it at <https://bit.ly/2R1w8HT>

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

- <https://science.nasa.gov/researchers/virtual-townhall-2020>

Let us know what you’ve been working on:

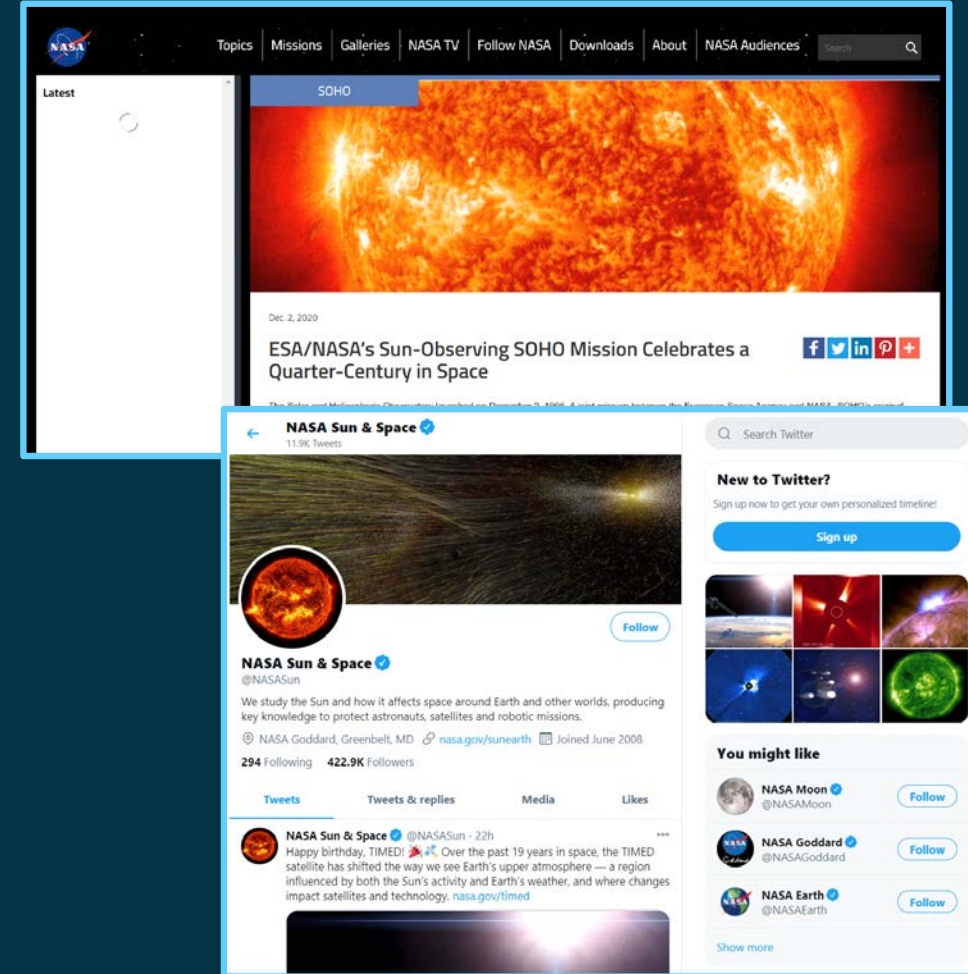
- <https://bit.ly/SubmitHelioScience>

Web and social media:

- NASA.gov/sunearth
- blogs.nasa.gov/sunspot
- @NASASun
- facebook.com/NASASunScience

Volunteer for a panel:

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





Heliophysics Division Looking Ahead

Missions

- Provide support for 20 operating science missions
- Support recently confirmed missions through KDP-C and beyond: AWE, IMAP, PUNCH, ESCAPADE, SunRISE
- Advance the following missions towards KDP-C in 2022: TRACERS/MAGIC, HERMES, GLIDE, Solar Cruiser, EZIE, and EUVST (in coordination w/JAXA)
- Down-select Medium Class Explorers (MIDEX-19)
- Continue pre-formulation activities ahead of DYNAMIC mission
- Select GDC instruments
- Maintain cadence of competitive Explorers program with the release of the AO for SMEX-22

Research

- Maintain healthy Research and Analysis Program
- Early Career Investigator Program cadence every 2 years
- Support robust suborbital program, including CubeSats
- Maintaining DRIVE initiative and prepare for selection of DRIVE Science Centers in early 2022

Cross-cutting

- Leverage community engagement inspired by Helio 2050, conduct mission concept studies, and initiate 2023 Decadal Survey
- Implement IDEA actions into the Heliophysics strategy
- Support early and mid-career individuals through roundtables and a robust support network
- Invest in modernization of data facilities and archives, including mission operations services and open science initiatives
- Elevate NASA's space weather presence through new initiatives in SWxSA
- Initiate new technology program to enable more focused, impactful, and innovative investments

The background of the slide is a composite of two cosmic images. The top half features a dark space with a prominent blue nebula on the right and a yellowish-orange nebula on the left. The bottom half is dominated by a bright orange and yellow nebula on the left, transitioning into a greenish-blue nebula on the right. Numerous stars of varying brightness are scattered throughout the scene.

#HelioRocks!

Sounding Rockets Program

Recent Successes



KINET-X/Delamere
16 May 2021
WFF

EUNIS/Daw; 18 May 2021; WSMR



VIPER/Bonnell
26 May 2021
WFF

CIBER 2/Zemcov; 7 June 2021; WSMR



RockOn/Koehler
25 June 2021
WFF



Dynamo-2/Pfaff
7 July 2021
WFF



Dynamo-2/Pfaff
11 July 2021
WFF

Congratulations Landsat 9 and CuPID!

- The Landsat 9 satellite launched from the Vandenberg Space Force Base in California Atlas V rocket at 2:12pm ET.
- The rocket then took the ESPA ring to a different altitude and deployed the Cusp Plasma Imaging Detector (CuPID) CubeSat and another 3 CubeSats
- CuPID will image the boundary where Earth's magnetic field interacts with the Sun's

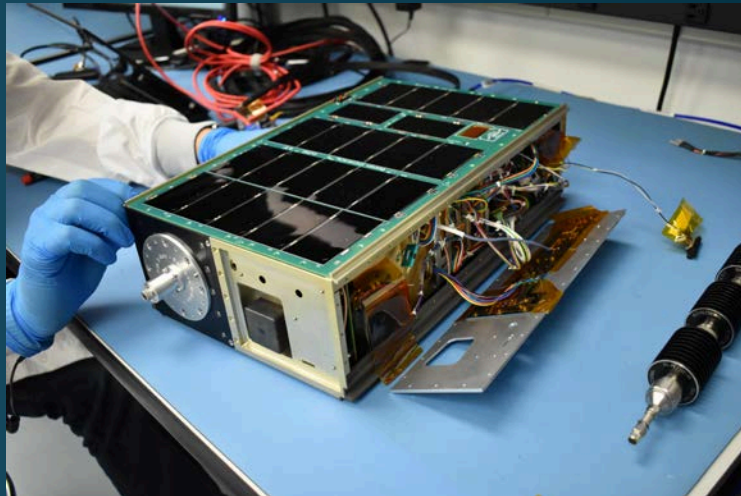


Image: CuPID in December 2019, when the chassis met the avionics.
Credits: Emil Atz



Image: Liftoff of AtlasV with Landsat9
Credits: United Launch Alliance

GOLD's Bird's-Eye Reveals Dynamics in Earth's Interface to Space

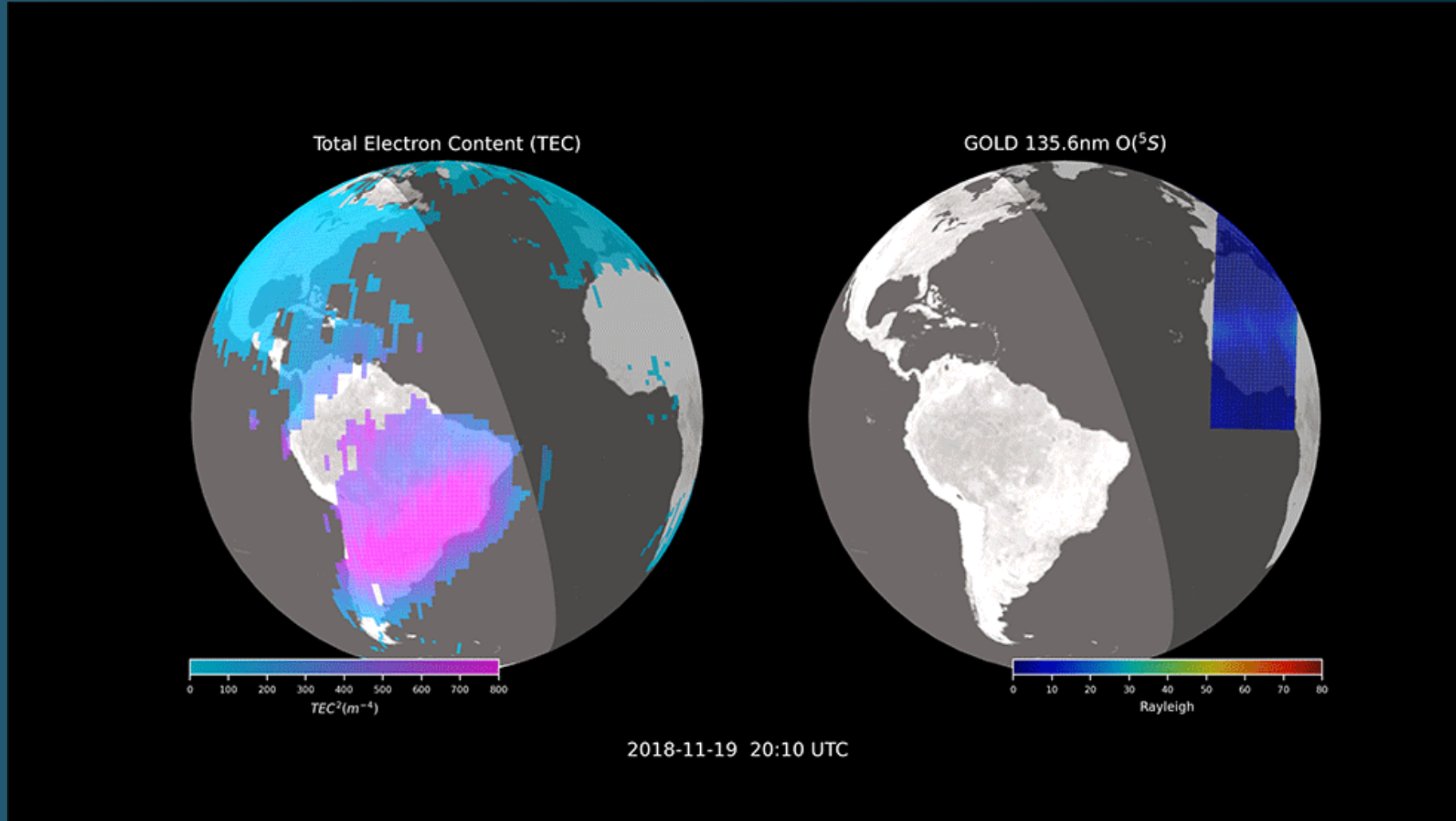
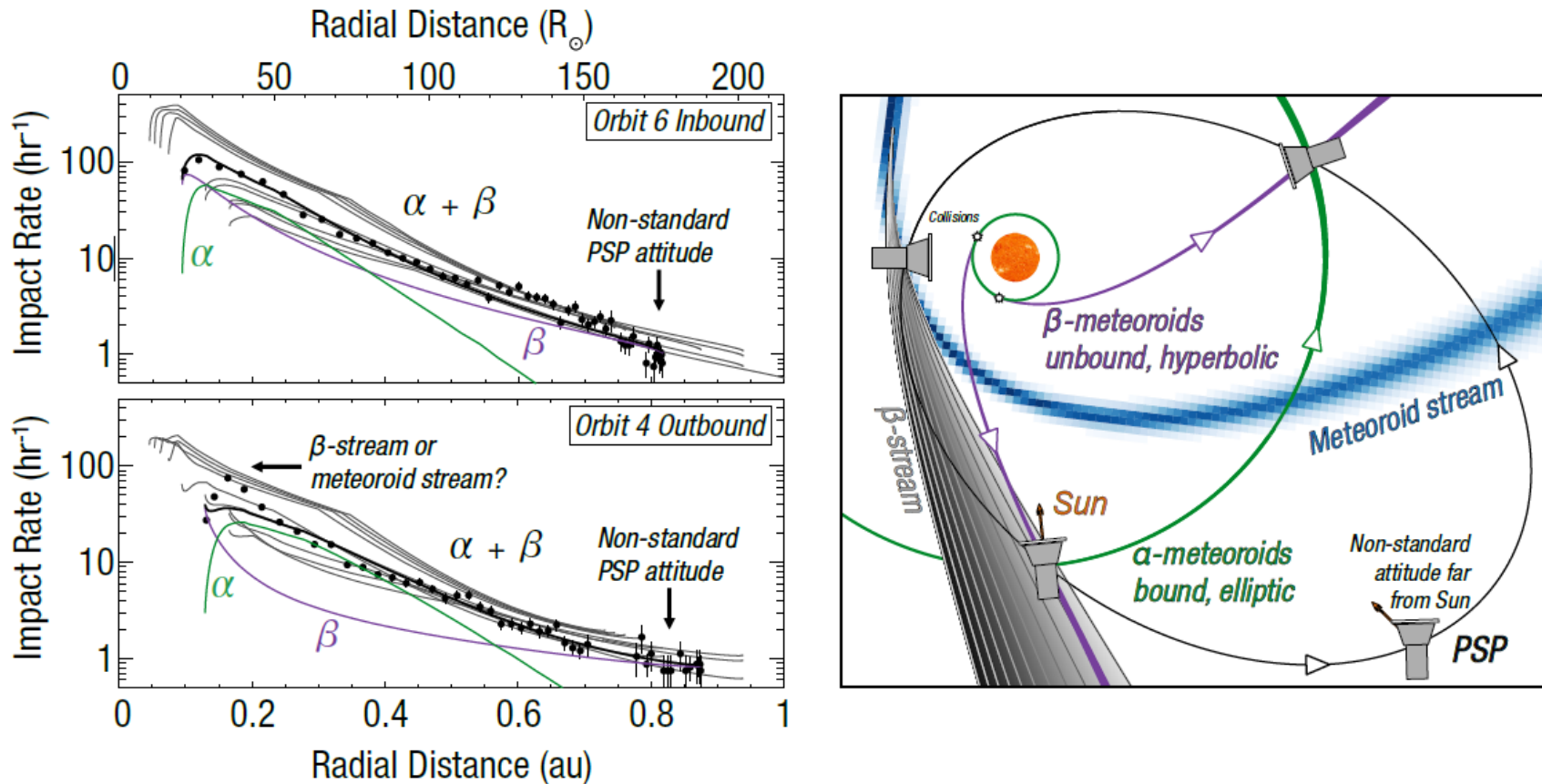


Image: NASA's GOLD mission saw a surprising asymmetric motion in one of the twin bands of charged particles that form in Earth's atmosphere at night. GOLD's unique perspective (right) made this observation possible, as other types of measurements made from ground-based instruments (left) can't see changes that happen over open waters. The red dots show the peak of the electron band as measured by ground-based sensors that measure total electron content, while the black dots show the peak of the electron band measured by GOLD. Credits: NASA's Scientific Visualization Studio 22

Parker Solar Probe Team Sheds New Light on Structure, Behavior of Inner Solar System Dust



Szalay et al. (2021)

Voyager 1: Persistent Plasma Waves

nature astronomy

Explore content ▾ Journal information ▾ Publish with us ▾ Subscribe

nature > nature astronomy > letters > article

Letter | Published: 10 May 2021

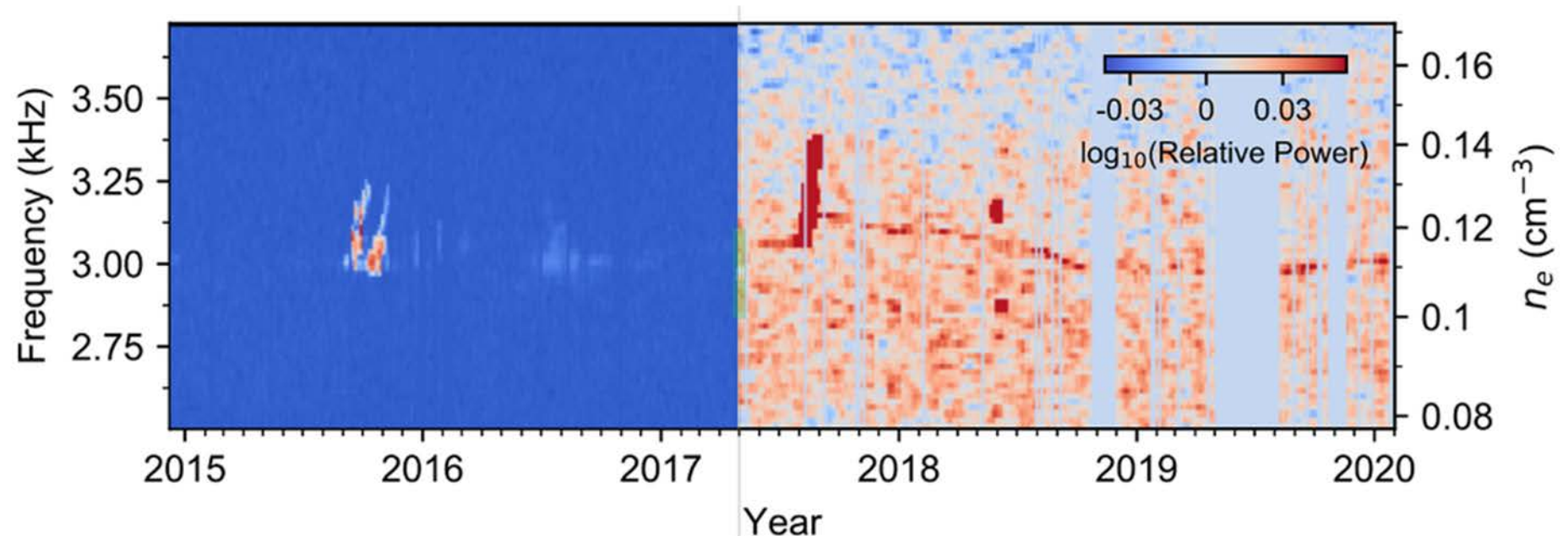
Persistent plasma waves in interstellar space detected by Voyager 1

Stella Koch Ocker , James M. Cordes, Shami Chatterjee, Donald A. Gurnett, William S. Kurth & Steven R. Spangler

Nature Astronomy (2021) | Cite this article

1371 Accesses | 1225 Altmetric | Metrics

Supported by HPD's
Outer Heliosphere
Guest Investigator (OHGI)
program





Innovation Request –



2 Eclipses + Solar Maximum



Background:

In 2017, millions in the US captivated by the first total solar eclipse of the millennium.

Lessons learned:

- Magnitude and sharp peak of the interest – what's next
- Need for early planning for programs, coordination with schools, science communication, and informal education.

New Opportunities in 2023-2024:

- Planning to design an experience with two solar eclipses during solar maximum to convert a generation to Heliophysics Science
- Use citizen science as a gateway to our missions and science.
- Use the concept of a "Big Year" to tie the three major Heliophysics events together and encourage the maximization of participation in a coordinated incentivized branded campaign.
- Achieve a broader vision for Heliophysics by utilizing these natural opportunities coinciding with the rise of citizen science within SMD.

What is a "Big Year"? A big year is a birding term for maximizing a birder's number of species.

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 rideshare program - historic number of missions on orbit and in development
- 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

