

National Aeronautics and  
Space Administration



# Heliophysics Division Update

## 2021 CEDAR Workshop

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NASA Heliophysics Division  
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# NASA Heliophysics is Experiencing Incredible Growth



## Poised to achieve the program of record outlined in 2013 Decadal and mid-term assessment

- Geospace Dynamics Constellation (GDC) passed KDP A in Sep. 2020 and instrument solicitation released June 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

## Enhanced and expanded the Heliophysics System Observatory (HSO) with new, innovative missions, a robust suborbital program, and leveraged creative rideshare strategies

- 12 missions in formulation or development and another 7 under study
- SunRISE and PUNCH (CubeSat constellations) proceeded into formulation
- TRACERS (w/MAGIC, a tech. demo.) proceeded into formulation
- Missions of Opportunity selected in Dec. 2020: EUVST (JAXA partner mission) and EZIE

## Invested in research and technology to enable enhanced return on science

- Solar Cruiser & 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 and excellent cost performance on recent missions, NASA has the largest and most vibrant Heliophysics System Observatory in its history.**



# HELIOPHYSICS SYSTEM OBSERVATORY

- 20 Operating Missions with 27 Spacecraft
- 1 Missions in Development
- 11 Missions in Formulation

■	FORMULATION
■	IMPLEMENTATION
■	PRIMARY OPS
■	EXTENDED OPS



OPERATING & FUTURE



# Research and Analysis Update

## Overall

- Maintaining healthy R&A Program
- Maintaining DRIVE initiative and establishment of DRIVE Science Centers (planning for Phase 2 selections)
- ECIP cadence every 2 years
- Engaging in efforts to increase diversity in research
  - Dual anonymous, high risk high reward, diversity and inclusion-specific solicitations
- Cross-Divisional programs – E.3 Exoplanets; E.4 Habitable Worlds (made 2 selections in E.3 for 2020; E.4 upcoming);
- AI/ML – strong emphasis in TMS program in ROSES 2019 (compete again in 2022)

## Citizen Science (new NASA HPD 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
- **Planning for Heliophysics Big Year (2023-2024)**
  - Focus on two solar eclipses and solar max
  - POC: Liz MacDonald
- 4 selections in 2021 from Citizen Science Seed Funding Program



## 2020 Jack Eddy Fellows



Lindsay Goodwin  
NJIT



Murong Qin  
BU



Camilla Scolini  
UNH





# New & Updated Research Opportunities in Heliophysics 2020-2021

- **GOLD-ICON** Guest Investigators *selections early Fall*
- **HTIDS**: Technology & Instrument Development for Science *due 8/5/21*
- **HLCAS**: Low-Cost Access to Space *9/23/21*
- **HFOS**: Flight Opportunity Studies *8/5/21*
- **HFORT**: Flight Opportunities for Research and Technology *2/24/22*
- **GDC IDS** (Interdisciplinary Scientists) *Step 2's came in last week.*
- **ISE**: Interdisciplinary Science for Eclipse
- **HCMS**: Heliophysics Mission Concept Studies
- **SWO2R2O**: Space Wx Ops to Research to Ops (includes additional Transition-Step)
- **HITS**: Heliophysics Innovations for Technology and Science *anytime before 3/29/22*

Sign up for SMD mailing lists by logging in at <http://nspires.nasaprs.com/> and checking the appropriate boxes under "Account Management" and "Email Subscriptions"



# Research Opportunities in Heliophysics: LWS

## **ROSES B.5 LWS Science – Due dates S1: 9/8/21, S2:11/18/21. Four Focused Science Topics**

- (1) Impact of Terrestrial Weather on the Ionosphere –Thermosphere
- (2) Pathways of Cold Plasma through the Magnetosphere
- (3) Understanding Large-Scale Evolution of Solar Wind throughout Heliosphere through the Solar Cycle
- (4) Towards a Quantitative Description of the Magnetic Origins of the Corona and Inner Heliosphere

## **ROSES B.6 LWS Strategic Capabilities – Due dates TBD (NET Q4, C2021)**

- (1) A global model of the magnetosphere
- (2) A model of CME evolution and impact on the inner heliosphere

## **ROSES B.18 LWS Tools & Method – Due dates S1: 7/1/21, S2: 8/31/21**

Applied artificial intelligence (AI) techniques

## **ROSES B.XX LWS Infrastructure – Due dates TBD (NET Q4, C2021)**

Jack Eddy Post Docs, LWS Summer School, LWS Institutes

**LWS Architecture Study** – Community input to be solicited in near future. Assessment of past/present LWS programs, identification of future LWS mission architecture. For details contact Simon Plunkett.

## **LWS Program Analysis Group (LPAG, <https://lwstrt.gsfc.nasa.gov/lpag>)**

- New Membership to be announced shortly
- 2021 Activities include long term review of FSTs



# Sounding Rockets Program *Launches have resumed!*

## KiNET-X

(Kinetic-scale Energy and momentum Transport eXperiment)

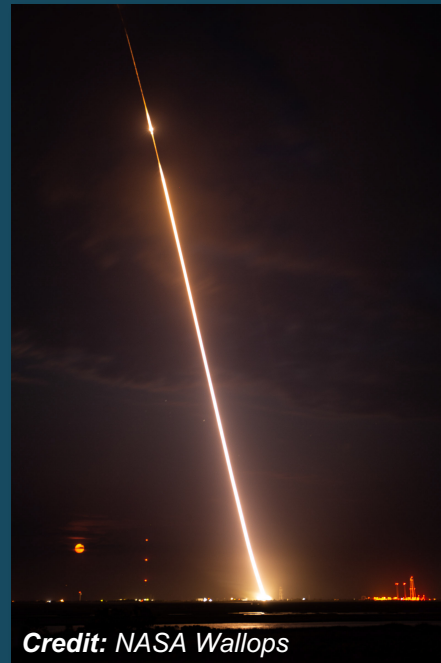
- Geospace experiment studying how energy and momentum are transported between different regions of space that are magnetically connected.
- **PI:** Peter Delamere / University of Alaska
- Launched from Wallops Flight Facility (WFF) at 8:44 p.m. EDT on May 16 on a Black Brant XII. First SRP mission from WFF since COVID restrictions began.



## VIPER

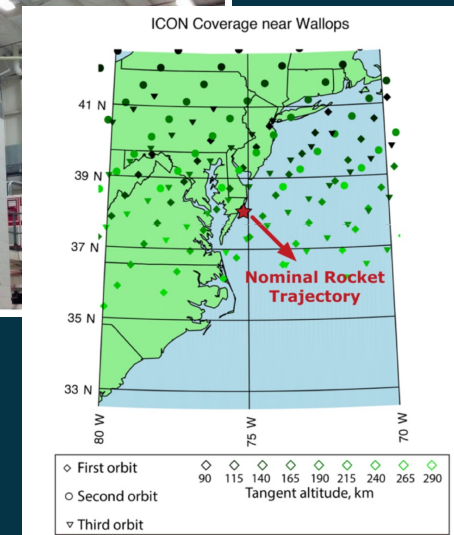
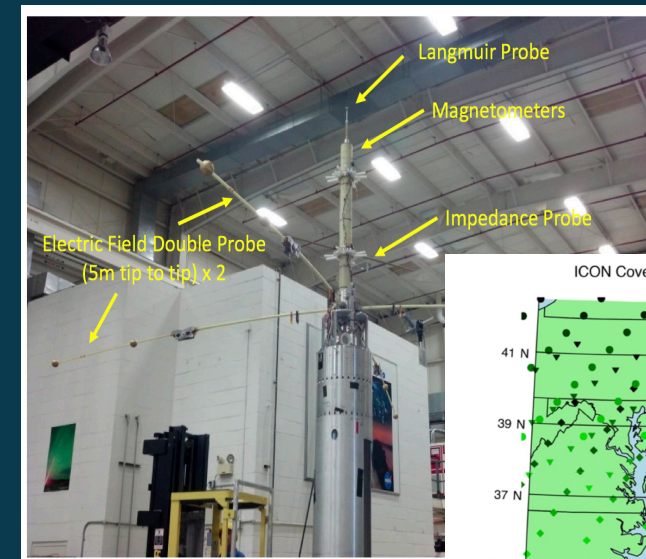
(Vlf trans-Ionospheric Propagation Experiment Rocket)

- Observational and modeling effort to understand Very Long Frequency (VLF) wave penetration through and propagation above the Earth's ionosphere
- **PI:** Dr. Bonnell / UC Berkeley
- Launched from WFF at 9:15 p.m. EDT on May 26 on a Terrier-Improved Malemute.



## DYNAMO (Upcoming)

- Rocket measurements of lower ionospheric dynamo current and winds.
- **PI:** R. Pfaff/ NASA GSFC
- Launch from WFF. Two identical payloads (Pfaff/GSFC; Clemmons/UNH) on two rockets launched in conjunction with ICON orbits; early July; ground magnetometer for daytime sporadic E.





# Planning for the Next Decadal



- **Heliophysics 2050 Workshop held 3-7 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
- “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**

- **Conversations between NAS, CSSP and Agencies (NASA, NSF, NOAA) ongoing**

- Decadal preparation, community insight/involvement
- Defining decadal survey scope, focus
- NASEM and HPD coordinated community webinars in development

- **Decadal Survey Prep Session: Today @1300 MDT (Doug Rowland, Jared Leisner)**

- **Helio2050 Report: Shasha Zou - next presentation!**

# PROSWIFT and NASA

## Some of the steps underway at NASA in line with PROSWIFT include:

- Strengthening partnerships with ESA and other international and interagency partners to maintain SOHO/LASCO and other space weather monitoring satellites.
- Planning for space weather monitoring capability on future NASA missions including GDC
- Working with NOAA and DOD to build new space-based monitoring missions, (e.g. NOAA-NASA SWFO-L1 mission) to ensure backup capability among SpWx observatories.
- Carrying out basic research in solar and space physics, and space weather, including joint interagency research solicitations with NSF & NOAA, including SWQU and R2O2R solicitations.
- Establishing interagency framework for supporting transition of SpWx research into benefit for operational and applied use, and to ensure that the insights from operations inform future direction of NASA-sponsored research;
- Supporting competitive awards for multidisciplinary science centers (e.g., DRIVE Centers) and preparing to solicit SpWx Science Centers of Excellence proposals.





# GDC & DYNAMIC

**GDC (Geospace Dynamics Constellation): decadal-recommended LWS mission to study the coupled ionosphere-thermosphere system and its response to external energy input.**

- NASA is formulating GDC as a strategic focus for I-T science
  - *Emphasis on community accessibility & engagement (incl. open science principles), space weather contributions*
  - *Complement current GOLD, ICON and future AWE, DYNAMIC; establish foundation for future investigations*
- GDC Final Program Element Appendix (PEA) released June 1; targeting selections early next year
- NASA recognizes the need for ground-based observations (per STDT report). Those discussions will ramp up after PEA and IDS selections.

**DYNAMIC (Dynamical Neutral Atmosphere-Ionosphere Coupling): decadal-recommended STP mission concept to study how lower-atmosphere variability affects geospace.**

- Currently in pre-formulation, released community announcement March 1 with mission expectations:
  - *leverage GDC measurements*
  - *launch as a rideshare secondary payload concurrent with GDC*
  - *lower cost cap than Small Explorer ("SMEX")*

**We welcome discussions on combining space & ground-based assets (NSF and other agencies) to maximize current and future scientific returns.**



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

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

## Heliophysics Division Goal

- Incorporate IDEA into the Heliophysics Division mission, vision, and strategy, resulting in a Division-wide commitment to lasting and specific IDEA goals and objectives.

## Ongoing and Exploratory Efforts

- Members of HPD participating in various trainings and working groups to identify potential near-, mid-, and long-term Division actions.
- Identify Division and SMD leadership opportunities for staff.
- Explore best practices for IDEA recruitment efforts, including hiring panels.
- Adopt inclusive R&A code of conduct.
- Sponsor/incentivize innovative mission outreach activities with IDEA as major focus (e.g., PUNCH, IMAP).
- Establish a community-wide early- and mid-career support network in partnership with other SMD Divisions, and with professional/scientific societies, focusing on providing mentors & mentees training and resources.
- Develop targeted and innovative R&A solicitations with an IDEA emphasis.



# Heliophysics Division Looking Ahead

- Confirmation of the following missions in 2021: HERMES, PUNCH, IMAP, TRACERS, SunRISE, ESCAPADE
- Down-select Medium Class Explorers (MIDEX-19)
- Continue pre-formulation activities ahead of DYNAMIC mission
- Maintain healthy Research and Analysis Program
  - Early Career Investigator Program cadence every 2 years
  - Support robust suborbital program, including CubeSats
  - Maintaining DRIVE initiative
  - Enhance the scientific return by innovatively connecting observations from one or more missions with satellite or ground observations from other Divisions, and/or other agencies within or outside the U.S. (HSO Connect, Daniel K. Inouye Solar Telescope, etc.)
- Continue planning for 2024 Decadal Survey (mission concepts, discussion with NASEM, NSF, and NOAA)
- Implement IDEA actions into the Heliophysics strategy
- Support early and mid-career individuals through roundtables and a robust support network

# Get Involved and Stay Informed!

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

## Check out our “Nicky Notes” email!

- Sign up for it: <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:

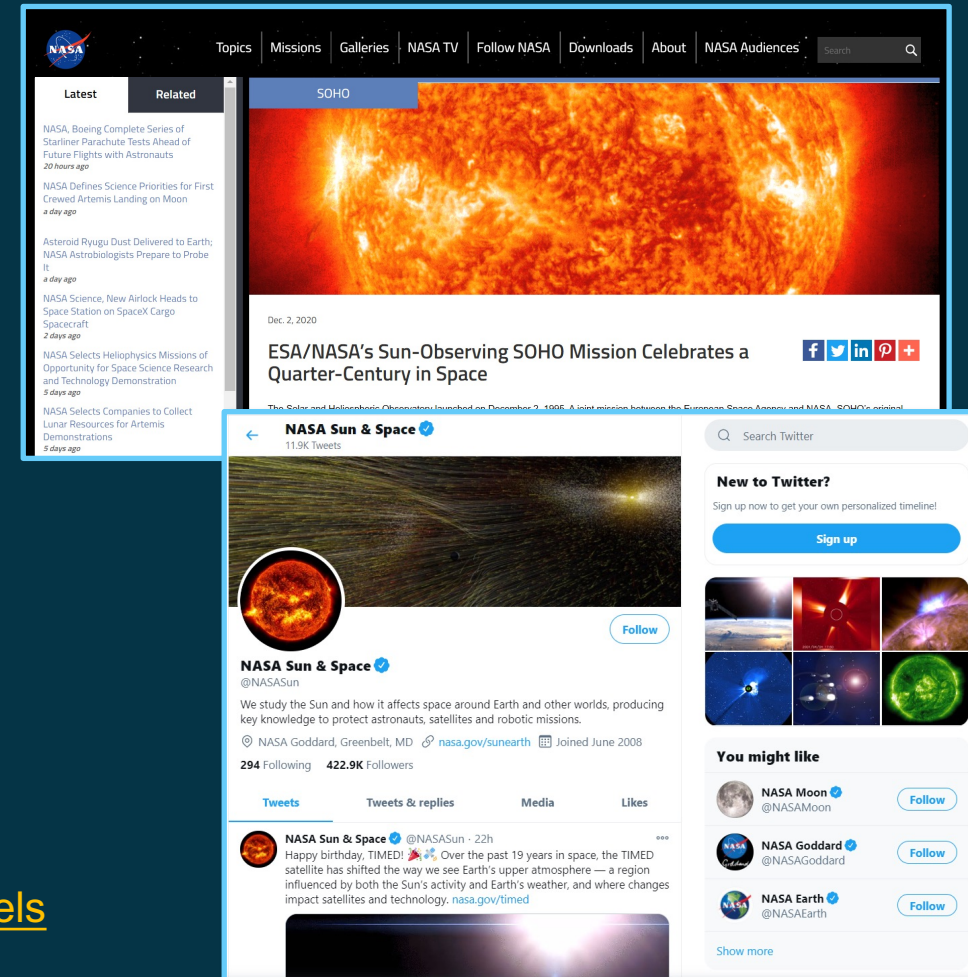
- [bit.ly/SubmitHelioScience](https://bit.ly/SubmitHelioScience)

## Web and social media:

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

## Volunteer for a panel:

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



The image displays two screenshots. The top screenshot is a NASA website page featuring a large image of the Sun. The page includes a navigation bar with links for Topics, Missions, Galleries, NASA TV, Follow NASA, Downloads, About, and NASA Audiences. A search bar is located in the top right corner. The main content area shows a 'Latest' section with several news items, including 'NASA, Boeing Complete Series of Starliner Parachute Tests Ahead of Future Flights with Astronauts' and 'ESA/NASA's Sun-Observing SOHO Mission Celebrates a Quarter-Century in Space'. The bottom screenshot is a Twitter profile page for 'NASA Sun & Space' (@NASASun). The profile includes a bio: 'We study the Sun and how it affects space around Earth and other worlds, producing key knowledge to protect astronauts, satellites and robotic missions.' It also shows the location 'NASA Goddard, Greenbelt, MD', the website 'nasa.gov/sunearth', and the date 'Joined June 2008'. The profile has 294 following and 422.9K followers. A tweet is visible, celebrating the 19th anniversary of the TIMED satellite.

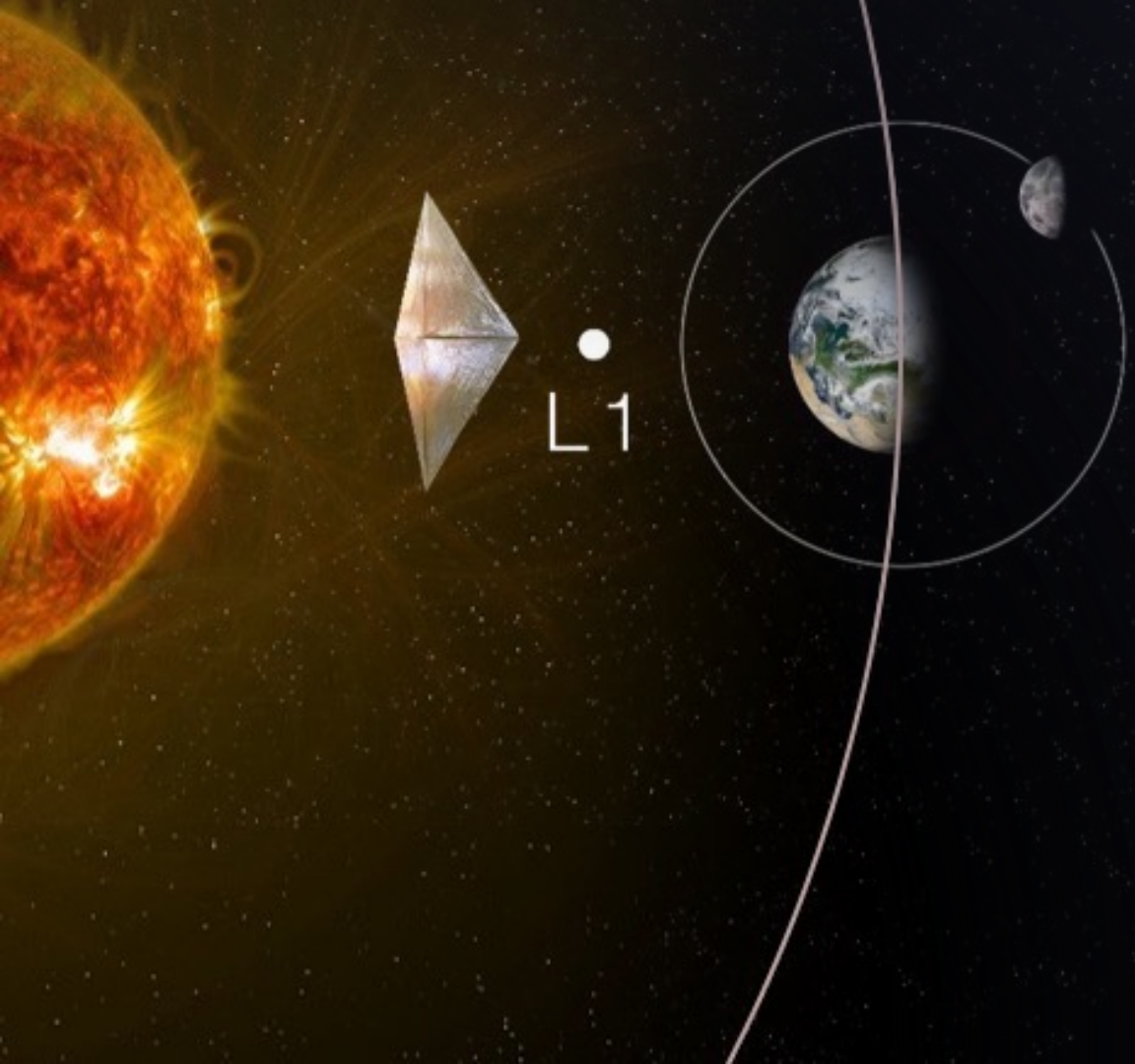




**#HelioRocks!**



# Solar Cruiser TechDemo *Enables* Sub-L1 Heliophysics and Solar Storm Monitoring



## Address key science questions such as:

- How do Coronal Mass Ejections (CMEs) and shock properties vary on moderate radial distances ( $\sim 0.1$  AU)?
- How do CME and shock properties vary with moderate angular distance?
- What is the structure of interplanetary CMEs, etc.?

## Space Weather Applications:

- Increase the warning times by up to 50% for both “typical” and “fast” CMEs from  $\sim 55$  min. to 83 min., and 20 min. to 30 min
- Directly benefits human exploration beyond LEO



# Parker Solar Probe

## Breaking Records

Parker Solar Probe completed its eighth close approach to the Sun, perihelion, on April 29, 2021, coming within a record of 6.5 million miles of the Sun's surface at a record speed of over 330,000 miles per hour.

## Parker Solar Probe Ushers in New Science on the Sun and Solar Wind

Scientists using data from Parker Solar Probe released a new collection of research papers in a special issue of the journal ***Astronomy & Astrophysics*** on June 2, 2021.

The issue, titled Parker Solar Probe: Ushering a New Frontier in Space Exploration, includes 37 papers on discoveries made during mission's first four orbits around the Sun. The new research builds upon initial results released in *Nature* in 2019 and a special supplement of *The Astrophysical Journal* in 2020.

