**Goddard Planetary Heliophysics Institute (GPHI)**

University of Maryland, Baltimore County · PHaSER Partner Institution · NASA GSFC

# Annual Report of Research Achievements

*Reporting Period: May 1, 2025 – April 30, 2026*

This report summarizes the scientific and technical accomplishments of GPHI/PHaSER faculty at UMBC working at NASA's Goddard Space Flight Center Heliophysics Science Division (HSD) during May 1, 2025–April 30, 2026. The 15 reporting researchers span four of the five HSD laboratories. Aggregate output statistics are presented below; individual researchers are described by their research activities rather than by individual productivity metrics.

### Table 1. GPHI Accomplishments by HSD Laboratory

| Code | Laboratory | Staff | Publications | Presentations | Proposals |
|---|---|---|---|---|---|
| 671 | Solar Physics | 2 | 9 | 16 | 4 |
| 672 | Heliospheric | 8 | 22 | 17 | 1 |
| 673 | Geospace | 4 | 25 | 12 | 4 |
| 674 | Space Weather | 1 | 7 | 2 | 3 |
| — | **TOTAL** | **15** | **63** | **47** | **12** |

*Overall totals: 63 publications · 47 presentations · 12 funded proposals · 15 researchers*

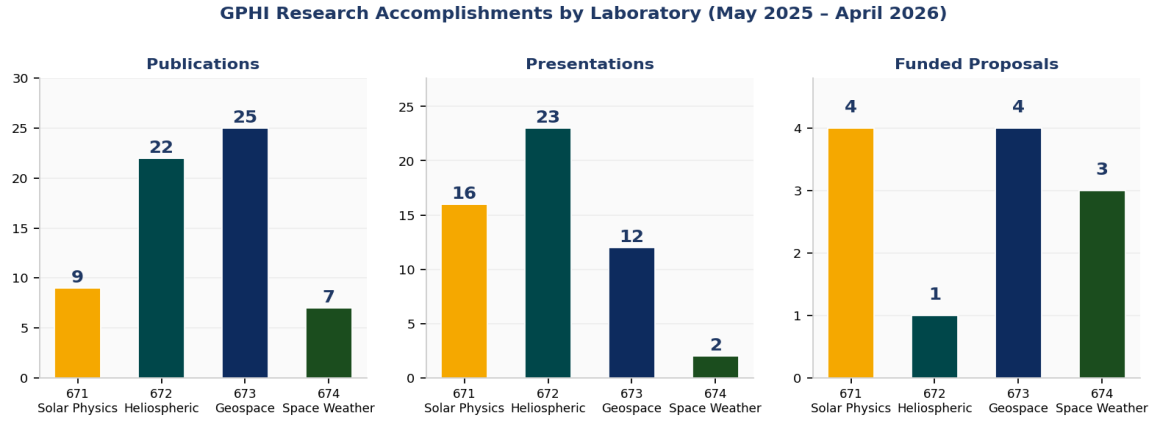


*Figure 1. Total publications, presentations, and funded proposals by HSD laboratory.*

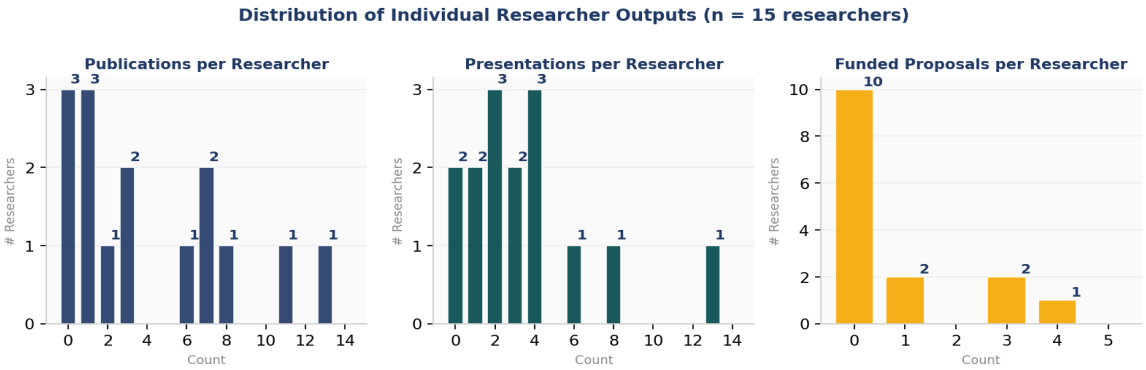


*Figure 2. Distribution of individual researcher output counts (n = 15; names not shown).*

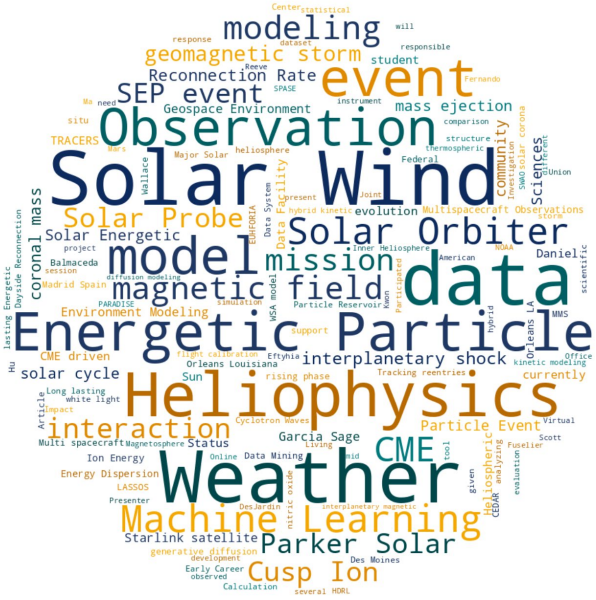


*Figure 3. Word cloud of key scientific themes from GPHI faculty research narratives (May 2025 – April 2026).*

## Code 671 – Solar Physics Laboratory

### Daniel da Silva · Sponsor: Charles N. Arge

Dr. da Silva led a diverse research portfolio spanning solar corona modeling, machine learning for heliophysics, and space weather forecasting. His work advanced generative diffusion models of the three-dimensional coronal magnetic field, earning him the Early Career Award at the ML in Heliophysics Conference (Madrid, October 2025). He developed DISCO, a GPU-accelerated guiding-center particle tracer for the MARBLE magnetospheric modeling project, and devised a data-mining methodology for uncertainty quantification of solar wind speed forecasts in the Wang-Sheeley-Arge (WSA) model — a critical component of the national space weather forecasting system operated by NOAA. He contributed to the TRACERS science team, coordinated software engineering for the WSA team, and served on the science team of the Surya 360M-parameter heliophysics foundation model. Dr. da Silva mentored two students through NASA's MUREP program, including an undergraduate who became a co-author on a 2026 publication.

### Cynthia López-Portela · Sponsor: Nicholeen Viall

Dr. López-Portela studied solar wind density structures using multi-viewpoint remote sensing in the visible band, applying triangulation techniques to determine three-dimensional kinematics and dynamics of white-light tracers in the inner heliosphere. She began working with SoloHI (Solar Orbiter) data and migrated core algorithms from IDL to Python. She

received a monetary award at the IAGA/IASPEI Joint Scientific Meeting in Lisbon (September 2025) and served as a volunteer NASA HEAT facilitator at three public outreach events, collectively reaching nearly 200 participants. She is also a board director of the HelioArc Foundation, a nonprofit focused on citizen science and heliophysics education.

## Code 672 – Heliospheric Physics Laboratory

### Anthony Buonomo · Sponsor: Brian Thomas

Mr. Buonomo contributed to the development of a paper-data linking system for the heliophysics community, creating programmatic connections between published scientific literature and observational datasets in the Coordinated Data Analysis Web (CDAWeb) and the Heliophysics Digital Resource Library (HDRL). This infrastructure work supports broader data discoverability and reproducibility for the heliophysics community.

### Fernando Carcaboso Morales · Sponsor: UMBC / NASA GSFC

Dr. Carcaboso Morales investigated the topology and evolution of coronal mass ejections (CMEs) and their interplanetary magnetic field signatures using suprathermal electron observations from Solar Orbiter and Parker Solar Probe. He performed Solar Orbiter EPD-SWA intercalibration, analyzed multi-spacecraft SEP transport during the December 2024 events, and served as a curation scientist for the Solar Orbiter and STEREO mission data archives. The CoSEE-Cat electron event catalog he co-authored was recognized as a Research Highlight by both ESA and NASA, and he received a NASA Peer Award for outstanding contributions. He carried out science outreach at the NASA Astro Camp and IMAP Workshop, and delivered invited seminars at UCL/MSSL (London) and the University of Alcalá (Madrid).

### Andriy Koval · Sponsor: R. Candey / A. Szabo / B. Thomas / D. Wilson

Dr. Koval contributed to the Parker Solar Probe magnetometer team and served as PI for the DSCOVR and Wind Magnetic Field Investigation (MFI) instruments. He advanced SPASE 3.0 metadata standards development and supported the Space Physics Data Facility (SPDF) with data archiving, calibration, and interoperability activities across multiple heliospheric missions.

### Antonio Niemela · Sponsor: David Lario

Dr. Niemela focused on multi-spacecraft analysis of solar energetic particle (SEP) events using Solar Orbiter, Parker Solar Probe, STEREO, and near-Earth assets, investigating particle transport, acceleration, and longitudinal spread during major events in the inner heliosphere. His work addressed CME-SEP associations, particle reservoir formation, and the role of large-scale heliospheric structures in modulating SEP access.

### Jeewoo Park · Sponsor: Adam Szabo

Dr. Park advanced understanding of the heliosphere and very local interstellar medium (VLISM) through extensive analysis of Voyager 1 and 2 magnetometer data. He successfully calibrated both spacecraft's magnetometer records and migrated the MAG data processing pipeline to a new Linux server. His lead-author manuscript (submitted to ApJ) characterizes the evolution of the VLISM magnetic field and intermittency from the magnetic hump in 2020 through mid-2025. He also expanded into IBEX energetic neutral atom studies and conducted an outreach presentation on heliophysics at a Korean high school in Howard County.

### Oksana Kruparova · Sponsor: Adam Szabo

Dr. Kruparova focused on interplanetary shocks and multispacecraft observations in the inner heliosphere. Her primary contribution was the scientific curation and maintenance of the Parker Solar Probe Interplanetary Shock List (SODA — ShOck Detection Algorithm), a widely used community data resource for shock identification, classification, and heliospheric context.

### Vratislav Krupar · Sponsor: Adam Szabo

Dr. Krupar carried out research on interplanetary radio bursts (Type III and Type IV), radio source localization, interplanetary shock radial evolution, and multispacecraft SEP events using Parker Solar Probe, Solar Orbiter, and STEREO data. He reported the first detection of low-frequency striae in interplanetary Type III radio bursts and studied radio-wave scattering signatures of the heliospheric magnetic field. He maintained the STEREO/WAVES VALERIE direction-finding tool and the HelioSwitch PSP switchback database as community resources.

### Andreas Weiss · Sponsor: Teresa Nieves-Chinchilla

Dr. Weiss conducted research on coronal mass ejection (CME) flux rope modeling and multi-point observations from Solar Orbiter and near-Earth spacecraft. His work advanced understanding of CME magnetic field structure evolution in the inner heliosphere, with implications for space weather forecasting accuracy. He is supported by a NASA ROSES Heliophysics Supporting Research (HSR) grant (2025–2028).

## Code 673 – Geospace Physics Laboratory

### Brandon Burkholder · Sponsor: Li-Jen Chen

Dr. Burkholder focused on simulating cusp ion and electron dispersions in support of the NASA TRACERS mission, and on geomagnetic storm simulations for the MMS mission. His work contributed to a broad collaborative research effort spanning Alfvén wing states at Earth and Mercury, magnetopause dynamics during the May 2024 Mother's Day storm, cusp reconnection rates, and Saturn's magnetosphere. He mentored two undergraduates — Yohannes Girma (magnetopause flux rope properties) and Azzan Porter (Juno bow shock crossings at Jupiter) — both of whom attended and gave oral presentations at the MMS Community Workshop in Paris.

### Alexander Lipatov · Sponsor: Daniel Gershman

Dr. Lipatov conducted hybrid code simulations relevant to MMS observations, focusing on particle dynamics at slow-mode shocks and magnetic reconnection sites. He has a manuscript in preparation based on this work. Dr. Lipatov is funded at 0.1 FTE, effective October 2025.

### Kevin Delano · Sponsor: Eftyhia Zesta / Tim Stubbs

Dr. Delano investigated the thermospheric nitric oxide (NO) response to both CIR-driven and CME-driven geomagnetic disturbances in rapid succession, combining TIMED in situ data with TIE-GCM simulations to analyze NO behavior at mid- and low-latitudes with a focus on local-time variability. He also performed extensive analysis of Solar Orbiter Heavy Ion Sensor (HIS) data from the spacecraft's encounter with Comet Leonard, examining pickup ions and tail geometry. He is PI of a NASA HSR grant supporting NO transport research (2025–2028), and reviewed six Step 1 LWS proposals in March 2026.

### Denny M. Oliveira · Sponsor: Eftyhia Zesta (0.4 FTE)

Dr. Oliveira conducted a highly productive research program in space weather and space physics, centered on interplanetary shock impact angles as drivers of geospace disturbances and satellite orbital drag during geomagnetic storms. His work tracking Starlink satellite reentries during the rising phase of Solar Cycle 25 received broad media attention (Phys.org, Gizmodo, New Scientist, among others). He delivered invited talks at the Los Alamos National Laboratory Center for Nonlinear Studies and the UMBC Physics Colloquium, and served as a lecturer at the ISWI Space Weather School in Mumbai (January 2026). He co-convened three major international conference sessions (COSPAR, IAGA/IASPEI, GEM/CEDAR), serves as Associate Editor of AGU's Geophysical Research Letters, and is Guest Editor of a Frontiers in Astronomy and Space Sciences special issue on the Gannon Storm. He mentored a CUA graduate student whose work resulted in a published paper, and an American University undergraduate studying Starlink drag.

## Code 674 – Space Weather Laboratory

## Scott A. Boardsen · Sponsor: Bobby Candey / Guan Le

Dr. Boardsen discovered observational evidence in Van Allen Probes data of proton shell diffusion associated with rising-tone quasi-periodic fast magnetosonic waves — results accepted for publication in JGR (March 2026). He conducted statistical and event studies of ion cyclotron waves in the inner heliosphere using PSP, Wind, and STEREO-A, and analyzed MMS ion cyclotron and drift mirror mode waves in an MMS-GEOTAIL conjunction. He is developing a high-cadence MMS FPI ion velocity moment dataset (0.15 s cadence) that will provide an additional 400 days of magnetosheath coverage beyond burst mode. He also aided analysis of ion Bernstein waves on the Endurance Sounding Rocket, contributed to SPDF/SPASE data infrastructure, and successfully posted the ROLSES-1 lunar radio telescope dataset to the Planetary Data System.