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Plastic Scintillator System for Cosmic Radiation Detection

The radiation environment in Low Earth Orbit (LEO), including gamma rays, neutrons, and high-energy charged particles, poses serious challenges to spacecraft electronics and detectors. Radiation exposure can cause material degradation, increased detector noise, and reduced mission lifetimes, creating a need for radiation-resilient detection systems and shielding for future exploration missions such as the Artemis program. This study investigates plastic scintillator systems based on polyvinyltoluene (PVT) and polystyrene (PS) for radiation detection in space environments. Scintillators were synthesized and doped with PPO and POPOP to enhance scintillation efficiency. A multilayer shielding architecture was designed using bismuth-based composites (4 cm) for gamma attenuation, boron-loaded high-density polyethylene (HDPE, 6 cm) for neutron moderation, and aluminum layers (0.5–1 mm) to suppress secondary electrons and provide structural protection. ESR film and Teflon were used for optical light guiding. Accelerated ionizing radiation tests were performed using a cobalt-60 source (50,000 mGy). Both PVT and PS scintillators produced visible scintillation under UV excitation after doping. The PVT-based scintillator showed stronger scintillation intensity and higher structural stability than the PS matrix. Scanning Electron Microscopy (SEM) revealed only localized micro-scale surface defects, with overall structural integrity preserved. These results indicate that PVT-based scintillators combined with multilayer shielding are promising for radiation detection in LEO and could support reliable radiation monitoring for future space missions.

Poster | HELIOTECH

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Low SWaP Fixed Bias Langmuir Probe Instrument for LEO Constellations and Integrated EUV flux Monitoring

One of the crucial measurements for characterizing any space weather event is the absolute plasma density, plasma density fluctuations (both spatial and temporal), and solar EUV flux. Among the various methods for performing in situ plasma density measurements is a simple fixed-bias Langmuir probe. This poster discusses various implementations of a Langmuir probe and why a Planar Ion Probe (PIP) is the easiest and best method for measuring high-cadence absolute ion density in planetary ionospheres. We present the performance of the instrument from the NASA LLITED dual CubeSat mission which included two 1.5U CubeSats. The same instrument is also flying on NASA ESCAPADE mission to Mars where it is proving to be a good monitor of integrated EUV flux. We present data from ESCAPADE Langmuir Probe and compare it with EUV flux as measured by GOES satellites. Due to its intended CubeSat platform, the designed instrument has extremely low size, weight, and power requirements and is intended to be flown as an innocuous hosted instrument on constellations of 100+ satellites.

Presentation | DAY 5 | SEPTEMBER 4 11:00 | Session | Advanced Electromagnetic Field Sensors and Magnetometers | Orbital Flight

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Enabling Reactive Science Through Event-Driven Operational Autonomy

Scientific phenomena in the Sun-Earth system are often transient, fast moving, and hard to predict. An observatory must be in the right place at the right time with the instruments in a mode best suited for what nature serves up. Past mission strategies relied on a combination of statistical predictions and operational approaches that cycled through various modes hoping to get lucky. We offer an event-driven, autonomous concept of operations where a spacecraft can detect its environment and can adapt in real time. To achieve this goal, we have designed and implemented two tools that work in cooperation: MEDOS (Module for Event Driven Operations on Spacecraft), and ReCAP (Remote Control, Actuation, and Planning). MEDOS fuses data streams from multiple instrument sources (payload and spacecraft bus) and provides a confidence that a given event is occurring. ReCAP provides a framework for real time dynamic reformulation of multi-agent systems, allowing the entire system to intelligently react to what MEDOS has recognized. MEDOS could, for example, fuse local magnetic field measurements with plasma measurements to conclude that a particular space weather event has occurred. ReCAP then coordinates a system-wide action – taking a responsive, opportunistic science measurement, and/or safing a subset of the instruments to prevent damage. We discuss this MEDOS/ReCAP responsive science concept of operations within the context of current and future missions such as NASA/Heliophysics' MMS mission and possible infusions with upcoming missions such as HelioSwarm, Links, Seven Sisters and GDC Pathfinder. Finally, we look at hypothetical next generation missions that depend on a real time response to changing space weather, including multi-point Heliophysics missions and Moon2Mars. We conclude with how event-driven autonomous operations enhance science return, reduce health and safety risk to space assets, and lower the operational cost of flight operations.

Presentation | DAY 1 | AUGUST 31 14:30 | Session | Platform Technologies, Mission Design, and Autonomy | HELIOTECH

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Determining Regions of Alfvénic Activity on the TRACERS Twin Satellites Utilizing Fourier-based Spectral Analysis of MAGIC and EFI Data

On July 23, 2025, the NASA small explorers Tandem Reconnection and Cusp Electrodynamics Reconnaissance (TRACERS) mission launched twin satellites to resolve spatial and temporal cusp dynamics. Aboard each satellite, the MAGnetometers for Capability and Innovation (MAGIC) technology demonstration measures vector geomagnetic field at 590 km at 128 samples s-1 in the Cusp to resolve quasi-static and Alfvénic structures. We present a methodology of determining regions of Alfvénic activity utilizing DC geomagnetic field measurements and supporting DC electric field measurements from the Electric Fields Instrument (EFI) through Fourier transform analysis. The ratio of these components in amplitude spectral space collapses to the local Alfvén speed, as suggested by theoretical analysis from Knudsen (1990) and is dominated by noise in regions without Alfvénic activity collapsing to a non-physical value. We show this ratio collapses to the local Alfvén speed on TRACERS SV2 utilizing expected density measurements from the International Reference Ionosphere Model from two sets of perpendicular E B pairs. We also show wave activity during electron dispersions observed by the Analyzer for Cusp Electrons (ACE) instrument indicates Alfvénic activity during small-scale electron structures.

Poster | HELIOTECH

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Updates from GTOSat: Progress and Challenges for Smallsat Rideshares to GTO

GTOSat is a 6U CubeSat mission that aims to pave the way for highly reliable, capable smallsat constellations and missions beyond low Earth orbit (LEO). Designed for a low inclination geosynchronous transfer orbit (GTO), GTOSat will study Earth's dynamic radiation belts, acting as a follow-on to NASA's Van Allen Probes mission and demonstrating the utility of smallsats for both science and space weather monitoring. From this orbit, it will measure energy spectra and pitch angle distributions of ~hundreds keV - MeV electrons and ions, with the primary science goal of advancing our quantitative understanding of particle acceleration and loss in the outer radiation belt. Two high-heritage instruments are included, the Relativistic Electron Magnetic Spectrometer (REMS), measuring energetic electrons and ions and built by The Aerospace Corporation, and a boom-mounted fluxgate magnetometer, providing 3-axis knowledge of the ambient local magnetic field and built by NASA GSFC. The low perigee and high eccentricity of GTO, combined with a high radiation environment and a rapidly changing orbital debris and conjunction assessment landscape, brought many unique challenges for the project. Here we'll discuss spacecraft design, testing, and current status, as well as a discussion of the technical and programmatic issues affecting the launch of GTOSat. These considerations are important for future smallsat missions targeting similar orbits.

Presentation | DAY 1 | AUGUST 31 14:45 | Session: Platform Technologies, Mission Design, and Autonomy | Orbital Flight

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CubeSat Constellation Management using Differential Drag Maneuvers

The EZIE mission is using differential drag maneuvers (DDMs) as a low-cost mission-enabling technology. These DDMs allow EZIE to eliminate the need for propulsion systems for constellation management, reducing mission cost, complexity, and risk. The maneuvers only depend on controlling each spacecraft to different attitudes, which is a capability already required for science observations. This presentation provides an overview of the concept strategy, flight experience, challenges, and lessons learned from the mission. A key focus is on the largest challenge: mission planning under high uncertainty in atmospheric drag. The drag force is dependent on the solar flux, and predict models have significant uncertainty that can vary the drag forces by 50% or more. Pre-launch, these uncertainties required the development of constellation configuration strategies robust to a wide range of deployment conditions. Similarly, lower than expected solar flux led to in-flight changes to the mission operations and DDM strategy. Despite these challenges, EZIE continues to successfully use DDMs for constellation control.

Poster | Orbital Flight

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Overview of Plasma-based Processes for the Passivation of Broadband Aluminum Mirror Coatings

Efficient and uniform Aluminum-based broadband mirrors are essential components for FUV/UV/O/IR (λ=100-2500 nm) astronomy. An ongoing collaboration between the US Naval Research Laboratory and NASA Goddard Space Flight Center focuses on different strategies for the optimization of AlF3 layers grown on Al mirrors to enhance FUV/UV/O/IR optical performance. In previous work we demonstrated the feasibility of a new process based on electron beam-generated plasmas in SF6 or NF3 environments for effectively fluorinating the surface of Al mirrors, resulting in native oxide removal and the formation of an AlF3 passivation layer with tunable thickness. This process does not require elevated substrate temperatures or ultra-high vacuum conditions. More recently, we have demonstrated high-quality AlF3 films growth on Al mirrors through the highly conformal plasma-enhanced atomic layer deposition (PEALD) process, which can be preceded by Al surface preconditioning with XeF2 passivation of the bare Al mirror and/or with the use of electron beam-generated plasmas. Both processes have demonstrated high FUV/UV/O/IR reflectivity, high-quality AlF3 layers, low surface roughness, good coating uniformity of the fluoride layer, low coating-induced polarization aberration, and improved durability.

Presentation | DAY 2 | SEPTEMBER 1 13:30 | Session: Next Generation Solar Science Instrument and Missions | HELIOTECH

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Laboratory Investigation into Electric Field Sensor Instabilities: Results from Campaign 3

Electric fields play a crucial role in the understanding and interpretation of plasma processes such as energy transfer, wave effects, and plasma shocks, to name a few. The most common technique for measuring these electric fields utilize an Electric Field Double Probe Instrument (EFI). This type of instrument has been flown on many missions ranging in plasma environments from the ionosphere to the solar corona and others, but it continues to prove difficult to measure electric fields from current state-of-the-art voltage probes without perturbing the space plasma itself. There are many documented instances where spacecraft have observed electric fields where there is no geo-physical explanation for the data received from the instrument, implying that the instrument itself could be the source of these potentials. To understand the cause of these anomalies and to work toward replicating them in the lab and in space, we tested and developed procedures to measure the impedance between various components of a scaled down physical double probe model. With impedance we describe the electrical interaction of components of the voltage probe under plasma parameters that have been scaled down with the geometric size of the model EFI to match space plasma conditions that these anomalies have been observed in, via the Space Physics Simulation Chamber (SPSC) at the Naval Research Laboratory. We then demonstrate the process to scale back up the frequency dependence of the measured impedance from the laboratory to an equivalent range for the full size EFI in space plasma. Finally, we present and discuss the theoretical gain response of the spacecraft EFI based on the findings of the laboratory impedance measurements and compare this to simulations done in other recent work.

Presentation | DAY 5 | SEPTEMBER 4 11:15 | Session: Advanced Electromagnetic Field Sensors and Magnetometers | HELIOTECH

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FOXSI-5 Sounding Rocket: Direct-Focusing Hard X-Ray Technology and Real-Time Flare Triggering for Solar Observations

The Focusing Optics X-Ray Solar Imager (FOXSI-5) sounding rocket launched successfully from Poker Flat Research Range on May 14th, 2026, advancing direct-focusing hard X-ray technology for solar flare imaging spectroscopy. The 2-meter focal length payload integrates seven Wolter-I X-ray optic modules with complementary focal-plane detectors covering ~0.5 to 20 keV. Three 2-shell modules from NASA Marshall Space Flight Center provide 3 to 4 arcsec FWHM angular resolution; two 1-shell modules from Nagoya University deliver ~1 arcsec at low energies; two 10-shell heritage modules supply higher effective area. The detector suite includes four double-sided CdTe strip detectors operated at -20°C and 200 V bias (0.8 keV resolution at 14 keV), two Si CMOS soft X-ray cameras with 11 μm pixels (0.4 keV at 10 keV), and a Quadpix CdTe Timepix3 camera with 55 μm pixels and event-based readout. Supporting hardware includes 3D-printed titanium ghost-ray collimators and pixelated silicon attenuators that prevent CMOS saturation during bright flares. The mission also matured the Early Large Solar flare Alert (ELSA) framework deployed at Poker Flat for triggered launches inside the 5 to 7 minute observing window. ELSA combines statistically optimized GOES trigger criteria derived from over 10,000 historical flares with the X-TOFF random-forest duration forecaster, WAFFLE near-real-time SDO/AIA emission measure maps, OLAF sub-minute EVE/ESP proxies, and advance targeting via the Kusano κ-scheme applied to SDO/HMI SHARP data. FOXSI-5 captured three simultaneous GOES C-class flares, bridging the flux regime between the earlier FOXSI flights (quiet-Sun and microflares) and FOXSI-4 (M-class), with joint observations from Hinode, IRIS, DKIST, OVSA, STEREO, PADRE, BBSO, Solar Orbiter, PSP, and SDO. We present first flight images, instrument performance, and the triggered-launch architecture, informing future direct-focusing solar X-ray missions.

Presentation | DAY 2 | SEPTEMBER 1 11:15 | Session: Next Generation Solar Science Instrument and Missions | HELIOTECH

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Lyot Filter Demonstration Instrument for Space-Borne Solar Physics Observations

The Lyot Filter Demonstration Instrument (LFDI) is a NASA-funded effort to raise the technical readiness level (TRL), from 4 to 5, of an electro-optically tunable birefringent filter suitable for spaceborne solar observations. LFDI avoids problems that limited previous space-based filters by implementing temperature-compensated tuning of liquid crystal variable retarders (LCVRs) and fully bonding the optical stack to prevent bubbles or inclusions. The program top-level goal was to demonstrate temperature-compensated tuning within a 3-stage Lyot filter for space-based solar H-alpha observations centered at 656.46 nm (656.28 nm in air), with a free spectral range (FSR) > 0.3 nm and a full-width half maximum (FWHM) < 0.05 nm. A birefringent Lyot filter stage transmission spectrum depends strongly on temperature, through both the birefringence of calcite (~0.03 nm/C) and the retardance of a unique liquid crystal tuning element (~-0.4%/C), making temperature-compensated tuning essential for stable science observations. These goals are captured in the LFDI Requirements Traceability Matrix as Level 1 Requirements LFDI-1 through LFDI-9, defining center wavelength, FWHM, FSR, tuning resolution, survival and operational temperature ranges, tuning stability, field of view, and FSR scan time. We report that the team at HAO succeeded across all goals, proving a viable path to flight. Full results are presented here, along with a description of future work to advance the instrument to TRL 6 through vibration testing of a flight-ready design and preparation for a high-altitude balloon flight. This technology is also extensible to other wavelength targets, and internal spectral calibration work is ongoing. With the core technology now proven, we are actively seeking partners interested in integrating this tunable Lyot filter into their solar telescope, or any application requiring precise, tunable narrowband filtering.

Presentation	DAY 2	SEPTEMBER 1 14:15	Session	Next Generation Solar Science Instrument and Missions	HELIOTECH

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CubeSat Imaging X-ray Solar Spectrometer (CubIXSS): A New H-FORT Mission to Probe Heating of Coronal Plasma

The CubeSat Imaging X-ray Solar Spectrometer (CubIXSS) is an upcoming 16U CubeSat mission to study the origins of hot plasma in solar flares and active regions. The observatory is in the final stages of environmental testing and instrument calibrations, prior to launch on USSF-178 scheduled for December 2026. Its 1-year prime mission is well timed with complementary missions such as SunCET, PADRE, and PUNCH and with perihelia of Parker Solar Probe and Solar Orbiter. We present the science background for CubIXSS, its technical design and expected performance of the instruments, and the final preparations in anticipation of launch. CubIXSS achieves its science objectives through sensitive, precise measurements of abundances of key trace ion species, whose X-ray spectral signatures provide a unique diagnostic of the chromospheric or coronal origins of heated plasma across a broad temperature range from ~1 to >30 MK and provide insight into links between plasma heating, particle acceleration, and magnetic reconnection. CubIXSS comprises two co-optimized and cross-calibrated instruments that fill a critical observational gap: * MOXSI, a novel diffractive spectral imager using a pinhole camera and X-ray transmission diffraction grating for spectroscopy of flares and active regions over an unprecedented spectral range of 1 to >70 Å; and * SASS, a suite of multiple spatially-integrated off-the-shelf spectrometers for high-cadence, high-sensitivity X-ray spectra of lines and continuum from 0.5 to >30 keV. The combo of CubIXSS and SunCET, an H-FORT CubeSat using a novel wide-field EUV imager, are a powerful probe into impulsive energy release and transport during solar eruptions, and the connections between coronal heating and solar wind formation and acceleration. CubIXSS is a 16U CubeSat funded under the NASA H-FORT program, and it serves as a pathfinder for the next generation of Explorer-class missions with improved capabilities for soft X-ray imaging spectroscopy.

Presentation	DAY 2	SEPTEMBER 1 9:45	Session	Next Generation Solar Science Instrument and Missions	Orbital Flight

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Low SWaP Sweeping Langmuir Probe for Orbital And Sub-Orbital Platforms Mitigating Spacecraft Charging

Electron temperature (Te) is a fundamental plasma parameter that is critically important for understanding a variety of plasma phenomena. For thermal plasmas this can be measured using techniques such as sweeping a bias voltage on a current conducting sensor, known as a Sweeping Langmuir Probe (SLP). Operating a SLP on a spacecraft where the surface area ratio of spacecraft-to-probe is small results not only in erroneous Te measurement, but it also dynamically swings the spacecraft floating potential (i.e. spacecraft charging) with every sweep and inadvertently affects other electrostatic instruments on the spacecraft. With the continued miniaturization of spacecrafts and CubeSats, and the growing need to be able to measure from a constellation of such small spacecraft, it is imperative to build an instrument that can circumvent the dynamic charging made by an SLP and still accomplish accurate Te measurements. The Space and Atmospheric Instrumentation Laboratory (SAIL) at Embry-Riddle Aeronautical University has developed a small form factor miniature Double Langmuir Probe (mDLP) that enables high sample rate observations of plasma density and electron temperature from orbital and suborbital platforms. The instrument is a dual-sensor Langmuir probe that can be swept with opposing bias voltages on each sensor to give electron temperature without swinging the payload floating potential. This is accomplished during a voltage sweep by biasing the electrodes with respect to each other, instead of a spacecraft ground, and allowing the center of the bias voltage sweep on the electrodes to float as needed to achieve current balance. The probe can be fitted with planar or cylindrical probes, of similar or asymmetric surface areas to increase the sampled regions of the I-V curve of the desired measurement. This work will present some bench and plasma chamber results of the novel instrument, with a focus on a Cubesat based planar sensor design.

Poster | HELIOTECH

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Plasma and Radiation Combined IN-situ Instrument (PRCINI)

The Plasma and Radiation Combined IN-situ Instrument (PRCINI) sensor integrates a modified version of the Parker Solar Probe/Energetic Particle Instrument (EPI)-Lo sensor (McComas et al., SSR, 2016) with a custom-designed electrostatic analyzer (ESA) to create a novel combined suprathermal and energetic ion instrument that measures energy, angular distribution, and compositional distributions from ~1 keV to ^{3}15 MeV, as well as ion charge-state composition from ~15 (protons) to ~220 keV/q, over co-planar fields-of-view; energetic electron measurements will also be made from 30 keV to ^{3}1 MeV. PRCINI incorporates this new "pumpkin" ESA into the self-contained electrostatic optics of EPI-Lo, providing the following benefits: 1) use of a shared MCP and energy detectors, which simplifies the number of gains and thresholds which must be considered during calibration and flight; 2) reduction and simplification in the number of electrical and mechanical interfaces; and 3) overall reduction on spacecraft resources. Strategically, PRCINI closes an energy gap from ~40 to ~130 keV for heavy ions (e.g., O+) that has plagued independent plasma and energetic particle instruments on recent missions such as Van Allen Probes (Mauk et al., 2013) and Magnetospheric Multiscale (MMS; Burch et al., 2016). This is especially important for magnetospheric investigations of transport in the plasma sheet, where the determination of ionspecies-dependent processes requires measurements of O+ that fall right aforementioned energy gap. PRCINI is currently funded by the NASA Heliophysics Technology and Instrument Development for Science (HTIDS) program.

Presentation | DAY 5 | SEPTEMBER 4 14:45 | Session | Solar Coronal Imaging and Heliospheric Science | HELIOTECH

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Plasma Observatory for Lunar Exploration (POLE)

As astronauts and rovers traverse lunar regolith, contact charging can generate static electricity, creating hazards from electrostatic discharge and dust adhesion to EVA suits, instruments, and surface systems. Apollo astronauts operated near the lunar equator, where a relatively dense plasma sheath likely helped dissipate accumulated charge. Artemis missions will target the lunar poles, where the near-surface plasma environment is expected to be more variable and less conductive, especially in shadowed terrain and across illumination boundaries. Key questions remain about how charge accumulates and dissipates on human systems, and how these processes depend on terrain, illumination, and plasma input from the solar wind and Earth's magnetotail. The Plasma Observatory for Lunar Exploration (POLE) is a payload intended for a future Commercial Lunar Payload Services (CLPS) lander to investigate the near-surface plasma environment at the Moon's south pole. POLE combines surface and space-weather measurements to characterize plasma from the regolith to the incident environment above the surface. The Surface Science Package includes a Photoelectron Spectrometer, Sweeping Langmuir Probes, and a tribocharging sensor to measure electron emission and inflow, thermal plasma properties, lander-plasma potential, near-surface electric fields, and charging from lander interactions. The Space Weather Package uses electron and ion electrostatic analyzers to measure precipitating plasma from the solar wind and magnetotail. Together, these measurements will constrain lunar surface potentials, assess charging risks to exploration systems, and provide new insight into sheath formation, electron transport, wake physics, and electrostatic dust mobilization at the lunar poles.

Presentation | DAY 1 | AUGUST 31 11:00 | Session | Heliophysics on the Moon and Mars | HELIOTECH

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Uninterrupted 24x7 Real-Time Monitoring of Thermospheric Weather Using Stratospheric Balloons

NASA's Heliophysics program seeks to understand space weather impacts on Earth's upper atmosphere and ionosphere, both for basic research, and also for safeguarding space flight operations. Here we describe how a fleet of "stratospheric sentinel" instruments could deliver to the web an uninterrupted 24x7 low-latency stream of wind and temperature measurements describing current weather conditions in Earth's thermosphere. To achieve this, a "smart" Fabry-Perot spectrometer would perform remote sensing observations and onboard analysis from a stratospheric super-pressure balloon platform, drifting at around 35 km altitude above the Southern Ocean and Antarctica. From this vantage point, the instrument would measure Doppler spectra of the 630 nm thermospheric optical emission that originates from approximately 240 km altitude. 24x7 observations of this faint optical signal are possible from the stratosphere because, from that altitude, the emission is always seen against an uninterrupted dark-sky background, regardless of solar illumination or tropospheric cloud cover. These optical observations are not possible from the ground, or from a spacecraft in either low Earth orbit (LEO) or in geostationary orbit. While non-optical wind measurements are possible from orbit with 24x7 coverage, it is difficult for such observations to resolve temporal responses to space weather events, due to the spatial/temporal ambiguity introduced by measurements from a rapidly-moving spacecraft. Individual balloon flights would last for around three months or more, with a Starlink satellite connection streaming high-level data products to the web in real-time. The typical sampling cadence would be five minutes or less, and geophysical data products would be distributed with less than 20 minutes latency. The ultimate motivation would be to construct a fleet of 3-4 such instruments to conduct overlapping missions that could sustain continuous thermospheric weather observations indefinitely. Development of this Stratospheric Sentinel fleet is motivated by two mission goals: MG-1: Quantify the time evolution of solar flare impacts on the wind and temperature fields in Earth's thermosphere. MG-1 responds to the 2024 Heliophysics Decadal Survey's ITM Priority Science Goals One [Objective 1.1, p430; Sec D.3.1] and Two [pp434-442; Sec D.3.2]. In particular, Objective 1.1 of Science Goal One specifically calls out the need to study the thermospheric response to extreme impulsive forcing during solar flares. MG-2: Support spacecraft launches and operations at LEO altitudes, by streaming to the web guaranteed uninterrupted real-time measurements of prevailing thermospheric weather. It is anticipated that this data product will be of particular relevance for agencies executing complex multi-spacecraft operations at LEO altitudes, such the weeks-to-months-long period of on-orbit refueling missions that will be required to support the lander vehicles for NASA's Artemis (lunar) and Mars deep-space flight programs.

Poster | HELIOTECH

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CAMEO: Imaging Auroral Conductances and Energy Deposition From a Cubesat

The Cubesat for Auroral Magnetosphere of Earth Observations (CAMEO) is an active H-FOS mission concept study that consists of a multi-wavelength, far-ultraviolet Earth auroral imager carried by a high-altitude spacecraft platform. CAMEO measures key parameters required in space weather forecasting, not provided by any current or known future mission, and would improve our understanding of how solar and geomagnetic activity causes disruptions in communications, precision navigation systems, and induces currents on the Earth's surface that impact power distribution systems. The mission is implemented through a rideshare spacecraft that is initially inserted into a polar Sun-synchronous orbit, where on-board solar-electric propulsion gradually raises the apoapse altitude to 3 Earth radii over a period of 16 months. The payload consists of three co-aligned imagers, differing only in the spectrally-selective reflective coatings that target atomic oxygen 135.6 nm, short wavelength N2 Lyman-Birge-Hopfield (LBH) bands (~140-150 nm LBHS), and long wavelength N2 LBH (160-170 nm LBHL). Data products would include high-cadence (30 sec) full-oval images acquired simultaneously by the three channels at <50 km spatial resolution for ~2.5 hours every ~6.5 hour orbit. Mature retrieval algorithms that are customized to the instrument design enable measurement of solar and geomagnetic inputs (QEUV - EUV solar flux 1-45nm, Q - precipitating particle energy flux, E0 - particle average energy) along with the corresponding Ionosphere-Thermosphere (IT) response in composition (ΣO/N2 - oxygen to nitrogen column density ratio), plasma density (HmE - height of maximum E-region electron density, NmE - maximum electron density), conductances (Hall & Pedersen), and the auroral boundary. We will describe how Heliophysics Science Goals are addressed through specific science questions, provide an overview of the CAMEO mission implementation, and consider possible funding opportunities.

Presentation | DAY 4 | SEPTEMBER 3 10:45 | Session: ITM Technologies and Missions | Orbital Flight

Presenting Author: Dankanich, John | Affiliation: NASA Marshall Space Flight Center | Email: john.dankanich@nasa.gov
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GeoStorm Beacon Design Reference Mission and Technology Drivers

Geomagnetic storms can cause disruptions to satellites, power grids, and communication networks. Therefore, a warning signal allowing for key systems to be safely shut down prior to their occurrence is desired. Holding a spacecraft along the Earth-sun vector continuously for a prolonged period requires constant propulsion. Electric propulsion can be leveraged to accomplish this for shorter periods of time but becomes limited by fuel capacity on the larger time scales. A solar sail, offering non-propellant-limited propulsion, is uniquely suited to accomplish this type of mission. NASA and NOAA thus desired to commission a conceptual design of a spacecraft capable of providing an average warning time to Earth of 20 minutes in the event of an ejecta on an Earth-bound trajectory at a maximum rate of 2600 km/s. This challenging mission requires new technologies at various technology readiness levels and risk to maturation.

Presentation | DAY 1 | AUGUST 31 16:15 | Session: Platform Technologies, Mission Design, and Autonomy | Orbital Flight

Presenting Author: Daw, Adrian | Affiliation: NASA Goddard Space Flight Center (NASA GSFC) | Email: adrian.daw@nasa.gov

Technology Infusions into Multi-slit Solar Explorer (MUSE): EUV Gratings, Coatings, and Photon Sieves

The Multi-Slit Solar Explorer (MUSE) comprises two instruments, a multi-slit extreme ultraviolet (EUV) spectrograph and a context imager, that will simultaneously obtain EUV spectra (along 35 slits) and images with the highest resolution in space and time ever achieved for the transition region and corona. The MUSE spectrograph (SG) is a truly innovative design that is enabled by number of prior EUV technology innovations supported by the Heliophysics Technology and Instrument Development for Science (HTIDS) and Low Cost Access to Space (LCAS) programs at NASA. The Extreme Ultraviolet Normal Incidence Spectrograph (EUNIS) sounding rocket obtained the first imaging spectroscopy of the soft X-ray spectral region of the Sun that includes the critical high-temperature channel of the MUSE SG to observe Fe XIX, by working with industry partners to develop diffraction gratings and optical coatings for this wavelength region. The team and capabilities developed for the EUNIS grating provided the gratings for MUSE and the Solar EruptioN Integral Field Spectrograph (SNIFS) sounding rocket. The HTIDS program supported additional grating development, resulting in capabilities with another industry partner that is providing the gratings for the EUV Snapshot Imaging Spectrograph (ESIS-II) sounding rocket. Another HTIDS award supported photon sieve development at NASA Goddard Space Flight Center to achieve unprecedented diffraction-limited imaging in the EUV. This technology is being used to calibrate the MUSE SG with techniques developed for EUNIS to provide higher fidelity calibration than previously possible. The technology innovations to be discussed in this presentation were supported by NASA awards HTIDS13_2-0074, HTIDS-16_2-0064, and HTIDS17-0046.

Presentation	DAY 2	SEPTEMBER 1 9:15	Session	Next Generation Solar Science Instrument and Missions	HELIOTECH

Presenting Author: Daw, Adrian | Affiliation: NASA Goddard Space Flight Center (NASA GSFC) | Email: adrian.daw@nasa.gov

Formation-Flying Photon-Sieve Telescopes: VISORS and Beyond

VISORS comprises two CubeSats in low Earth orbit that together will form a photon sieve telescope with unprecedented resolution in the extreme ultraviolet (EUV). The sieve on the optics spacecraft forms a solar image of He II 303.8 Å with diffraction limited resolution of 0.090" that is recorded by the detector spacecraft 40 m away with 0.036" pixels at a cadence as fast as 7 frames per second. Increasing the separation by 6 cm allows Si XI 303.3 Å to be imaged as well. These will be the highest resolution EUV images of the Sunever obtained, in both space and time, and will reveal individual energy-release sites in the solar corona to understand what processes energize the solar atmosphere. The mission will achieve formation for 10 seconds per orbit, demonstrating technology that is scalable up to larger missions with even higher resolution in the future. The mission is funded by the National Science Foundation, with the science instrument supported under a Space Act Agreement between NASA GSFC and the University of Illinois. The enabling photon sieve development was funded by NASA award HTIDS17-0046.

Presentation	DAY 2	SEPTEMBER 1 9:30	Session	Next Generation Solar Science Instrument and Missions	Orbital Flight

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Neutron Dose of Unknown Radiation Environments (nDURE)

The Neutron Dose of Unknown Radiation Environments (nDURE) instrument is an advanced neutron spectrometer being developed at NASA Goddard Space Flight Center to address critical gaps in radiation monitoring for lunar surface operations and future Mars missions. Applying ICRP 116 fluence-to-effective dose conversion factors, approximately 60% of neutron effective dose arises from neutrons above 10 MeV, with roughly 40% from neutrons above 100 MeV – yet no lunar surface or orbital instrument to date has directly measured the range between 20-100 MeV. Current state-of-the-art instruments, including LEND/LRO and the Lunar Prospector neutron spectrometer, cover approximately 0.4 eV–15 MeV. nDURE extends this range to 100 MeV, directly targeting the energy domain where both measurement uncertainty and crew cancer risk are greatest, including the secondary high-energy neutron component generated when galactic cosmic rays fragment in regolith and habitat shielding. The modular instrument design enables customization for diverse mission platforms including spacecraft, landers, and aircraft, with configurable energy range tuning to meet specific mission requirements. nDURE directly addresses NASA's Moon to Mars and Ignition/Moon Base Initiative and is being developed for deployment as a low SwAP payload on a Commercial Lunar Payload Services (CLPS) lander. This presentation will provide an overview of the instrument concept, measurement capabilities, technical design approach, and current development progress toward lunar flight readiness. nDURE data will close the high-energy validation gap in transport models such as MCNP6, PHITS, and Geant4, supporting improved neutron environment models critical for crew health risk estimation, shielding design, and mission planning for Artemis and future deep space exploration missions.

Presentation	DAY 1	AUGUST 31 11:45	Session	Heliophysics on the Moon and Mars	HELIOTECH

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Remote Sensing of Solar Wind and Space Weather with PUNCH

The Polarimeter to Unify the Corona and Heliosphere (PUNCH) is a Small Explorer mission that images the outer solar corona and inner heliosphere as a single system. Simple dioptric imagers on four spacecraft work together as a single "virtual instrument" with a 90 degree field of view centered on the Sun. PUNCH demonstrates a new mission paradigm, with constellations of low-cost smallsats performing tasks that would once have been devoted to larger platforms in deep space. PUNCH science requires sophisticated post-processing of images from the separate cameras, to merge them into seamless mosaic images with very tight requirements on image co-alignment, distortion, uniformity, and photometry; and the PUNCH SOC is believed to be the most sophisticated data pipeline yet produced for a heliophysics mission. I will describe the new technologies and techniques embodied in the PUNCH mission hardware and post-processing data pipeline, and also discuss implications of the PUNCH data stream for the science of heliophysics and technology of space weather forecasting.

Presentation: DAY 2 | SEPTEMBER 12:00 | Session: Solar Coronal Imaging and Heliospheric Science | HELIOTECH

Presenting Author: Dorfman, Seth | Affiliation: University of California, Los Angeles (UCLA) | Email: sethd@spacescience.org
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Measurement of the Alfvén Wave Parametric Decay Instability Growth Rate in the Laboratory

Alfvén waves, a fundamental mode of magnetized plasmas, are ubiquitous in space and laboratory plasmas. The nonlinear behavior of these modes is thought to play a key role in important problems in space plasma, such as the heating of the solar corona and solar wind turbulence. In particular, theoretical predictions show that these Alfvén waves may be unstable to various parametric instabilities, but space observations of these processes are limited. We demonstrate the first measurement of the Alfvén wave parametric decay instability (PDI) growth rate [1]. Experiments are conducted on the Large Plasma Device at UCLA in which a high amplitude $\delta B/B0{\sim}0.7\%$ pump Alfvén wave is launched from one end of the device and a smaller seed Alfvén wave is launched from the other side. When the frequency of the seed wave is chosen to match the backward wave expected from PDI, damping of the seed wave is reduced. We compare this reduction in damping to the theoretically expected PDI growth rate while accounting for acoustic mode damping. Results show agreement between measurements, theoretical predictions, and related simulations. This provides critical validation for PDI theories and simulations that could help interpret future space observations. [1] S. Dorfman F. Li, X. Fu, S. Vincena, P. Pribyl, and T. A. Carter, "Measurement of the Alfvén Wave Parametric Decay Instability Growth Rate," Phys. Rev. Lett. 136, 135201 (2026). *Supported by NASA grant 80NSSC23K0695 and DOE Grant DE-SC0023893. This work was performed at the UCLA Basic Plasma Science Facility supported by DOE and NSF.

Presentation: DAY 5 | SEPTEMBER 4 13:00 | Session: Advanced Electromagnetic Field Sensors and Magnetometers | HELIOTECH

Presenting Author: Dow, Matthew | Affiliation: University of Alabama | Email: mcdow1@crimson.ua.edu
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Constellation and Transfer Trajectory Design for the SWIFT Space Weather Mission

The Space Weather Investigation Frontier (SWIFT) mission concept seeks to improve space-weather forecasting through a constellation of spacecraft operating near the Sun-Earth L1 point. The baseline architecture consists of three chemically propelled Node spacecraft and one solar sail-propelled Hub spacecraft positioned sunward of the Nodes in a sub-L1 science orbit. To maximize the scientific value of the observations, the constellation must maintain a near-regular tetrahedral geometry while satisfying operational constraints on spacecraft separation and communications. This work develops science-orbit and transfer-trajectory solutions for the SWIFT mission using Circular Restricted Three-Body Problem (CR3BP) dynamics and a nonideal solar sail model. The resulting trajectory optimization problems are solved using the Astrodynamics Software and Science Enabling Toolkit (ASSET). A family of pseudo-periodic Lissajous orbits is developed to satisfy recently introduced mission requirements, including a maximum Node separation constraint of 50 Earth-radii and a solar exclusion zone. Relative to previous halo-orbit-based architectures, the new science-orbit solutions increase the average tetrahedral quality factor from approximately 0.61 to 0.84 while maintaining valid science operations for more than 2.5 years. Transfer trajectories are subsequently designed for both the Hub and Node spacecraft. Hub transfers achieve insertion into the target sub-L1 science orbit within one year while maintaining solar sail incidence angles below 20 deg. Optimal two-impulse Node transfers require less than 400 m/s of total ΔV per spacecraft. These results demonstrate the feasibility of the SWIFT mission architecture under updated mission constraints and highlight the utility of solar sail propulsion for sustained sub-L1 operations and enhanced space-weather monitoring.

Presentation: DAY 1 | AUGUST 31 14:00 | Session: Platform Technologies, Mission Design, and Autonomy | Orbital Flight

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AtmOCube: The Atmospheric Oxygen Cubesat Mission for Mesosphere Lower Thermosphere Wave Dynamics

Atmospheric Oxygen CubeSat (AtmOCube) mission will use a single 16U class spacecraft carrying two compact, monolithic Spatial Heterodyne Interferometers (SHIs) configured as limb sounders to determine the temperature changes in 3-D at altitudes of 80-120 km, the observational "gap" in the upper mesosphere-lower thermosphere. From the 3D temperature fields, the AtmOCube mission derives key GW parameters—including full 3D wave vectors, propagation direction, and momentum flux—without requiring coincident wind measurements. The GW momentum fluxes, their directions, and vertical gradients control how wave energy and momentum are deposited into the lower thermosphere and subsequently modulate thermospheric density, composition, and ionospheric structure. The mission aims to improve understand of how upward-propagating atmospheric gravity waves (GWs) contribute to short-term variability in thermosphere–ionosphere (TI). Global, seasonally resolved constraints on mesoscale GWs in the MLT range are needed. By delivering a global, seasonally resolved climatology of directional mesoscale GW momentum flux and its vertical gradient in the MLT "gap", AtmOCube provides an operationally relevant constraint to improve whole-atmosphere/TI models and forecasts of drag and GW-driven ionospheric disturbances that affect space assets. AtmOCube is funded through NASA's ROSES Heliophysics Flight Opportunities for Research and Technology (H-FORT) program and is implemented by LASP in partnership with FZ Jülich, which provides the SHI payload, calibration, and end-to-end retrieval/data-processing heritage. As a focused demonstration mission, it also de-risks a scalable measurement approach for follow-on satellite constellations that can deliver the cadence needed for operational space-weather services.

Presentation | DAY 4 | SEPTEMBER 3 10:30 | Session ITM Technologies and Missions | HELIOTECH

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Calibration Challenges in Vector-Scalar Atomic Magnetometers: Implications for Multi-Spacecraft Missions

Inter-spacecraft calibration remains a central challenge in heliophysics and is becoming increasingly important as missions move toward distributed constellations, where consistent magnetic field measurements across platforms are required. Calibration differences among spacecraft can introduce systematic errors that are difficult to distinguish from true field variations, particularly in multi-point observations. Fluxgate magnetometers—the most widely used vector sensors in space—offer high precision but require extensive ground and in-flight calibration to correct thermal and temporal drifts. This motivates the development of technologies that reduce calibration effort while maintaining accuracy. Vector–scalar atomic magnetometers enable vector reconstruction from the intrinsic atomic response to the magnetic field, offering the potential for calibration independent of spacecraft maneuvers and external references. Although calibration remains necessary, these systems benefit from an intrinsic scalar reference that supports stable vector reconstruction. In this work, we investigate the robustness of calibration in a vector–scalar atomic magnetometer under realistic conditions relevant to the Compact Spaceborne Magnetic Observatory CubeSat mission developed under the MagQuest challenge. The mission aims to provide accurate magnetic field measurements for the World Magnetic Model used, for example, in navigation. The instrument combines two scalar rubidium magnetometers with a triaxial reference coil system to extract vector information using three low-frequency sinusoidal modulations (13, 17, and 23 Hz). Expected accuracy is <1 nT (scalar) and <5 nT (vector), with vector errors including spacecraft attitude and other platform effects. Using simulations and representative datasets, we show how directional dependencies and finite sensor bandwidth affect calibration accuracy and demonstrate mitigation strategies relevant for future multi-spacecraft missions.

Poster | HELIOTECH

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Integration and Test of MEGA-H: A Multi-Detector Imaging System for Heliophysics Applications

MEGA-H is a HESTO-sponsored instrument-development program to develop a large-format, multi-detector, imaging system that is optimized for use as a focal plane subsystem for a wide-field coronagraph. The optical path employs pickoff mirrors that partition the image field onto three individual detectors. The detectors can be located conveniently apart from each other while preserving the whole FOV and producing a seamless recombined image without any gaps in field coverage. This architecture enables a scientist to choose the best detector for the task – a solution that may have good detection properties but insufficient number of pixels – and combine multiple detectors to achieve the desired pixel count. The MEGA-H camera system is built around COTS telescope optics that provide both a wide FOV (10 degrees on diagonal) and high instantaneous field of view (iFOV) (<1.5") to observe the Sun's corona. We describe progress with integration, alignment, and initial field testing of the instrument. Procedures were developed to align the pickoff mirrors and the three detectors using an off-axis parabola collimator and a theodolite. The MEGA-H instrument includes a focus mechanism, which was used to find the optimal positioning for each of the detectors such that all three detectors appear to lie on a single focal plane. After a preliminary round of alignments in the lab we moved the instrument to a rooftop location for an initial look at distant mountains. A second round of alignments and rooftop imaging was needed to bring all elements into final position. We report on a mountaintop field test to view sky under similar conditions to solar eclipse in totality.

Presentation | DAY 5 | SEPTEMBER 4 15:15 | Session Solar Coronal Imaging and Heliospheric Science | HELIOTECH

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Quantum Atomic Scalar Magnetometer for LEO Heliophysics Applications

The ASM-1 is an extraordinarily compact, accurate, and robust quantum magnetometer designed to measure total magnetic field in Low Earth Orbit (LEO) environments. There is a pressing need for low Size, Weight, Power, and Cost (SWaP-C) magnetometers for heliophysics applications, particularly for in-situ magnetic field perturbation data to track space weather. The ASM-1 can also be used as a high accuracy reference for fluxgate magnetometers, enabling precise and accurate measurements for many LEO heliophysics applications, including, but not limited to, field-aligned currents (FACs) and solar wind-magnetosphere-ionosphere coupling. The ASM-1 has flown on a CubeSat as part of the MagQuest program. Through the MagQuest project, the ASM-1 passed all space qualifying tests, including shock, vibration, thermal vacuum, and radiation. This low SWaP-C device is built with low outgassing materials and components with low power needs, only needing 1 W of power. This increases its design life and allows it to be integrated into small payloads with other instruments. The ASM-1 has a B field range of +/- 100,000 nT with absolute accuracy of < 2 nT, precision of 1 pT, and sensitivity of 20 pT/√Hz. The sensor physics package volume is 18 x 18 x 25 mm, and the total instrument mass is 17 g. The low cost and size of the instrument enables it to be used on virtually all space missions that require magnetic field measurements. The ASM-1 uses the Zeeman resonance of cesium atoms to make magnetic field measurements and has stability indistinguishable from an Overhauser magnetometer. These specifications make the ASM-1 optimal for measuring total magnetic fields below the magnetosphere.

Presentation DAY 5 SEPTEMBER 4 10:30 | Session: Advanced Electromagnetic Field Sensors and Magnetometers | HELIOTECH

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LOBSTR: A Small Mission Ready for Big Radiation Science

LOBSTR (LabOratory for the Behavior of the SloT Region) is a mission concept that underwent a mission concept study and reached closure, which focuses on studying high-energy particles in the radiation belts. LOBSTR utilizes two identically instrumented SmallSats in precise orbits, separated by at least 30 degrees longitudinally, to study particle evolution and how it varies with magnetic local time. LOBSTR builds on Van Allen Probe heritage, but expands our capabilities by its synchronized orbits, so that the same electron and proton populations can be measured in the same drift period. This allows for LOBSTR to capture the dynamics of proton trapping and loss in the inner belt, as well as wave-particle interactions changing the electron distributions near the so-called "impenetrable barrier". This mission concept fits within a SmallSat size, with an anticipated SmallSat budget, while utilizing radiation mitigating strategies to survive a challenging GTO-like orbit.

Presentation DAY 4 SEPTEMBER 3 16:45 | Session: Magnetospheric Dynamics & Geospace Missions and Technologies | Orbital Flight

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SelenITA: A Multi-Platform Mission to Investigate the South Polar Lunar Surface Environment

The SelenITA mission is a multi-point mission to characterize the variability in plasma, dust, electric, and magnetic fields in the lunar polar surface environment and the associated hazards to landed systems. This is accomplished by two elements, landed and orbital science packages. The surface suite will obtain spatially distributed measurements of the south polar electrodynamic plasma environment at the lunar surface on a CLPS lander and rover. The orbiter will provide complementary plasma, magnetic field, radiation and dust observations at varying low lunar altitudes centered above the south pole. Each mission element will further science both individually and collectively. The surface suite is a dual platform science investigation enabled by a stationary lander and a mobile platform conceived to investigate the causal mechanisms that drive the electric, magnetic, and plasma properties of the lunar south polar plasma environment. The scientific objectives, derived from community priorities, are to determine how solar wind, terrestrial magnetotail plasma, solar activity associated with coronal mass ejections, crustal magnetic fields, strong contrasts in illumination, and local topography act together to shape the near-lunar surface electric and magnetic fields, the distribution of charged particles, and the motion of dust. We plan to land in the vicinity of at least one small PSR with enhanced crustal magnetization. This geometry permits repeated comparisons between conditions within the PSRs and those in nearby illuminated terrain, while assessing local electrostatic changes at different solar zenith angles and during transitions in plasma forcing across various boundaries in the solar wind/magnetotail space environment. This enables the combined roles of magnetic structure, solar illumination, and plasma variability to be studied together, especially, with their role in volatile transport or trapping.

Presentation DAY 1 AUGUST 31 12:15 | Session: Heliophysics on the Moon and Mars | Orbital Flight

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Chromospheric Magnetism Explorer (CMEx)

CMEx is a NASA Heliophysics SMEX mission concept in Extended Phase A. The mission uses ultraviolet spectropolarimetry to diagnose magnetism from the solar photosphere to the transition region, exploring how the magnetic field evolves from the β >> 1 photosphere to the β << 1 corona to form twisted non-potential flux ropes in the corona. This key β transition happens in the chromosphere where only UV spectropolarimetry can give us access to the highly complex dynamics where plasma properties change rapidly. Recent advances in the understanding of the polarization of UV chromospheric lines, which are not observable from the ground, have primed a space-based mission like CMEx for success. CMEx observes many near-UV spectral lines, including the well-known Mg II h and k lines as well as a series of Fe II lines, with full-Stokes polarimetry to provide quantitative diagnostics of plasma parameters densely sampling the 9 pressure scale heights in the chromopshere, thus enabling studies of how the magnetic field in and around active regions gets reconfigured leading up to the eruption process, how flares lead to persistent changes in photospheric and chromospheric magnetic fields, and what the large-scale magnetic structure is of prominences in their stable phase, and how it changes in the transition from equilibrium to eruption.

Presentation DAY 2 SEPTEMBER 1 9:00 | Session Next Generation Solar Science Instrument and Missions | HELIOTECH

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Narrow angle Energetic Neutral Atom (NENA) Camera

Decades of in-situ observations of the geospace environment have revealed the "mesoscale" nature of the energy and mass flow in the magnetosphere. "Mesoscale" generally refers to larger than gyroradius scales, but smaller than global processes. Advanced simulations of the geospace have underscored the impact that mesoscale particle transport and energization from the outer to the inner magnetosphere have on building up the ring current, one of the major energy sinks during geomagnetic storms. Nonetheless, assessing that impact observationally has been very challenging in part because of the lack of key observational techniques enabling measurements of the relevant storm-time dynamics across the required range of scales. One way to overcome this observational limitation of mesoscale processes is through energetic neutral atom (ENA) imaging. ENA imaging provides global context that resolves the spatiotemporal ambiguity that has plagued the in-situ measurements to-date. Additionally, the sophistication of inversion techniques allows ENA images to retrieve the ion conditions along the path of emission, providing quantitative assessment of magnetospheric processes. We present a new generation Narrow angle Energetic Neutral Atom camera (NENA) with unprecedented angular resolution and sensitivity. From a vantage point along a high inclination (~70°), ~8 RE circular orbit, two identical, orthogonally mounted NENA-like cameras can capture mesoscale injections as they travel from the outer to inner magnetosphere. Each NENA camera, with a 50x50 deg FOV, covering an energy range of 3-300 keV H, and 20-300 keV O, at a ~3.5x3.5 deg resolution, has a large aperture to achieve 10× higher sensitivity than any previously-flown 2D ENA camera, to achieve <1 min temporal resolution. The NENA camera is targeted towards the implementation of the Links mission concept, which was highlighted as a top priority mission, in the 2024 Solar and Space Physics Decadal Survey.

Presentation DAY 5 SEPTEMBER 4 10:00 | Session Magnetospheric Dynamics & Geospace Missions and Technologies | HELIOTECH

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A High-Rate Spectrometer for Solar Hard X-rays (and More?)

High-energy X-ray measurement is one of the few methods available for probing particle acceleration and the hottest plasmas in solar flares. However, measurement of these "hard" X-rays is made difficult by dynamic range in space, time, and energy. In particular, the spectra fall steeply with energy, so that the highest energy photons – which are potentially the most scientifically lucrative – require high sensitivity and can be difficult to measure in the presence of stronger flux at low energies that dominates instruments' livetime. Often, solar X-ray spectrometers have resorted to attenuators, moveable or not, to block the brightest fluxes, but this inherently limits the instrument sensitivity and is difficult to tune optimally. Other commonly employed tactics are to identify and discard "piled-up" events, i.e. events in which more than one photon arrives during a measurement period, or to simply allow the photons to pile up and correct for this in post-analysis. The former results in wasted photons and the latter leads to time-consuming and difficult analysis. The advent of high-speed ADCs and fast digital logic devices provides an opportunity for a different solution: FPGA-based pulse shape discrimination that identifies closely spaced photon arrivals and retains information about the events. Our development pairs this digital processing with a scintillator + SiPM based X-ray sensor and custom analog electronics. This presentation will describe the scientific drivers of our development and outline the plan for our design—a flexible, low-SWaP instrument that can be deployed for flare science or space weather nowcasting missions. While our development is optimized for solar hard X-ray measurement, instruments could be adapted for measurement of X-rays from other astrophysical sources, or for other particles besides photons.

Presentation DAY 2 SEPTEMBER 1 11:45 | Session Next Generation Solar Science Instrument and Missions | HELIOTECH

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Overview of the STORIE Mission for Ring Current ENA Imaging

The Storm Time O+ Ring Current Imaging Evolution (STORIE) mission recently launched to the International Space Station (ISS) on May 15, 2026 and will provide continuous space weather imaging using remote sensing of the ring current with Energetic Neutral Atoms (ENAs). The STORIE payload is a hosted on a zenith looking platform on the Columbus Module of the ISS where it will image the ring current ENA from the inside out. The mission addresses compelling issues of ring current science including issues of buildup and decay, as well as the role of heavy ions. These heavy ions originate as cold plasma in the ionosphere before being accelerated to form the higher energy population in the magnetosphere. This presentation will overview the mission, including current science status. We will discuss the science objectives, and elaborate on the advantages of ENA imaging from the unique vantage point of the ISS. We will then present the result of numerical models illustrating the expected ENA signal. We will discuss the approach to inverting the ENA signal to obtain the ring current ion flux. Finally, we will show some first light results from the instrument.

Poster | HELIOTECH

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Optics for Compact Two-dimensional Energetic Atom (OCTEA)

OCTEA is a NASA funded HTIDeS project to advance the technological readiness level (TRL) of the optics for a compact (1U-CubeSat-sized) two-dimensional ENA imager, capable of capturing the dynamics of low-altitude, precipitating RC ions. The OCTEA science goal is to determine the dynamics of stormtime ring current (RC) loss. Geomagnetic storms can pump petaJoules of energy into the RC and trigger space weather events affecting satellites, communications, power grids, or humans in space. RC losses regulate the strength and timing of the storm peak and recovery. OCTEA targets (S1) the space-dependent dynamics of low-altitude RC loss during storms, and (S2) the dynamic interplay between ions and neutrals during low altitude ion precipitation. OCTEA is a follow-up to a Southwest Research Institute (SwRI) funded Internal Research (IR) project that designed, fabricated, and built a 1U CubeSat volume, 0.6 kg energetic neutral atom (ENA) optics prototype. We report progress from Year 2 of the HTIDeS funded period of performance: testing, structural and optical analysis, documentation, and design studies. OCTEA advances an ENA imager with great promise for use in scientific investigations on future Heliophysics missions. The OCTEA optics module has an ample geometric factor, low mass, and is compact. In conjunction with separate development of technology for compact ultraviolet and ion filters, the new OCTEA technology is the central component for a light, low-resource ENA imager that is well-suited for deployment on CubeSats and other resource-limited NASA missions.

Presentation | DAY 5 | SEPTEMBER 4 9:15 | Session | Magnetospheric Dynamics & Geospace Missions and Technologies | HELIOTECH

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HEPSTER: High Energy Proton SSD Telescope and chErenkov Radiator to Fill a Critical Space Weather Measurement Gap

The High Energy Proton SSD Telescope and chErenkov Radiator (HEPSTER) is a space weather instrument capable of measuring solar energetic particles (SEP) protons in the critical energy range of about 10 to 500 MeV. High-energy SEPs represent one of the most significant Space Weather (SWx) hazards both for human space flight and space assets, so characterizing these particles is critical. In particular, protons are the most intense of all SEP species, with intensities of several orders of magnitude over other species. Currently, there are no instruments measuring high-energy SEP proton in the Heliophysics Systems Observatory (HSO). The HEPSTER instrument proposes to bridge this critical measurement gap. HEPSTER achieves this by utilizing a unique combination of solid-state detectors (SSDs) and Cherenkov radiators optimizable for multiple space environments from geospace, planetary, to interplanetary regions. HEPSTER is much more compact, has lower mass and consumes less power than previous instruments with similar capabilities, e.g., PAMELA. We will discuss the importance of HEPSTER, as well as some of the unique challenges in integrating signals from two different detector types.

Presentation | DAY 2 | SEPTEMBER 1 16:30 | Session | Space Weather Monitoring and Space Debris | HELIOTECH

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What Causes On Orbit Electric Field Instrument Instabilities?

Recent in situ measurements of electric fields from missions such as Polar, DEMETER, the Van Allen Probes, and Parker Solar Probe have reported anomalies in double-probe electric field measurements, attributed to unintended coupling between the sensor and nearby driven stub surfaces through the ambient plasma. Although commonly observed in on-orbit measurements, the cause of these anomalies remains poorly understood. Here we present a model of the feedback interaction between the EFW sensor and driven stub surface mediated by the surrounding plasma. We use a numerical simulation of conductive surfaces immersed in a warm, magnetized plasma to calculate to analyze the stability of the feedback interaction across a range of plasma environments. By incorporating a simplified model of the stub-biasing electronics, we directly compare model predictions with the anomalous gain and phase responses observed on orbit by the Van Allen Probes EFW. The modeled feedback response agrees well with EFW observations. We suggest that feedback involving kinetic H^+ lower-hybrid modes explains the observed anomalies. This effect is strongest in dense plasmas where the Debye length approaches the stub length. These results provide a physical framework for interpreting anomalous double-probe measurements and may guide the design of future electric field instruments in space plasmas.

Presentation | DAY 5 | SEPTEMBER 4 13:30 | Session: Advanced Electromagnetic Field Sensors and Magnetometers | HELIOTECH

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Pre-Flight Degaussing to Diminish PNI RM3100 Sensor Offset

The reduction of magnetic interference in magnetometer readings has been a prevalent issue in spacecraft design, assembly, and integration. Magnetic cleanliness programs are introduced to minimize the magnetization of magnetometers and counteract DC magnetics interfering with the measurement of geophysical signatures during flight. The NASA HERMES NEMESIS sensor suite experienced magnetization of PNI RM3100 sensors which prompted this investigation. We present the results of degaussing the RM3100 which improved sensor offset without affecting resolution. In addition, repeated magnetization and degaussing is discussed to assess sensor resilience. We present the RM3100 degaussing procedure as a preemptive and standard degaussing procedure.

Poster | HELIOTECH

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Compact Rubidium Quantum Magnetometers for Space Weather Observations from LEO and VLEO

High-resolution measurements of Earth's magnetic field are essential for advancing space weather research, improving geomagnetic field models, and enabling future navigation and Earth science missions. Recent advances in miniaturized quantum sensing have made it possible to deploy high-performance quantum magnetometers on resource-constrained spacecraft operating in low Earth orbit (LEO) and very low Earth orbit (VLEO).FieldLine Industries has developed compact rubidium optically pumped quantum magnetometers based on wafer-fabricated MEMS alkali vapor cells. Combining sub-picotesla sensitivity with low size, weight, and power (SWaP), these sensors are well suited for CubeSat platforms. In collaboration with the University of Colorado Boulder, HEX20, and the CU National Security Initiative, these sensors are being integrated into the COSMO and MAGNETO missions to enable space-based magnetic field measurements from LEO and VLEO. This poster presents the sensor technology, mission concepts, and ground-based observations demonstrating the potential of compact quantum magnetometers for next-generation space weather observations and high-resolution geomagnetic mapping.

Poster | Orbital Flight

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Structure and Progression of IonospheRic density IrregulariTies (SPIRIT)

The SPIRIT mission aims to investigate the generation and multi-scale structure (tens of km to decameters) of high-latitude plasma density irregularities driven by solar wind-magnetosphere coupling and local ionospheric instabilities. As primary drivers of space weather, these irregularities serve as an ideal vehicle to reveal fundamental physical linkages (solar wind-magnetosphere-ionosphere coupling and plasma instabilities) and predict high-latitude scintillation. Building on previous and existing LEO missions, SPIRIT fills critical observational gaps by providing the greatly enhanced time resolution and simultaneous in-situ measurements required to identify these mechanisms. SPIRIT utilizes a 12U CubeSat equipped with a high-resolution instrument suite measuring electron density and temperature, electric fields, and magnetic fields. To optimize irregularity observations during the 1-year operation, SPIRIT employs a near noon-midnight polar orbit, focusing on the cusp and nightside auroral oval, where plasma irregularities most prevail. Supported by ground-based instruments (ISRs, ASIs, GPS receivers) and GEMINI 3D modeling, SPIRIT will achieve breakthroughs in the physics of the coupled magnetosphere-ionosphere-thermosphere system by, for the first time, testing theoretical expectations proposed for a variety of generation mechanisms of density irregularities.

Presentation | DAY 4 | SEPTEMBER 3 13:45 | Session: ITM Technologies and Missions | Orbital Flight

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Space Storm Solar Sail Sentinel (S5) Mission Overview

Space Storm Solar Sail Sentinel or S5 is a 1653 square meter solar sail mission under development by NASA's Marshall Space Flight Center to mature solar sail propulsion technology with a planned launch in November 2029, on a rideshare slot with NOAA's SOLAR A mission. Partnered with Marshall Space Flight Center, Opterus R&D is providing the sail booms and deployment system and Applied Aerospace & Defense (formerly NeXolve) is providing the sail membrane. Additionally, a spacecraft bus provider will be awarded in the near future but as of writing this abstract, the spacecraft bus award is still pending. The S5 mission provides the next critical step in solar sail technologies which includes deploying the largest solar sail and steering capability to reach a sub-Sun-Earth L1 halo orbit plus demonstrating performance of a magnetometer with a solar sail spacecraft. This mission lays the groundwork for future solar sail missions such as follow-on sub-Sun-Earth L1 halo space weather monitors with higher sail performance for increased solar storm warning time, and high inclination solar probes. This presentation will talk about a detailed overview of the S5 mission and heritage of the mission that has led to this point.

Presentation | DAY 1 | AUGUST 31 16:30 | Session: Platform Technologies, Mission Design, and Autonomy | Orbital Flight

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Deciphering the Nightglow: The Synergy of Atmospheric Observations, Modeling Calculations, and Laboratory Experiments

Throughout the night, various chemical reactions, energy transfer, and other excitation processes in Earth's upper atmosphere contribute to a weak light emission known as the nightglow. Space- and ground-based observations, atmospheric models, theoretical calculations, and laboratory experiments are routinely used to investigate the underlying processes and advance the state of knowledge about this relatively poorly understood atmospheric region in which space meets the Earth's atmosphere. We will discuss our studies of the mechanisms regulating the mesospheric OH Meinel band nightglow emission as examples that highlight the synergy of atmospheric observations, modeling, and laboratory experiments. Each one of these subdisciplines of upper atmospheric science has an important role and their interplay is essential for progress. The latter is inevitable, even though it invariably appears frustratingly slow, as if going nowhere in infinitely small steps!

Poster | HELIOTECH

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3D-ICoN (Ion and Cold Neutral) Wide Field-of-View, Plasma and Neutral Particle Imager

In this presentation, we report on the development of the 3D-ICoN (Ion and cold Neutral) imager, a novel particle analyzer providing wide field-of-view, neutral and charged particle imaging in a compact, low-SWaP (size, weight and power) package. The instrument combines a modified version of the H-TIDES funded 3D-Cylindrical and Tiny Spectrometer (3D-CATS) development and an Electron-impact Ionization Source (EIS) to enable neutral particle detection capability. Details of the instrument design and results from charged particle optics simulations of the geometry will be presented. The baseline design currently being developed is targeted at "cold" neutral particles in LEO and is compact enough to be flown on a CubeSat within a 2U resource envelope, inclusive of all electronics. The EIS is a novel (patent pending), naturally pulsed, electron source that can deliver from 1e4 to 1e8 electrons within a few nanoseconds. This makes it particularly attractive for time-of-flight measurements with an electron impact ionization source and opens several applications for both space as well as ground-based instruments. Details of the EIS and some of its applications currently being pursued and the results of several initial tests carried out with combinations of 3D-CATS and EIS will also be discussed.

Presentation | DAY 2 | SEPTEMBER 1 15:15 | Session: Space Weather Monitoring and Space Debris | HELIOTECH

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Progress Towards Enabling Enhanced Capabilities of 3D-CATS (3D-Cylindrical and Tiny Spectrometer)

3D-CATS is an H-TIDeS funded development of a novel space plasma analyzer providing instantaneous, multiple energy, wide field of view sampling in a compact, low-SWaP package. The analyzer uses nested cylindrical geometry and delivers energy-azimuth angle-elevation angle images to achieve a "fast" (high cadence) measurement capability. Two different analyzer geometries are being developed in parallel. Details of the geometries, their advantages and disadvantages, the science they are being targeted at and the status of each will be presented. Detector rate handling is a key challenge of making high cadence measurements. This aspect and how it's being addressed will also be discussed. Besides fast measurements, 3D-CATS offers additional capabilities, including combined electron-ion detection and composition. To achieve this, we are developing Secondary Electron Emission Surfaces (SEES) using structures coated with Magnesium Oxide and Tungsten. Details of the SEES and the techniques being developed to enable 3D-CATS's enhanced capabilities will be presented.

Poster | HELIOTECH

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Shuttered Plasma Instrument for Detecting Environmental Response (SPIDER) Test and Calibration

Understanding ionospheric plasma escape into the magnetosphere remains a critical open question in heliophysics. The composition of ion outflows, particularly heavy ions such as N^+ and O^+, influences magnetospheric dynamics by modifying Alfvén velocity and reconnection rates, yet past missions have lacked the mass resolution needed to distinguish closely spaced species. The Shuttered Plasma Instrument for Detecting Environmental Response (SPIDER) is a compact ion composition sensor designed to resolve H^+, He^+, N^+, and O^+ over 10 eV to 5 keV with $M/\Delta M = 7$. SPIDER combines a high-speed electrostatic shutter, cylindrical electrostatic analyzer, and channel electron multiplier detector in a 3U-compatible, 3 W payload. Its modular architecture and selected components were chosen during the design phase to reduce cost, simplify integration, and enable rapid turnaround for CubeSat, sounding rocket, and hosted-payload missions. This presentation will discuss the integrated instrument test results and calibration data demonstrating SPIDER's performance and technology readiness.

Poster | HELIOTECH

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A-STEP Payload Adaptation for the Flying Foundational Robots Orbital Mission

The AstroPix Space Technology Experimental Payload (A-STEP) is a charged particle and gamma-ray detecting instrument capable of measuring charged particle and high energy radiation from the sun. It is comprised of 12 monolithic HV CMOS silicon detectors (AstroPix). A-STEP was originally developed for a rideshare on a sounding rocket. This effort adapts A-STEP for a fully orbital-compatible system integrated with the Motiv Space Systems Flying Foundational Robots (FFR) program. We will present the upgrades needed for orbit operations including, environmental qualification testing (vibration, thermal-vacuum), and thermal analysis. The payload communicates via Ethernet at 32 kbps with +28V power input. On orbit, A-STEP will measure cosmic-ray rates and environment, producing calibrated data products before and after interactions with Motiv's robotic arm. The team will deliver the instrument in the Fall, provide Safe-to-Mate and operational procedures and support I&T through launch (early 2027) and operations through October 2027.

Presentation | DAY 1 | AUGUST 31 14:15 | Session: Platform Technologies, Mission Design, and Autonomy | Orbital Flight

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First Flight and Design of AMPPS (Additively Manufactured Plastic Plasma Spectrometer)

This describes the design, testing, and sounding rocket flight of AMPPS (Additively Manufactured Plastic Plasma Spectrometer). AMPPS is a tophat-style electron spectrometer, and measures the energies of electrons from roughly 20eV to >10keV. The purpose of AMPPS was a technology demonstration for several new manufacturing and design concepts. The electrostatic analyzer was fully 3D printed, and it was built monolithically, meaning all the electrodes and insulators were printed together as one piece. Another innovation was a fully printed microchannel plate holder structure, which has proven very resilient and convenient. The properties of the plastic allow it to act as an integrated spring. Electrical connections and insulators were combined into the prints, dramatically simplifying the design. AMPPS was a last-minute addition on the BaDASS (Black and Diffuse Auroral Science Surveyor) rocket. AMPPS was designed for the "tuna can" volume of a CubeSat. After establishing the collaboration at HELIOTECH 2025, design changes, testing, and integration were done in late 2025. More calibration was done at Southwest Research Institute in early 2026. Launch was Feb 9th 2026 from Poker Flat. Electron energy spectrograms from AMPPS show several interesting features, such as monoenergetic low-energy features, broadband features, and oscillations. Comparisons with other instruments, data anomalies and mistakes and weakness of the design will be described. AMPPS was developed at University of Alaska Fairbanks with collaboration from NASA Goddard, Denali Scientific, and Southwest Research Institute. Students at the UAF Space Systems Engineering Lab were involved in mechanical manufacturing, software, circuit design, testing, and data analysis. This includes undergraduates, graduate students, and a high school student. Development has been supported by NASA Heliophysics H-TIDeS, NASA Research Initiation Award, Alaska Space Grant Program, and Alaska NASA EPSCoR.

Poster | HELIOTECH

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Hybrid Electric Field and Plasma Instrument (HEFPI)

Cold ("low-energy") plasma with sub-eV to few-eV thermal energies is widespread in terrestrial magnetospheric environments but remains difficult to measure because spacecraft floating potentials are often comparable to particle energies. The terrestrial plasmasphere provides an ideal testbed for addressing this challenge, as it contains a cold, dense plasma population that dominates the mass density and a hotter thermal population that dominates the energy density and pressure. To address this long-standing measurement gap, we are developing a novel boom-deployed, current-biased plasma instrument concept that integrates electrostatic particle analyzers with double-probe electric-field technology, leveraging the strong heritage of the Space Sciences Laboratory in both instruments and enabling simultaneous measurements of cold plasma populations and electric fields. We present SPIS simulation results comparing conventional spacecraft body-mounted sensors, body-mounted biased sensors, and the proposed boom-deployed current-biased configuration under representative plasmaspheric conditions. The simulations show that body-mounted sensors remain strongly affected by spacecraft sheath effects, even with active biasing, whereas the boom-deployed current-biased concept significantly improves cold plasma measurements by reducing spacecraft-induced perturbations. These results provide quantitative guidance for instrument design optimization and support maturation of the concept toward higher TRLs for future heliophysics missions, including the terrestrial Plasmaspheric Explorer (PLEX) and future investigations of cold plasma environments in planetary ionospheres, magnetospheres, and the moons of Jupiter and Saturn.

Presentation | DAY 5 | SEPTEMBER 4 13:45 | Session | Advanced Electromagnetic Field Sensors and Magnetometers | HELIOTECH

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The Miniaturized Charging Mitigation Shell Instrument for Space Plasma Sensors

The miniaturized charging mitigation shell (CMS) project investigates instrument technology designed to improve measurement conditions for future small plasma sensors. The low-energy (<30 eV) space plasma ion and electron distributions elude characterization by space plasma sensors due to common spacecraft-environment interactions. An excess of artificial electrons leaving the spacecraft can lead to positive charging of surfaces or deployed structures, creating a non-uniform positive potential that prevents ions with total energies (thermal and kinetic) below this potential from reaching frame-mounted plasma ion sensors. The CubeSat-scale, ~100 mm diameter concentric shell structure of the CMS anticipates interfacing with an interior-mounted small electrostatic analyzer (ESA) type sensor so that both may deploy with a boom away from a host while carrying new capabilities to enable more frequent measurement of cold plasma distributions. We assume an ESA due to its longstanding reliability for plasma measurements as well as its complexity requiring multiple voltage supplies to achieve sensor operation. Other, less complex plasma sensors may also interface with and benefit from a CMS. We will describe CMS development efforts to date, discussing methods leveraged to actively or passively mitigate the expected on-orbit conditions that can compromise routine plasma measurements, followed by presentations of data acquired while testing such methods in the lab. Our current instrument development goal aims to improve the measurement conditions for low-energy plasma ions by anticipating and seeking to mitigate the positive charging that occurs on sunlit spacecraft. Experience gained through this project may transfer to measurement of low-energy plasma electrons.

Poster | HELIOTECH

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Updates on the NASA SunRISE Mission

NASA's Sun Radio Interferometer Space Experiment (SunRISE), currently planned for launch in 2026, will be the first space-based radio interferometer designed to study solar radio bursts in the inner heliosphere. The mission consists of six identical 6U CubeSats flying in passive formation in supersynchronous geosynchronous Earth orbit, with a nominal 10 km baseline. Each spacecraft carries a decametric-hectometric radio receiver operating from 0.1–25 MHz and a GNSS receiver for precise orbit determination. Through ground-based processing, SunRISE will localize and track Type II radio bursts associated with coronal mass ejections and Type III bursts associated with solar flares. These observations will provide new insight into particle acceleration and transport as well as magnetic connectivity from ~2 to 20 solar radii. SunRISE data will also support improved assessment of space weather hazards relevant to future human missions to the Moon and Mars. This presentation will discuss the mission architecture, science processing approach, and current mission status ahead of launch.

Presentation | DAY 2 | SEPTEMBER 1 14:45 | Session | Space Weather Monitoring and Space Debris | HELIOTECH

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Achievements and Lessons Learned from CIRBE Mission

CIRBE (Colorado Inner Radiation Belt Experiment) was launched on 15 April 2023 and re-entered on 4 October 2024 due to atmospheric drag. Its advanced science payload, REPTile-2 (Relativistic Electron and Proton Telescope integrated little experiment-2), onboard the Blue Canyon Technologies XB1 spacecraft bus, provided some of the most detailed low-Earth-orbit observations of radiation belt electron dynamics to date. These measurements revealed several previously unobserved or poorly understood phenomena, including: (1) multi-order-of-magnitude enhancements of outer radiation belt electron fluxes during geomagnetic storms; (2) multiple electron "wisps" in the inner belt associated with human-generated VLF transmissions; (3) electron "drift echoes," or "zebra stripes," spanning both the inner and outer radiation belts; (4) bursty precipitation of high-energy electrons (up to ~3 MeV) associated with whistler-mode chorus waves; (5) energy-dependent electron precipitation associated with EMIC waves, including determination of the minimum precipitating energy; (6) evolution of reversed electron energy spectra in the slot region and outer belt; (7) confirmation of the CRAND contribution to inner-belt electrons and the role of atmospheric processes in shaping their energy spectra and pitch-angle distributions; and (8) acting as a remote-sensing tool for magnetotail dynamics. The mission also yielded valuable lessons for future small-satellite programs: (1) test early and often, including off-nominal scenarios; (2) acquire an engineering development unit (EDU) early; (3) maintain configuration consistency between the EDU/flat-sat and flight spacecraft; and (4) continue development and testing despite launch uncertainties to maximize mission readiness. These scientific achievements and programmatic lessons demonstrate the value of focused CubeSat missions for advancing heliophysics research and informing future mission development.

Presentation | DAY 4 | SEPTEMBE 3 16:30 | Session | Magnetospheric Dynamics & Geospace Missions and Technologies | Orbital Flight

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Building on Proven Heritage: Miniaturized Energetic Particle Instruments for Future NASA Heliophysics and Exploration Missions

The Relativistic Electron and Proton Telescope integrated little experiment-2 (REPTile-2), flown on the Colorado Inner Radiation Belt Experiment (CIRBE) CubeSat under NASA's H-FORT program, demonstrated that miniaturized energetic-particle instruments can provide high-quality, high-energy-resolution measurements. REPTile-2 measured electrons from 0.25–6 MeV and protons from 6.5–100 MeV, revealing previously unobserved features of radiation belt dynamics and establishing a strong flight heritage for future missions. Building on this heritage, the Medium Energy Electron Telescope (MEET), developed under NASA's H-TIDeS program, has completed fabrication, environmental testing, and calibration and is currently in storage, ready for flight. MEET extends measurement capabilities to lower energies, covering 30–800 keV electrons and 1.1–60 MeV protons. A modified REPTile-2 engineering model, designated REPTile-3, is currently undergoing proton beam calibration and thermal-vacuum testing for flight on the Emirates Mission to the Asteroid Belt (EMA), scheduled for launch in March 2028. REPTile-3 will measure electrons (0.1–5 MeV), protons (1.2–100 MeV), and helium ions (18–200 MeV) across heliocentric distances ranging from 0.71 to ~3 AU. Leveraging the demonstrated performance of REPTile-2, the flight readiness of MEET and REPTile-3, and newly developed analysis techniques, we have developed the concept of BEAM (Bidirectional Energetic pArticle Measurements), consisting of an upward-looking telescope (BEAM-u) and a downward-looking telescope (BEAM-d) for future lunar and Martian missions. BEAM-u extends measurement capabilities to 40 keV–6 MeV electrons, 500 keV–2 GeV protons, and 8 MeV–8 GeV helium ions, enabling comprehensive characterization of the space radiation environment. Together, these developments demonstrate a low-risk technology pathway from proven flight heritage to future heliophysics, lunar, Martian, and deep-space exploration missions.

Presentation | DAY 5 | SEPTEMBER 4 9:45 | Session | Magnetospheric Dynamics & Geospace Missions and Technologies | HELIOTECH

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ESCAPADE: Lessons Learned from a Low-Cost Helio Mission to Mars

Launched in November 2025, ESCAPADE is a twin-spacecraft low-cost mission that will revolutionize our understanding of how space weather conditions drive magnetic structure and flows of energy and momentum throughout Mars' unique hybrid magnetosphere, and how this interaction drives both ion and sputtering escape. ESCAPADE will measure magnetic field strength and topology, suprathermal ion distributions and electron flows, and thermal electron and ion densities. Our 2-part scientific campaign of temporally and spatially-separated multipoint measurements in different regions of Mars' diverse plasma environment, will allow us to a) untangle spatial from temporal variability b) understand short time scale ionospheric variability, and c) unravel the cause-and-effect of solar wind control of ion and sputtering escape. ESCAPADE are small spacecraft (~200 kg dry mass) manufactured by Rocket Lab USA. UC Berkeley provides science leadership, project management, mission systems engineering, electrostatic analyzers, magnetometer booms, and science and mission operations. NASA GSFC provides magnetometers, and Embry Riddle Aeronautical University provides Langmuir probes. The two craft ("Blue" and "Gold") will spend approximately one year within a few million kilometers of earth, making two passages through the distant magnetotail before a trans Mars injection in November 2026, a ten-month ballistic transfer, and Mars arrival in September 2027. The 1-year science mission will begin between April and June 2028. We will a) present early data from the mission including in a previously unexplored region of Earth's distant magnetotail collected in March 2026, b) discuss some of the new approaches and trade-offs that were necessary to deliver and operate a capable planetary science mission at approximately one-tenth of the typical cost and c) deliver lessons learned by NASA and the ESCAPADE team that may be applied to future low-cost planetary science missions.

Presentation | DAY 1 | AUGUST 31 9:45 | Session: Heliophysics on the Moon and Mars | HELIOTECH

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Simultaneous Electric Field Measurements and Electron Plasma Diagnostics with Current-Biased Whip Antennas

The revolutionary FIELDS instrument design aboard Parker Solar Probe demonstrates that a system of current-biased whip antennas can simultaneously serve as both an electric field instrument and an electron plasma diagnostic package. Using four current-biased whip antennas (V1–V4), FIELDS measures electric fields from DC to radio frequencies while enabling electron density and temperature diagnostics through (1) quasi-thermal noise (QTN) spectroscopy based on radio-frequency electric field measurements and (2) the spacecraft surface charging technique, which infers density from the probe-to-spacecraft potential that serves as the baseline for DC electric field measurements. QTN provides a gold-standard electron density measurement that can be used to empirically calibrate the spacecraft surface charging technique within the same instrument, enabling reliable high-cadence density measurements with greater sensitivity to density fluctuations. A key challenge in combining these capabilities is that the bias current required for DC electric-field measurements is expected to increase shot noise and potentially degrade QTN observations. However, recent analyses show that the shot noise increase associated with the applied bias current is substantially smaller than theoretically predicted, allowing high-quality QTN measurements to be maintained under nominal operating conditions. These results demonstrate the compatibility of current-biased DC electric field measurements and QTN plasma diagnostics within a single instrument architecture and highlight the potential of current-biased whip-antenna systems as a powerful and resource efficient approach for future heliophysics and planetary missions.

Poster | HELIOTECH

Presenting Author: Maddox, Kirk | Affiliation: Applied Aerospace & Defense (AA&D) | Email: kirk.maddox@nexolve.com
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Update on Development, Testing, and Manufacturing of the Space Storm Solar Sail Sentinel (S5) for Improved Space Weather Monitoring

In September of 2023, the National Oceanic and Atmospheric Agency (NOAA), in conjunction with NASA Marshall Space Flight Center (MSFC), funded Applied Aerospace & Defense (formerly known as NeXolve) to manufacture, assemble, package, and deliver a 4-quadrant 1,653 m^2 solar sail for a soon-to-come flight mission. This will be the largest solar sail ever flown and will demonstrate the propulsive capability needed to continuously station keep in a stable sub-solar Lagrange Point 1 (L1) orbit for improved detection and warning times of inbound potentially destructive solar storm events. Less than two years later in August 2025, the S5 mission was funded to develop flight hardware for a technology demonstration mission that will utilize the 1,653 m2 solar sail to demonstrate feasibility of deploying, navigating, and maneuvering a mission class solar sail. S5 will also utilize a magnetometer, provided by NOAA, to demonstrate the ability to monitor Coronal Mass Ejections (CMEs) from its sub-L1 location, thereby increasing solar storm detection and warning time by as much as 50%. The S5 mission rejuvenates the previous Solar Cruiser mission profile, and will incorporate an upgraded deployment system, deployable booms, active mass translator, and spacecraft bus. Recently, in January 2026, Applied completed the 4th and final quadrant of the flight membrane marking the completion of the full 1,653 m2 solar sail, which is the largest solar sail ever constructed. Throughout the previous Solar Cruiser program and the current S5 program, Applied has continued to develop new technologies that demonstrate scalability, extensibility, feasibility, and reliability. These technologies enhance solar sail mission capabilities and scalability to larger and higher performance sails for future missions. This presentation describes the current solar sail state-of-the-art as defined by S5 and the progress towards the embedded technology enhancements for future mission improved capabilities.

Presentation | DAY 1 | AUGUST 15:00 | Session: Platform Technologies, Mission Design, and Autonomy | HELIOTECH

Presenting Author: Mamakos, Paul S. | Affiliation: Space Ocean Corp | Email: paul@spaceoceancorp.com

Nuclear Electric Propulsion for Sustained Out-of-Ecliptic Heliophysics Missions

Sustained out-of-ecliptic observation remains a critical heliophysics capability gap. Current missions achieve limited solar polar coverage through gravity-assist inclination cranking, requiring multi-year flyby sequences that constrain observation geometry and duration. We present a mission architecture for a compact nuclear-electric-propulsion (NEP) spacecraft capable of achieving and maintaining high-inclination heliocentric orbits without planetary gravity assists. The architecture pairs a Kilopower-class fission reactor (10-20 kWe, based on the KRUSTY-demonstrated design commercialized by Space Nuclear Power Corporation) with lithium-fed magnetoplasmadynamic thrusters derived from JPL/Princeton LiLFA heritage. Lithium offers lower ionization energy than xenon, enabling higher thrust efficiency at compact fission power levels. The reactor operates independent of solar distance, eliminating power degradation that constrains solar-electric systems beyond 3 AU. Mission-enabling measurements from a sustained polar vantage include solar polar magnetic field imaging, coronal mass ejection propagation geometry inaccessible from the ecliptic, heliospheric current sheet structure, and three-dimensional solar wind velocity mapping. The same NEP architecture supports fast-transit outer solar system missions, providing continuous thrust along non-ecliptic trajectories that reduce transit time to Jupiter and Saturn while enabling heliospheric boundary science en route. We present vehicle configuration, delta-V budget, reactor-thruster integration, and a phased development roadmap leveraging hardware at TRL 4-5 with a path to flight demonstration within the current decade.

Presentation | DAY 1 | AUGUST 31 16:00 | Session: Platform Technologies, Mission Design, and Autonomy | HELIOTECH

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Characterization of Multidimensional and Magnetized Solitons for Orbital Debris Detection

Ion acoustic solitons generated by the interaction between charged space debris and ionospheric plasma have been proposed as a method to detect sub-centimeter scale debris in low Earth orbit. In this work, solitons are simulated and characterized using a 2D two fluid moment model. The debris is modeled as fully-charged Gaussian source term in Poisson's equation, traveling at a prescribed constant velocity through the quiescent plasma. The results show the development of precursor solitons for a certain range of debris Mach numbers, and the mechanism that causes the transition to purely pinned solitons is described. The resulting solitons are characterized based on the debris speed, potential, and size, as well as the various environmental conditions, such as the ion-to-electron temperature ratio, magnetic field strength, and magnetic field orientation relative to the debris motion. In the presence of a strong enough magnetic field that magnetizes the ions, the solitons are amplified but exhibit a much narrower profile. The introduction of an angle between the magnetic field and the debris motion causes the solitons to travel at a different, larger angle. A perpendicular magnetic field, either in-plane or out-of-plane, leads to the complete absence of precursors. Lastly, representative simulations that mimic particular orbital conditions show that for Earth's magnetic field, the soliton behavior very closely follows the unmagnetized results presented.

Poster | HELIOTECH

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PADRE: The Solar Polarization and Directivity in X-Ray Experiment Technical and Science Updates

The Solar PolArization and Directivity X-Ray Experiment (PADRE) is a NASA 12U CubeSat mission designed to study the Sun in hard X-rays (HXRs) from low Earth orbit, targeting the solar cycle 25. PADRE launched successfully on June 23, 2025, aboard SpaceX's Transporter-14 mission, with first contact established the same day. PADRE was designed and built to measure the angular distribution of accelerated electrons in solar flares through two physically independent and complementary measurement techniques: spatially-integrated spectro-polarimetric HXR measurements via the SHARP (Solar Hard X-ray Polarimeter) instrument; and directivity measurements via the MeDDEA (Measuring Directivity to Determine Electron Anisotropy) system, which quantifies HXR anisotropy by cross-calibrating detectors observing the same flare from multiple perspectives. The latter approach is conducted in coordination with Solar Orbiter/STIX, enabling reliable two-point measurements of flare HXR fluxes. In this presentation, we will review the mission objective, instrumentation onboard PADRE and provide an update to the community of the data and preliminary photometric, spectral and co-observation results with Solar Orbiter and FOXSI-5.

Presentation | DAY 2 | SEPTEMBER 1 10:00 | Session: Next Generation Solar Science Instrument and Missions | HELIOTECH

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Waves, Instabilities and Noise Spectrometer for Multi-Point Ionospheric Measurements

The Waves, Instabilities, and Noise Spectrometer is a compact plasma-wave instrument designed for CubeSat missions capable of high-cadence measurements of ionospheric plasma particle structure and wave activity. The instrument uses Quasi-Thermal Noise (QTN) spectroscopy to derive electron density and temperature directly from naturally occurring plasma fluctuations while simultaneously observing wave activity across kinetic scales. The current instrument architecture consists of deployable BeCu antennas, ultra-low-noise pre-amplifiers, an Analog Filter Board (AFB), a 20-bit Analog-to-Digital Converter (ADC), and a Data Processing Unit (DPU) capable of real-time spectral processing. The system operates between 32 kHz and 32 MHz and utilizes Polyphase Filter Bank (PFB) and Blackman–Harris windowing to produce clean onboard spectra at cadences reaching hundreds of spectra per second. The instrument also includes a synchronized power filtering and power supply (PFPS) board designed to minimize internally generated electromagnetic interference. The instrument is currently at TRL-4 and is proposed to advance to TRL-6 through development of a high-fidelity prototype and implementation of radiation-hardening-by-design modifications required for operation in radiation-rich ionospheric environments. The proposed effort includes upgrades to subsystem fidelity, satellite interface development, FPGA and onboard software expansion, and radiation-tolerance testing. The resulting instrument provides a low-cost and scalable platform for future ionospheric missions requiring high-cadence plasma diagnostics and distributed multi-point measurements.

Presentation | DAY 4 | SEPTEMBER 3 14:00 | Session ITM Technologies and Missions | HELIOTECH

Presenting Author Mason, James | Affiliation Johns Hopkins University Applied Physics Laboratory (JHU APL) | Email james.mason@jhuapl.edu
CoAuthors SunCET Team

Overview of SunCET: Sun Coronal Ejection Tracker

An overview of the Sun Coronal Ejection Tracker (SunCET), which will observe coronal mass ejections in the extreme ultraviolet with an exceptionally wide field of view: from sun center out to 5 solar radii with no gaps.

Poster | Orbital Flight

Presenting Author Mayyasi, Majd | Affiliation Boston University (BU) | Email majdm@bu.edu
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An Innovative Instrument for High Dispersion UV Spectroscopy

A high-heritage UV spectrograph has been redesigned to achieve higher dispersion by extending the focal length and folding the optical path into a pragmatic space-deployable configuration. The resulting instrument design can achieve higher spectral resolution, efficiency, and lower background rate using a micro-channel plate detector while maintaining low power consumption and low mass. The system is designed to measure FUV emissions (including H-Lyman-a, D-Lyman-a, and O-triplet emissions) with ~5 km/s resolution. The resulting spectral resolution surpasses state-of-the-art systems on the Hubble Space Telescope and Mars Atmosphere and Volatile Evolution mission and enables unprecedented discernment between the different populations of H atoms that make up interplanetary hydrogen. Further advances in the data reduction pipeline optimize the signal-to-noise for faint emissions while simulating the background produced from proximity to a radioisotope thermoelectric generator. The instrument is currently being developed for a target technology readiness level of 5. The goals of the instrument measurements are to distinguish the kinetic properties (velocities, number densities, and temperatures) of unperturbed Interstellar Medium H atoms from Hydrogen Wall H atoms to better our understanding of the dynamics at the edge of our Solar System – a key objective of the planned NASA Interstellar Probe (ISP) mission. However, this instrument has versatile applications for terrestrial, planetary, cometary, and heliospheric science and can complement lunar and planetary, as well as heliospheric missions.

Presentation | DAY 2 | SEPTEMBER 1 13:45 | Session Next Generation Solar Science Instrument and Missions | HELIOTECH

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GD-Trailblazer Overview

The Geospace Dynamics Constellation (GDC) mission is a top priority of the two most recent Heliophysics decadal surveys, and is designed to improve understanding of the variability of the space weather environment surrounding Earth. Following the cancellation of GDC, in early 2026 Congress directed NASA with the "goal of achieving a trailblazer launch in 2027, followed by subsequent launches". This "trailblazer", called GD-Trailblazer, is designed to demonstrate rapid procurement and launch taking advantage of industry capabilities. In this talk I highlight the approaches taken by the GD-Trailblazer project to achieve this ambitious timeline.

Presentation | DAY 4 | SEPTEMBER 3 9:00 | Session ITM Technologies and Missions | Orbital Flight

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Space Debris Detection and Characterization Using an In-situ Lidar Sensor Platform

The proliferation of space debris in Low Earth Orbit (LEO) poses significant risks to operational spacecraft and future space missions. While ground-based tracking systems can monitor larger debris objects, the sub-millimeter to millimeter-sized debris population remains largely uncharacterized due to detection limitations. Here we describe a three-year long NASA ROSES funded project, in which we developed a novel low Size, Weight, and Power (SWaP) lidar sensor capable of detecting and characterizing small debris particles (0.1-3 mm) in-situ. The project employed a wide beam lidar architecture utilizing a frequency doubled custom-built Master Oscillator Power Amplifier (MOPA) fiber laser (532 nm) paired with photomultiplier tube (PMT) detectors featuring large active areas (14x14 mm). This lidar configuration permits wide area collection at high signal-to-noise ratio and eliminates the need multichannel readout electronics, significantly reducing system complexity and cost. Over three years, the team conceptualized, designed, built, and conducted several rounds of comprehensive laboratory experiments, progressing from component-level testing to integrating for prototype validation. The culmination of the project demonstrated the lidar prototype capability in a hypervelocity experiment conducted at NASA White Sands Test Facility (WSTF). The test was successfully executed, demonstrating and characterizing millimeter and sub-millimeter debris particles at orbital velocities (4-7km/s), raising the technology readiness level floor from four to five. This technology offers broad applications beyond LEO debris monitoring, including interplanetary dust detection and Lunar and Martian dust environment characterization. Thus, the technology demonstrates significant potential for infusion into future NASA science and exploration missions.

Presentation | DAY 2 | SEPTEMBER 1 16:15 | Session | Space Weather Monitoring and Space Debris | HELIOTECH

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Sounding of Atomic Oxygen via Room-temperature TeraHz Limb Sounder (TLS) Technology: A Robust and Versatile Approach for Remote Sensing of Global Thermospheric Wind, Temperature, and Density

The 2024 NASA Heliophysics Decadal Survey continues to highlight the need for the Dynamical Neutral Atmosphere-Ionosphere Coupling (DYNAMIC) mission, which will for the first time provide direct measurements of wind in the lower thermosphereic/ionospheric range. We have been developing state-of-the-art room-temperature based heterodyne receiver technology to meet these objectives. High-resolution spectroscopy provides an ideal measurement capability as the oxygen atoms naturally emit Terahertz radiation due to thermal excitation, such that detection of this emission from a space-platform allows for global measurements of neutral winds and temperature over all local times and at all latitudes, including where aurora occurs. Measurements of the neutral wind global profiles, during both day and night in an altitude region between ~100 km to ~400 km can readily be achieved. In this region, most of the ion-neutral energy/momentum coupling takes place and the neutral atmosphere responds to external energy inputs, provides critical observational constraints to the complex dynamics in the coupled lower atmosphere/thermosphere/ionosphere/magnetosphere system. TeraHz Limb Sounder (TLS) is a low-mass, low-power, high spectral resolution heterodyne spectrometer system operating in the TeraHz (THz) frequency regime designed to remotely measure thermospheric wind velocity, temperature and atomic oxygen (O) density profiles from a low-earth orbit platform. It is envisioned to have two spectral channels that resolve the Doppler line shapes of the OI emissions at 2.06 THz (145 mm) and 4.7 THz (63 mm). This talk will describe recent progress made in developing all-solid state, room-temperature detector systems that can map the atomic oxygen line at 2.06 THz and 4.7 THz.

Presentation | DAY 4 | SEPTEMBER 3 14:15 | Session | ITM Technologies and Missions | HELIOTECH

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DYNAGLO CubeSat Mission

The upcoming DYNamics Atmosphere GLObal-Connection (DYNAGLO) CubeSat mission will help fill a crucial observational gap in the thermosphere that will aid in our understanding of how Earth weather propagates upward and influences space weather which is at the forefront of geospace science. DYNAGLO's primary science goal is to determine what spectrum of gravity waves are present in the thermosphere and to what extent are they driven by lower atmospheric sources. Due to launch in January 2027, DYNAGLO is a constellation of two 6U CubeSats in a string-of-pearls configuration, each with a miniaturized Far Ultraviolet Imager (FUVI) to provide common volume 2D swaths (latitude, longitude) of neutral density variations and nighttime aurora emission. FUVI will measure airglow emission from atomic oxygen (135.6nm) and nitrogen from Lyman-Birge-Hopfield (LBH) bands to be used as dynamical tracers of variability in the thermosphere. One CubeSat can measure global GW characteristics but two CubeSats flying in formation will allow the first direct measure of GW phase speed and direction of propagation. This presentation will present the DYNAGLO mission concept and the anticipated science return.

Presentation | DAY 4 | SEPTEMBER 3 10:00 | Session | ITM Technologies and Missions | Orbital Flight

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Electrojet Zeeman Imaging Explorer (EZIE) Mission: Redefining How We Study Magnetosphere-Ionosphere Coupling

The frontier of magnetosphere–ionosphere coupling research is increasingly focused on mesoscale processes. In the auroral region, spatial scales of ~100 km and larger are thought to contain much of the key information about ionospheric electrojet currents. While auroral forms can be readily imaged from the ground and space, the mesoscale structure of the electrojets themselves has remained difficult to observe. Most current knowledge comes from ground-based magnetic measurements and derived equivalent currents, but because the current layer (~110 km altitude) is not far above the observing instruments, much of the mesoscale structure is smoothed out before reaching the ground. NASA's Electrojet Zeeman Imaging Explorer (EZIE) addresses this challenge with a novel remote-sensing technique that directly images auroral electrojets. EZIE measures polarized microwave emission from the atmospheric O_2 118.75 GHz spectral line. Perturbations of the geomagnetic field caused by electrojet currents modify the polarization state of the emission through Zeeman splitting, allowing magnetic field variations to be inferred remotely. The spacecraft observe from altitudes above 500 km, while the emission originates near 80 km altitude, close to the electrojet current system. In this sense, EZIE functions analogously to a solar magnetograph, remotely measuring magnetic-field perturbations from space. EZIE consists of three CubeSats flying in a pearls-on-a-string configuration in a Sun-synchronous orbit near magnetic pre-midnight. Each spacecraft carries four radiometers viewing different cross-track angles, providing sensitivity to spatial scales from roughly 100 to 1000 km. EZIE is therefore the first mission designed to observe auroral electrojets directly at the mesoscales most relevant to substorm dynamics and magnetosphere–ionosphere coupling. This presentation reviews the mission status, measurement technique, data products, calibration activities, and science results.

Poster | Orbital Flight

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EZIE OSSE: End-to-End Simulation Experiment as a Mission-Enabling Technology

The Electrojet Zeeman Imaging Explorer (EZIE) employs a comprehensive Observing System Simulation Experiment (OSSE) that has played a central role throughout mission development, from concept formulation through science operations. The OSSE integrates physics-based geospace models, instrument simulations, orbital geometry, and retrieval algorithms within a unified end-to-end framework that reproduces the complete measurement and processing chain. This capability was used to inform instrument requirements, evaluate constellation configurations, quantify expected performance, guide calibration strategies, and support the development and validation of science retrievals and operational data pipelines. Beyond its traditional role in assessing science return, the EZIE OSSE served as a mission-enabling technology that reduced development risk, accelerated readiness for operations, and provided a foundation for interpreting mission observations. Beyond its pre-launch role, the EZIE OSSE continues to serve as testbed for future development of pipeline capabilities, experiment planning, and testing of hypothetical cases. We describe the architecture of the EZIE OSSE, its applications throughout the mission lifecycle, and lessons learned that may inform future heliophysics missions employing novel measurement concepts and small-satellite architectures.

Presentation | DAY 4 | SEPTEMBER 3 13:15 | Session | ITM Technologies and Missions | Orbital Flight

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Rocket Flight Results from the APES-360 and CHIMPS Prototype Electron Spectrometers

We present results from recent sounding rocket flights where we tested the prototypes of the Acute Precipitating Electron Spectrometer-360 (APES-360) and the Capped-Hemispherical Instrument for Measuring Pitch-angle Spectra (CHIMPS). The CHIMPS instrument was originally developed under the Ground Imaging-to-Rocket investigations of Auroral Fast Features (GIRAFF) sounding rocket mission, funded under HFORT in 2020. The APES-360 instrument was developed under an HTIDeS project, funded in 2021. We evaluate their performance by comparing the measured fluxes to other electron spectrometers onboard the payloads. We build several iterations of the CHIMPS instrument, incorporating lessons learned from prior flights. We present examples of data from the rocket flights as well as the design and performance characteristics and discuss possible uses for future missions.

Poster | HELIOTECH

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Advancing the Capturing Ionospheric Coupling And Dynamic Aurora's (CICADA) Mission Concept

We present recent work advancing the Capturing Ionospheric Coupling And Dynamic Aurora (CICADA) mission concept - a nanosatellite-based investigation to connect visible auroral signatures with underlying wave-particle interactions and magnetospheric drivers. CICADA addresses three key science objectives: quantifying the fraction of dynamic discrete arc aurora associated with Alfvénic activity, determining the proportion of precipitating auroral electrons causally linked to Alfvén waves, and elucidating the relationship between field-aligned currents and patches of pulsating aurora. By integrating in-situ measurements of magnetic fields, electric fields, plasma density, precipitating electrons, and co-located auroral imaging on a single 16U nanosatellite in low Earth orbit (400–600 km), CICADA enables detailed analysis of energy transfer from the magnetosphere to the ionosphere. This mission demonstrates a novel Alfvénic wave-particle correlator technique, paving the way for future explorations of the auroral acceleration region at higher altitudes. CICADA contributes to understanding fundamental plasma processes such as waves, turbulence, and magnetic reconnection, which govern energy transport in space plasmas. Operating in a sun-synchronous or polar orbit for at least six months, the mission will sample diverse geomagnetic conditions, providing statistically robust datasets. Through cost-effective commercial nanosatellite platforms and innovative deployable instrumentation, CICADA advances nanosatellite capabilities for heliophysics, offering insights into auroral dynamics that will help inform our understanding of space weather.

Presentation | DAY 4 | SEPTEMBER 3 11:30 | Session | ITM Technologies and Missions | Orbital Flight

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Cross-scale INvestigation of Earth's Magnetotail and Aurora (CINEMA) Mission

The Cross-scale INvestigation of Earth's Magnetotail and Aurora (CINEMA) is in the Phase B preliminary design phase as part of NASA's Small Explorer program. CINEMA is a constellation of nine 16U CubeSats each carrying a comprehensive set of instruments to measure energetic electrons and ions, auroral emissions, and magnetic field perturbations. The overarching goal is to understand the role of plasma sheet structure and evolution in Earth's multiscale magnetospheric convection cycle. CINEMA's nine satellites are in polar low-Earth orbits and quickly traverse the low-altitude footprint of the magnetotail, obtaining a snapshot of its radial profile in minutes. CINEMA obtains information about the structure of the magnetotail remotely through its imprint on particle pitch-angle distributions. Multiple vantage points allow CINEMA to track the time evolution of the magnetotail, including important magnetospheric boundaries (isotropy boundaries, open-closed boundary). Mesoscale aurora and bursty energetic particle precipitation serve as tracers of specific mesoscale and kinetic-scale dynamics. Field-aligned currents (FACs) are sensed by measuring magnetic field variations at each satellite. Combining remote sensing of plasma sheet structure and evolution with auroral imaging and measurements of FACs, CINEMA will provide key observations needed to understand magnetotail dynamics. The comprehensive multipoint measurements will also enable a wide range of synergistic science, including space weather applied research. CINEMA leverages recent instrument developments for small satellites. A prototype of the particle instrument is currently operating on the NASA Relativistic Electron Atmospheric Loss (REAL) CubeSat. The auroral imager takes its heritage from the DISC CubeSat camera and NASA Caruthers mission of opportunity. This presentation will provide an overview of the CINEMA mission and its instruments.

Presentation | DAY 4 | SEPTEMBER 3 15:00 | Session | Magnetospheric Dynamics & Geospace Missions and Technologies | Orbital Flight

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Relativistic Electron Atmospheric Loss (REAL) CubeSat

The REAL (Relativistic Electron Atmospheric Loss) CubeSat was launched into a low-Earth sun-synchronous orbit on 23 July 2025 as a rideshare with NASA TRACERS. The 3-axis stabilized 3U CubeSat was designed to characterize different modes of radiation belt atmospheric loss by making high cadence measurements of energetic electrons at different pitch angles. The REAL medium and high energy sensor heads use solid-state detectors and measure electrons from ~80 keV to 2 MeV in 4 look directions with time resolution up to 20 ms (typically, 100 ms for medium and 50 ms for high). The low energy sensor is an electrostatic analyzer measuring electrons between 1-40 keV at 1-second resolution. REAL routinely downlinks 60 MB of science data daily, providing a rich dataset for studying radiation belt electron loss. In addition to addressing REAL science objectives, the data enable studies across a wide range of heliophysics topics, such as: the connection of pulsating aurora and electron microbursts; the relative roles of current sheet scattering and scattering by plasma waves; lightning-induced precipitation; and precipitation scale sizes that are critical to estimate radiation belt energy loss and atmospheric energy input. Since launch, the REAL team has been coordinating with other teams to collect synergistic data during conjunctions with other missions and ground-based instruments. For example, conjunctions between REAL and TRACERS occur every 3.5 days, and teams have targeted high-resolution data collection over Canadian all-sky imagers. This coordinated effort demonstrates the important role played by NASA CubeSat and suborbital missions as part of the Heliophysics System Observatory. This presentation will provide an overview of the REAL CubeSat and mission profile.

Presentation | DAY 4 | SEPTEMBER 3 15:30 | Session | Magnetospheric Dynamics & Geospace Missions and Technologies | Orbital Flight

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Cooled Mass Spectrometry of the Turbopause Region

The turbopause (70–120 km), marks the transition between the homosphere and heterosphere where turbulent mixing gives way to molecular diffusion. This region plays a fundamental role in ion-neutral chemistry, atmospheric escape processes, and the response of the upper atmosphere. Despite its importance, the turbopause remains poorly characterized due to the lack of direct, high-resolution in situ measurements capable of simultaneously resolving neutral and ion composition with sufficient sensitivity and mass resolution. We present the development of a compact multi-pass high-resolution Time-of-Flight Mass Spectrometer (W-TOF) designed for sounding rocket investigations of Earth's turbopause region between 70 and 120 km altitude. The instrument employs a cryogenically cooled bow shock reducing, ram-facing aperture integrated into the rocket nose cone to directly sample atmospheric neutrals during ascent, significantly reducing instrument background and enhancing sensitivity to trace species. The instrument is fitted with two ion sources, one for neutrals and one for ions. Atmospheric gases are ionized within an electron-impact storage ion source and analyzed by a multi-pass W-configuration TOF analyzer that extends the effective ion flight path while reducing the overall size of the instrument, providing mass resolving power exceeding > 4,000 resolution (t/2dt) while maintaining high transmission and sensitivity. Following apogee, the instrument transitions to ion mode during descent. A Bradbury-Nielsen gate ion shutter selectively admits ambient ions into the analyzer while rejecting neutrals and instrument-generated ions, enabling direct measurements of ion composition, ionospheric structure, and ion-neutral coupling processes. This dual-mode measurement capability provides an unprecedented opportunity to characterize both neutral and charged particle populations.

Poster | HELIOTECH

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N-TOF: a Next-Generation Compact Ion Spectrometer for Heliophysics and Space Weather Studies

Understanding plasma ion composition across a broad energy range is essential for characterizing atmosphere–ionosphere–magnetosphere coupling and space weather at Earth. A key open problem is quantifying ion loss, particularly the escape of N^+ ions. Present-day instruments cannot reliably resolve N^+ and O^+ peaks in the energy ranges relevant for atmospheric outflow into the ionosphere and inner magnetosphere, limiting our ability to track composition-dependent energy transfer during geomagnetic storms. The N-TOF instrument is a compact (~3U) top-hat electrostatic analyzer (ESA) with an integrated time-of-flight (TOF) section, optimized to resolve N^+ and O^+, whose masses differ by only ~2 u. It is designed to separate target ion species with 50% peak separation over 100 eV to 30 keV. Its architecture advances magnetospheric plasma composition measurements for ionosphere-magnetosphere interaction studies and space weather applications by enabling clean N^+/O^+ discrimination without relying on extreme high-voltage acceleration. Historically, N^+/O^+ separation in top-hat ESA–TOF instruments required high post-ESA acceleration and large linear electric field TOF analyzers with reflectrons operating at up to ±15 kV (e.g., CAPS, PEPE). In N-TOF, carbon foils that produce the star signal in the conventional TOF analyzers are replaced by graphene foils and micro-pore optics (MPOs) to achieve sufficient M/Q resolution at much lower voltages. This combination extends sensitivity below 1 keV, allows post-acceleration (PAC) voltages below 5 keV, and reduces ion scattering and energy straggling. The use of graphene foils and MPOs is the central technological innovation of N-TOF; realizing this capability requires new fabrication and integration processes beyond those established for traditional carbon foil systems.

Presentation | DAY 4 | SEPTEMBER 3 15:45 | Session: Magnetospheric Dynamics & Geospace Missions and Technologies | HELIOTECH

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Instrument Performance, Calibration, and Validation of the Microwave Electrojet Magnetogram Instrument for the EZIE Mission: 1.25 Years

The Electrojet Zeeman Imaging Explorer (EZIE) mission was launched in March 2025 and represents a unique way of measuring the temporal and spatial structure of Auroral and Equatorial Electro-jets in the Earth's atmosphere. EZIE consists of three pearls on a string 6U CubeSats within 2-10 minutes of each other. EZIE's takes advantage of the Zeeman effect to indirectly measure current fields in the ionosphere. In the presence of a magnetic field, the oxygen emission line at a 118.75 GHz splits in three lines (pi and sigma lines). The sigma lines are proportional to the strength of the magnetic field. Each EZIE CubeSat carries the Microwave Electrojet Magnetometer (MEM) payload instrument developed at NASA-JPL. MEM consists of four mm-wave radiometers with a single backend spectrometer measuring approximately 16MHz bandwidth around the 118.75 GHz at a 49 KHz spectral resolution. MEM is a fully polarimetric radiometer. The spectrometer across all stokes measurements shows the magnitude of line split in frequency. The four polarization spectral shapes give information about the direction of the magnetic field relative to the space-craft line of sight vector. Over the past 15 months MEM instrument performance has been extremely stable across all 12 radiometers. The noise performance of the radiometer has exceeded the initial goal requirement achieving around 1.6K. MEM does not have any internal calibration sources, however, periodic cold-sky observations at every orbit all the instrument calibration to be tracked and validated. We will present on-board instrument performance, as well as a detailed account of post-launch calibration activities with respect to EZIE. We will present, how EZIE measurements have helped correct decades old atmospheric models and first order validation of the instrument calibration with respect to ground-truth and retrieved magnetic field products during quiet conditions. We will also present future technology concepts enabled by MEM.

Poster | HELIOTECH

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Development of the SOlar Neutron TRACking (SONTRAC) Instrument

Solar eruptive events including solar flares and coronal mass ejections are known to accelerate charged particles to high energies. If those charged particles precipitate toward the solar surface, those accelerated ions can produce secondary neutrons via interactions with the dense plasma of the chromosphere and photosphere. Solar neutrons are among the least measured products of solar flare acceleration due to their low interaction cross sections and brief lifetime before they undergo beta decay. The SOlar Neutron TRACking (SONTRAC) instrument aims to fill this measurement gap. SONTRAC is a novel imaging neutron spectrometer utilizing a scintillating fiber hodoscope read out by miniature silicon photomultipliers. In this work, we describe the refinement and optimization of the next-generation SONTRAC instrument based on lessons learned from tests of the previous generation of SONTRAC. These refinements include a newly designed fiber bundle, the development of custom silicon photomultiplier arrays and newly designed readout electronics. We also discuss the testing and validation of the next generation of SONTRAC. Updates on the development of these technologies as well as future plans will be discussed.

Poster | HELIOTECH

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Assistance Magnetometer on the Resolute Rocket Rideshare

The Assistance Magnetometer will fly on the Resolute Rocket Mission as a Rideshare payload and takes the name of one of the sister Arctic exploration ships to HMS Resolute. The magnetometer will (1) enable crucial space environment technology development for a new boom-less magnetometer; (2) provide rocket magnetic noise identification; (3) provide redundancy to the fluxgate magnetometers; (4) mitigate risk of boom deployment mis-alignment and failure; and (5) contribute to understanding of estimates of Poynting Flux (S) and field-aligned currents (FAC) for cusp science investigations enabling calibrated and clean magnetometer observations to observe the smallest scales of S and FAC possible. The presentation will describe the design of the instrument and description of the noise identification algorithms.

Presentation | DAY 5 | SEPTEMBER 4 13:15 | Session Advanced Electromagnetic Field Sensors and Magnetometers | HELIOTECH

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First Look at ICI-5bis Sounding Rocket Triaxial Fluxgate Magnetometer Data

The ICI5b sounding rocket launched from Andøya Space in Andenes Norway on March 10th, 2026. The Iowa Spaceflight Laboratory at the University of Iowa provided two triaxial fluxgate magnetometers to complement the European suite of plasma instruments, as a technology demonstration of new fluxgate technology. The rocket was launched to intercept an auroral arc during a modest substorm to better understand: the role of Alfvén waves in auroral precipitation, how turbulence and instabilities vary with different scales, and how soft electron precipitation influences plasma structuring. Initial results suggest that both Space Weather Iowa Magnetometer (SWIM) instruments operated nominally, capturing the DC vector magnetic field throughout flight. This was a HESTO Pathfinder flight, providing a flight demonstration of a nanosatellite scale fluxgate gradiometer infusing new low-noise fluxgate cores. Here we present first results of the data from the suborbital flight.

Poster | HELIOTECH

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Scotopic Solar Activity X-ray Imager SmallSat (SSAXI-SmallSat) Mission Concept

The Scotopic Solar Activity X-ray Imager SmallSat (SSAXI-SmallSat) mission concept builds on the instrument prototype of SSAXI-Rocket. SSAXI-SmallSat science goals are to: (1) characterize the quiescent solar coronal transients contribution to the quiet Sun heating budget, (2) constrain the active region hot plasma plasma temperature (>1 MK) structure and evolution, and (3) quantify the elemental composition change of low first ionization potential elements (Fe, Ca, Mg, Si) in active regions and the quiet Sun. SSAXI-SmallSat is designed to image the spectral soft X-ray flux from 0.5 – 7 keV over a large dynamic range (~104), on timescales of a minute or less. Spectrally integrated soft X-ray flux will be measured on sub-second time scales. SSAXI-SmallSat will combine small X-ray focusing optics (Wolter-1) with on-axis imaging resolution of 10 arcseconds or better with high-speed readout detectors (CMOS), to construct comprehensive observations of the solar corona from 1 MK – 30 MK. These high-time cadence and spectrally resolved measurements will help uncover the dominant physics of intermittent heating processes in the magnetic solar corona and other Sun-like stars. The SSAXI-SmallSat Mission Concept has been selected by the 2024 NASA Heliophysics Flight Opportunities Studies (HFOS) for Instrument plus Mission Design Lab studies in preparation for a flight mission proposal submission.

Presentation | DAY 2 | SEPTEMBER 1 10:15 | Session Next Generation Solar Science Instrument and Missions | HELIOTECH

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Total Solar Eclipse in 2033 Over Alaska

On the morning of March 30, 2033, a total solar eclipse will occur over western Alaska. The umbra's eastern boundary will span part of Nunivak Island and up to just east of Prudhoe Bay. The line of greatest eclipse will pass from Nome up through Utqiagvik. The eclipse obscuration will be greater than 90% throughout Alaska. There are a number of well-instrumented locations inside the path of totality including the Toolik Field Station, with totality lasting about 1.25 minutes, and the (proposed) Oliktok Point sounding rocket launch site, with totality lasting slightly over 2 minutes. At these two sites, the penumbral duration is just under 2 hours. Also, the Poker Flat Research Range will see a maximum obscuration of about 98% and a penumbral duration of just under 2 hours. Several radars observe ionospheric regions over northern Alaska that will be perturbed, including PFISR and SuperDARN. This upcoming total solar eclipse will provide a large natural perturbation to the high latitude ionosphere/thermosphere and there are many open science questions that can be addressed by observing the impulse response. Note that previous rocket and ground-based eclipse studies have shown that even a partial eclipse can produce observable effects. This eclipse also occurs in the morning, with the sun having just risen at some of the south-western locations in the path of totality, which may create unique ionosphere/thermosphere responses. This poster will review previous eclipse effects and present open questions for this upcoming eclipse that could be addressed with sounding rockets, balloons or orbital platforms (such as the recently selected DYNAMIC mission).

Poster | HELIOTECH

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Dione: A Pathfinder Mission for Understanding the Ionosphere-Thermosphere Responses to Magnetospheric Forcing

Dione is a NASA small satellite prototype for future constellations that in different configurations will provide global and localized measurements of Ionosphere-Thermosphere responses to Magnetospheric energy input in a variety of scales, enabling their better forecast and prediction. The payload for the spacecraft includes four instruments: a miniaturized fluxgate magnetometer with two sensor heads, an ion sensor that measures vector plasma drifts and deduce the in-situ electric fields, an electrostatic analyzer that measures precipitating electrons and up-going secondary electrons, and a neutral mass spectrometer measuring total neutral density and composition. The Dione is a 6U CubeSat that will be 3-axis stabilized in a circular low-earth (400-540 km), high-inclination orbit, traversing the auroral precipitation and high latitude currents in every orbit. This presentation focuses on mission-level architecture, but provides contextual information on science objectives, instruments, and spacecraft. This presentation will also include details of how lessons learned from previous missions with similar architecture were incorporated into Dione development, Integration and Testing. Moreover, we will present how these lessons can and should be applied to future missions and which are scalable to enable more rapid and effective constellations. Plain language: Dione is a small NASA satellite that will be in a circular low-earth orbit (400-600 km), going over the auroral regions and high latitudes in every orbit. This enables the simultaneous measurement of both the magnetospheric energy inputs and the resulting responses from the atmosphere. Information on that relationship can be used to enable better forecasting and prediction of space weather. Especially when applied to the larger scales of constellations.

Presentation | DAY 4 | SEPTEMBER 3 10:15 | Session ITM Technologies and Missions | Orbital Flight

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Current State of the All-solid-state 4.7 THz Terahertz Limb Sounder (TLS) for Observing Thermospheric Winds, Temperature, and O Density

TeraHz Limb Sounder (TLS) is a remote sensing radiometric instrument that collects light from Atmospheric Oxygen, O, emission lines that arise from transitions of the fine structure levels. The 4.75 THz OI emission (3P1->3P2) is the brightest thermospheric emission source; it is present everywhere and is always in thermodynamic equilibrium with the ambient temperature at least up to 500 km altitude. This OI emission line enables concurrent estimation of Oxygen density, temperature and line-of-sight wind component from the acquired spectra. TLS enables the first long-term observations in a low SWAP package of this emission line , which is specifically called out in the 2024 Decadal Survey as the science enabling instrument for thermosperhic science and was called out as a high-priority technology development in the 2023 HESTO report. This HTIDeS technology maturation project presents a viable way toward achieving an all-solid-state heterodyne receiver solution. The initial concept design featured the 3rd order harmonic mixer based on the GaAs technology pumped by the Local Oscillator (LO) at ~1.6 THz. The project achieved a prototype LO with world record output power at 1.6 THz. Detailed electromagnetic simulations and other works on higher-order THz mixers, however, indicated mixer noise levels, Tsys, or >80,000 K DSB, which would not enable a desired radiometric sensitivity. The team re-designed the 4.7 THz frontend to a sub-harmonic mixer design that got enabled by the new generation of commercially available W-band amplifiers, promising ~0.7mW LO output power up to ~2.4 THz. We employed a minimum variance optimal estimation method for the evaluation of TLS receiver performance on simulated data acquired by using the state-of-the-art Observing Simulated System Experiment (OSSE). We performed line-of-sight and profile inversion performance retrievals over the predicted ranges of system noise, integration times, and sampling resolution.

Presentation | DAY 4 | SEPTEMBER 3 14:30 | Session Solar Coronal Imaging and Heliospheric Science | HELIOTECH

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Tomographic Reconstruction of Ionospheric Plasma Density from Faraday Rotation for the GNEISS Sounding Rocket Mission

The GNEISS sounding rocket mission (Lynch 397 and 398), which launched in February of 2026 out of Poker Flat AK, consisted of two rockets launched nearly simultaneously, and aimed to study current closure in non-sheetlike discrete auroral arcs. It leveraged multiple heterogeneous data sources, including remote sensing from ASI cameras and the PFISR Radar, and several in-situ particle and field instruments carried by each rocket. It also collected Total Electron Content (TEC) data through the Lattice Beacon system, a network of rocket-based transmitters and ground-based receivers deployed across interior Alaska. Each rocket carried a USRP Software-Defined Radio (SDR) that transmitted a 163 MHz continuous-wave linearly polarized signal, which was received by 10 low-cost two-channel SDR-based receivers spread out under the trajectory of the rockets. The receivers were equipped with cross-yagi antennas, enabling them to measure the polarization of the received signal. The Faraday effect causes the plane of polarization of the transmitted signal to rotate by an amount proportional to the TEC along the signal's path. With the initial polarization of the transmitted signal known from the rocket attitude data, Faraday rotation angle and therefore TEC can be inferred. Tomographic reconstruction techniques allow the TEC data over 20 lines of sight to be inverted into a 2d, or possibly 3d map of plasma density under the rocket trajectory. This information will complement existing density measurements and inform plasma density over a much larger space than would be possible from Radar and in-situ measurements alone.

Presentation DAY 4 SEPTEMBER 3 13:30 | Session ITM Technologies and Missions | HELIOTECH

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Aeolus-Earth Heliophysics Mission

The Aeolus-Earth Mission (DWTS-Helio) is a recently selected NASA Heliophysics investigation that will apply the innovative Doppler Wind Temperature Sounder (DWTS) technique to the Space Atmosphere Interaction Region (SAIR) at ~105-180 km. The technique, invented by Gordley & Marshall (2011), applies the Doppler Scanning with Gas Filter (DSGF) technique using a cryo-cooled MWIR radiometer to view the limb of the atmosphere from LEO (orbital velocity creates the Doppler shifts required by the technique). For this implementation of DWTS, a Nitric Oxide (NO) low pressure gas cell is used. The limb of the atmosphere is observed from a spacecraft at orbital velocity, and as an observed air volume passes through the field of view, this velocity creates a set of Doppler-shifted images. These images are used to create Doppler Integrated Pass (DIP) signals, from which atmospheric temperature and wind profiles are extracted (it may be considered a converse of the successful in-flight calibration of gas cells used for the HALOE instrument). The technique is relative, removing the need for absolute radiances, and the signal-to-noise ratio for this technique is high, resulting in good measurement precision. Different gas cells can be used to create different altitude coverage and may be combined to measure a more continuous altitude range. For example, using a NO cell captures the lower atmosphere from 30-50km as well as the SAIR, while using the 13 isotopologue of CO2 would capture 50-120km. Due to the desired data volume as well as power and thermal considerations, this initial Aeolus-Earth flight will be more suited for a 'hosted' payload on an Orbital Maneuvering Vehicle platform instead of the 'free-flyer' option originally investigated. Lastly, the technique is sufficiently powerful that a two-channel system could produce full Mars atmosphere data not currently possible.

Presentation DAY 4 SEPTEMBER 3 11:15 | Session ITM Technologies and Missions | Orbital Flight

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Lightsheet Anomaly Resolution and Debris Observation (LARADO) Observation Preliminary Results

Objects in the size range of 0.1 mm to 3 cm are not currently trackable but have enough kinetic energy for hazardous or lethal consequences to spacecraft. The detection of small orbital debris, which potentially poses a risk to most space missions, requires a combination of a large sensor area and large time coverage. For example, a sensor with a time area product of 3 m^2*years is considered to be able to make a significant contribution to our understanding of the near-Earth small debris population. Deploying physically large sensors, however, is generally resource intensive, due to their size and weight. The lightsheet sensor concept, allows the creation of a "virtual witness plate" without any supporting physical structure and therefore presents an attractive opportunity for the detection small debris anywhere between low Earth orbit to interplanetary space. In this work, we will present preliminary results from the LARADO instrument on STPSat-7 which was launched via a Minotaur IV on April 7, 2026.

Presentation DAY 2 SEPTEMBER 1 16:45 | Session Space Weather Monitoring and Space Debris | HELIOTECH

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Soft X-ray Hybrid CMOS Detectors: An Option for Solar Observation

Soft X-ray (SXR) instruments are sensitive to emission from the hot plasma produced in the solar corona, both during flares and at quiescent times. SXR observations of flares and associated eruptions can thus be used to investigate magnetic energy release through examining heating processes, a major aspect of the flow of energy throughout these events. Past solar SXR missions such as Hinode, MinXSS, and the various iterations of GOES have concentrated on either spectroscopy or imaging, and/or have required multiple filters for concentration on either low or high source brightness. The ability to perform both imaging and spectroscopy simultaneously, for both quiescent and high-flaring states, would open new doors of solar observation, but has been difficult historically due to the wide range of wide dynamic range during both the quiet and flaring sun. The most successful published example to date has been the flights of the PhoENIX monolithic CMOS sensor on the flights of the FOXSI-3 and FOXSI-4 sounding rockets. Despite their optimization for solar observations, it was necessary to employ two telescopes with varying degrees of attenuation. Hybrid-CMOS detectors (HCDs) present an attractive option for use in solar observations. They offer improvements over CCDs in their rate capabilities, their radiation hardness and their power requirements, and improvements over monolithic CMOS in their energy band of sensitivity and in their rate capabilities. HCDs offer both high full frame rates (>150 frame/sec), as well as the capacity to operate in an event-driven mode that can bring the effective frame rate to a blistering ~10,000 frame/sec. These sensors have the potential to offer substantial improvements in detector dynamic range, which could be implemented in future SXR solar missions to allow observation of sources across a much wider range in brightness.

Poster | HELIOTECH

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Commercial Science as a Service: Utilising the C-130J Super Hercules as a Sustainable and Globally Deployable Airborne Science Platform

Scientific communities worldwide continue to face increasing challenges associated with the cost, availability, and operational flexibility of traditional airborne science platforms. This paper presents a novel Commercial Science as a Service (CSaaS) model that leverages the proven capabilities of the C-130J Super Hercules aircraft as a sustainable, multi-mission airborne science platform capable of supporting atmospheric, heliophysics, astrophysics, Earth observation, and technology demonstration missions on a global scale. This paper examines the operational architecture, economic sustainability, AI-enabled mission framework, and scientific applications of the ASCENT Program. It demonstrates how existing aerospace platforms can be transformed into next-generation airborne laboratories, establishing a repeatable and scalable model for delivering affordable, responsive, and sustainable science missions while expanding access to advanced research infrastructure worldwide.

Poster | HELIOTECH

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Flight Status of the STORIE ISS Energetic Neutral Atom Imaging Science Instrument for Geospace Remote Sensing

The Storm Time O+ Ring Current Imaging Evolution (STORIE) mission was launched to the ISS on May 15, 2026, with SpaceX CRS-34 as part of the Space Force STP-H11 suit. STORIE employes a large aperture neutral atom imaging instrument with FOV (4o x +/- 46o), (GF ~1 sr.cm2) making line of sight H, O ENA measurements in the energy range ~1-200KeV. After successful deployment to the Colombus Module few days later the instrument was successfully activated verifying nominal engineering operation and presently in fine science measurement commissioning. The instrument is based on multi-foil TOF sensing/coincidence, HV electrostatic optics, HV plasma/charged particle rejection, and solar blind UV suppression. Leveraging the motion of the ISS and real time telemetry STORIE makes global inside-out line-of-site ENA images for real time studies of geospace and space weather. This presentation will summarize the inflight instrument performance, including energy range, H, O separation, angular resolution, energetic particle rejection, UV rejection including direct sun light, in flight calibration, signal and noise.

Presentation | DAY 5 | SEPTEMBER 4 9:00 | Session | Magnetospheric Dynamics & Geospace Missions and Technologies | Orbital Flight

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CLASS: A Miniaturized FUV Lyman-Alpha SHS for Future Heliophysics Missions

Solar Energetic Particles (SEPs; >10 MeV) pose significant hazards to spacecraft and astronauts, yet the mechanisms responsible for their acceleration remain poorly understood. Measurements of superthermal ions in the near-Sun environment are essential for determining how coronal mass ejection (CME) shocks generate SEPs, but current observations rely on large, resource-intensive instruments. The Compact Lyman-alpha Spatial Heterodyne Spectrometer (CLASS) is a miniature, ultra-sensitive far-ultraviolet (FUV) instrument designed to address this challenge. Utilizing Spatial Heterodyne Spectroscopy (SHS), CLASS provides high-resolution spectroscopy of the hydrogen Lyman-alpha line (121.6 nm) with spectral resolution $\Delta\lambda < 0.01$ Å in a compact package (<2 kg). Its monolithic, all-reflective SHS architecture, the first of its kind, substantially reduces mass, volume, and alignment complexity relative to conventional coronagraph spectrometers, making it well suited for future flight missions. CLASS is designed to detect faint Lyman-alpha wing enhancements and line broadening signatures associated with superthermal ions and solar wind outflows in the extended corona. Following space validation, CLASS will enable transformative measurements of SEP source regions in the inner heliosphere and directly support Heliophysics Decadal Survey priorities, including improved space weather forecasting and understanding SEP origins. Acknowledgments: This work was conducted at the Jet Propulsion Laboratory, California Institute of Technology, under contract with NASA.

Presentation | DAY 2 | SEPTEMBER 1 10:30 | Session | Next Generation Solar Science Instrument and Missions | HELIOTECH

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N-TOF Materials Development: Graphene Foils and Alternatives to Copper-Oxide Blackening

Resolving N^+ and O^+ in the 100 eV–30 keV range is critical for quantifying atmosphere–ionosphere–magnetosphere coupling and space weather at Earth, yet their masses differ by only ~2 u. Conventional electrostatic analyzer (ESA) and time of flight (TOF) instruments achieve this by using ultra-thin carbon foils, large TOF sections, and high post acceleration voltages (up to ±15 kV). The N-TOF instrument is optimized to discriminate N^+/O^+ while reducing size, weight, power, and cost by introducing enabling technologies such as graphene foils and alternative blackening solutions. Graphene foils are atomically thin carbon membranes that generate secondary electrons with significantly reduced ion energy loss and angular scattering relative to conventional foils. Graphene foils promise higher M/Q resolution at lower voltages and improved low energy sensitivity. Using PMMA backed "Trivial Transfer" graphene, we established a floating process to transfer foils onto centimeter-scale electroformed nickel grids with up to ~75% intact cell coverage – comparable to 3 mm commercial graphene transmission electron microscopy grids but over an order of magnitude larger area. Iteration on the transfer process is ongoing, with the goal of achieving >95% intact cell coverage and a reproducible, flight ready process. In parallel, we evaluated alternatives to Ebonol-C copper oxide blackening, which, while optically excellent, is fragile, process sensitive, and supply limited. Through coupon and ESA tests, we assessed coatings including Acktar Vacuum Black, Aerodag, and AnoBlack [Ni]TE. Several candidates provide comparable UV absorptivity, with substantially improved mechanical robustness, process control, and yield. Together, these efforts demonstrate graphene foils and blackening alternatives for next generation ESA-TOF instruments, reducing technical and programmatic risk while enabling high resolution composition measurements for future heliophysics and space weather missions.

Poster | HELIOTECH

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A Methodology for Evolving Aerodynamically Optimal Spacecraft in the Free Molecular Flow Conditions of Very Low Earth Orbits

Very low Earth orbit (VLEO) enables improved spatial resolution and access to the lower thermosphere, but sustained operations are limited by strong, highly variable aerodynamic drag in the free molecular flow regime. Designing for this high-drag environment is only part of the challenge; the spacecraft must also meet numerous other requirements, including mass, volume, power, and pointing constraints. Together, these requirements motivate design methods that can explore large parameter spaces with multiple competing objectives. We present an end-to-end workflow for VLEO shape optimization that couples the point-cloud-based representation from our ECLIPSE evolutionary computation framework with the Vehicle Environment Coupling and TrajectOry Response (VECTOR) aerodynamic simulator. A key challenge is ensuring that the aerodynamic model and optimization representation use a consistent and effective level of geometric detail. As a first step, we conducted sensitivity studies in VECTOR to quantify the impact of surface feature size and surface resolution on computed force coefficients. These results set the minimum feature scale and mesh resolution in the ECLIPSE pipeline, ensuring that geometric changes translate into meaningful evolutionary pressure. Building on this, we used the NSGA-II multi-objective evolutionary algorithm implemented in ECLIPSE to evolve a population of spacecraft shapes that explicitly trade volume against drag. The runs produced a diverse Pareto front of optimized geometries, demonstrating that the workflow can generate and evaluate candidate geometries and apply selection pressure across a wide design space. The key benefit of this method is that it is unconstrained by conventional engineering intuition: by evolving free-form geometries directly, it explores a far larger and more complex design space than traditional methods can practically cover, potentially revealing aerodynamically optimal shapes that would otherwise remain undiscovered.

Presentation | DAY 1 | AUGUST 31 15:45 | Session | Platform Technologies, Mission Design, and Autonomy | HELIOTECH

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In-Flight Cosmic-Ray Muon Measurements with a CubeSat-Size Detector Prototype

Variations of the radiation environment in Earth's atmosphere are coupled to solar activity on long timescales (the 11-year cycle) and to transient events (flares, coronal mass ejections, solar energetic particles, etc.). Monitoring and predicting this radiation environment, in Earth's lower atmosphere and near-Earth space, is essential for astronauts, aircraft crew, and passengers. Acquiring such measurements requires detector technology that is compact, reliable, and affordable. This talk presents the current status and results of compact cosmic-ray muon detectors (CubeSat-size prototypes) that could be used for in-flight measurements. Summary statistics from more than 20 flights will be presented, together with an assessment of the prototypes' reliability through comparison with physics-based radiation environment models. Other applications of the technology, including the currently operating ground-based muon detector network (gLOWCOST) and the prospect of space-borne measurements, will be discussed.

Presentation | DAY 2 | SEPTEMBER 1 15:30 | Session | Space Weather Monitoring and Space Debris | HELIOTECH

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Dione: Constellation Pathfinder for Near Earth Space Weather

Dione is a NASA small satellite prototype for future constellations. It will demonstrate measurements in smaller scales that can then be used with many small satellites that cover a more global region of space. The main science target is the energy input that comes into the atmosphere from farther out, in the magnetosphere; and then the response of the atmosphere to that input. Dione will measure several key properties of space plasmas: the magnetic field, the charged particles that create the aurora, the drift of the plasma, and the neutral particles. Dione is on a circular low-earth orbit (400-600 km), going over the auroral regions and high latitudes in every orbit. This enables the simultaneous measurement of both the magnetospheric energy inputs and the resulting responses from the atmosphere. Information on that relationship can be used to enable better forecasting and prediction of space weather. Especially when applied to the larger scales of constellations and the combination of measurements from the ground. This presentation focuses on the Dione science objectives and the heterogeneous approach of combining in-situ Dione and ground-based observations.

Poster | Orbital Flight

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Line Survey and Density Sensitivity Studies in Support of Hinode, MUSE, and Solar-C

We plan to measure key atomic data used to analyze solar EUV spectra. Our work builds on expertise developed under our previous two HTIDS grants. Fe X traces 1 MK coronal gas. It has been observed by SERTS and EIS/Hinode and will be studied by EUVST/Solar-C. Our work has found significant errors in the Fe X line identifications. These hinder accurate interpretation of Fe X spectra. We will carry out a high-resolution Fe X line survey in the ~170-290 Å bandpass to resolve these issues by unambiguously identifying Fe X lines in the EIS and EUVST bandpasses. Ca XV offers useful density diagnostics for high temperature emission from active regions and solar flares. Accurate densities are required for constraining steady-state vs. impulsive heating models. These diagnostics use the emission lines at 181.90, 182.86, and 200.97 Å, which are observed by EIS and will be observed by EUVST. However, solar flare observations find that these lines do not agree as to the inferred density, likely due to errors in the underlying atomic data. We will experimentally calibrate these Ca XV density diagnostic line ratios. MUSE is a 35-slit spectrometer with bandpasses centered on three bright EUV lines: Fe XIX at 108 Å, Fe IX at 171 Å, and Fe XV at 284 Å. The multiple slits will result in overlapping spectra. To disambiguate these data, a complex model will be used that accounts for all blending lines; but many of these blends are unidentified and significant contributions are expected from several charge states of O, Ne, Al, Si, S, Mg, Fe, and Ni. We have already carried out extensive line surveys for the 171 A bandpass for AIA/SDO. We will perform detailed line surveys for each of these elements in the 108 and 284 Å bandpasses to precisely determine wavelengths, identify blends or unrecognized lines, and enable reliable use of the MUSE spectra. For this work, we will use the Lawrence Livermore National Laboratory electron beam ion trap to resolve the above issues.

Presentation | DAY 2 | SEPTEMBER 1 14:00 | Session | Next Generation Solar Science Instrument and Missions | HELIOTECH

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Quantifying Microbursts as a Radiation Belt Loss Process Through the Combination of Direct Measurements of Precipitating Electrons and Imaging of Atmospheric X-rays

A major outstanding question in radiation belt physics is the degree to which microbursts deplete the outer radiation belt. Microbursts are highly localized, intense bursts of electrons with energies in the keV-MeV range. They are observed at low altitudes on magnetic field lines corresponding to the outer radiation belt, most often during the main and early phases of geomagnetic storms. The goal of the Imaging Microburst Precipitation with Atmospheric X-ray Emissions (IMPAX) CubeSat is to quantify relativistic electron microburst precipitation as a radiation belt loss mechanism. IMPAX will measure the energy distribution, both flux and spectrum, of electron microburst precipitation into the Earth's atmosphere as well as their source location. These measurements will enable us to quantify this loss process to a much greater extent than previous balloon-based missions and enable us to determine the relative importance of microburst precipitation as a radiation belt loss process. IMPAX will be employing the novel approach of combining high-resolution direct measurement of electrons within or near the loss cone with the imaging, in low-Earth orbit, of bremsstrahlung X-ray emissions created when precipitating microbursts hit the upper atmosphere. This combination allows a precise measurement of the bounce loss cone electron flux and spectrum as well as the energy-time dispersion required for the identification of the microburst generation location. The I-AXIS X-ray imager and the I-FIRE particle detector will provide us with the observations required to answer our science questions. In its science-taking mode, IMPAX will have to point the I-FIRE instrument towards magnetic zenith to sample loss cone electrons, while I-AXIS will be pointing towards magnetic nadir, where it will image the upper atmosphere. The mission has recently passed NASA's CDR gate review and is in the assembly, integration, and testing phase and scheduled to be launched in October 2027.

Presentation DAY 5 SEPTEMBER 5 9:30 | Session Magnetospheric Dynamics & Geospace Missions and Technologies | Orbital Flight

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Ion Velocity Mass Spectrometer (IVMS) Tech Demo Flown on GIRAFF Sounding Rocket

We present initial results of our Ion Velocity Mass Spectrometer (IVMS) tech demo that was flown on the Ground Imaging to Rocket investigation of Auroral Fast Features (GIRAFF) sounding rocket flight (36.380 GE) on February 9, 2025 UT, from Poker Flat AK. The purpose of the flight was to measure in situ particles and fields within active auroral features, in search of flickering aurora. An all-sky camera north of Poker Flight, along with the upstream solar wind plasma and magnetic field measurements were used to determine when to fly. The IVMS uses a Circular Wien Filter (CWF) which measures the ion velocity V combined with top hat electrostatic energy analyzer referred to as ESA which measures the ion energy-per-charge $E/Q = ½ (M/Q) \times V$^2. So, by knowing the ion's E/Q and velocity V one can measure the ion's mass per charge M/Q. The CWF is composed of 16 SmCo magnets with field strength ~ 0.25 Tesla. The instrument was designed to measure ions up to 30 kV but was operated in flight between 30 V and 15 kV. The IVMS had sixteen 22.5° angular sectors but only 8 were used to cover 180° in ion pitch angles with rocket spin axis aligned with the local magnetic field. In one spin period, it covers 4π space. Using gyrotropy and performing 32 energy step sweeps in ~ 1 second one can get a complete measurement of the ion velocity distribution function (VDF). We measured protons, nitrogen and oxygen ions, once each spin, so a measurement cycle was completed in ~ 3 seconds and then repeated until re-entry. The maximum altitude reached was 303 km. We will present results along with a more detailed description of instrument parameters, and planned improvements based upon the results obtained. Most of the design improvements have to do with the CWF such as increasing the magnetic field strength to ~ 1 Tesla, in order to increase the mass resolution.

Poster | HELIOTECH

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Tandem Ion Mass Spectrometer for Moon to Mars Missions

We will present a progress report about our Tandem Ion Mass Spectrometer (TIMS) and its primary application for the Moon to Mars Program. It has energy-per-charge range 1 V ≤ E/Q ≤ 50 kV, wide field-of-view (FOV) 360° x 90°, and wide dynamic range in ion intensities (i.e., can also observe solar wind protons). Regarding the moon, our prime interest is the composition of volatiles coming from Permanent Shadow Regions (PSRs) within the South Polar Atkins Basin. TIMS is composed of frontend (Circular Wien Filter (CWF) and top hat Electrostatic Analyzer (ESA)) and 3-stop time-of-flight (TOF) backend with -15 kV post-acceleration. We will present some results of our TIMS tech demo, and new simulation results of TIMS that will impact its design parameters. It's important for TIMS algorithm which corrects for carbon foil (CF), induced ion scattering and ion energy straggling, to increase TIMS frontend mass resolution which is proportional to the CWF magnetic field strength B (i.e., increase B to ~ 1 Tesla using SmCo magnets). We are also looking into using high intensity neutron beams (i.e., J-PARC and ORNL) to measure the 3D magnetic field within the CWF, and Goddard's Magnetic Field Facility to measure the weaker magnetic fields outside the CWF. Regarding the algorithm we are presently investigating the use of AI to replace our physics-based algorithm. Future TIMS versions, will include heavier suprathermal ions and interstellar ions up to ~ 50 kV in the solar wind. For these measurements we need to boost GF > x10, increase detection efficiencies and use High Temperature Superconducting (HTS) magnets. Our future goal is the Milky Way's lower mass peak ~ 80 amu (i.e., 84Kr+) due to core collapse supernovae (CCSNe) with minor contribution from Binary Neutron Star (BNS) mergers (Chen et al., MNRAS, 529, 1154, 2024); to do this need to increase TIMS max energy to 80 kV (see Livi et al., SSR, 2025), with CWF B ~ 3.2 Tesla. HTS magnets will require cryogenic technologies.

Presentation DAY 1 AUGUST 31 11:30 | Session Heliophysics on the Moon and Mars | HELIOTECH

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Science Data Systems: EZIE Constellation Operations

The Electrojet Zeeman Imaging Explorer (EZIE) science data system supports constellation-scale data processing from Level-0 telemetry through higher-level science data products. The system architecture integrates workflow orchestration, event-driven automation, data management, and monitoring within a multi-institutional pipeline designed to enable reliable, repeatable, and traceable operations across multiple spacecraft. Emphasis is placed on the automation strategy used to reduce operational burden while maintaining visibility into system state, reprocessing requirements, and off-nominal investigations. By incorporating redundancy to improve operational resilience, the architecture supports continuity across distributed teams and systems and mitigates single-point failures in routine processing and response activities. The calibration approach adopted during operations is also described, along with lessons learned from the development and operation of the EZIE pipeline. These experiences highlight key design considerations for balancing scalability, robustness, and operational simplicity within a low-Earth-orbit mission data system.

Poster | HELIOTECH

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Conversion Surfaces for Low-energy Space Plasma Detection

Charge-changing conversion surfaces have been used as a detection technique for low-energy space plasma for decades. They have been successfully applied in instruments onboard planetary, lunar, and heliophysics missions such as IMAGE, IBEX, Mars Express, Venus Express, JUICE, BepiColombo, Chandrayaan, and, most recently, IMAP. Conversion surfaces enable the detection of charged and neutral particles either by changing the charge state or by emitting secondary electrons when particles are scattered at the surface at a grazing incident angle. They are an effective detection technique for energetic neutral atoms and interstellar neutral atoms at energies below 1 keV, at which other techniques, like carbon foils, are less efficient. Diamond-like carbon (DLC) is currently one of the most efficient materials for conversion surface coatings in space instruments designed for energetic neutral atom measurements. We present a comprehensive characterization of these DLC coatings and beam-test results with low-energy ion beams, including conversion efficiencies, angular scattering distributions, and negative and positive ion yields, for ion masses from 1 to 16 amu and energies from below 100 eV up to 2000 eV.

Poster | HELIOTECH

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X-ray Imaging of Energetic Electron Precipitation: First Results from the AEPEX Mission

Energetic electrons within Earth's radiation belts are a major source of radiation in the space environment and pose significant risks to spacecraft. During geomagnetic disturbances, electron fluxes can increase by orders of magnitude before gradually declining over subsequent days. A key pathway for this decline is atmospheric precipitation, particularly during the recovery phase of storms. When these electrons enter the upper atmosphere, they generate enhanced ionization across the lower thermosphere, mesosphere, and upper stratosphere, driving chemical changes that elevate NOx and HOx concentrations and deplete ozone. Accurately quantifying radiation belt loss processes and their atmospheric consequences requires detailed knowledge of the precipitating electron flux, energy spectra, and their spatial and temporal variability. The Atmospheric Effects of Precipitation through Energetic X-rays (AEPEX) CubeSat mission is designed to characterize the properties and extent of electron precipitation by measuring bremsstrahlung X-rays produced in the atmosphere. The Atmospheric X-ray Imaging Spectrometer (AXIS) forms images of hard X-ray emissions associated with precipitation events. AXIS combines coded aperture imaging with pixelated detector technology to provide ~100 km spatial resolution across a ~1000 by 1000 km field of view while measuring the photon energy spectrum between 50 and 250 keV. Complementary measurements of electron flux and spectra are provided at 1-second resolution by dual solid-state particle detectors derived from FIREBIRD heritage. AEPEX was launched in March 2026 and inserted into a 510 km sun-synchronous orbit in May 2026. Here, we describe the mission architecture, instrument design, and initial on-orbit performance, and present early observations demonstrating the mission's capability to characterize energetic electron precipitation.

Presentation: DAY 4 | SEPTEMBER 3 16:00 | Session: Magnetospheric Dynamics & Geospace Missions and Technologies | HELIOTECH

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DENTS: An In-Situ Sensor for Detection and Characterization of Small Debris Particles at Low Earth Orbit

Small orbital debris (< 1 cm) in near-Earth space constitute an evolving anthropogenic environment that poses an ever-increasing hazard to spacecraft and other valuable assets. These particles impact spacecraft at hypervelocity (> 1 km s^{-1}), producing effects ranging from surface erosion and enhanced instrument noise to system degradation or failure. With the rapid growth of space activity, the risk from small debris is now comparable to, or exceeds, that from natural meteoroids in Low Earth Orbit (LEO). Despite their importance, small debris remain poorly characterized due to a critical observational gap: they are largely undetectable from the ground and inadequately measured by existing on-orbit systems. The Debris and Meteoroid Environment Sensor (DENTS) is designed to address this gap through an in situ coincidence detection approach. DENTS integrates three complementary measurement techniques (polyvinylidene fluoride (PVDF) impact sensors, charge-collecting impact plates, and electric field antennas) into a single, cohesive instrument. It is sensitive to particles down to ~10 nm and can constrain velocity and mass for particles in the 1–100 μm size range over velocities from 1 to 70 km s^{-1}. In addition to direct impact detection, DENTS characterizes impact-generated plasma and associated electromagnetic disturbances, including debris clouds produced during hypervelocity impacts. We present recent advances in DENTS development to Technical Readiness Level (TRL) 5, including prototype validation in dust accelerator facilities, simulated space environment testing, and progress toward flight-ready configurations. DENTS is designed as a scalable instrument for deployment across platforms ranging from CubeSats to the International Space Station. It will enable characterization of small debris populations, including their temporal and episodic variability, as well as their impact on spacecraft systems.

Presentation: DAY 2 | SEPTEMBER 1 15:45 | Session: Space Weather Monitoring and Space Debris | HELIOTECH

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EZIE: Delivering High-Impact Heliophysics Science with a Rapid, Low-Cost CubeSat Mission

NASA's cost-effective Electrojet Zeeman Imaging Explorer (EZIE) focuses on a science problem that is ideally suited to today's smallsat technologies, combining: novel miniature instrument technology, state-of-art commercial CubeSats, propulsion-less constellation management, and a brand-new remote sensing technique. The spatiotemporal morphology of the ionospheric electrojets, which couple Earth and space and flow in the very low Earth orbital (VLEO) regime, are priorities for NASA science and space weather research. Flying a fleet of in situ magnetometers on separate spacecraft in VLEO is not technically feasible. EZIE instead remotely senses the fingerprint of electrojet current–induced magnetic field perturbations through the Zeeman splitting of the 118-GHz oxygen thermal emission near the electrojets (~105 km). Four compact spectropolarimeters in each of three Microwave Electrojet Magnetogram (MEM) instruments (12 total radiometers) aboard three 6U CubeSats in an in-line orbit configuration map the 2-D electrojet structure. By combining maps from the three spacecraft, the structure and temporal evolution of the electrojet are determined over a period of several minutes. The EZIE constellation was launched March 15, 2025 on the SpaceX Transporter-13 rideshare and deployed into low Earth orbit. The EZIE MEM instruments, built by the Jet Propulsion Laboratory, utilize novel microwave technology developed for Earth science and applied here to heliophysics. The EZIE CubeSats were developed commercially by Blue Canyon Technologies. Variable temporal sampling of the auroral region is accomplished solely by using differential drag maneuvers to control the inter-satellite spacing. EZIE was made possible through a unique collaboration of university, government, and commercial organizations, which successfully merged industry standards with agile commercial processes and technology while maintaining the oversight and accountability critical for mission success.

Presentation: DAY 4 | SEPTEMBER 3 9:30 | Session: ITM Technologies and Missions | Orbital Flight

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Vigil Compact Coronagraph (CCOR-3)

The Compact Coronagraph (CCOR) is a novel white-light solar coronal imager built by the US Naval Research Laboratory (NRL) on behalf of the National Oceanographic and Atmospheric Administration (NOAA) to provide operational space weather observations. The first CCOR launched on the GOES-East spacecraft to geosynchronous orbit on June 25, 2024. The second CCOR (CCOR-2) launched on the Space Weather Follow-On Lagrange 1 (SWFO-L1) spacecraft on September 24, 2025. In this paper, we describe the design and operations concept of the third CCOR instrument, CCOR-3. CCOR-3 is one of the remote sensing payloads on the European Space Agency (ESA) Vigil space weather monitoring mission. The Vigil spacecraft will operate at the fifth Sun-Earth Lagrange point, L5, and will allow CCOR-3 to observe the emergence of solar eruptions such as coronal mass ejections (CMEs) from a unique vantage point off the Sun-Earth line. CCOR-3 images will be used by ESA and NOAA space weather forecasters to estimate CME speed, trajectory and mass. These parameters are inputs to physics-based, heliospheric forecast models used by space weather forecasters to predict the arrival of coronal mass ejections at earth and the onset of the resulting geomagnetic storms. The CCOR-3 project is sponsored by NOAA. Distribution Statement A. Approved for public release: distribution is unlimited.

Presentation | DAY 2 | SEPTEMBER 2 15:00 | Session | Space Weather Monitoring and Space Debris | HELIOTECH

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First Spectra and Performance Characterization of a Spaceborne Vacuum Ultraviolet Fourier Transform Spectrometer

Fourier Transform Spectroscopy (FTS) has long provided unparalleled spectral resolution at visible and infrared wavelengths, but its application in the vacuum ultraviolet (VUV) has been limited by the lack of suitable beam-splitting technologies. The all-reflective VUV FTS architecture of the DeOliveira-Joyeux FTS pioneered at the SOLEIL Synchrotron demonstrated that ultra-high-resolution spectroscopy is achievable at wavelengths below 140 nm, opening new opportunities for heliophysics, planetary science, and astrophysics. Under NASA's HTIDeS program, the Laboratory for Atmospheric and Space Physics (LASP) is developing a ruggedized, compact VUV FTS suitable for future space missions. The instrument is designed to provide resolving powers approaching 10^6 while maintaining a substantially smaller footprint than conventional high-resolution grating spectrographs. We present the first spectra measured with the LASP VUV FTS engineering model and summarizes recent performance characterization of the instrument's critical subsystems. Initial measurements obtained using the visible reference channel demonstrate successful operation, optical alignment, and spectral reconstruction, providing the first verification of instrument functionality. Particular emphasis will be placed on characterization of the path-length measurement interferometer, which serves as the instrument's precision position metrology system. In addition, we present results from the scanning and stabilization subsystems that control the moving reflector assembly. The integrated stabilization system combines precision flexure mechanisms, piezoelectric actuators, and optical feedback control to maintain mirror alignment. Together, these demonstrations represent major milestones in the maturation of a spaceborne VUV FTS and provide a path toward future flight opportunities for ultra-high-resolution VUV spectroscopy.

Presentation | DAY 2 | SEPTEMBER 1 10:45 | Session | Next Generation Solar Science Instrument and Missions | HELIOTECH

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Shields-1 Mission Highlights: Technology Demonstration to Space Weather Observations

Shields-1, 3 unit (U) CubeSat, re-entered the atmosphere following orbital decay on 2/12/2026, after operating more than 7 years in polar low earth orbit, part of the NASA ELaNaXIX mission. The 3U CubeSat performed a technology demonstration of radiation shielding technologies during the mission with active dosimetry and observed the July-August 2019 solar minimum galactic cosmic radiation (GCR) environment, July 2023 solar active period, and the 11-12 November 2025 most energetic solar particle event (SPE) since 2005. The 11 November 2025 SPE generated ground level enhancement (GLE) -77. During the November SPE, 4 dosimeters operated with minimum proton thresholds of 201 MeV, 166 MeV, 151 MeV, and 132 MeV. The 201 MeV minimum proton energy channel measured a dose rate that was 15 times the baseline dose rate at the beginning of the SPE and a total of 0.508 cGy in 24 hours, which was 3 times greater than an average daily dose during an active solar period in July 2023. Shields-1 observed the SPE onset at 1052 UTC on 11 November 2025 over the South Pole and during GLE-77. The Shields-1 mission increased the development of small satellite radiation shielding and space weather observations with shielded dosimetry over the 7 years in operation.

Presentation | DAY 1 | AUGUST 31 15:30 | Session | Platform Technologies, Mission Design, and Autonomy | Orbital Flight

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Loft Orbital Heliophysics Flight Solutions

Loft Orbital serves heliophysics hardware and software customers with hosted payload, dedicated and constellation satellite missions in LEO. Loft offers customers a bus agnostic flight solution. Our standard satellite platform is the Longbow, derived from the OneWeb bus with more than 600 satellites in orbit. Longbow platforms are pre-qualified and maintained on shelf, enabling an on orbit delivery timeline of under 8 months from contract. Loft pre-books batches of Space-X launches ~every four months. Loft's Hub universal payload adapter acts as a hardware and software abstraction layer between the bus and payload, providing standardized interfaces. Loft's Cockpit mission control system allows customers to manage their payload. For heliophysics missions in LEO, Longbow offers up to 85 kg of payload accommodation, up to 200 W orbit-average power, up to 1100 W peak power, pointing accuracy, and knowledge better than 0.03° (3σ), slew rates above 1°/s, and X-band downlink up to 1.12 Gbps. Loft's AIT facility operates to ISO Class 8 standards and has in-house experience with magnetic cleanliness verification. For AI service, Loft has deployed multiple satellites equipped with radiation-hardened compute capable of on-orbit edge processing and inference and integrated Inter-Satellite Link capability through GEO relay for always on connectivity, and eliminating the need for ground station passes to transmit. Time-sensitive detections and notifications can be delivered immediately, while the full dataset can be downlinked later. Loft has deployed AI missions on behalf of customers for three years with an open infrastructure, allowing partners to deploy and iterate software in space. NASA JPL successfully demonstrated a visual language model operating on Loft infrastructure in space to classify optical imagery directly at the sensor. Loft is scaling our AI architecture with launch of the 10-satellite Altair constellation this year.

Poster | HELIOTECH

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L-MAG: A Dual-Fluxgate Magnetometer Suite That Can Survive the Lunar Night

Lunar magnetic field measurements connect the Moon's space environment, crust, and deep interior, enabling investigations from mantle conductivity and water content down to the evolution of the ancient lunar dynamo and the properties of the lunar core. However, these insights require long-duration, ultra-stable, low-noise vector magnetometry on the timescale of many days: a challenging feat given the extreme thermal cycling and severe power constraints on the lunar surface that threaten both measurement stability and instrument survival. Thus, L-MAG is an efficient, temperature-stabilized, dual-fluxgate magnetometer (FGM) system designed for continuous lunar surface operations through lunar day/night cycling. This system adapts two TRACERS-class FGMs, currently being built without an assigned flight opportunity, and will be qualified to TRL6 by the end of 2026. The key enabling technology is a magnetically transparent heater and thermally efficient sensor mount that minimizes parasitic heat loss without bulky blankets or complex harnessing. L-MAG validates its low-conductance mechanical interfaces and passive thermal treatments with thermal balance testing and detailed thermal simulation. A simple lander-compatible architecture keeps the dual-FGM suite easy to integrate and accommodate across CLPS landers, making it a strong candidate for upcoming survive-the-night capable landers, providing significant power and thermal margins for sustained, low-drift lunar magnetometry at any latitude. L-MAG is therefore a key milestone in enabling the long-duration surface measurements required to probe the Moon's interior, volatile inventory, and thermal evolution.

Presentation | DAY 1 | AUGUST 31 11:15 | Session | Heliophysics on the Moon and Mars | HELIOTECH

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HFLoop: A Compact Triaxial HF Magnetic Sensor for Solar and Planetary Radio Emissions

HF radio emissions, including type II solar radio bursts produced by CME-driven shocks, provide key remote diagnostics of electron acceleration and geoeffective space-weather drivers, but existing spacecraft measurements largely rely on electric-field antennas that are difficult to accommodate on small spacecraft and provide limited vector information. HFLoop uses three orthogonal ~20 cm loop antennas to measure vector magnetic fluctuations across the 10 kHz-100 MHz band, enabling direct characterization of wave intensity, polarization, and propagation direction without electrostatic assumptions. The instrument utilizes a novel printed design to bring manufacturing, assembly, and schedule costs down while maintaining noise performance capable of reaching the cosmic background at 1 MHz. The entire triaxial deployment system fits within a 4U CubeSat volume and will be qualified to TRL6 by late-2026 with environmental, vibration, TVAC, and deployment tests. HFLoop has already successfully flown on a NASA high-altitude balloon mission and is therefore ready for an orbital tech demo or mission, either of which would serve as a significant milestone towards routine HF magnetic-field measurements, enabling a viable path for small spacecraft to monitor solar radio bursts, diagnose CME-driven shocks, and expand radio astronomy across the heliosphere.

Presentation | DAY 5 | SEPTEMBER 11:30 | Session | Advanced Electromagnetic Field Sensors and Magnetometers | HELIOTECH

Presenting Author: Turner, Drew/Nordheim, Tom | Affiliation: Johns Hopkins University Applied Physics Laboratory (JHU APL) | Email: drew.turner@jhuapl.edu/tom.nordheim@jhuapl.edu
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Site-agnostic Energetic Lunar Ion and Neutron Environment (SELINE): A Future Lunar Surface Radiation Monitor

SELINE, the Site-agnostic Energetic Lunar Ion and Neutron Environment instrument is a combined charged particle telescope and neutron spectrometer that will provide unprecedented observations of the cosmic ray and secondary/albedo radiation environment on the lunar surface. As the pace of lunar exploration increases, better understanding of the surface radiation environment is critical for planning and executing human exploration of the Moon. The lunar surface is continuously irradiated by galactic cosmic ray (GCR) and other energetic particles which modify the regolith and produce a spectrum of secondary particles. Some of these secondaries escape the surface and contribute to the total ionizing dose on the surface. The secondary particle dose presents a significant contribution to total dose for astronauts engaged in operations on the Moon, and a space weather gap analysis, [1], has highlighted the need for better radiation measurement on the lunar surface. SELINE addresses this gap by simultaneously measuring all the contributions to the surface dose. SELINE consists of three high-heritage components: the Cosmic Ray Isotopes and Solar Particles (CRISP) telescope, the Fast Neutron Spectrometer (FaNS), and the Data Processing Unit (DPU). CRISP is a bi-directional, deep-detector stack that simultaneously measures the incident GCR flux and the charged secondary flux emanating from the lunar surface. FaNS is a capture-gated neutron spectrometer developed from heritage instruments on MESSENGER and Psyche that will measure the fast neutron component of the albedo flux. The DPU is based on APL's DPU-Lite architecture which was developed to provide flight-capable electronics at lower costs and faster development cycles than traditional space electronics. This talk will give an overview of the SELINE instrument, its science investigation, and status of its development. [1] Vourlidas, A., et al., (2021) "Space Weather Science and Observation Gap Analysis for NASA."

Presentation | DAY 1 | AUGUST 31 12:00 | Session: Heliophysics on the Moon and Mars | HELIOTECH

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Development of the Suprathermal Particle and Relativistic Electron Magnetic Spectrometer (SuPREMeS)

The Suprathermal Particle and Relativistic Electron Magnetic Spectrometer (SuPREMeS) is a novel and innovative instrument design that promises to deliver a next-generation, high-performance, and low-resource option for measurements of energetic particles in space. With funding support from NASA's Heliophysics Strategic Technology Office (HESTO), we are in the process of advancing the instrument design from Technology Readiness Level (TRL) 3 to 6, enabling a new instrument to address science related to Earth's and other planetary radiation belts, solar energetic particles (SEPs), and cosmic rays. SuPREMeS employs a novel geometry and state-of-the-art, innovative design for a magnetic spectrometer that enables an extended energy range (50 keV to 10 MeV for electrons; 1 – >12 MeV/nuc for ions); high energy resolution (~2%); ion composition; extraordinary signal cleanliness from background characterization and removal; multiple simultaneous fields of view; and magnetic cleanliness, all from a compact, low size-mass-and-power (SWaP) instrument. In this presentation, we will: introduce the SuPREMeS concept and design; discuss instrument performance expectations and supporting simulation results; present preliminary results from prototype testing; and detail the latest estimates for performance ranges and SWaP.

Presentation | DAY 4 | SEPTEMBER 3 16:15 | Session: Magnetospheric Dynamics & Geospace Missions and Technologies | HELIOTECH

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MiniMag: A Broadband Magneto-Optical Magnetometer for Future Heliophysics and Planetary Missions

Magnetic field measurements are fundamental to heliophysics and planetary science investigations, providing critical observations of magnetic field dynamics, plasma waves, magnetic reconnection, particle acceleration, and space weather processes. Most heliophysics missions rely on two complementary magnetometer technologies: fluxgate magnetometers for low-frequency measurements and search-coil magnetometers for higher frequencies. Achieving broadband magnetic field coverage therefore requires two sensors, increasing instrument mass, power consumption, and the complexity of spacecraft integration. The Miniature Magneto-Optical Magnetometer (MiniMag) is a novel single-sensor magnetometer based on the Faraday effect. It is designed to address this limitation by enabling broadband magnetic field measurements with a single compact instrument. MiniMag is being developed to measure magnetic fields from DC to 40 kHz, spanning the frequency range currently covered by both fluxgate and search-coil magnetometers. The underlying sensing approach offers a pathway toward substantially higher-frequency measurements in future implementations. MiniMag's compact size, low mass and power consumption make it attractive for small satellites, multi-point measurements on a single spacecraft, and future exploration missions operating under stringent resource constraints. Ongoing development under NASA H-TIDeS is focused on technology maturation from TRL 3 to TRL 6 through miniaturization, environmental testing and performance characterization. This presentation will provide an overview of the MiniMag instrument concept, recent development progress, and the path toward deployment on future heliophysics, lunar, and Mars missions.

Presentation | DAY 5 | SEPTEMBER 4 10:45 | Session: Advanced Electromagnetic Field Sensors and Magnetometers | HELIOTECH

Presenting Author Vourlidas, Angelos | Affiliation Johns Hopkins University Applied Physics Laboratory (JHU APL) | Email angelos.vourlidas@jhuapl.edu
CoAuthors APL-Argotec-NRL Teams

MiniCOR: Developing a Miniature Coronagraph for LEO Operations

Coronagraphs capture the development of coronal mass ejections (CMEs) throughout near-Sun space and provide critical information on CME evolution and propagation, which in turn supports space weather forecasting. It makes strategic sense to lower the technological and logistical barriers to maintaining space-based coronagraphic observations. MiniCOR is an ambitious coronagraph design to address these challenges. The technical goal of MiniCOR is to demonstrate that a miniaturized 3U coronagraph can return data with higher cadence and equal or better sensitivity than currently operating full-size coronagraphs. MiniCOR is a funded project under the NASA HPD H-FORT program. It began development in 2024 for launch into a Sun-synchronous polar orbit in 2028. Derived from the successful COR2 coronagraph on the STEREO mission, MiniCOR will leverage 'smart' on-board processing to optimize observations and data downlink, delivering state-of-the-art observations of the corona from 3 to 20 solar radii at a cadence of 4 minutes.

Presentation | DAY 5 | SEPTEMBER 4 14:30 | Session | Solar Coronal Imaging and Heliospheric Science | Orbital Flight

Presenting Author Vourlidas, Angelos | Affiliation Johns Hopkins University Applied Physics Laboratory (JHU APL) | Email angelos.vourlidas@jhuapl.edu
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Scanning Coronal and Heliospheric Imager: Instrument Concept and Prototype Development

White light imaging of the solar corona and inner heliosphere is a key measurement for tracking the evolution of solar transients such as coronal mass ejections (CMEs). In particular, high-resolution measurements over a broad field-of-regard (FoR) enable enhanced understanding of the fine-scale structure of CMEs as well as how shocks develop and accelerate particles throughout the inner heliosphere, all of which influence the potential space weather impacts of eruptive events at the Earth, the Moon, and Mars. Previous instrument designs have generally required a tradeoff between high resolution (e.g., coronagraphs) and wide field-of-view (e.g., heliospheric imagers), or alternatively relied on scanning imagers with bulky designs/components such as scanning mirrors or gimbaled systems. To address this gap, we are developing the Scanning Coronal and Heliospheric Imager (SCHI), which uses novel achromatic metasurface Risley prisms to rapidly map a large FoR with a small instantaneous field-of-view (FoV). This approach enables improved spatial resolution and signal-to-noise ratio within a compact 6U+ CubeSat-compatible form factor. The use of metasurface optical components also reduces system size and improves performance, including reduced FoV distortions, compared to conventional refractive optics alone. SCHI's compact volume, relaxed pointing requirements, and adaptable concept of operations make it an ideal payload for both research and operational space weather missions supporting cislunar and Moon-to-Mars exploration. Here we present the instrument concept and recent developments, including the fabrication and characterization of full-scale metasurfaces for the first SCHI prototype. This research is supported by NASA HTIDeS grant 80NSSC24K0643.

Presentation | DAY 5 | SEPTEMBER 4 15:00 | Session | Solar Coronal Imaging and Heliospheric Science | HELIOTECH

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Adagio: Empowering Cost-Effective Hosted Payloads and Novel Mission Concepts Amidst SMD Budget Constraints

As the extent of the budget constraints across NASA's Science Mission Directorate (SMD), both the heliophysics and broader space science community must pivot toward more cost-effective and sustainable strategies to continue a robust cadence of exploration and scientific progress. Launch costs have fallen, but as traditional LEO operations continue to be cost-prohibitive, hosted science payloads offer a critical alternative for flying high-priority instruments. However, fully leveraging these hosted opportunities requires streamlined development cycles and risk-reduction mechanisms that fit within tightly restricted budgets. This presentation introduces Adagio, an innovative platform tailored specifically to address this fiscal and operational reality. Currently pre-launch, Adagio fills a vital gap in the technology operations pipeline by providing an affordable, standardized approach to the development, integration, and verification of hosted science payloads. By mitigating technical risks early and optimizing the rideshare process, Adagio offers a low-cost, scalable framework that aligns directly with the current resource-constrained environment of NASA SMD. The introduction of Adagio does not just represent a cost-saving measure, it can serve as a creative catalyst for the community. By dramatically lowering the barrier to entry for flight validation, this platform empowers scientists, technologists, and Principal Investigators (PIs) to generate novel, high-impact mission ideas that were previously deemed impossible or financially unfeasible. This presentation will detail the capabilities of the Adagio platform, discuss its role in accelerating technology readiness, and demonstrate how it can unlock a new frontier of collaborative, cost-effective heliophysics investigations in alignment with HESTO's technology infusion goals.

Poster | Orbital Flight

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Improving Thermospheric Neutral Density Specification and Nowcasting Capability at NOAA

Accurate specification of thermospheric neutral density (ND) is critical for orbit determination in Low Earth Orbit (LEO). Thermospheric ND is highly dynamic with day-to-night, altitude, and solar activity variations. The scarcity of thermosphere ND observations limits our ability to predict dynamic upper atmospheric changes. The ND data shortage creates critical uncertainties in modeling space weather, satellite drag calculations, and LEO satellite orbit trajectory predictions. NOAA NESDIS Office of Space Weather Observations is supporting a study to develop algorithms for thermosphere neutral density estimation from precision orbit determination (POD) from LEO satellite constellation and data assimilative process to integrate the orbit-averaged neutral density into the Whole Atmosphere Model (WAM). SpaceX provided 18 months of Starlink satellites POD and other necessary relevant data for this study. The POD derived neutral density is validated with the High Accuracy Satellite Drag Model (HASDM) model. Data assimilation (DA) with the orbit-averaged neutral density data demonstrates the neutral density data can remove the bias in the model. This presentation will highlight the ND data processing algorithm and the DA system, preliminary results, ongoing work at NOAA to improve the thermosphere neutral density specification, nowcasting, and forecasting capability, and the desire for direct measurements for ND references.

Poster | HELIOTECH

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Lessons Learned from Marshall Grazing Incidence X-ray Spectrometer (MaGIXS)

The Marshall Grazing Incidence X-ray Spectrometer (MaGIXS) is a slitless X-ray spectrograph operating in 0.5 -2 keV (6-30 Ang) range. The concept was first awarded an Instrument and Technology Development Award in 2012. The instrument has flown twice in two different configurations. The first build and flight was funded by Low Cost Access to Space in 2014 and the second flight in 2021. A third flight is planned for December 2026. The instrument contains mirrors and a low noise camera made by MSFC and a grating made by SAO and MIT. Both versions of the instruments posed unique alignment challenges. In this talk, I will discuss the lessons we have learned over the roughly 15 years of MaGIXS development.

Presentation | DAY 2 | SEPTEMBER 1 11:30 | Session: Next Generation Solar Science Instrument and Missions | HELIOTECH

Presenting Author: Wu, Qian | Affiliation: National Center for Atmospheric Research (NCAR) | Email: qwu@ucar.edu

HIWIND Results from the New Zealand Flight

HIWIND is the only balloon-borne Fabry Perot interferometer for thermospheric wind observation, which capable of measuring thermospheric winds during day and night. It flew on NASA superpressure balloon from New Zealand in April 2025. The instrument observed day and night mid latitude thermospheric wind during the flight. We analyzed the observational results and compared the observations with NCAR TIEGCM first principle global ionosphere and thermosphere model and found significant discrepancies with the simulations. The observed daytime thermospheric winds are much larger than the model prediction. We further compared the ionosphere density simulation from the TIEGCM and compared with COSMIC 2 observations. We noted that the TIEGCM simulated ionospheric peak heights are higher than the observations indicating the model does not have sufficiently strong wind to push the ionosphere to lower height. That is consistent with HIWIND observations. Further study is ongoing to track down the source of the model discrepancy.

Presentation | DAY 4 | SEPTEMBER 3 11:45 | Session: ITM Technologies and Missions | HELIOTECH

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CoAuthors: Scott Sewell (NCAR)

WindCube Science and Current Status

WindCube is the first CubeSat carrying thermospheric wind measuring Fabry Perot interferometer. It will study geomagnetic storm effect on the ionosphere and thermospheric wind reaction to the storm. It will also study atmospheric input to the thermosphere by examining the nonmigrating tide originated from the lower atmosphere. It can potentially enable new upper atmosphere study and space weather research. Thermospheric winds are known to have strong impact on the ionosphere and space weather. Since the ending of the NASA ICON mission, we do not have thermospheric wind observations from the space now. WindCube has completed its instrument construction and integrated into the spacecraft in Denmark at Space Inventor. The instrument is undergoing environmental and other pre-flight tests. We are scheduled to launch from Vandenberg Air Force Base.

Presentation | DAY 4 | SEPTEMBER 3 9:45 | Session: ITM Technologies and Missions | Orbital Flight

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CORA: A CubeSat Mission Concept for Investigating Radiation Belt Electron Acceleration in GTO

Operating a small satellite in a highly elliptical Geostationary Transfer Orbit (GTO) presents substantial environmental and architectural challenges, yet provides essential access for studying Earth's outer radiation belt. Scientifically, the CubeSat On the Radiation belt electron Acceleration (CORA) mission concept leverages this GTO trajectory to sweep across a wide range of L-shells, capturing sparse in-situ data between 5.8 Earth radii and geosynchronous orbit. In this regime, CORA utilizes the High-Energy-Resolution relativistic electron Telescope (HERT) to measure 1–7 MeV electron fluxes with an energy resolution of $dE/E < 15\%$. These precise measurements are required to isolate and quantify the contribution of electron acceleration processes. To achieve these science goals, the CORA mission concept study evaluates the feasibility of hosting HERT in this harsh environment, specifically analyzing radiation tolerance, communication access, and orbital lifetime. A major focus of the study is resolving the conflict between mission lifetime requirements and post-mission disposal regulations. Because natural orbital decay from GTO is often too slow to ensure timely reentry, the study evaluates multiple end-of-life Δv budgets. Results indicate that integrating low-thrust propulsion for modest perigee reduction is the most efficient strategy, ensuring reentry compliance without sacrificing the primary science timeline. Ultimately, the CORA concept establishes a pathway for maturing the HERT payload to flight readiness (TRL 9) while demonstrating that CubeSat platforms can successfully operate in high-eccentricity orbits to deliver valuable science and space weather data.

Poster | Orbital Flight

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HERT: A Miniaturized High-Energy-Resolution Telescope for Relativistic Electrons and Solar Energetic Protons

The High-Energy-Resolution relativistic electron Telescope (HERT) is a miniaturized instrument under development designed to measure energetic particles in near-Earth space. Conforming to a 2.5U form factor with a mass of 4 kg and a power consumption of 4-5 W, HERT utilizes a stacked silicon solid-state detector architecture with a field-of-view of approximately 33°. The primary objective of HERT is to measure relativistic electrons in the 1-7 MeV energy range with an energy resolution of $dE/E<15\%$. Currently undergoing comprehensive bench testing and Sr-90 radioactive source testing in the laboratory, the instrument is targeted for development in a Geostationary Transfer Orbit to obtain the high-energy-resolution relativistic electron measurements necessary to quantify electron acceleration processes. In addition to its primary electron measurement capabilities, recent Geant4 simulations have demonstrated expanded instrument functionality in measuring energetic protons. These simulations show that by leveraging the instrument's structural shielding, HERT can also measure solar energetic protons over an energy range from ~10 MeV to the GeV level. Extending the observable solar energetic proton spectrum to this high-energy end provides critical data for understanding solar energetic particle events and their space weather impacts. The combined electron and proton measurement capabilities of HERT, together with its compact design, support broader space weather monitoring efforts and have the potential to contribute directly to NASA's Moon-to-Mars objectives.

Presentation | DAY 2 | SEPTEMBER 1 16:00 | Session: Space Weather Monitoring and Space Debris | HELIOTECH

COLOR KEY

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DAY 1	Platform Technologies, Mission Design, and Autonomy
DAY 2	Next Generation Solar Science Instruments and Missions
DAY 2	Space Weather Monitoring and Space Debris
DAY 4	Ionosphere-Thermosphere-Mesosphere (ITM) Technologies and Missions
DAY 4/5	Magnetospheric Dynamics & Geospace Missions and Technologies
DAY 5	Advanced Electromagnetic Field Sensors and Magnetometers
DAY 5	Solar Coronal Imaging and Heliospheric Science
POSTERS	Posters