National Aeronautics and Space Administration

Sounding Rockets Program Office Quarterly Newsletter

Rocket Report

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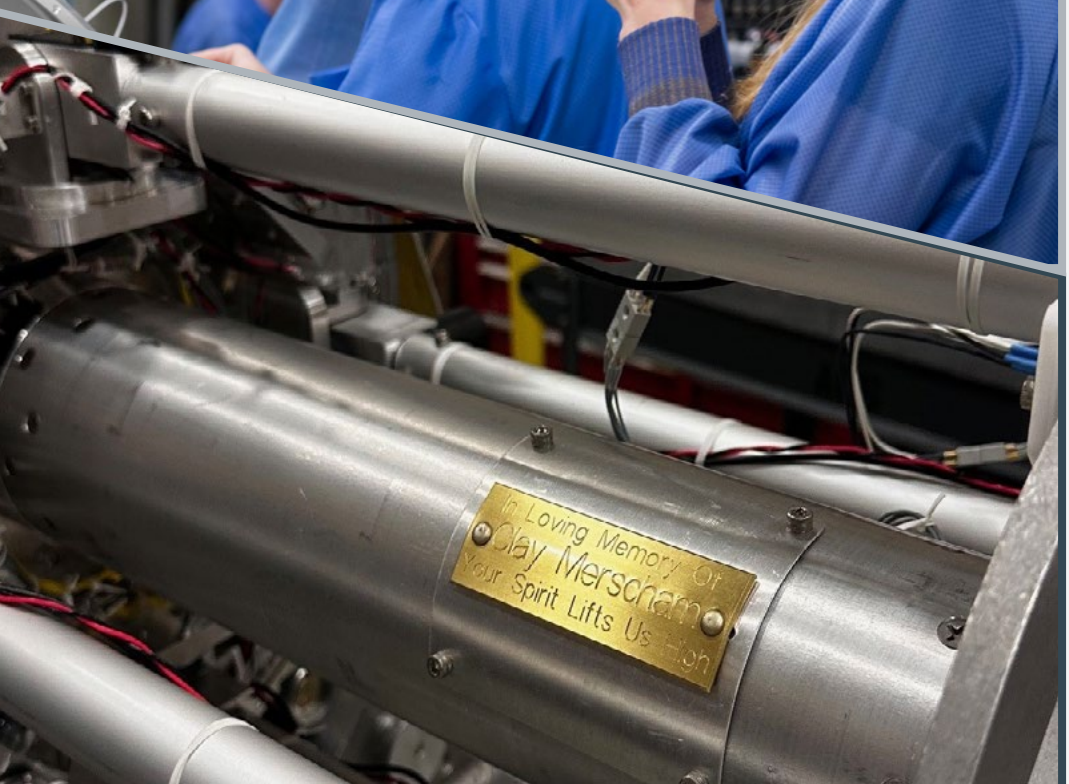
2024



INSIDE

Cover photo:
Total Solar Eclipse. Credit: NASA/Gopals–wamy

APEP–2 integration.
Photos by Berit Bland/NSROC.

APEP–2 team with three payloads.
Photos by Berit Bland/NSROC.

PICTURE OF THE QUARTER

Program News

This quarter was focused on integrating and testing payloads for the upcoming Solar Eclipse and the Solar Flare campaign.

The Atmospheric Perturbations around Eclipse Path (APEP) 2 includes three payloads to be launched from Wallops Island, VA during the April 8, 2024, Total Ecliipse.

Payload and science teams are at Poker Flat Research Range, AK preparing to launch two Solar Physics payloads to study solar flares.

Turbulent Oxygen Mixing Experiment–plus (TOMEX–plus) integration is ongoing at Wallops for launches from Wallops Island currently scheduled for August 2024.

The next student mission, RockOn, is scheduled to be launched on June 20, 2024. The workshop will be held at Wallops and starts the weekend before the launch. For students interested in sounding rocket flight opportunities, please see: https://www.nasa.gov/sounding–rockets/rocksat–programs.

The Sounding Rocket Working Group (SRWG) meeting was held at Wallops in January. Virtual participation was also facilitated.

We are welcoming Nathan Empson and Ernie Bowden as detailees to the Sounding Rockets Program Office (SRPO). Both are detailed from the Engineering Technology Directorate (ETD) and have extensive experience with sounding rocket missions and operations. They will serve as Mission Managers for sounding rockets.

Explore Eclipses:https://science.nasa.gov/eclipses/fu–ture–eclipses/eclipse–2024/where–when

36.392, 393, & 394 UE Barjatya/Embry-Riddle University - Atmospheric Perturbations around Eclipse Path (APEP) 2 - April 8, 2024

Upcoming Mission April 2024

Sounding rockets are well suited to study the dynamics of Earth's ionosphere and an opportunity to do so is presented by the Total Solar Eclipse on April 8, 2024 when three Black Brant IX sounding rockets will be launched from Wallops Island, VA to study the ionosphere before, during, and after the peak eclipse.

Three rockets, with similar instrumentation, were launched from White Sands Missile Range (WSMR), NM during the Annular Solar Eclipse on October 14, 2023. Results from this mission were presented at the American Geophysicsl Union (AGU) Fall Meeting 2023 (pdf).

APEP–2 will detect changes in the ionosphere using instruments such as Langmuir probes, electric field probes, magnetometers, ionization gauges, and accelerometers. Simultaneous multipoint measurements will be achieved by ejecting four instrumented deployables from each payload. Springs are used to deploy the ejectables at a velocity of 3 m/s and they will take data for about 7 to 8 minutes. This allows taking measurements in a larger volume of space.

The ionosphere is a region of the Earth's atmosphere between 90 and 500 km altitude, where solar radiation ionizes gases, i.e. strips molecules and atoms of their electrons, creating ions and free electrons. This state of matter is called plasma. The ionosphere is affected by Earth's gravity, earth's magnetic field, the solar wind, the Interplanetary Magnetic Field (IMF), solar flares, terrestrial weather and various other processes, and is a very dynamic environment.

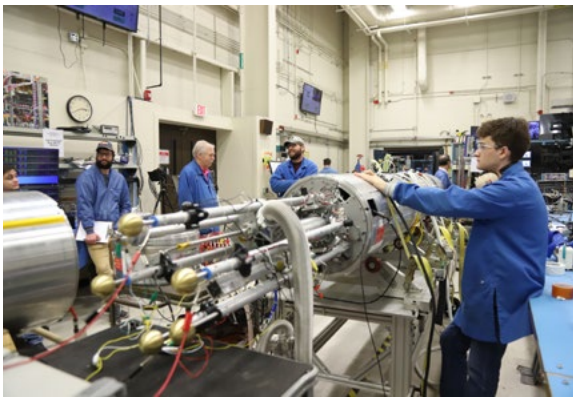
Eclipses present a unique opportunity to study the effects of a supersonic cooling shadow of the Moon as it moves across the ionosphere and its effect on the structure and energetics of the ionosphere–thermosphere system.

Launching the rockets and instruments during a solar eclipse allows scientists to study the ionosphere during a simulated day/night cycle, where nighttime conditions are created by the Moon eclipsing the Sun and altering the radiation environment.

The first rocket, launched approximately 35 minutes before the local peak eclipse measures the ionosphere as the eclipse is starting. The second rocket is launched during the peak eclipse period when the ionosphere has the maximum shielding from solar radiation. Approximately 35 minutes after the eclipse, when solar radiation again reaches the ionosphere, the third rocket is launched.

An eclipse creates waves in the ionosphere as the supersonic cooling shadow races across the ionosphere. The situation gets further complicated because most of the time there are already existing waves in the ionosphere due to terrestrial weather or an ongoing space weather event, such as a flare hitting Earth, especially during the ongoing Solar Max. Visualize this as a motorboat racing across a disturbed ocean which already has waves and tides.

Scientists want to understand how the ionosphere responds to all these disturbance activities because all satellite communications go through the ionosphere before they reach Earth. And as society gets more dependent on space based assets, such as GPS and satellite based communications, we need to understand and consequently model all perturbations and irregularities in the ionosphere.



One of the APEP–2 payloads during sequence testing at Wallops. Credit: NASA Photo/Berit Bland.

Upcoming Missions Solar Flare Campaign April 2024

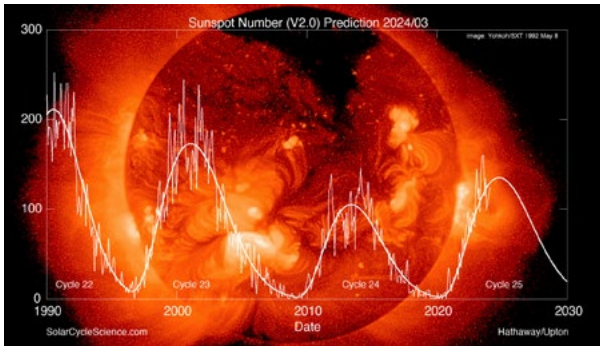
36.370 US Glesener/University of Minnesota - Focusing Optics X-ray Solar Imager (FOXSI) 4 & 36.371 NS Savage/NASA Marshall Space Flight Center- High-Resolution Coronal imager (Hi-C)- Flare

Solar actiivty waxes and wanes in a cyclic fashion with an 11–year period. We are currently in Solar Cycle 25 which reached minimum in 2019. NOAA's Space Weather Prediction Center currently predicts the maximum in the solar cycle to occur between November 2024 and March 2026.

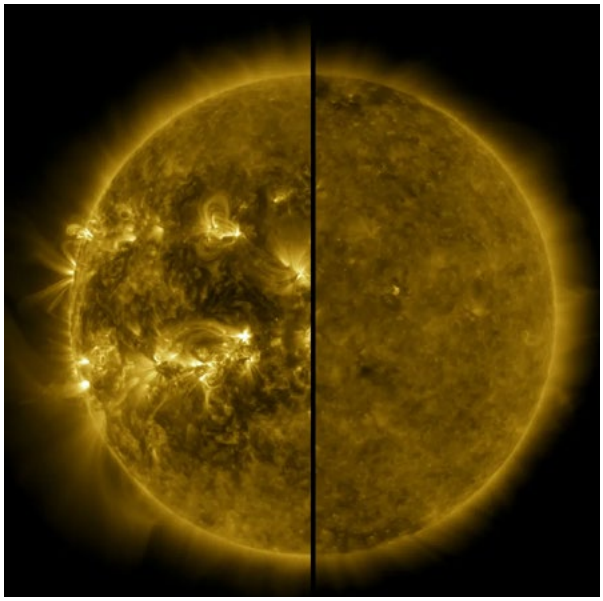
During high solar activity, sunspots, flares, and, Coronal Mass Ejections (CMS) increase and this is an optimum period to study solar flares using Sounding Rockets. The Solar Flare campaign with two payloads is currently underway at Poker Flat Research Range (PFRR) in Alaska.

The goals of the campaign are to acquire multi–scale, multi–wavelengh observations of a solar flare and open up the possibility of validation of flare–optimized instruments. Most Solar Physics payloads are launched from White Sands Missile Range, NM, but this launch site does not offer the flexibility to be launch ready and wait for a flare event to occur. PFRR enables a two week launch window with daily opportunities to launch. Scientists monitor solar activity, using GOES x–ray data, during the daily window and, if a suitable flare occurs, can elect to launch with a few minutes notice. This increases the possibility studying a large flare. (Monitor solar activity using NOAA GOES x–ray flux data.)

Hi–C Flare and FOXSI–4 will launch to study solar flares in two separate wavelenghts. Hi–C is optimized for Ultraviolet wavelenths at 12.9 nm, and FOXSI–4 is optimized for hard X–rays between 4 – 20 keV. The campaign also attempts to coordinate measurements when the Solar Orbiter (SO) or the Parker Solar Probe (PSP), two missions observing the Sun with remote and in–situ instruments from close distances, are in prime measurement locations.



Llatest solar cycle prediction from http://solarcyclescience.com/forecasts.html
Credit: Hathaway/Upton



This split image shows the difference between an active Sun during solar maximum (on the left, captured in April 2014) and a quiet Sun during solar minimum (on the right, captured in December 2019). December 2019 marks the beginning of Solar Cycle 25, and the Sun's activity will once again ramp up until solar maximum, predicted for 2025.
Credits: NASA/SDO

Upcoming Mission May 2024

36.396 UG Zemcov/Rochester Institute of Technology - Cosmic Infrared Background Experiment (CIBER) 2 - May 5, 2024

The Cosmic Infrared Background ExpeRiment 2 (CIBER–2) is a rocket–borne instrument designed to conduct comprehensive multi–band infrared (IR) measurements of spatial fluctuations in the extragalactic background light (EBL) on a wide range of angular scales.

The EBL is the summed light produced by all emission over the Universe's history, and it encodes a great deal of information about the history of stars and the assembly of cosmic structure over time. At near–IR wavelengths, the EBL teaches us about the first objects that formed during the earliest phases of galaxy assembly all the way up to the most faint and diffuse objects in the nearby Universe. Broad–band intensity mapping is a technique in which spatial fluctuations are used to unambiguously disentangle the faint EBL from brighter foreground emission from our solar system and Milky Way galaxy. Multiple intensity mapping studies, including those by CIBER–2's predecessor rocket experiment, have found that fluctuations in the EBL significantly exceed predictions from galaxy models. What could be causing the discrepancy is unclear, and better measurements are required.

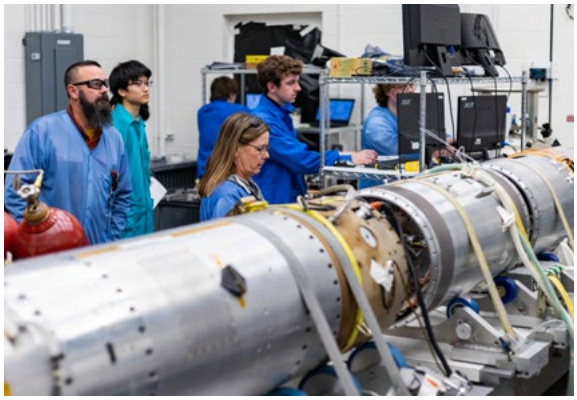
CIBER–2 is a sounding rocket experiment designed to isolate the sources of near–IR fluctuations, and testbed technologies that will be used in the Spectro–Photometer for the History of the Universe, Epoch of Reionization, and ices Explorer (SPHEREx) Medium Explorer (MIDEX) mission. CIBER–2 comprises a 28.5–cm telescope cooled to 80 K that images to three HAWAII–2RG detectors with dual–band filters to simultaneously obtain degree–scale data over the range 0.5–2.0 μm in six bands.

CIBER–2 made a successful first flight from White Sands Missile Range in New Mexico on June 7th of 2021, and a second flight was attempted in April 2022. No science was collected due to termination of flight shortly after launch.

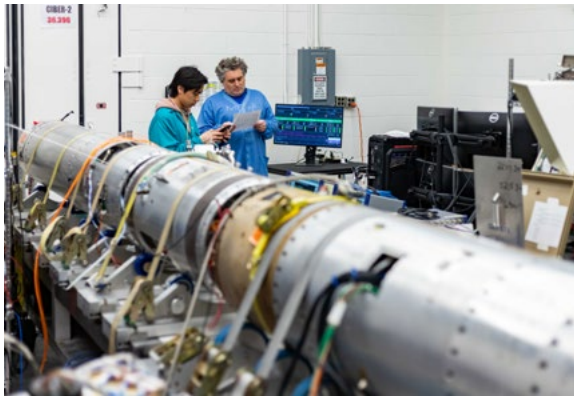
CIBER–2 is led by the Rochester Institute of Technology in collaboration with the California Institute of Technology, the University of California Irvine, Kwansei Gakuin Univiersity and the Kyushu Institute of Technology in Japan, and the Korea Astronomy and Space Science Institute.

CIBER–2 is currently scheduled to launch from WSMR on May 5, 2024

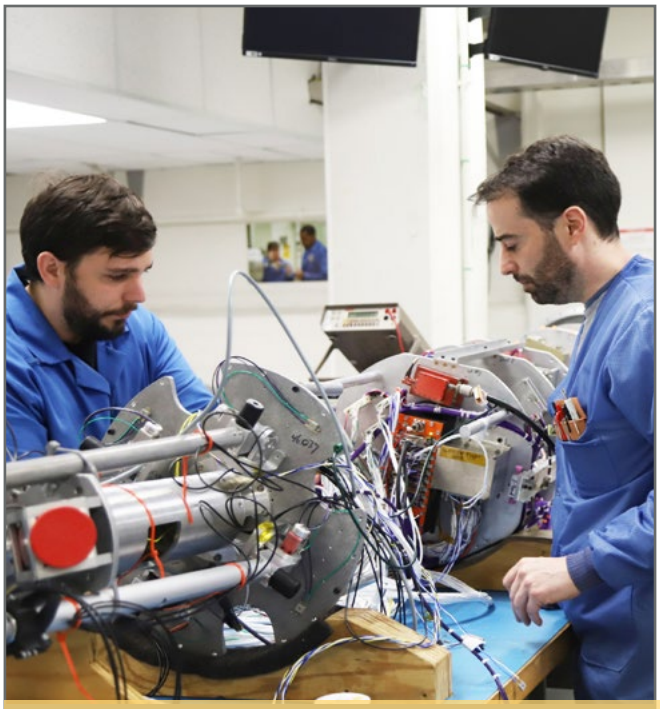
CIBER–2 testing at Wallops. Credit: NASA Photo/Berit Bland.



CIBER–2 sequence testing at Wallops. Credit: NASA Photo/Berit Bland.



CIBER–2 sequence testing at Wallops. Credit: NASA Photo/Berit Bland.



Picture Place

Integration and Testing

36.335, 41.123 & 41.124 CE Clemmons/Aerospace Corporation - Turbulent Oxygen Mixing Experiment Plus (TOMEXplus)

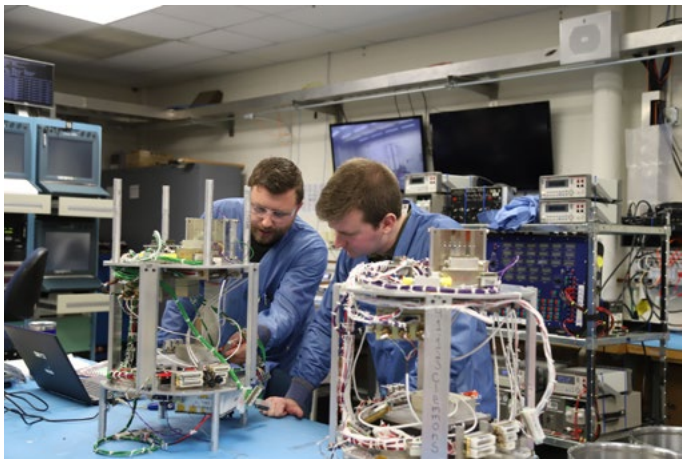
The Turbulent Oxygen Mixing Experiment Plus (TOMEXplus) sounding rocket mission explores the three–dimensional nature of turbulent phenomena near the mesopause through a three–rocket salvo combined with ground–based remote–sensing instrumentation and state–of–the–art model–ing. The energy cascade spectrum from 15 m to 2 km is covered by the centerpiece of the rocket–borne instrumentation, a sodium lidar system. These measurements are supplemented and complemented by in–situ measurements of atmospheric density, winds, temperature, and compo–sition, and two concurrently–launched vapor trail rockets provide context measurements of winds and atmospheric mixing. A ground–based segment includes a camera that images waves through OH airglow measurements and an iron lidar that provides context measurements of the tempera–ture and winds. A modeling component is included to help interpret the measurements returned by the experiment. The architecture of the overall experiment is presented, and the conditions under which the experiment will be performed discussed.

The launch window opens on 25 August 2024 at NASA's Wallops Island, VA launch facility.

TOMEX Plux telemetry data display.
Photo by Berit Bland/NSROC

Vapor trail payload build up.
Photo by Berit Bland/NSROC

Instrumented payload build up.
Photo by Berit Bland/NSROC



Vapor trail payload build up.
Photo by Berit Bland/NSROC

SCHEDULE FOR NEXT QUARTER

MISSION	DISCIPLINE	EXPERIMENTER	ORGANIZATION	PROJECT	RANGE	DATE
36.370 US	SOLAR AND HELIOSPHERIC	GLESENER	UNIV OF MINNESOTA	FOXI–4	FB	04/05/24
36.371 NS	SOLAR AND HELIOSPHERIC	SAVAGE	NASA MSFC	HI–C Flare	FB	04/05/24
36.392 UE	GEOSPACE SCIENCES	BARJATYA	EMBRY RIDDLE UNIVERSITY	APEP 2	WI	04/08/24
36.393 UE	GEOSPACE SCIENCES	BARJATYA	EMBRY RIDDLE UNIVERSITY	APEP 2	WI	04/08/24
36.394 UE	GEOSPACE SCIENCES	BARJATYA	EMBRY RIDDLE UNIVERSITY	APEP 2	WI	04/08/24
36.396 UG	UV/OPTICAL ASTROPHYSICS	ZEMCOV	RIT	CIBER–2	WS	05/05/24
36.391 DS	SOLAR & HELIOSPHERIC	TUN	NRL	HERSCHEL 3	WS	06/18/24
41.133 WO	STUDENT OUTREACH	KOEHLER	NASA WFF	ROCKON	WI	06/20/24

FB – Poker Flat Research Range, AK
WI – Wallops Island, VA
WS – White Sands Missile Range, NM

MISCELLANEA

Launch photos from our Florida correspondent, Ahmed Ghalib.

Ahmed was on location in Florida to cover two SpaceX Falcon launches from the Cape.

Falcon Heavy carries the X–37B Spaceplane to orbit for the US Space Force. Launch date: December 28, 2023.
Credit: Ahmed Ghalib/NSROC

Falcon 9 carries Starlink satellites to orbit. Launch date: December 29, 2023.
Credit: Ahmed Ghalib/NSROC