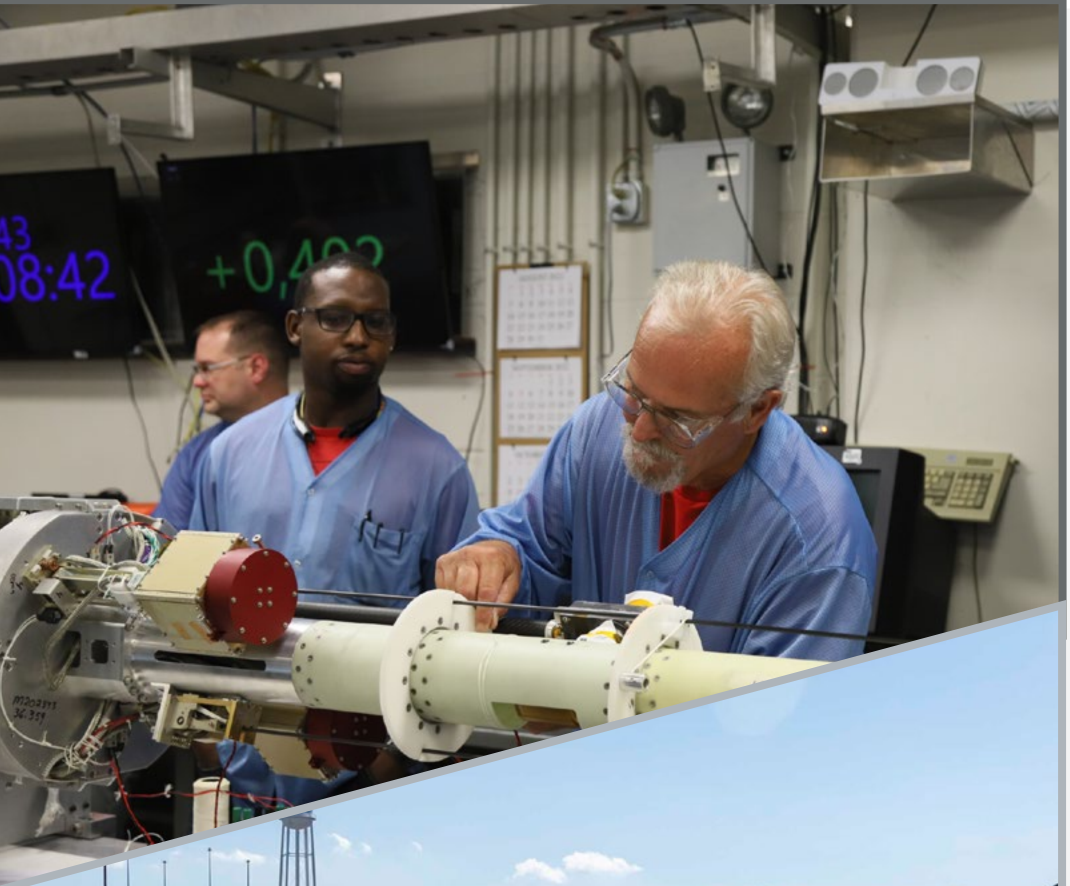
National Aeronautics and Space Administration

Sounding Rockets Program Office Quarterly Newsletter

2022

Rocket Report



INSIDE

Cover photo:
Australia recovery operations.
Photo provided by: Max King/NASA

Rocket team in Australia, summer 2022.
Credit: NASA Photo/Brian Bonsteel

Program News

Six missions were launched during the third quarter of 2022. The first two were launches from Arnhem Space Center, Australia and included the Dual–channel Extreme Ultraviolet Continuum Spectrograph (DEUCE) and Suborbital Imaging Spectrograph for Transition region Irradiance from Nearby Exoplanet host stars (SISTINE). The remaining launches included, two flights from White Sands Missile Range (WSMR), NM, both involving studying Supernova remnants, and two flights from Wallops Island, VA, one flight to test technologies for an upcoming campaign from Kwajalein, Marshall Islands, and one student outreach mission. Initial results from all flights indicate they were successful.

The inaugural **Sounding Rocket Symposium** was held August 17 – 19, 2022 at NASA Wallops Flight Facility. The symposium provided a common venue for researchers and engineers to interact, share ideas, and discover the ever–increasing capabilities and advances within the Sounding Rocket program. For more information and see: https://sites.wff.nasa.gov/code810/Symposium/Sounding–Rocket–Symposium.html

The RockOn and RockSat programs are now managed by NASA Wallops Flight Facility. See: https://www.nasa.gov/sounding–rockets/rocksat–programs to apply to fly.

Sounding Rocket Symposium participants.
Photo by: Berit Bland/NSROC

36.339 UG France/University of Colorado - Suborbital Imaging Spectrograph for Transition region Irradiance from Nearby Exoplanet host stars (SISTINE) 3 - launched July 6, 2022

SISTINE 3 was designed to make measurements of the ultraviolet radiation environment around low–mass stars and the effects of that UV on potential exoplanet atmospheres, including the gases thought to be signs of life.

SISTINE 3 measured the ultraviolet light output from α Centauri A and B, two stars of the three–star Centauri system that are the closest stars to our Sun. A southern hemisphere launch was required to study these stars as they are not accessible from our standard northern hemisphere launch range. The data from this mission will be used in conjunction with the complementary data from the Dual–channel Extreme Ultraviolet Continuum Spectrograph (DEUCE) also launched from Australia and studying Centauri.

SISTINE 3 launch.
Photo by Brian Bonsteel/Wallops Imaging Lab.

SISTINE 3 recovery.
Photo by Brian Bonsteel/Wallops Imaging Lab.

SISTINE 3 pre–launch checkes.
Photo by Brian Bonsteel/Wallops Imaging Lab.

36.350 UG Fleming/University of Colorado - Dual-channel Extreme Ultraviolet Continuum Spectrograph (DEUCE) - launched July 11, 2022

The Dual–channel Extreme Ultraviolet Continuum Experiment (DEUCE) is a spectrograph operating in the 500 – 900 Å range.

The purpose of the DEUCE mission from Australia was to generate the first EUV spectrum of the most accessible potential exoplanetary system, the Centauri A and B System. The spectrum range for DEUCE was in the 500 – 900 Å range. At present, no low–mass star other than the Sun has ever been observed in the 500 – 900 Å spectral window. These observations provide a crucial, and unique, input for models of planets orbiting G–type and K–type stars.

The data from this mission will be used in conjunction with the complementary data from 36.339 Suborbital Imaging Spectrograph for Transition region Irradiance from Nearby Exoplanet host stars (SISTINE) also launched from Australia and studying α Centauri.

This was the fourth flight of DEUCE.

DEUCE Science team in Australia.
Credit: Brian Bonsteel/NASA Wallops Imaging Lab.

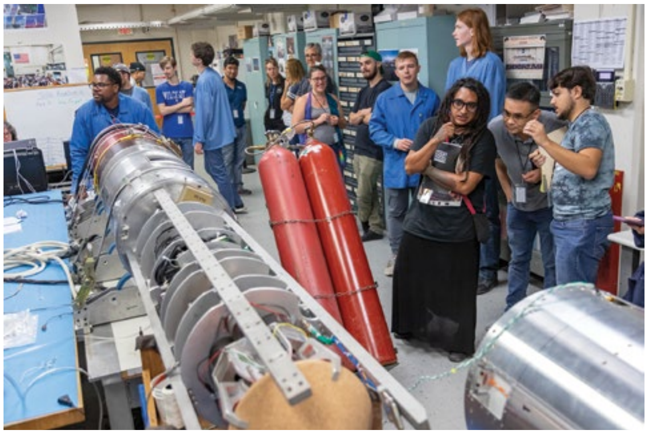
46.036 UO Koehler/Colorado Space Grant-RockSat-X - launched August 11, 2022

RockSat–X was successfully launched from Wallops Island, VA on August 11, 2022. RockSat–X is the third, and most advanced student flight opportunity.

RockSat–X experiments are fully exposed to the space environment above the atmosphere. Power and telemetry were provided to each experiment deck. Additionally, this payload included an Attitude Control System (ACS) for alignment of the payload. These amenities allow experimenters to spend more time on experiment design and less on power and data storage systems.

The following schools participated in RockSat–X in 2022:
College of the Canyons
University of Hawaii Community Colleges
Northwest Nazarene University
Community Colleges of Colorado
Virginia Tech
University of Kentucky

To apply for future flight opportunities, see:
[https://www.nasa.gov/sounding–rockets/rocksat–programs](https://www.nasa.gov/sounding-rockets/rocksat-programs)



RockSat–X sequence testing.

University of Kentucky team and Abby Shefer (far right) with the experiment.

RockSat–X participants on Wallops Island after launch.

All images on this page by Berit Bland/NSROC.

36.355 UH Figueroa/Northwestern University - Micro-X - launched August 22, 2022

Micro–X combines a high–energy–resolution X–ray microcalorimeter with an imaging mirror to obtain imaging X–ray microcalorimeter spectra from an astronomical source.

As a photon is absorbed in a microcalorimeter and its energy converted to heat, the resulting temperature rise can be measured by the resistance change of a Transition Edge Sensor (TES). These microcalorimeters need to be cooled to temperatures of about a hundredth of a degree above absolute zero to function properly. In the X–ray band, high resolution spectroscopy has, with few exceptions, only been available for point sources. This leaves nearly all the brightest extended sources inaccessible for detailed study at the highest spectral resolution. Micro–X fills this need: the energy resolution of TESs combined with the imaging of the mirror means Micro–X can observe extended X–ray sources with unique sensitivity.

The goals of Micro–X were to:

- study Supernova Remnants and dark matter interactions using high energy resolution X–ray observations
- advance the technology readiness level of TES detectors and readout technologies for future space operations

This, the second flight of Micro–X, targeted the Cassiopea A Supernova Remnant (SNR).

Micro–X team at WSMR, NM.
Photo by: Visual Information Branch/WSMR

Payload after impact with recovery helicopter.
Photo by: Visual Information Branch/WSMR

46.025 UE Barjatya/Embry Riddle- Sporadic E Electro Dynamics Demonstration (SpEED Demon) - launched August 22, 2022

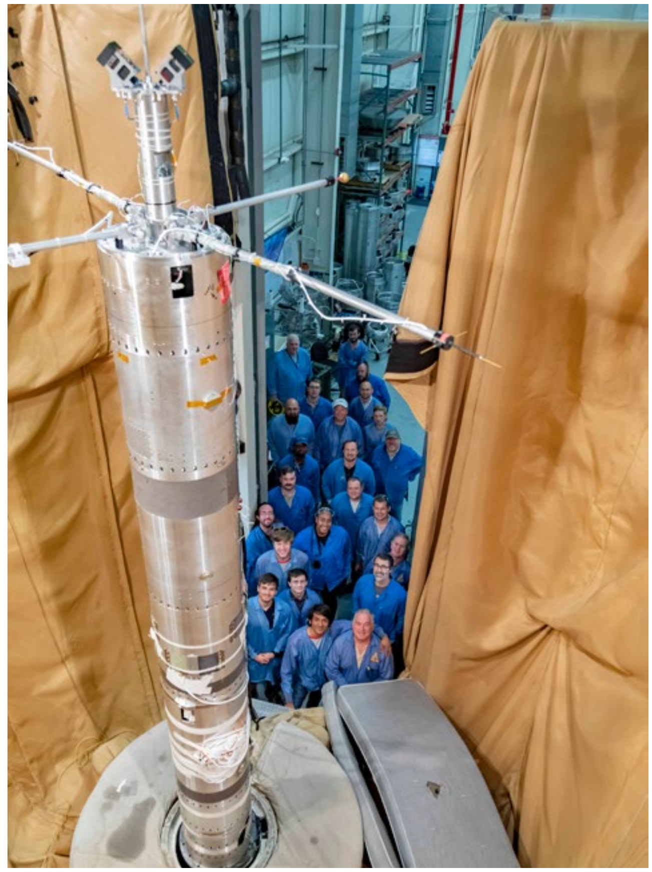
Sporadic E Electro Dynamics Demonstration (SpEED Demon), was a technology demonstration mission for the future Sporadic E Electro Dynamics (SEED) campaign, scheduled for Kwajalein, Marshall Islands in 2024.

The main payload consisted of a Sweeping Langmuir Probe for plasma density and electron temperature, a pair of multi Needle Langmuir Probes for 5 KHz electron density, Positive Ion Probe for relative ion density, ionization gauges and sensitive accelerometers for background neutral density, a suite of sensitive magnetometers, and a pair of electric field measurements. The main payload ejected four sub payloads, each carrying an ion density measurement along with a sensitive magnetometer and an accelerometer capable of performing 'falling sphere' analogous neutral density measurements

SpEED Demon's goal was to reduce risk surrounding new experiment instrumentation and possibly capture comparative mid–latitude science with in–situ measurements of sporadic E (E_S) layers with the same instruments planned for flight on SEED.

Overall science objectives included:

- Measure the magnitude of field aligned currents associated with E_S layers at mid–latitude.
- Measure the in–situ spatial patchiness of the E_S layers at mid–latitude.



SpEED Demon with payload team at NASA Wallops.
Photo by: Berit Bland/NSROC

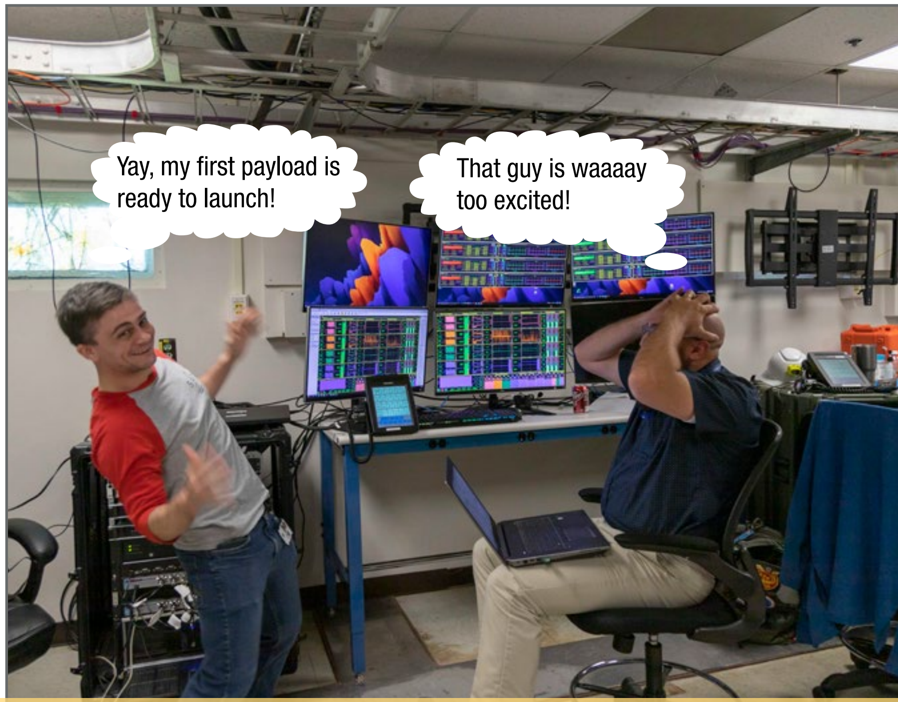
SpEED Demon with science team on Wallops Island.
Photo by: Berit Bland/NSROC

36.367 UH McEntaffer/Penn State University - The Rocket for Extended-source X-ray Spectroscopy (tREXS) - launched September 26, 2022

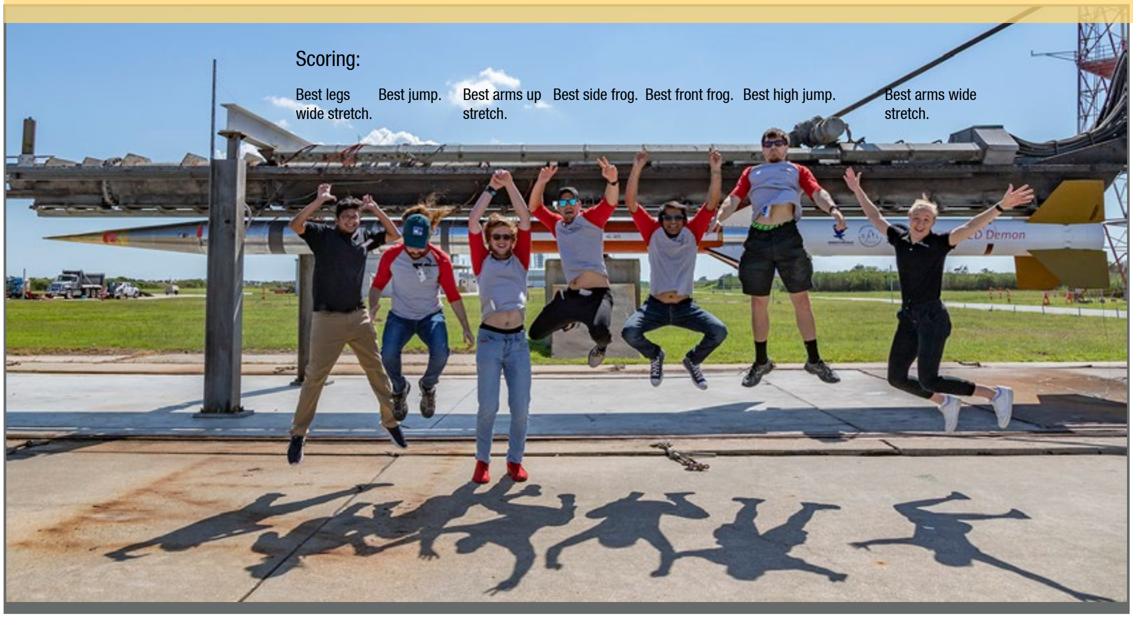
The Rocket for Extended–source X–ray Spectroscopy (tREXS) is a sub–orbital reflection–grating spectrograph designed to detect soft–X–ray emission from extended astronomical sources. The instrument, optimized to observe Supernova Remnants (SNR), is composed of passive, mechanical focusing optics and arrays of reflection gratings. The instrument has been optimized to effciently diffract and read out emission from highly ionized C, N, and O, and targeted the Cygnus Loop SNR.

As a relatively close, middle–aged SNR, the Cygnus Loop offers an excellent target to study the evolution of SNRs and the interaction of the SNR ejecta with the surrounding interstellar medium (ISM). The Cygnus Loop SNR is thought to have originated from a core–collapse supernova in a pre–existing cavity created either from precursor winds or as the result of a natural void between interstellar clouds.

Payload integration at NASA Wallops.
Photo by: Berit Bland/NSROC



Picture Place



Integration and Testing

Post deployment boom checks on SpEED Demon.
Photo by Berit Bland/NSROC

46.025 UE Barjatya/Embry Riddle - SpEED Demon

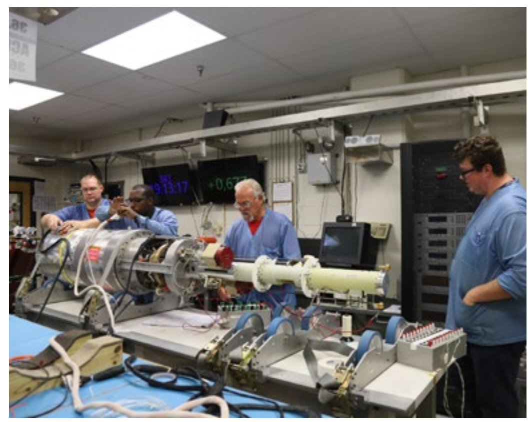
SpEED Demon integration was completed in August and the mission was launched on August 23, 2022. See page 9.

36.359 & 36.364 UE Bounds/University of Iowa - Aurora Current and Electrodynamics Structures (ACES) 2

The purpose of the Aurora Current and Electrodynamics Structures (ACES) 2 mission is to:

- Determine the distribution of the ionospheric currents and the associated energy dissipation in a stable arc.
- Determine the role of the Alfven resonator in governing the structuring of current closure.

ACES 2 includes two rockets and payloads, the 36.359, hi–flyer, will be launched first, followed by 36.364, low–flyer, about 2–minutes later. The mission will be launched from Andoya Space, Norway in November 2022.



ACES 2 integration at Wallops. Photo by Berit Bland/ NSROC

Deployables being prepared for integration into payload.
Photo by Berit Bland/NSROC

36.361, 36.362, 41.127 and 41.128 UE Lehmacher/Clemson University - Vorticity Experiment (VortEx)

The purpose of the Vorticity Experiment (VortEx) is to characterize mesoscale dynamics (10–500 km) in the upper mesosphere and lower thermosphere (90–120 km), a region which also contains the Earth’s turbopause. Rocket and ground–based measurements will be combined to distinguish, on one hand, between divergence in the horizontal flow field and divergent motions, such as gravity waves, and on the other hand, vorticity in the horizontal flow field and vortical motions, such as expected to occur in quasi–stratified mesoscale turbulence. These processes are crucial for a better description of subgrid processes and eddy diffusion in global atmospheric models. The complete experiment is comprised of two identical salvos, each with two rockets.

Campaigns
Peru 1975 & 1983

Campaign Condor, Peru 1983

Located close to the magentic equator, the Punta Lobos launch range in Peru is a perfect site to study the equatorial ionosphere.

Two sounding rocket campaigns have been conducted at Punta Lobos. The first one in 1975 and the second in 1983,

In 1975, 19 rockets were launched during the Antarqui campaign spanning late May to early June. The launches included seven Arcas, four Nike–Tomahawks, and eight Nike–Apache rockets.

Project Condor in 1983 included six Nike–Orion, six Arcas, and two each of Taurus–Orion, Taurus–Tomahawk, Terrier–Malemute rockets, for a total of 18 launches. The first launch occurred on February 27 and the last on March 23.

Punta Lobos, located approximately 40 miles south of Lima, Peru, offers a Pacific Ocean impact area, and several scientifically important ground observation facilities, such as the Jicamarca incoherent scatter radar. Jicamarca is located about 15 miles northeast of Lima.

The Condor campaign in 1983 focused on investigating the equatorial F–region, particularly spread–F (EFS), and plasma instabilities in the equatorial electrojet. The campaign resulted in excellent data in both the F–region and E–region objectives.

Two Nike-Orions staged at Punta Lobos, Peru in 1983.

A variety of instruments were clustered together near the magnetic equator to perform coordinated measurements of the same spread–F events simultaneously.

The two Terrier–Malemute rockets instrumented with electric field, plasma density, and energetic particle detectors were launched in the approximately southward and southwestward trajectories. The Jicamarca Radio Observatory (JRO), provided continuous monitoring of 3–meter F region irregularities with backscatter power and interferometric drift velocity measurements at an operation frequency of 50 MHz. At Ancon a 14–MHz HF radar was operated to monitor the evolution of 10–m density irregularities. Scintillations and spaced receiver drift measurements were also conducted at the same location using several satellite transmissions. [1)]

Two of the Nike–Orions, 31.032 & 31.033/ Goldberg, investigated the electrical structure

Peruvian Navy with the recovered pay-load, 33.027, Project Condor.

of the equatorial middle atmosphere and evaluate perturbations on this environment induced by the X–ray star Sco X–I. The two rockets were launched near Sco X–I star–rise and after it had attained an elevation angle of 70 deg E. Both payloads carried instrumentation during parachute descent to measure X–ray and electron fluxes, ion density, conductivity and mobility and in situ electric fields. Additionally, several smaller payloads capable of measuring the atmospheric electrical parameters were launched. An enhanced flux of X–rays was observed on the second Nike Orion flight (31.033). This increase is directly attributed to Sco X–I, both from the spectral properties of the measured X–ray distribution and by spatial information acquired from a spinning X–ray detector during the upleg portion of the 31.033 flight.[2)]

Ref.
[1] The Condor Equatorial Spread F Campaign: Overview and Results of the Large–Scale Measurements
[2] Response of the middle atmosphere to Sco X–I

SCHEDULE FOR NEXT QUARTER

MISSION	DISCIPLINE	EXPERIMENTER	ORGANIZATION	PROJECT	RANGE	DATE
36.359 UE	GEOSPACE SCIENCES	BOUNDS	UNIV OF IOWA	ACES–2	NOR	11/16/22
36.364 UE	GEOSPACE SCIENCES	BOUNDS	UNIV OF IOWA	ACES–2	NOR	11/16/22

MISCELLANEA

NSROC Lunch-N-Learn, Motor Processing, presented by Joe Polidan, Vehicle Systems Group.