National Aeronautics and Space Administration

Rocket Report

2019

Sounding Rockets Program Office

What's inside...

In Brief...

The Chief Sounding Rockets Program Office attended the ESA/PAC meeting in Essen, Germany, June 16 – 24, 2019.

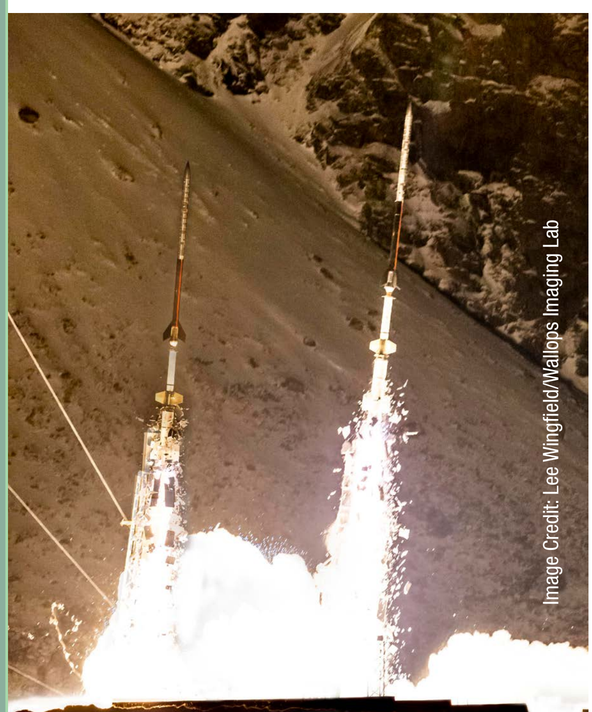
Cogratulations to Dr. Craig Kletzing for the selection of Tandem Reconnection and Cusp Electrodynamics Reconnaissance Satellites (TRACERS) mission as a NASA–launched rideshare mission.

The WRATS teacher workshop will be held August 12 – 16, 2019. 20 teachers have been selected for this year's opportunity.

The TAURUS rocket motor is being decom–missioned for sounding rocket use. Disposal firings of the remaining inventory have been conducted on Wallops Island.

51.001 & 51.002 UE Larsen - Auroral Zone Upwelling Rocket Experiment (AZURE) successfully launched on April 5, 2019.

Two Black Brant XI-A rockets were launched from Andoya Space Center (ASC) in Norway for the AZURE mission. The payloads were identical and carried 24 ampules with vapor tracers each, 16 containing Trimethylaluminum and 8 with a Barium/Cupric Oxide/Strontium mixture. Additionally, each payload had an instrumented section with ion gauges, to measure neutral densities and temperatures and photometers to provide altitude profiles of the auroral emissions.



Composite image of the AZURE launches.

AZURE studied the flow of particles in the ionosphere, the electrically charged layer of the atmosphere. Of specific interest were the E and F regions of the ionosphere.

The E and F regions contain free electrons that have been ejected from their atoms through photoionization. After nightfall, electrons recombine with the positively charged ions, lowering the regions' overall electron density. The daily cycle of ionization and recombination makes the E and F regions especially turbulent and complex.

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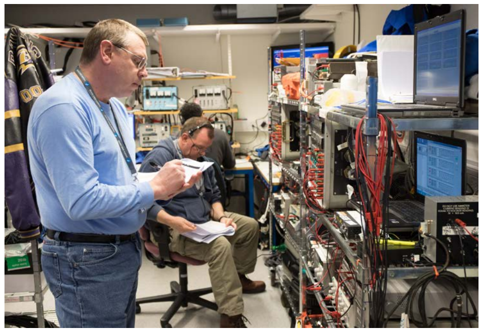
AZURE continued

AZURE measured the vertical winds in these regions, which re-distribute the energy, momentum and chemical constituents of the atmosphere.

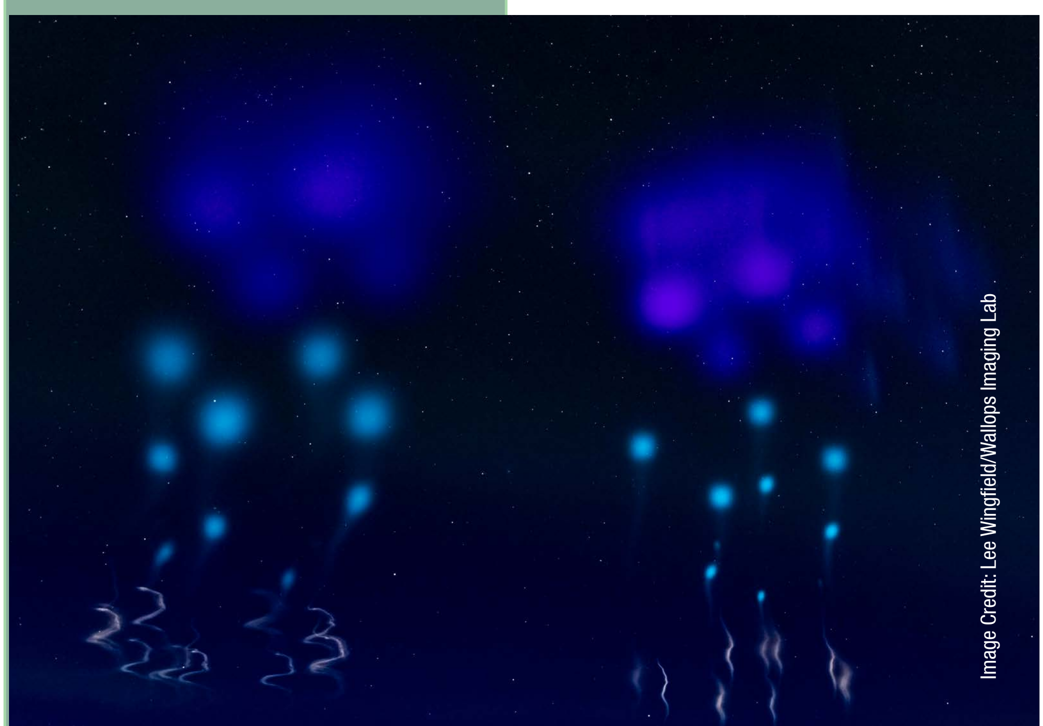
The wind measurements were obtained using vapor tracers deployed from the payloads, and ground based optical observatories to track the evolution of the resulting traces. Vapor deployments occurred between 71 and 155 miles altitude.

By tracking the movement of these colorful clouds via ground-based photography and triangulating their moment-by-moment position in three dimensions, AZURE will provide valuable data on the vertical and horizontal flow of particles in two key regions of the ionosphere over a range of different altitudes.

The rockets were launched two minutes apart on April 5, 2019.



Pre–launch activities for AZURE.
John and Wayne (top image) and Meghan (bottom image). Both photos by Lee Wingfield.



Vapor tracers deployed by AZURE.

36.332 NS McKenzie - Chromospheric Lyman-Alpha Spectro Polarimeter (CLASP)-2 successfully launched April 11, 2019.

The CLASP-2 instrument used ultraviolet light to look for hidden details in Sun's chromosphere (the Sun's atmosphere) to unlock new clues about how the Sun's energy travels up through the layers of its atmosphere, and eventually out into space. CLASP-2 recorded both images and polarized ultraviolet spectra of the Sun, specifically the Magnesium II h and K lines.

CLASP-2 was a follow-on mission to the Chromospheric Lyman-Alpha Spectro-Polarimeter, which recorded the first-ever polarization measurements of ultraviolet light emitted from the sun's chromosphere. Polarization measurements are important because they provide information on the strength and direction of the Sun's magnetic field, which plays a central role in sculpting the solar atmosphere.

CLASP–2 on the pad at White Sands Missile Range, NM.

CLASP-2's launch and data collection were coordinated with two satellites: NASA's Interface Region Imaging Spectrograph (IRIS), and the joint JAXA/NASA Hinode satellite observatory. Also taking coordinated data were the Dunn Solar Telescope in Sunspot, New Mexico, and the Goode Solar Telescope in Big Bear, California.

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36.344 & 345 UE Hysell - TooWINDY successfully launched June 19, 2019 from Roi Namur, Marshall Islands.

TooWINDY was a re-fly of the Waves and Instabilities from a Neutral Dynamo (WINDY) mission launched in 2017. Two Black Brant IX rockets were launched from Roi Namur, Kwajalein Atoll, Marshall Islands on June 19, 2019.

TooWINDY studied a phenomenon called equatorial spread F, or ESF. ESF disturbances occur in the F region of the ionosphere post sunset at latitudes near the equator. These disturbances interfere with radio communication, navigation, and imaging systems and pose a hazard to technology and a society that depends on it. Predicting ESF would improve the reliability of space-borne and ground-based communication systems. The intent of the TooWINDY mission was to answer questions about the origin, i.e. the events preceding a disturbance, of ESF by measuring the influence of horizontal thermospheric winds on the formation of ESF, as well as, taking measurements of ionospheric densities and electric and magnetic fields.

An important element of these experiments involved measurements of the atmospheric winds at high altitudes. Just as on the ground, winds at very high altitudes carry a tremendous amount of energy and are known to have a direct effect on the ionospheric disruptions that were the focus of TooWINDY. Wind measurements at these altitudes are difficult because of the very low atmospheric density. Several tracer techniques have been perfected to accomplish this by optical tracking of visible gases released from the rockets. Lithium vapor and trimethyl aluminum (TMA) gas have been particularly effective. TMA reacts spontaneously on contact with oxygen to produce a pale white glow visible from the ground. For the TooWINDY mission, sunlight reflected by the Moon illuminated the lithium, producing an emission that was detected with cameras equipped with narrow-band filters. The lithium under these illumination conditions, rather than twilight conditions, was not visible to the naked eye. Using moonlight for illumination allowed the launches to occur later in the evening, when the critical ESF conditions occur. Both gases, which are harmless when released at these altitudes, move with the background atmosphere and can therefore be used to determine the wind speeds and direction over the height ranges where the releases occurred.

Data from the ARPA Long-Range Tracking and Instrumentation Radar (ALTAIR) was used to monitor the state of the upper atmosphere/ionosphere in order to determine when the large-scale disruptions occurred and thus when to launch the rockets.

The two payloads, one instrumented and one carrying vapor tracers, were launched 5-minutes apart into ESF conditions.

Image composite of the TooWINDY launches.

TooWINDY team on Roi Namur, Kwajalein Atoll, Marshall Islands.

41.126 UO Koehler - RockOn! student mission successfully launched on June 20, 2019

For the 12th year in a row the RockOn! student mission was flown successfully from Wallops Island, VA. The launch occured on Thursday, June 20th at 05:30 EDT with over 200 excited students watching their experiments head for space.

Three types of experiments were included in the 2019 RockOn! flight: RockOn Workshop experiments, RockSat-C experiments and Cubes-in-Space.

RockOn workshop experiments are constructed the week before launch at Wallops Flight Facility. Students arrived on Friday, June 14th and started experiment construction on Saturday. All experiments were ready for integration into the payload by Monday afternoon.

Teams of three, with both students and faculty members, work together to build, program and test a workshop experiment. The experiments include a microprocessor for data collection and a suite of sensors such as thermistors, pressure transducers, accelerometers, and geiger counters. Additionally a camera is located on one of the experiment boards. The workshop experience prepares students to participate in more advanced flight opportunities, such as RockSat-C and RockSat-X. 28 experiments were part of the RockOn workshop portion of the payload.

Preparing RockOn! canisters for integration.

RockSat-C experiments are more advanced and designed and constructed by the students. This year nine Colleges and Universities participated in RockSat-C.

Cubes-in-Space is a program for students age 11 to 18. One inch cubes with student designed experiments are flown in the nosecone of the rocket. Students and teachers submit a proposal for an experiment to the

Cubes–in–Space returned after flight.

Cubes-in-Space program. The proposals are reviewed and 80 teams are selected for flight on the rocket

Links for more information on:

[RockOn!]

[RockSat-C]

[Cubes-in-Space]

Workshop in F–3.

RockOn! and RockSat–C students and payload team in F–10.

Payload integration activities.

Launch photo: Allison Stancil–Erwin

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Picture Place

Ground station three upgrades in progress.

All smiles...

Manufacturing payload parts.

Integration activities RockSat–X.

It never snows in Northern Norway, but man, don't they warn ya'? It storms, man, it storms.

Integration & Testing

36.281 UG Bock– Cosmic Infrared Background Experiment (CIBER) 2

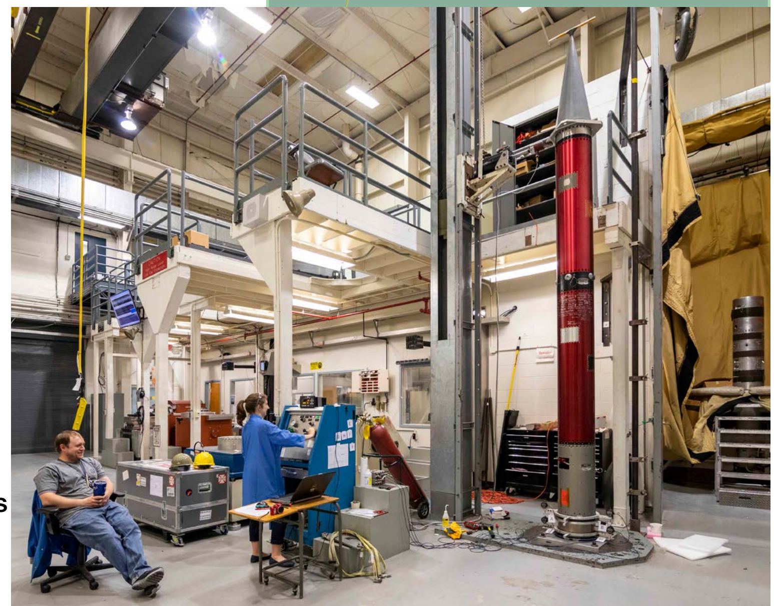
CIBER-2 is a near-infrared rocket-borne instrument designed to conduct comprehensive multi-band measurements of extragalactic background light (EBL) anisotropy on arcsecond to degree angular scales. In addition to emission from known and first-light galaxy populations, low surface brightness tidal streams of stars from gravitational interactions during galaxy formation at redshifts $0 < z < 2$, called interhalo light (IHL), may also contribute a significant fraction of the EBL. The role of IHL in the history of galaxy formation is unclear. The CIBER-1 fluctuation measurements suggest IHL contributes a large EBL fraction, comparable to that produced by known galaxy populations. Thus charting the history of IHL production is of great astrophysical interest. CIBER-2 is scheduled to launch from White Sands Missile Range in February 2020.

36.340 DR Abbett

This reimbursable mission is a development and test project that will utilize high definition cameras to view free flying test objects ejected from the payload under exo-atmospheric conditions. The objective of this flight is to conduct a sounding rocket test to deploy several test objects (TOs), collect on-board video of their deployments, obtain infrared (IR) and radar signature data during the ballistic phase and track one or more TOs until demise. This mission is currently scheduled to launch late August 2019.

41.126 UO Koehler – RockOn!

The RockOn! payload carries experiments from the first two levels, out of three, of the student flight opportunities offered by the Colorado Space Grant Consortium in collaboration with NASA. The first, and simplest, type of experiment is the RockOn! workshop payloads. These are assembled by teams of students and faculty during the one week workshop held at NASA GSFC Wallops Flight Facility, June 16 - 21, 2020. Each payload includes several sensors to measure acceleration, radiation, temperature etc. and uses a microprocessor to facilitate onboard data collection.



The level two experiments are part of the RockSat-C flight opportunity, which gives the students more control over the type of experiment and its contstruction.

Participants in the third level, and most advanced, student flight opportunity, RockSat-X, fly their experiments on a dedicated mission.

All students attend payload integration and some testing activities at Wallops and attend the launch of RockOn! See page four for launch information and more details on this year's mission.

46.022 UO Koehler – RockSat–X

RockSat-X is the most advanced student flight opportunity offered by Colorado Space Grant Consortium in collaboration with NASA. Student experiment teams sign up for the RockSat-X program in the fall, a year prior to launch, and complete reviews similar to what is standard for the NASA Sounding Rockets Program.

The RockSat-X payload offeres accommodations similar to other sounding rocket payloads, and include an Attitude Control System (ACS), Telemetry, access to the space environment through ejectable skins, and recovery.

Students design and manufacture their own experiments, in compliance with NASA standards, and must pass several reviews, as well as, integration and testing prior to flight. RockSat-X is scheduled for launch August 12, 2020 and students are invited to view their experiments take flight from Wallops Island, VA.

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Want to contribute?

Working on something interesting, or have an idea for a story? Please let us know, we'd love to put it in print!

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Launch Schedule July – September 2019

MISSION	DISCIPLINE	EXPERIMENTER	ORGANIZATION	PROJECT	RANGE	DATE
36.346 UG	UV/OPTICAL ASTROPHYSICS	FRANCE	UNIV. OF COLORADO	SISTINE	WS	08/05/19
46.022 UP	STUDENT OUTREACH	KOEHLER	COLORADO SPACE GRANT	RockSat-X	WI	08/12/19
36.320 US	SOLAR & HELIOSPHERIC	KANKELBORG	MONTANA STATE UNIVERSITY	ESIS	WS	08/20/19
36.352 UG	UV/OPTICAL ASTROPHYSICS	MCCANDLISS	JOHNS HOPKINS	FORTIS	WS	08/25/19
46.020 GT	TEST & SUPPORT	HESH	NASA GSFC-WFF	SUB-TEC 8	WI	09/24/19
36.322 GS	SOLAR & HELIOSPHERIC	DAW	NASA/GSFC	EUNIS	WS	09/25/19

WS - White Sands
WI -Wallops Island

The end of an era is upon us!

The Taurus motors, originally developed as the Hon–est John surface–to–surface missile and manufac–tured in the 50's and early 60's, have been used by the Sounding Rockets Program since 1978.

The first sounding rocket with a Taurus motor was a Taurus–Orion, 33.001 Zipf, launched from Churchill, Canada on March 30, 1978. A couple of years later, the Taurus–Tomahaw saw its first flight. 34.001 Wescott, was launched from Poker on March 19, 1980. The first three stage Taurus–Nike–Tomahawk, 38.001 Wescott/Kelley, flew from Poker on April 2, 1984. A total of 60 Taurus–Orions, 12 Taurus–Toma–hawks, and 15 Taurus–Nike–Tomahawks have been flown. The Taurus was then taken into use as the second stage in the Black Brant XI and Black Brant XII configurations. Eight Black Brant XI and 26 Black Brant XII have been flown.

Photos show disposal firing of the Taurus motors currently in inventory. The motors will no longer be used by the Sounding Rockets Program.

All images: Chelsey Ballarte/Office of Communications