



Sounding Rockets Program Office Quarterly Newsletter

# ROCKET REPORT

4 1  
3 2 2021

CAUTION  
High Noise Level  
Use Ear Protection



We helped land on Mars!

See page 8.



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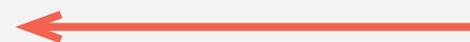
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Cover photo:

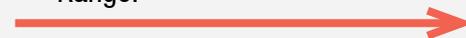
36.326 NR Payload team in F-10 in 2017. The Advanced Supersonic Parachute Inflation Research and Experiments (ASPIRE) was a series of three Terrier-Black Brant sounding rockets to test parachutes for the NASA Perseverance Rover.

Pictures taken prior to Covid-19.



12.088 NR Gilbert vehicle on the launch pad at White Sands Missile Range, NM.

Photo by: White Sands Missile Range.





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## Program Overview

During the Covid-19 pandemic most of the Sounding Rockets Program Office (SRPO) and NASA Sounding Rocket Operations Contract (NSROC) staff have continued to telework to the greatest extent practical during the first quarter of 2021. In lieu of submitting mission specific re-start packages, a program wide re-start request has been approved. Mission integration and testing activities will be scheduled in accordance with rules outlined in the package. By keeping our total footprint in F-10 to a minimum, electrical and mechanical manufacturing have been able to continue to work onsite to help keep mission hardware moving forward, and payload teams involved in approved missions have returned to limited onsite work necessary to complete mission integration and testing.

Other mission preparations, such as mission milestone meetings, have been performed as scheduled for future flights. Facility inspections have also been performed on a regular basis.

One mission, 12.088 NR Gilbert – Aerodynamic Buffet Flight Test (ABFT) was successfully launched from White Sands Missile Range, NM on March 30, 2021.

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12.088 NR Gilbert/NASA Engineering and Safety Center - launched March 30, 2021

The ABFT investigated the unsteady aerodynamic environment acting on a launch vehicle in the transonic flight regime, called transonic buffet, by measuring the constantly-changing surface pressures on a rocket using several hundred miniature pressure transducers imbedded in the skin of the vehicle.

The measurements will be used to better understand the shortcoming, and help improve, current analytical methods used to model this aerodynamic environment and how it interacts with the structure of a launch vehicle.

Current state-of-the-art prediction methods are based on wind tunnel data measured at quasi-steady test conditions. These conditions do not simulate the constantly-accelerating trajectory conditions of a launch and may result in less accurate load predictions, ultimately requiring heavier than necessary vehicle structures to account for these uncertainties. Since transonic buffet loads are some of the largest contributors to the structural design requirements, improving these prediction methods loads may lead to lighter, more efficient, and more capable launch vehicles.

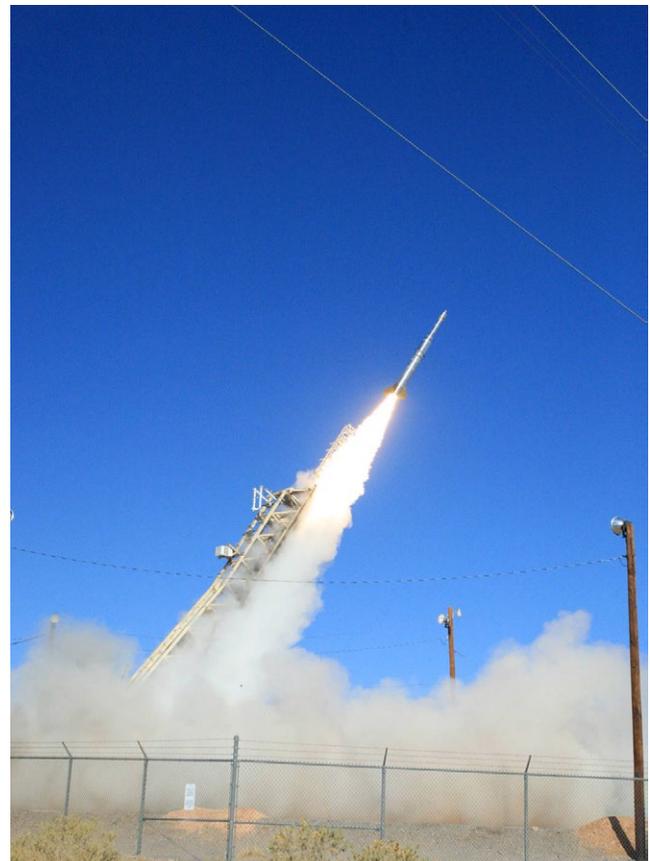


Integration at Wallops Flight Facility.

## Missions Flown



Payload integration at Wallops Flight Facility.



Vehicle on launcher at White Sands Missile Range.

## Integration and Testing



Scott with deployable sub-payloads.



Gary and Kyle working on KiNET-X during integration activities.

## 52.007 UE Delamere/University of Alaska - Kinetic-scale Energy and momentum Transport eXperiment (KiNET-X)

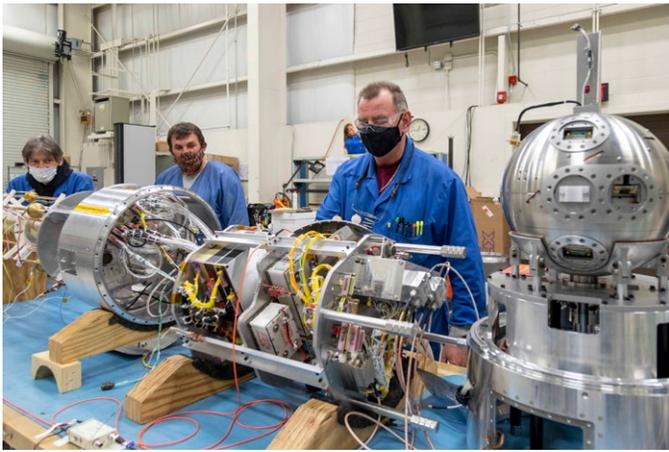
KiNET-X is a multi-instrument payload with participation from several science institutions and organizations, currently scheduled for launch from Wallops Island, VA in May 2021.

KiNET-X is designed to enhance our understanding of a key aspect of heliophysics; the energy and momentum coupling between spatially separate but magnetically linked plasma regimes.

With known energy and momentum input, KiNET-X is designed to test the understanding of kinetic-scale transport. In particular, these questions are addressed:

- 1) how momentum transport is affected by ion kinetic-scale physics,
- 2) how electromagnetic energy is converted into plasma kinetic and thermal energy,
- 3) the interplay between fluid- and kinetic-scale processes.

Four Distributed Payload Communication a.k.a SWARM sub-payloads will be flown on KiNET-X. The sub-payloads for this mission have been modified from the original design to accommodate science requirements. The sub-payload experiments are provided by Dr. Lynch/Dartmouth College and include two each Petite Ion Probes (PIP) and Electron Retarding Potential Analyzers (ERPA).



Clay, Irvin and Wayne with one of the Daytime Dynamo payloads.



Brian and Irvin during integration at Wallops.

## 36.357 & 358 UE Pfaff/NASA Goddard Space Flight Center - Daytime Dynamo 2

The mission, Dynamics, Winds, and Electric Fields in the Daytime Lower Ionosphere, will explore the ion–neutral coupling, winds, and electrodynamics that govern the global atmospheric dynamo which flows at the base of the daytime ionosphere during both quiet and disturbed conditions. Two Terrier–Black Brant vehicles carry identical payloads, one will be launched during quiet conditions, and the other during disturbed conditions.

The Daytime Dynamo mission is scheduled for launch from Wallops Island, VA in July 2021.

## 46.028 UE Bonnell/University of California Berkeley - VLF trans-Ionospheric Propagation Experiment Rocket (VIPER)

The transmission of terrestrial VLF emissions through the ionosphere has a measurable and often significant effect upon both energetic and relativistic electron populations in the magnetosphere. Both natural (e.g. lightning transients) and artificial (e.g. ground VLF transmitter radiation) sources contribute significantly to these VLF emissions. While the VLF penetration process has been modeled and the wave amplitudes measured at the upper bounds of the ionosphere (600–800 km altitude), the actual electrodynamics of the attenuation and propagation process have not been measured from the Earth–ionospheric waveguide, through the ionosphere, and above.

The VLF Trans–Ionospheric Propagation Experiment Rocket (VIPER) rocket will fly a fully 3D electromag–

netic field measurement, DC through VLF, and relevant plasma, and neutral particle measurements at mid–latitudes through the radiation fields of an existing VLF transmitter and naturally–occurring lightning.

The VIPER mission is currently scheduled for launch from Wallops Island, VA in May 2021.



Tim and Kerry working on the VIPER payload.

## Mars parachute testing 2017-2018

In preparation for the successful Perseverance rover landing on Mars on February 18, 2021, the Sounding Rocket Program flew three missions for the Jet Propulsion Laboratory (JPL) in 2017 and 2018. The Principal Investigator was Ian Clark of JPL.

### **Flight 1, 36.326 NR – MSL Build-to-Print Chute at 35,000 lbf launched October 4, 2017 (SR01)**

The primary objectives of this test were to conduct a shake-out of the sounding rocket test architecture, to deploy Mars2020's build-to-print parachute design in a low-density supersonic test environment, and to acquire sufficient test data to characterize the flight environments, loads, and performance of the parachute. SR01 was completed successfully on the first launch attempt. The experiment was delivered to the desired test conditions by the launch vehicle, the build-to-print DGB was deployed successfully at a Mach number of 1.77 and a dynamic pressure of 452 Pa, the parachute and payload were recovered from the ocean, and the required test data was collected. The parachute produced a peak measured load of 32.4 klbf.

### **Flight 2, 36.327 NR – Strengthened Chute at 47,000 lbf launched March 31, 2018 (SR02)**

The second supersonic test flight, SR02, took place on March 31, 2018. The launch vehicle, test platform, instrumentation, mission operations, and test methodologies were nearly identical to SR01. However, the SR02 test article was a strengthened version of the MSL parachute with the same geometry but different materials and construction. The parachute successfully inflated and produced a peak measured load of 56.0 klbf at about Mach 2.

### **Flight 3, 36.328 NR Strengthened Chute at 70,000 lbf launched September 7, 2018 (SR03)**

The third supersonic test flight, SR03, took place on September 7, 2018. The launch vehicle, test platform,

instrumentation, mission operations, and test methodologies were nearly identical to SR01 & SR02. The SR03 test article was similar to the SR02 strengthened parachute, but incorporated a change in materials for the vehicle attachment bridles. The SR03 parachute inflated in 0.410 seconds and survived a peak inflation load of 67.3 klbf at Mach 1.85.

All three flights met their comprehensive success criteria.



Parachute deployed on sounding rocket flight.



Parachute deployed on Mars.



**INTEGRATION ACTIVITIES**



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## Mission Milestone Meetings

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### 46.025 & 46.026 US Barjata/Embry Riddle - Sporadic E Electrodynamics (SEED)

A Design Review was held on January 21, 2021.

The goal of the SEED missions is to collect the first simultaneous multipoint spatial and temporal observations of low-latitude Sporadic-E layers and their associated electrodynamics and neutral dynamics.

The SEED mission includes four spring ejected sub-payloads with telemetered data back to the primary payload.

SEED is currently scheduled for launch from the Reagan Test Site (RTS) in Roi-Namur, Marshall Islands in June 2022.

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### 52.010, 46.034 & 46.035 UE Conde/University of Alaska - Auroral Waves Excited by Substorm Onset Magnetic Events (AWESOME)

A Mission Initiation Conference for this mission was held on February 2, 2021.

This project will study the density, wind, and composition perturbations that occur in Earth's high latitude thermosphere in response to impulsive local forcing during auroral substorms. It is motivated by the premise that generation of acoustic-gravity waves plays a far greater role in the substorm response than is generally recognized or implemented in current models.

Two Terrier-Improved Malemute, and one Black Brant XII-A, will be flown for this mission. The launches are scheduled for March 2023 from Poker Flat Research Range, AK.

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### 46.033 AR Leathe/Sandia National Laboratory-High Operational Tempo (HOTSHOT)

A Requirements Definition Meeting for this mission was held on February 11, 2021.

For the HOTSHOT mission, the Sandia National Laboratory is providing the payload with a host of experiments onboard and NSROC is providing the Terrier-Improved Malemute launch vehicle and recovery system. Additional NSROC payload support requirements are being evaluated.

This mission is currently scheduled for launch from Wallops Island, VA in August 2021.

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### 36.370 US Glesener/University of Minnesota - Focusing Optics X-ray Solar Imager (FOXSI)

A Mission Initiation Conference for this mission was held on February 16, 2021.

The goals for the FOXSI mission include the development of high-resolution direct focusing optics for solar hard X-ray (HXR) and soft X-ray (SXR) imaging spectroscopy and understand the nature of energy release and transfer during solar flares.

This will be the fourth flight of FOXSI.

This mission is currently scheduled for launch from Poker Flat Research Range, AK in March 2024.

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### 36.372 US Chamberline/University of Colorado - Solar eruption Integral Field Spectrograph (SNIFS)

A Mission Initiation Conference for this mission was held on February 22, 2021.

SNIFS will study the high frequency dynamics associated with small (nanoflares, spicules, RBEs) and large (solar flare) energy releases in the lower solar atmosphere.

New technologies used by SNIFS include:

- Mirrorlet Integral Field Spectrograph
- 4MP CMOS detector and software

This mission is currently scheduled for launch from Poker Flat Research Range, AK in March 2024.

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### 36.373 UG France/University of Colorado - Suborbital Imaging Spectrograph for Transition region Irradiance from Nearby Exoplanet host stars (SISTINE) 2

A Mission Initiation Conference for this mission was held on March 12, 2021.

The SISTINE 2 mission will be the second flight of the payload designed to study the radiation environment around low-mass stars and their effects on potential exoplanet atmospheres. The target stars for this mission are Procyon A and B. Both stars will be observed simultaneously during the flight.

This mission is currently scheduled for launch from White Sands Missile Range, NM in November 2021.

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### 36.374 NS McKenzie/NASA MSFC - Chromospheric Layer SpectroPolarimeter Reflight (CLASP2.1)

A Mission Initiation Conference for this mission was held on March 23, 2021.

The Science goal of CLASP2.1 is the mapping of circular polarization of the Mg II h & k lines over a solar active region caused by scattering and magnetic effects.

This mission is currently scheduled for launch from White Sands Missile Range, NM in August 2021.

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### 52.009 AE Reeves/Los Alamos National Laboratory- Beam- Plasma Interactions Experiment (Beam-PIE)

A Design Review for this mission was held on March 25, 2021.

The two primary objectives for Beam-PIE are to demonstrate and increase the technology readiness level of the new electron accelerator technology for space applications and to study wave generation from pulsed electron beams and quantify the generation efficiency of whistler waves relative to extraordinary-mode type waves.

This mission is currently scheduled for launch in January 2022 from Poker Flat Research Range, AK.

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### 36.367 US McEntaffer/Penn State University - The Rockets for Extended-source X-ray Spectroscopy (tREXS)

A Design Review for this mission was held on March 30, 2021.

The Science goal of tREXS is to observe diffuse soft X ray emissions, ~0.2 – 0.8 keV (~1.5 – 5 nm), from the Cygnus Loop Supernova Remnant.

This mission is currently scheduled for launch in October 2021 from White Sands Missile Range, NM.

## From the Archives: MaCWAVE-MIDAS 2002

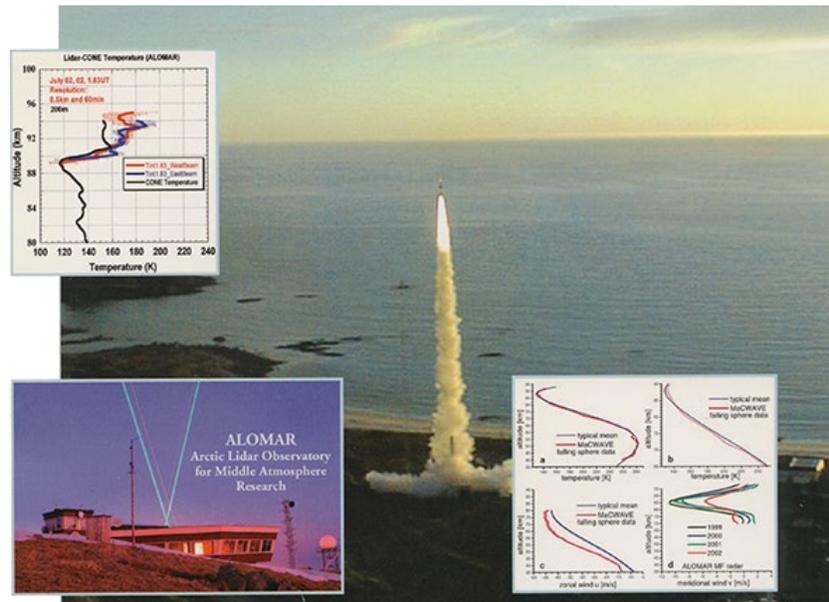
The Mountain and Convective Waves Ascending Vertically and the Middle atmosphere Investigations of Dynamics And Structure (MaCWAVE/MIDAS) collaborative rocket and ground-based measurement programs were performed at the Andøya Rocket Range and the nearby ALOMAR observatory in northern Norway during July 2002.

MIDAS was a bi-lateral German-Norwegian project with participation from several research organizations in the two countries.

Project scientists for MIDAS were Dr. Tom A. Blix from the Norwegian Defence Research Establishment (FFI), and Prof. Dr. F.-J. Lübken from the Leibnitz-Institut für Atmosphärenphysik (IAP), Kühlungsborn, Germany. In addition, scientists from the University of Colorado at Boulder; the University of Oslo, Norway; and the Technical University Graz, Austria, were participating in the campaign.

MIDAS was closely coordinated with the NASA Goddard Space Flight Center's (GSFC) MaCWAVE project. Dr. Richard Goldberg, GSFC, Laboratory for Extraterrestrial Physics, was the principal investigator for MaCWAVE.

The summer component of the MaCWAVE program was focused on gravity wave



Terrier-Orion 41.032 launches from Andøya Space on July 1, 2002. Inserts show data from the campaign and the ALOMAR Observatory. Image from AGU Research Letters 2004.

propagation, instability, and wave-wave and wave-mean flow interaction dynamics contributing to summer mesopause structure and variability. The MIDAS program concentrated on small-scale dynamical and microphysical processes near the summer mesopause. The merged program yielded a comprehensive data set comprising two 12-hour rocket salvos, including 25 MET rockets and 5 sounding rockets, ground-based lidar, radar, and balloon data, and coordinated overpasses of the TIMED satellite. The sounding rockets included three

Improved Orions for MIDAS, two Terrier-Orions for MaCWAVE. The MET rockets included 12 Super Loki falling sphere and 12 Viper IIIA falling sphere.

Ref.  
GEOPHYSICAL RESEARCH LETTERS, VOL. 31,  
L24S02, doi:10.1029/2004GL019411, 2004

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## SCHEDULE

MISSION	DISCIPLINE	EXPERIMENTER	ORGANIZATION	PROJECT	RANGE	DATE
36.324 US	SOLAR & HELIOSPHERIC	HARRIS	UNIV OF ARIZONA	SHIELDS	WS	04/19/21
52.007 UE	GEOSPACE SCIENCES	DELAMERE	UNIV OF ALASKA FAIRBANKS	KINET-X	WI	05/03/21
46.028 UE	GEOSPACE SCIENCES	BONNELL	UNIV. OF BERKELEY	VIPER	WI	05/10/21
36.322 GS	SOLAR & HELIOSPHERIC	DAW	NASA/GSFC	EUNIS	WS	05/18/21
36.281 UG	UV/OPTICAL ASTROPHYSICS	ZEMCOV	RIT	CIBER-2	WS	06/06/21
41.130 UO	STUDENT OUTREACH	KOEHLER	COLORADO SPACE GRANT	ROCKON	WI	06/24/21

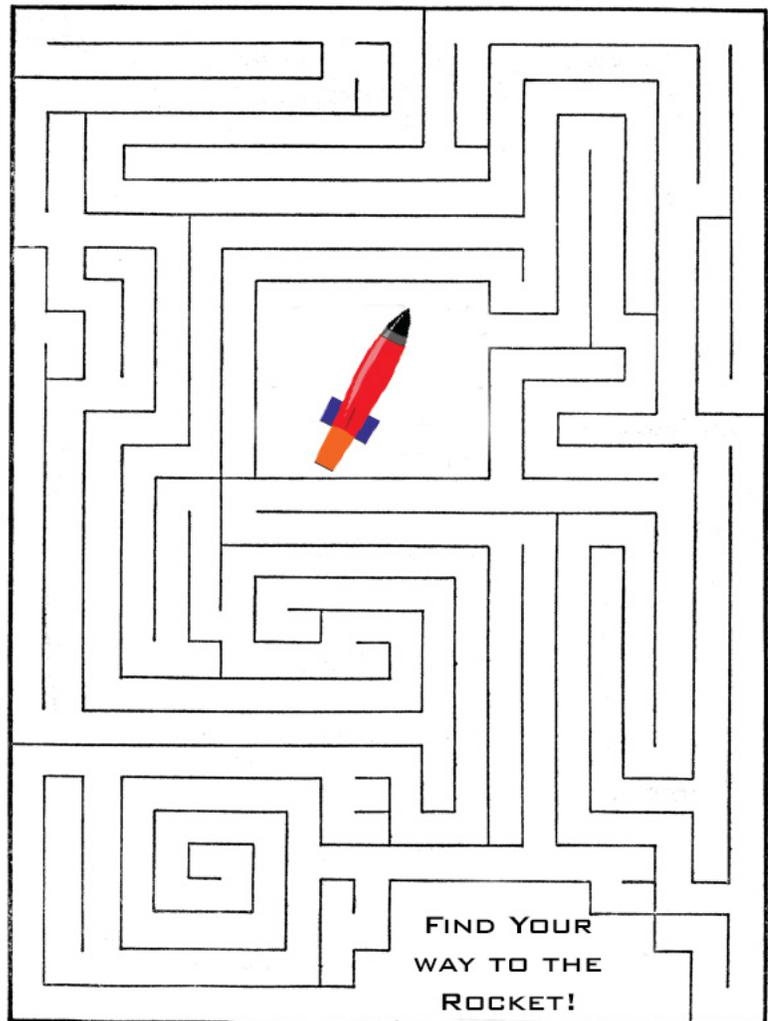
## MISCELLANEA



### For students

Answers from previous newsletter.

The launch range located at coordinates 65 degrees North, and 147 degrees West is Poker Flat Reserach Range in Alaska.



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