

National Aeronautics and Space Administration



Sounding Rockets Program Office Quarterly Newsletter

ROCKET REPORT





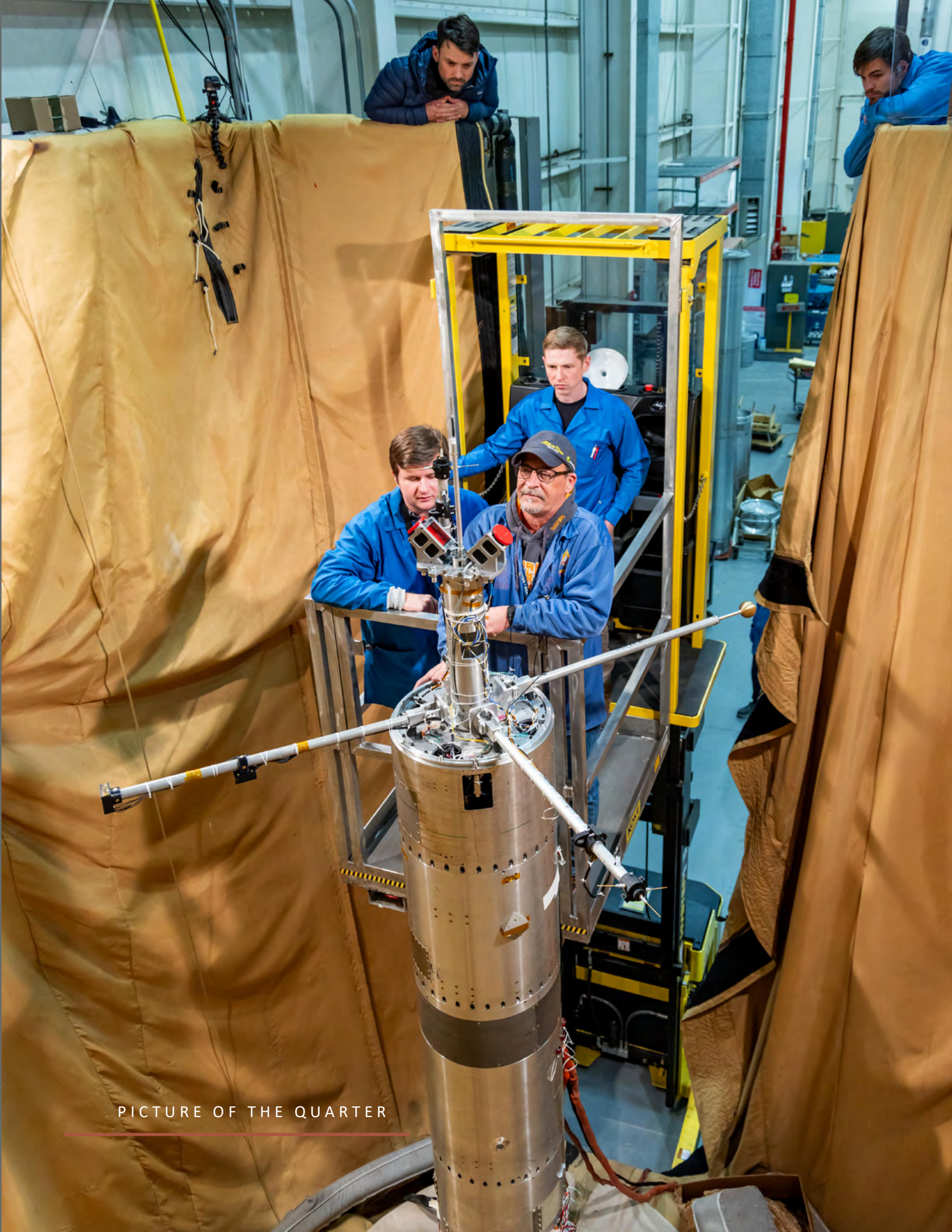
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Cover photo:
GIRAFF and BADASS mission teams at Poker
Flat Research Range, AK.
Credit: NASA Photo/Lee Wingfield

Sporadic E Electrodynamics (SEED) pay-
load deployment testing.

Photo by Berit Bland/NSROC.



PICTURE OF THE QUARTER

Program News

Two sounding rocket campaigns were staged at Poker Flat Research Range, AK this quarter.

The first campaign launched two rockets in February and the second campaign launched two rockets in March. A third rocket was planned for February, but science conditions were not favorable and the mission is being rescheduled for a later date.

The [Sounding Rocket Working Group](#) held the winter meeting via Teams in January. The working group includes scientists, Sounding Rocket Program Office personnel, NASA HQ personnel and engineering staff.

Shipments for the June Kwajalein campaign are on the way. Two rockets will be flown for Dr. Barjatya/Embry–Riddle Aeronautical University to study Equatorial Sporadic E, a periodic disturbance in the E layer of the Ionosphere.

Other upcoming launches for the next quarter include a solar mission from White Sands Missile Range, NM, and a student launch, RockOn, from Wallops Island, VA.



Moose in Alaska.
Credit: Danny Bowden

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36.380 & 381 GE Michell/NASA Goddard Space Flight Center - Ground Imaging to Rocket investigation of Auroral Fast Features (GIRAFF) - February 2 & 9, 2025.

Missions Launched

Two Terrier–Black Brant rockets were launched for the GIRAFF mission from Poker Flat Research Range, AK. First off the pad was 36.381 GE, launched on February 2nd. 36.380 GE was launched on February 9th.

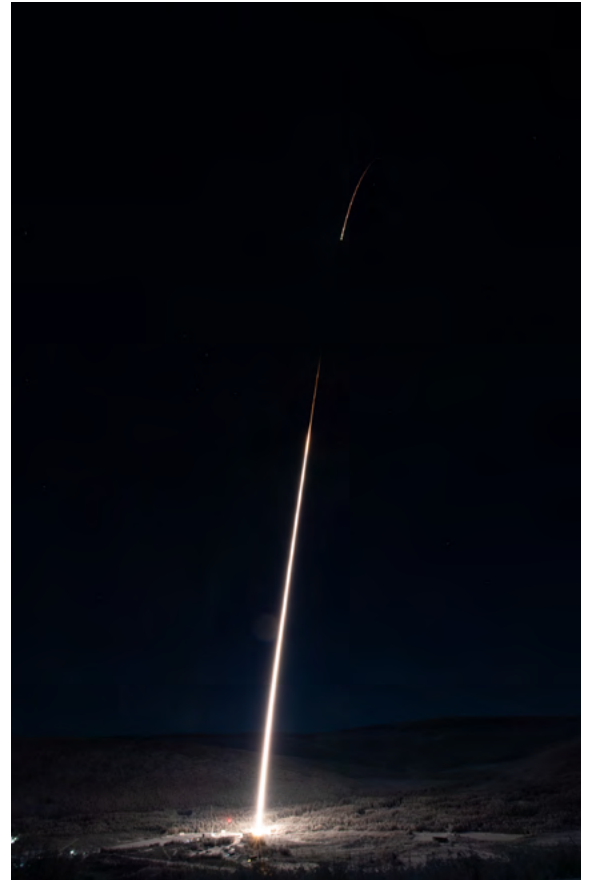
The goal of GIRAFF is to study the processes responsible for creating the fastest optical variations observable within the aurora. This investigation focused on two specific mechanisms of energy coupling, namely Electromagnetic Ion Cyclotron (EMIC) wave–particle interactions at low altitude (<3000 km) and chorus wave modulation in the equatorial magnetosphere that can have significant impacts on the total energy flux of electrons precipitating from the magnetosphere to the ionosphere/thermosphere.

To better understand the mechanisms of these interactions, this investigation was designed to target two different, yet somewhat similar auroral phenomena, namely flickering and fast pulsating aurora, where these wave–particle interactions are manifested as modulations of the auroral luminosity, which typically occur at relatively high frequencies between a few Hz and 15 Hz or more.

GIRAFF accomplished the science goal by launching two identical rockets through either pulsating or flickering aurora using a suite of science instruments with previous sounding rocket heritage.

The main questions GIRAFF hopes to answer are:

1. What are the precipitating electron spectra (energy, flux and temporal characteristics) responsible for creating flickering and fast pulsating aurora?
2. What constraints can be placed on locating where the electromagnetic wave –particle interactions occur for flickering and fast pulsating aurora?
3. To what extent do the spatial variations observed in the optical auroral emissions correspond to variations within the precipitating electron distributions?



One of the GIRAFF rockets launching from Poker.
Credit: NASA Photo/Lee Wingfield

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46.034 & 52.010 UE Conde University of Alaska - Auroral Waves Excited by Substorm Onset Magnetic Events (AWESOME)- March 25, 2025. 46.035 launched March 29, 2025.

Missions Launched

Two, of three, sounding rockets were launched for the AWESOME mission on March 25, 2025 from Poker Flat Research Range, AK. First off the pad was a Terrier–Improved Malemute, 46.034, launched at 11:52:00 UTC, the second rocket, a four stage Black Brant XII–A, 52.010, was launched at 12:30:00 UTC. The third AWESOME launch occurred on March 29th, at 09:30:00 UTC.

AWESOME is a three payload investigation to study the density, wind, and composition perturbations that occur in Earth's high latitude thermosphere in response to impulsive local forcing during auroral substorms.

AWESOME is motivated by the premise that generation of acoustic–gravity waves play a far greater role in substorm response than is generally recognized or implemented in current models.

The investigation planned to launch three payloads in series in one night (46.034 → 46.035 → 52.010), at roughly 30 minutes apart following an auroral substorm of the required strength. Due to a technical issue with 46.035 this payload was launched separately on March 29, 2025.

46.034 and 46.035, Terrier–Improved Malemute payloads, are identical and each include a rocket propelled ejectable subpayload system with Ion Gauge instrumentation, as well as a six kg TM puffer canister. 52.010 also incorporates an identical rocket propelled ejectable subpayload system along with five Ejectable Deployment Systems (EDS) consisting of eight Barium/Strontium ampule releases and 12 TMA ampule releases.

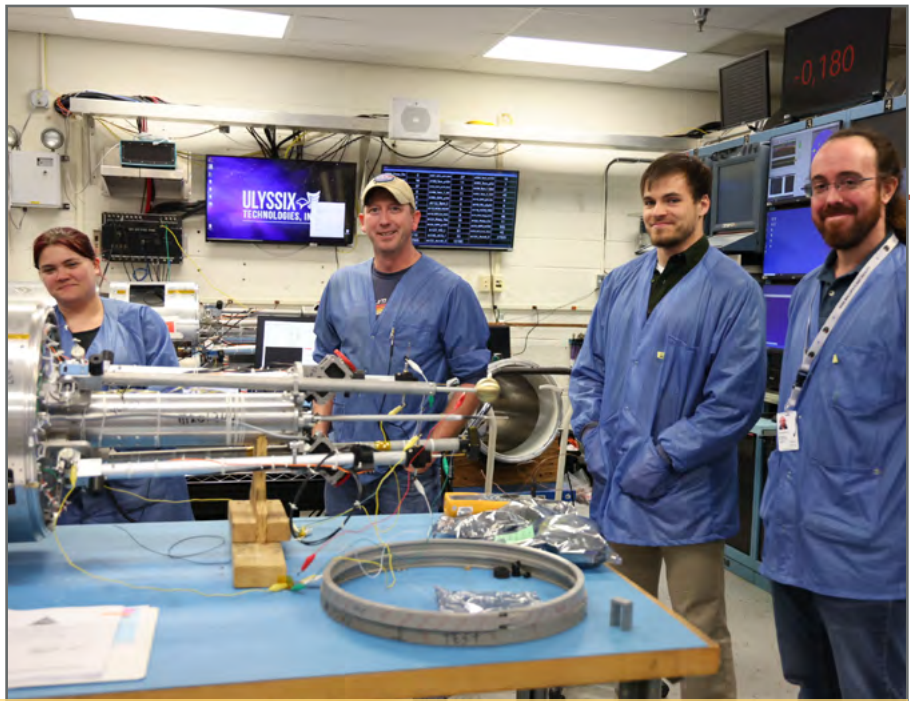
All payloads required ground observations from multiple downrange sites to track chemical tracers.



Payload work at Poker.
Credit: NASA Photo/Lee Wingfield



Talos motor for Black Brant XII–A on the way to the pad.
Credit: NASA Photo/Lee Wingfield



PICTURE PLACE



Credit: NASA Photo/Lee Wingfield



Integration and Testing

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

The Turbulent Oxygen Mixing Experiment Plus (TOMEXplus) sounding rocket investigation 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 modeling. 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 composition, 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 temperature and winds. A modeling component is included to help interpret the measurements returned by the experiment.

The launch window opens on August 17, 2025 at NASA's Wallops Island, VA launch facility.



TOMEX Plus 36.335 payload MOI measurements.
Photo by Berit Bland/NSROC

46.026 & 46.037 UE Barjaty/Embry Riddle - Sporadic E Electrodynamics (SEED)

The SEED investigation aims to take comprehensive measurements of the electrodynamics associated with Es (sporadic E) layers observed at the low latitude location of Kwajalein Atoll in Marshall Islands. In particular, SEED aims to investigate density-temperature anti-correlations.

SEED is a comprehensive experiment to address a series of specific but interlinked science questions related to the Es layer phenomena, especially high altitude (>100 km) Es layers, at low latitude location (Kwajalein) during solar-minimum. Progress on these 3 questions will also contribute to broader science goal of understanding the role of Es layers in ionosphere coupling:

1. Are low-latitude/equatorial Es layers associated with field aligned currents (FAC) of magnitude of 1 to 2 uA/m² in the presence of a night time F region dynamo?
2. How do electric fields and winds modulate temperatures and conductivities in the E region via field aligned currents?
3. How do these field aligned currents (associated with a Sporadic E) themselves change over time through the modulation that they introduce in the electric field?

The launch window opens on June 13, 2025 at the Roi Namur/Kwajalein Atoll/Marshall Islands launch site.



SEED integration at Wallops.
Photo by Berit Bland/NSROC

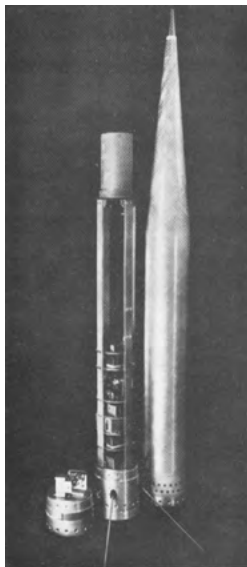
From the Archives Thumba, India rocket launches

Sounding Rocket launches from Thumba, India

The first sounding rocket launch from the Indian site Thumba Equatorial Rocket Launching Station (TERLS) occurred on November 21, 1963. Between that date and April 7, 1972, a total of 52 rockets were flown.

Nike–Apache, 14.128, was the first vehicle type to launch from Thumba and also the most frequently used launch vehicle. Arcas and Nike–Tomahawk rockets were also flown.

In 1964 Dr. Cahill/University of New Hampshire was the first US scientist to launch scientific payloads from TERLS. Four Nike–Apache rockets, 14.079 through 14.082 were launched in January 1964. The purposed of these launches was to determine the vertical current distribution of the equatorial



Nike–Apache payload launched from TERLS. Credit: Dr. Cahill

electrojet over India. The rockets were launched from near the magnetic dip equator at the TERLS Site (8.52°N; 76.87°E). A proton magnetometer measured the magnetic field, and a single Langmuir probe monitored electron density.

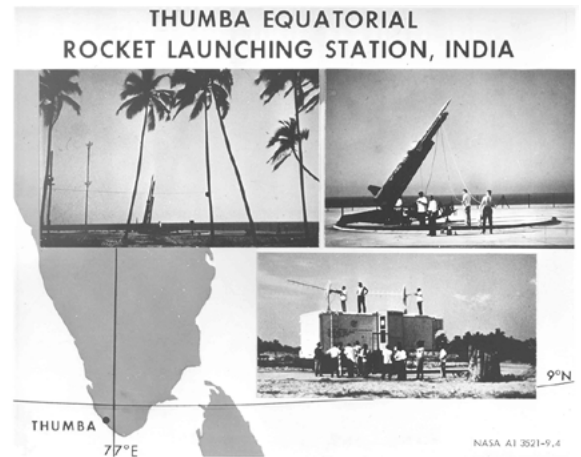
The flights were successful and the results indicate that the equatorial electrojet over India is a thin layer of current, centered about 109 km, with a more diffuse tail extending up to about 130 km.

J.C. Modlin/NASA Goddard Space Flight Center, part of a contingent sent to TERLS for these launches, submitted a trip report with travel information and operations at the launch range.

Some observations from the trip report:

“We (Goddard employees) were amazed at the work the Indians had done in making TERLS an up–and–coming rocket range. Their method of doing things is entirely different than ours, but the end result is one of which they can be proud.”

“The TERLS Rocket Launching facility is located only a few miles from Trivandrum along the Malabar Coast. It faces the Arabian Sea and the village of Attipura. The present site was selected by a survey team consisting of Indian and American personnel as the best compromise of a 11 locations near the magnetic equator.”



Collage of images from TERLS operations. Credit: NASA

“A good portion of the range is studded with coconut palms, making it very picturesque”

“When planning rocket launchings at Thumba, the 75 inches of rainfall should be taken into consideration. Most of it comes during the monsoon season from June through October. At all other times, TERLS should be fine for experiments designed for studies around the equator.”

“Because of the large number of coast–wide fishing boats and ships which operate within the impact areas, range clearances must be obtained at TERLS, as at any other range. However, these notices are not always heeded, and numerous small fishing craft may be unaware of impending firings.”

[Read the full report.](#)

SCHEDULE FOR NEXT QUARTER

MISSION	DISCIPLINE	EXPERIMENTER	ORGANIZATION	PROJECT	RANGE	DATE
46.026 UE	GEOSPACE SCIENCES	BARJATYA	EMBRY–RIDDLE	SEED	KWAJ	06/13/25
46.037 UE	GEOSPACE SCIENCES	BARJATYA	EMBRY–RIDDLE	SEED	KWAJ	06/13/25
41.134 WO	STUDENT OUTREACH	KOEHLER	NASA WFF	ROCKON	WI	06/26/25

KWAJ – Kwajalein Atoll, Marshall Islands
WI – Wallops Island, VA
WS – White Sands Missile Range, NM

MISCELLANEA



Does one energy drink provide enough energy for Ahmed (Electrical Engineer) to strike payload with hammer?

Kinetic Energy (KE) Joules = $\frac{1}{2} \text{ mass} \times \text{velocity}^2$

Hammer mass est: 0.5 kg
Speed of hammer est.: 10 m/s

$KE = \frac{1}{2}(0.5 \text{ kg}) \times (10 \text{ m/s})^2$
 $KE = 25 \text{ J or } 0.025 \text{ kJ}$

Additional energy used by Ahmed:

Cerebral Metabolic Rate: 0.25 kcal/min or
1.05 kJ

Human body energy use: 0.007 kJ/min

Total energy use/min: hammer blow +
brain effort + body effort = $0.025 + 1.05$
 $+ 0.007 = 1.082 \text{ kJ}$

Answer: Yes, one drink is sufficient.

The real question is – What is an Electrical Engineer doing with a hammer?

