Spacecraft Radiation Sensing and Radio Communication

TES-22 Science Mission Payload and Technology Development

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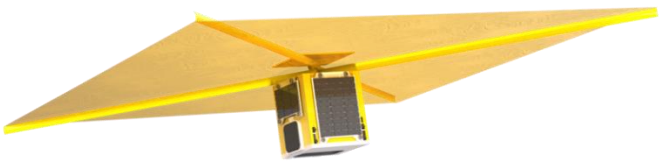
NASA Ames Research Center Nano Orbital Workshop Group

The Nano Orbital Workshop (NOW) group at NASA Ames is a skunkworks small satellite research team working to develop a host of novel technologies to enable rapid, low-cost development of small satellites with cutting-edge capabilities. For several years the NOW group has successfully partnered with the University of Idaho to research and develop technologies that are of interest to the group's Technical and Educational Satellite (TechEdSat – TES) series of .X classification engineering demonstration flights. Missions of this type accept extremely high technical risk to allow for the rapid advancement and testing of cutting-edge spacecraft technologies to help enhance the capabilities of small spacecraft while simultaneously reducing cost.

With the recent ISS launch of TES-10, the Virgin Orbit deployments of TES-7 and TES-13, and the Firefly launch of TES-15, the NOW group continues to develop and test novel technologies on Cube Satellites. An upcoming iteration in this series is TES-22, a 1U CubeSat which will serve as a rapid-deorbit thermosphere test probe to study the radiation environment of the upper atmosphere. TES-22 is scheduled for launch aboard a Falcon 9 in the summer of 2024. While the preliminary design of the 1U structure and avionics has been completed for TES-22, the science payload will be developed by capstone students.

This project group will propose a science mission satisfied by a radiation sensor, develop the necessary hardware and software to integrate the selected sensor into a flight-ready payload, and then travel to NASA Ames in California to integrate their science payload with TES-22 and/or perform environmental testing of TES-22 prior to launch vehicle integration. Throughout the year the team will participate in NASA gate reviews to advance their payload and the TES-22 mission while conducting the project per NASA science mission requirements and Do-No-Harm engineering practices to prepare students for spaceflight engineering projects.



Current TES-22 Design

Primary Project Goal: Radiation Sensor Payload with LoRa Radio

The goal of this capstone team is to design, propose and construct a science mission payload to study the radiation environment of the upper thermosphere. While the overall goal of the science mission has already been locked in, it will be up to the team to develop specific, meaningful science objectives and select appropriate sensors to meet them. Once a mission is designed, a payload will need to be constructed. The payload will include the radiation sensor(s) and support electronics, a LoRa radio for independent ground communications, and interfaces with the TES-22 core avionics. Additionally, custom solar panels will need to be designed for this 1U spacecraft.

If time allows, it is also desired for the software required to preform spacecraft to spacecraft communications via LoRa to be developed, as the TES-22 mission will coincide with other TES-n flights, enabling 'swarm' experimentation opportunities. Additionally, a LoRa ground station for use by the University of Idaho should be developed.

Success in these areas will yield the opportunity to integrate the developed hardware into the TES-22 spacecraft, and to participate in the environmental testing and flight operations of the TES-22 mission. Team members can expect to learn much about the NASA project management process, NASA gate reviews, and what it takes to bring a payload to flight-ready status, an invaluable experience for the New Space economy.

TES-22, 1U Falcon 9 launch, ETL Summer 2024
Get project through NASA CDR, PDR, & FRR
NOW is producing 1U core avionics and structure

Radiation Sensor Payload Design

- Development of science mission objectives, selection of an appropriate sensor, and design of support electronics and structure
- Electronics need to be developed and integrated with TES-22 avionics and structure
- Mechanical enclosure and Systems Engineering
- Microcontroller with LoRa downlink
- Verification and Validation of science requirements
- Trip to bay area for integration and/or environmental testing (schedule dependent)

1U Solar Panels

- Design electrically and mechanically

LoRa experiment

- Satellite-to-Satellite LoRa comms experiment needs to be developed
- LoRa ground station construction for Idaho

Electrical Engineering

- Solar panel design, payload hardware design and testing

Mechanical Engineering

- Payload design, systems architecting, systems engineering for NASA design reviews

Computer Science/Engineering

- LoRa cross-link experiment between spacecraft, Microcontroller firmware for payload, potential avionics software work

Biological Engineering

- Science requirements management and experiment design, payload sensor selection, NASA science mission management

Students: EE, CompE, MechE, CompSci/Engr, BioE
NASA Ames Liaisons: Malachi Mooney-Rivkin, Avery Brock
UI Instructor Liaison: Feng Li
Budget: >$5,000

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