ELaNa IX International Space Station CubeSat Deployment

December 2015

NASAfacts

OVERVIEW

NASA will enable the deployment of three small research satellites, or CubeSats, selected through the CubeSat Launch Initiative (CSLI) for two universities and one primary school as part of the ninth installment of the Educational Launch of Nanosatellite (ELaNa) missions. More than 400 students have been involved in the design, development and construction of the CubeSats that will be deployed from the International Space Station (ISS) via the commercially operated NanoRacks CubeSat Deployer (NRCSD) system. ELaNa IX will launch on the fourth Orbital-ATK Cygnus Commercial Resupply Services (CRS) mission atop an Atlas V rocket that is scheduled to lift off December 3 from Cape Canaveral Air Force Station, Florida, at 5:55 p.m. EST. CubeSat deployments from the ISS via the CubeSat deployer are made possible through a Space Act Agreement between NASA and NanoRacks LLC.

CubeSats are playing an increasingly larger role in exploration, technology demonstrations, scientific research and educational investigations at NASA. These miniature satellites provide a low-cost platform for NASA missions, including planetary space exploration; Earth observation; fundamental Earth and space science; and technology demonstrations such as cutting-edge laser communications, energy storage, in-space propulsion and autonomous movement capabilities. They also allow educators an inexpensive means to engage students in all phases of satellite development, operation and exploitation through real-world, hands-on research and development experience on NASA-funded ride-share launch opportunities.

The CubeSat Launch Initiative enables the launch of CubeSat projects designed, built and operated by students, teachers and faculty. CSLI provides access to space for CubeSats developed by the NASA centers and programs, educational institutions and nonprofit organizations, enabling all these CubeSat developers access to a low-cost pathway to conduct research in the areas of science, exploration, technology development, education or operations. ELaNa Missions, managed by the Launch Services Program at NASA's Kennedy Space Center in Florida, provide a deployment opportunity or ride-share launch to space for the CubeSats selected through CSLI. ELaNa mission managers and their teams reach students at schools and colleges across the United States, providing spaceflight education through the preparation of payloads – licensing, integration and testing – that are flown in space. Since its inception in 2010, the initiative has selected more than 100 CubeSats and launched 43 CubeSats from primarily educational and government institutions around the United States. These miniature satellites were chosen from a prioritized queue established through a shortlisting process from responses to public announcements on NASA's CubeSat Launch Initiative. NASA will announce another call for proposals in mid-August 2016.

Basic CubeSat Facts:

- Built to standard dimensions of 1 unit (1U) which is equal to 10x10x10 cm
- Can be 1U, 2U, 3U or 6U in size
- Weigh less than $1^{1/3}$ kg (3 lbs) per U – 6U may be up to 12-14 kg
- Deployed from standardized dispensers

CUBESAT DEPLOYMENT

The CubeSats are housed in the NRCSD, a stackable, modular, ground loaded dispenser built by NanoRacks LLC in Webster, Texas. Each deployer accommodates up to 6.5U of CubeSat volume. Astronauts on the space station stack the NRCSDs into an eight-dispenser configuration, which are then mounted on the Japanese Experiment Module airlock slide table and moved outside of the station. The Kibo arm captures the table and positions the entire facility toward Earth. Upon the approval to proceed from NASA and JAXA, the NRCSDs are commanded one by one, allowing the dispenser doors to open and the large internal spring to be released, deploying the CubeSats into an orbital altitude similar to that of the ISS, around 400 km above Earth. After 30 minutes in orbit, the internal timers on the CubeSats allow their onboard computers to boot up and begin transmitting. The CubeSat teams utilize their ground stations to listen for their beacons to determine the small satellites' functionality and operational status. CubeSat mission durations and orbital lives vary, but are anticipated to last at least 120 days. Upon mission completion, the CubeSats fall toward Earth, burning up in the atmosphere.

SAFETY AND MISSION ASSURANCE

Each CubeSat developer verified that its satellite complied with the NRCSD requirements. Each ELaNa CubeSat complies with U.S. and NASA orbital debris mitigation standard practices.

STMSat-1

St. Thomas More Cathedral School – Arlington, Va.

The St. Thomas More (STM)Sat-1 mission is an education mission to provide hands-on, inquiry-based learning activities with an on-orbit mission to photograph the Earth and transmit images to our primary ground station and to remote ground stations throughout the country. All 400 students in the pre-K to 8th grade school participated in the design, building and testing of the spacecraft. More than 10,000 grade school students around the world will participate in the mission as Remote Mission Operation Centers receive images from the spacecraft as it flies over their school. STMSat-1 will be the first CubeSat NASA has launched for a primary school.

St. Thomas More student holds the STMSat-1 CubeSat.
Credit: St. Thomas More Cathedral School

CADRE

CubeSat investigating **A**tmospheric **D**ensity **R**esponse to **E**xtreme driving

University of Michigan – Ann Arbor, Mich.

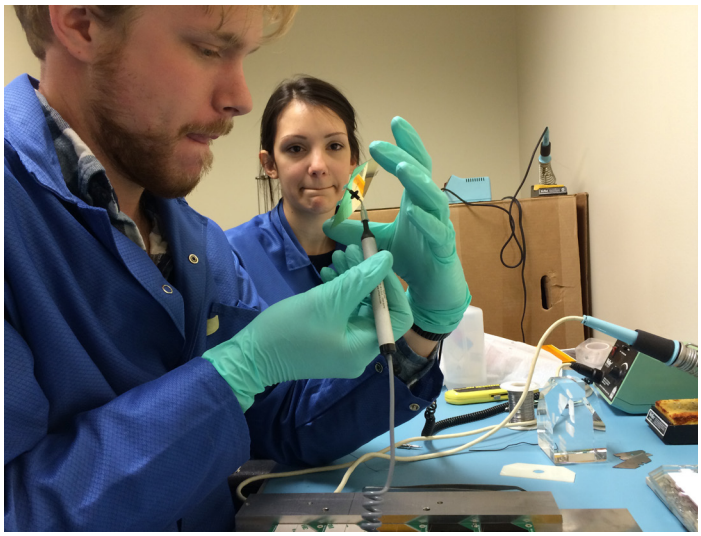
The CADRE mission is a space weather investigation that will improve our understanding of the dynamics of the upper layers of our atmosphere: the thermosphere and ionosphere. Phenomena ranging from solar storms to the aurora energize the atmosphere in a variety of regions and scales whose effects can propagate across the globe. CADRE will be one of the first missions to flight test the Wind Ion Neutral Composition Suite (WINCS), which will measure various aspects of the upper atmosphere, such as the wind speed and the temperature. These are needed to specify the weather that is occurring in the thermosphere and ionosphere. CADRE will assist researchers who have upper atmospheric weather models by providing data that can be used to validate their models. It also will provide valuable information on how the density changes in the upper atmosphere as energy is added. This is important for predicting satellite orbits and mitigating collisions.

MinXSS

Miniature **X**-Ray **S**olar **S**pectrometer

University of Colorado Boulder – Boulder, Colo.

The MinXSS mission is a science investigation to study solar flares, active regions, the quiescent sun, and their impact on Earth's upper atmosphere. Specifically, MinXSS will observe the sun's energy distribution in soft X-rays, which penetrate into the Earth's ionosphere, thermosphere, and mesosphere. MinXSS will measure the intensity of the soft x-ray spectrum from 0.4 keV (30 Å) to 30 keV (0.4 Å), with energy resolution better than 0.15 keV. The team developed a Sun Position Sensor and X-ray Photometer to provide independent, fine-pointing knowledge of the solar position and broadband X-ray comparisons for use in science processing.



University of Colorado students handle the MinXSS solar cell.
Credit: University of Colorado Boulder

To contact the ELaNa IX Launch Public Affairs Office, call 202-358-1100

For more information about the NASA's CubeSat Launch Initiative, visit: http://go.nasa.gov/CubeSat_initiative

For more information about the ELaNa IX CubeSats, visit: **STMSat-1**: www.stmsat-1.org/ **MinXSS**: lasp.colorado.edu/home/minxss/

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