ELaNa XII CubeSat Launch on NROL-55 Mission

October 2015

NASAfacts

OVERVIEW

NASA will launch four small research satellites, or CubeSats, selected through the CubeSat Launch Initiative (CSLI) as part of the twelfth installment of the Educational Launch of Nanosatellite (ELaNa) missions. Over 50 students have been involved in the design, development and construction of the CubeSats that will be flown on the National Reconnaissance Office's (NRO) Government Rideshare Advanced Concepts Experiment (GRACE) which is an auxiliary payload to the NRO's L-55 mission scheduled to launch on Oct. 8, 2015, from Vandenberg Air Force Base, CA. GRACE will carry a total of 13 CubeSats, four of which are sponsored by NASA's CubeSat Launch Initiative.

CubeSats are playing an increasingly larger role in exploration, technology demonstration, scientific research and educational investigations at NASA. These miniature satellites provide a low-cost platform for NASA missions, including planetary space exploration; Earth observations; fundamental Earth and space science; and developing precursor science instruments like cutting-edge laser communications, satellite-to-satellite communications 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 rideshare 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 non-profit organizations giving 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 KSC, provide a rideshare launch for the CubeSats selected through CSLI. ELaNa mission managers and their team reach students by introducing educational spaceflight in schools and colleges across the United States through the preparation of payloads that are flown in space. Since its inception in 2010, the initiative has selected more than 100 CubeSats and launched 37 CubeSats from primarily educational and government institutions around the U.S. These miniature satellites were chosen from a prioritized queue established through a shortlisting process from proposers that responded 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

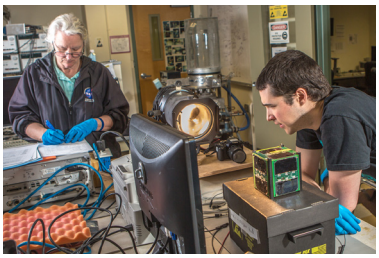
Four CubeSat projects were selected for the ELaNa XII mission. There will be two P-PODs aboard the Atlas V rocket that will ferry them to space. Similar to NRO's previous CubeSat rideshares, GRACE will reach orbit on an ATLAS V rocket, mounted to the Aft-Bulkhead Carrier, located on the aft (or back) end of the Centaur-upper-stage. The P-POD was designed and manufactured by the California Polytechnic State University of San Luis Obispo, Calif., to integrate CubeSats onto launch vehicles. After the main payload deploys, the CubeSats will separate from their P-PODs. After 45 minutes in orbit, the CubeSat transmitters will turn on and university ground stations will listen for their beacons, determine their small satellites' functionality and announce operational status. CubeSat mission durations and orbital life vary, but are anticipated to last at least 90 days. Upon mission completion, the CubeSats fall to Earth, burning up in the atmosphere.

SAFETY AND MISSION ASSURANCE

Each CubeSat developer verified that its satellite complied with the P-POD requirements. NASA jointly conducted a mission readiness review with each CubeSat developer. Each ELaNa CubeSat complies with U.S. and NASA orbital debris mitigation standard practices.

ARC Alaska Research CubeSat

University of Alaska Fairbanks – Fairbanks, Alaska



Denise Thorsen and Jesse Frey perform tests on the ARC CubeSat. Credit: University of Alaska Fairbanks.

The Alaska Research CubeSat (ARC) mission is a technology demonstration mission to increase the technology readiness level of the ARC subsystems and to provide NASA relevant data of the launch environment. Beyond validating the basic platform, two critical subsystems will be tested, (i) a novel low-power attitude control and determination system, and (ii) a communication system capable of high bandwidth data transfer. ARC is the first satellite designed, built, tested and operated by engineering and science students from Alaska.

BisonSat

Salish Kootenai College – Pablo, Mont

BisonSat student Zachary DuMontier tests solar panels. Credit: Salish Kootenai College

The BisonSat mission is an Earth Science mission that will demonstrate the acquisition of 100-meter or better resolution visible light imagery of Earth using passive magnetic stabilization from a CubeSat. The science data, 69 km x 52 km color images with a resolution of 43 meters per pixel, a few of which will be images of the Flathead Indian Reservation in northwest Montana, will be used primarily for engaging tribal college students and tribal communities in NASA's mission. BisonSat is the first CubeSat designed, built, tested, and operated by tribal college students.

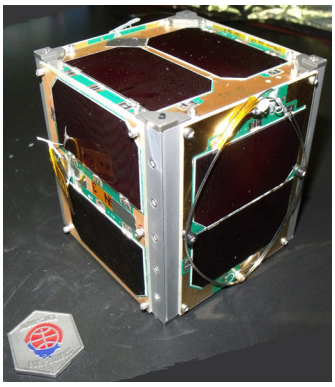
LMRST-Sat

Low Mass Radio Science Transponder - Satellite Jet Propulsion Laboratory, Calif.

The LMRST-Sat mission is a technology demonstration mission to raise the technology readiness level (TRL) of a developmental model of the X-Band LMRST while also providing a ranging calibration target in Earth orbit. This target can be interrogated by stations in the Deep Space Network (DSN) to produce standard Doppler and Ranging data types that are used to navigate spacecraft and perform radio science measurements. LMRST-Sat consists of a prototype X-Band LMRST and support bus electronics for the purpose of controlling and monitoring the transponder. Bus electronics were provided by Pumpkin, Inc. in collaboration with Stanford University Space Systems Development Lab (SSDL). Future flight versions of LMRST can be used on deep space missions to provide routine radio science measurements as an independent instrument rather than relying on scheduled, rare opportunities requiring use of the spacecraft telecommunications system.

Fox-1

AMSAT, The Radio Amateur Satellite Corporation – Kensington, Md.



The Fox-1 CubeSat will host two-way FM communications transponder and experimental payloads. Credit: AMSAT

Fox-1 is a 1-Unit CubeSat whose primary focus is education that will host a two-way FM communications transponder and experimental payloads. The communications package is specifically designed to be easy-to-use requiring only a simple walkie-talkie style radio combined with a small hand-held antenna. Using amateur radio frequencies, it will be open and available to the general public. This simple, low-cost on-orbit capability facilitates a wide spectrum of STEM educational opportunities from inspiring young minds and engaging secondary school students to educating teachers and university students. As a capstone project at Penn State University for the 2011-2012 academic year, senior engineering students developed a 3-axis Micro-Electro-Mechanical-System (MEMS) gyroscope to measure the spin and wobble of the satellite. A payload developed by Vanderbilt University and sponsored by NASA's Experimental Program to Stimulate Competitive Research (EPSCoR) will record occurrences of radiation-induced bit upsets in modern commercial-off-the-shelf memory chips that exhibit a sensitivity to low-energy protons. The mission will contribute to the validation of ground-based test methods for hardness assurance and error rate predictions.

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

For additional information about the ELaNa XII CubeSats, visit:

ARC: spacegrant.alaska.edu/content/student-satellite-program
FOX-1: http://www.amsat.org/?page_id=1113

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