Free ride for NMSU's BalloonSat yields big success

No aimless wanderer, NMSU's latest student satellite was a hitchhiker with a purpose. Catching a ride on a test flight of a new NASA experimental balloon in late May, the little "BalloonSat" proved itself viable, sending photographs from on high and taking measurements that will further cosmic-ray research.

The balloon launch of the satellite was the latest in the four-year odyssey of a project that to date has involved more than 100 electrical and mechanical engineering students in their senior design courses. Mechanical engineering students designed the structure and electrical engineering students designed the software and electronics components. Each semester the design was refined as new groups of students tested and improved the satellite.

The project had its roots in 1999 as part of an Air Force-funded project to design and build three nanosatellites that would fly in a constellation. This Three-Corner Satellite Project was designed to use digital cameras to capture stereo images of cloud formations. NMSU designed and built the communications system, to test the capabilities of inexpensive, commercial-grade components in space.

For the Three-Corner Satellite project, New Mexico State teamed with the University of Colorado and Arizona State University. Two of the Three-Corner Satellite components were launched in December 2004 from Cape Canaveral, Fla., aboard an experimental rocket, but the rocket under-performed and the satellites never made it into orbit. The third member of the Three-Corner Satellite project is currently at the Smithsonian in Washington, D.C.

The current nanosatellite project began in 2003 and is an all-NMSU venture with a scientific payload important to NASA's program to search for ultra-high-energy cosmic rays.

"NASA wants to build a large space-based detector to look for ionization tracks made in the atmosphere as the highest energy cosmic rays pass through," said Steve Stochaj, the science coordinator on the project. Because the light produced by the interaction of cosmic rays with the atmosphere is in the ultraviolet part of the spectrum, designers of the detector need to know the level of the background ultraviolet radiation from the Earth. The NMSU satellite has two instruments to measure the ultraviolet rays, one that would look into space and one that would look down at the planet, to provide the needed benchmarks.

Like the Three-Corner Satellite project, the cosmic ray satellite was funded by the Air Force in its highly competitive university nanosatellite program, but it was not selected for launch aboard a rocket. The backup plan for having a mission for the satellite was to seek an alternative to a rocket flight where the science mission could still be conducted and the planned orbital operations could be simulated. Additional funding to convert the satellite to a balloon launch was obtained from the International Foundation for Telemetering so that the alternative launch plan could be achieved.

So Stephen Horan, Klipsch School of Electrical and Computer Engineering department head, and Stochaj, leader of the university's aerospace research cluster, began searching for a ride. They looked to NMSU's Physical Science Laboratory (PSL), which launches scientific balloons for NASA, and found it with an experimental flight that was planned to test a new NASA balloon to support scientific research flights.

The launch was originally scheduled for May 5 from Fort Sumner, N.M., but weather conditions were not conducive to flight until May 31.

The velocity and direction of surface winds, shear winds as the balloon ascends, and winds at the 120,000-foot float altitude have to be just right, explained Horan. And they have to be just right for approximately 24 hours for the duration of the flight.

The balloon was launched from NASA's facility in Fort Sumner on May 31 and was aloft for approximately 30 hours.

"Having the payload go up on a balloon is in some ways better than having it go up on a rocket," said Horan. "It's less expensive and you have more control, but you also have more time to conduct experiments."

In this case, approximately 21 hours of flight during the dark of night afforded the instruments ample opportunity above the Earth's atmosphere to get the desired ultraviolet measurements. It also provided enough time to ensure that the hardware, software and sensors were all operating properly.

The payload was also equipped with a camera that was operated via computer by Horan to take random shots of Earth.

"It all worked pretty much as expected," said Horan. "It served as a dry run for an actual orbit and proved that it will work. We were able to test our instruments, gather science data, and even remotely control the operations over the Internet from the NMSU campus. And from a visual inspection, the physical structure is intact. We could reuse it immediately. This will help us gain other opportunities to launch payloads."

As progress at the Southwest Regional Spaceport continues to develop, the possibilities for putting small satellites and other student-built payloads into space grow more interesting.

"My vision is to have a stable of student-built payloads here at NMSU" that could fly on rockets and space planes to be launched from the spaceport, Horan said.

Photo is available at
http://ucommphoto.nmsu.edu/newsphoto/research_balloon.jpg
CUTLINE: The uppermost part of a NASA balloon is filled with helium before it is launched from Fort Sumner on May 31. It carried a New Mexico State University BalloonSat project to an altitude of 120,000 feet.(NMSU photo)

Stephen Horan
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