NASA lining up ICESat-2's laser-catching telescope

November 3 2014

Engineers and technicians check the fit of ICESat-2's telescope to its sling, before moving it into place on the instrument's optical bench. Credit: Debbie McCallum/NASA

To catch individual laser photons that have travelled more than 600 miles from a satellite to Earth and back, the satellite's telescope needs to be perfectly positioned. Last week, engineers and technicians at NASA's Goddard Space Flight Center in Greenbelt, Maryland, fitted the mirrored telescope of the Ice, Cloud and land Elevation Satellite-2 (ICESat-2) into

its place.

It's the latest milestone in the assembly of a satellite that will measure the elevation of Earth from space, helping scientists track changes to Earth's ice-covered poles, take stock of forests, map ocean surfaces and characterize clouds.

ICESat-2's single instrument is the Advanced Topographic Laser Altimeter System, or ATLAS. Once in orbit, ATLAS will time how long it takes for light from its green lasers to travel to Earth's surface and back. By analyzing those times with computer programs and determining the distance light travels, scientists can calculate surface elevation.

In a Goddard cleanroom, teams are working in parallel on two sections of ATLAS: the box structure, which holds electronics that control the instrument, and the optical bench, which supports the instrument's lasers, mirrors, and the 2.6-foot, 46-pound beryllium telescope that collects light.

Each ATLAS laser pulse contains more than 200 trillion photons, but only a dozen or so return to the telescope, where they're sent via optical fibers to the instrument's detectors. To catch those few photons, the telescope and its associated equipment, called the Receiver Telescope Assembly or RTA, need to align perfectly to the laser.

The telescope's base is bolted in place by three metal feet, which are required to fit flush with the bench to within ten thousandths of an inch, said Bente Eegholm, the RTA lead at Goddard. The technicians, she noted, beat that requirement. The team had designed a multi-step procedure to make that fit. At the heart were two plates – one with three 1-inch spheres on top, the other with three cone-shaped grooves machined to balance evenly on the spheres.

The cleanroom crew used a precision crane to lift the RTA out of its box, setting it down temporarily on low scaffolding where they could attach the grooved plate to the base of a telescope. They lifted the RTA again, this time positioning it inches over the optical bench and setting it atop a mount with the sphere plate.

"Using that design, the telescope rests perfectly," said Carol Lilly, integration and testing manager for the ATLAS instrument at Goddard. Knowing the alignment was correct, the team slowly lowered the telescope assembly and bolted it into place.

The ATLAS telescope team has been testing the optical performance of the telescope mirror since it arrived at Goddard on March 25, 2014, Eegholm said. They investigated how it worked with other parts of the instrument. They designed a way of testing its optical performance in a thermal vacuum chamber, snaking in fiber optics so they could send light through the RTA while it cycled through hot and cold temperatures, testing how well it would perform in space-like conditions.

Work assembling the ATLAS instrument began in Spring 2014. In addition to assembling and testing some of the first mirrors and lenses that will direct the laser out of the bench, the ATLAS team has also been attaching electronics to the box-shaped frame of the instrument. Earlier this fall, the ATLAS team conducted a 'fit check,' lowering the bench into place on the box to see how the connections will work together.

Once all of the ATLAS components are in place and tested, the instrument will be transported to Orbital Sciences Corp. in Gilbert, Arizona, where it will be attached to the spacecraft. ICESat-2 will then be shipped to Vandenberg Air Force Base in California for launch.

More information: For more information about ICESat-2, visit: icesat.gsfc.nasa.gov/icesat2/

Provided by NASA's Goddard Space Flight Center