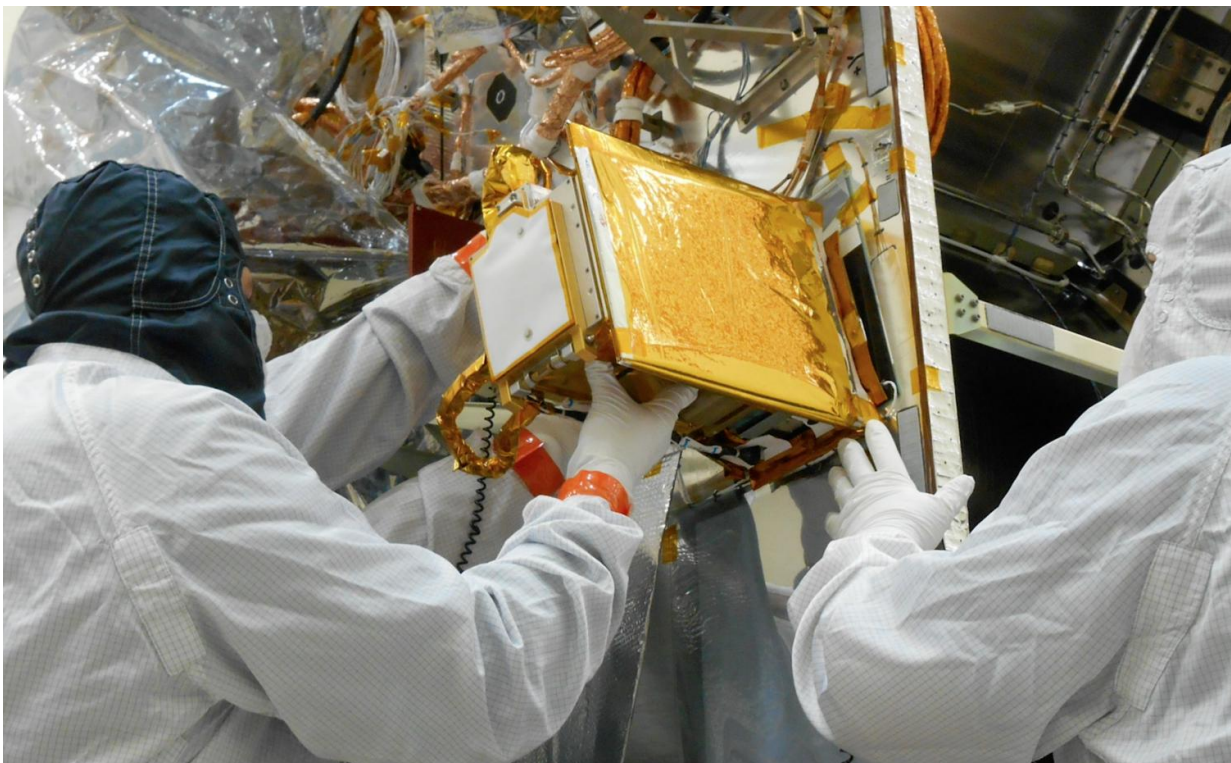


NASA instrument to use X-rays to map an asteroid

July 12 2016, by Sarah Schlieder



Technicians install the REXIS instrument onto the OSIRIS-REx spacecraft.
Credit: NASA

NASA's OSIRIS-REx spacecraft will launch September 2016 and travel to the near-Earth asteroid Bennu to harvest a sample of surface material and return it to Earth for study. But before the science team selects a

sample site, they can find out a bit about Bennu's elemental make-up.

To determine the composition of Bennu's surface, the Origins, Spectral Interpretation, Resource Identification, Security-Regolith Explorer (OSIRIS-REx) team equipped the spacecraft with an instrument that will identify which elements are present on the asteroid and measure their abundance.

The Regolith X-ray Imaging Spectrometer, or REXIS can image X-ray emission from Bennu in order to provide an elemental abundance map of the asteroid's surface.

"REXIS is different from the other imaging instruments on OSIRIS-REx because we're going to determine what Bennu is made of at the level of individual atomic elements," said Richard Binzel, REXIS principal investigator and instrument scientist at the Massachusetts Institute of Technology (MIT), Cambridge. "We're sniffing the atoms on the surface of Bennu."

To do that, REXIS gets a little help from the sun. Atoms on Bennu's surface absorb incoming solar X-rays that are emitted along with the solar wind. This causes electrons in the atom to move to a higher energy level. However, because these excited electrons are unstable, they quickly de-excite and drop back down to their original energy level and emit their own X-ray in turn. This process is known as fluorescence.

"You have all this energy coming in, and it kicks electrons up to the next [energy level](#), but the electrons quickly decay back down and emit X-rays of precisely that same energy," said Josh Grindlay, REXIS co-principal investigator and deputy instrument scientist at Harvard University, Cambridge, Massachusetts. "The net result is a glowing surface on Bennu."

The energies of the re-emitted X-rays are characteristic of the elements from which they came. Elements absorb and re-emit X-rays at different, specific energies. The energies that the science team will see glowing at Bennu's surface will tell the researchers which elements are present.

In order to map these emitted X-rays, REXIS is fitted with what's known as a coded aperture mask. The mask consists of a pattern of pinholes that, when X-rays shine through, creates a shadow pattern on REXIS' detector.

Imagine sitting in your bedroom at night and a car drives by. The headlights cast a pattern of light and shadow on the walls. As the car moves, so do the shadows. In REXIS' case, it's the spacecraft that moves over the asteroid [surface](#). The changing shadow patterns allow the team to identify any particular bright spots on Bennu that might be especially abundant in a certain element.

REXIS was selected as a Student Collaboration Experiment for the OSIRIS-REx mission. Built by a team from MIT and Harvard, students will perform data analysis of REXIS as part of their coursework.

"This has been an amazing experience for the students," said Rebecca Masterson, REXIS co-principal investigator and instrument manager at MIT. "They get to see how a mission evolves and what it takes to get to the point of launch. They're getting to see how an idea goes from conception to completion and actually play a role in its success."

More than 100 students will have been involved in REXIS upon the completion of the OSIRIS-REx mission.

"Even though OSIRIS-REx hasn't left the ground, I think REXIS is already a success," said David Miller, NASA's chief technologist and a former REXIS team lead at MIT. "We've inspired so many students.

They are our next generation of space scientists and engineers, and they've already had a profound impact on our abilities to go further and explore deep space."

Provided by NASA's Goddard Space Flight Center

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