

Driveway test paved way for asteroid sampler

The asteroid collection device to be installed in August on the OSIRIS-REx asteroid probe has a surprising backstory.

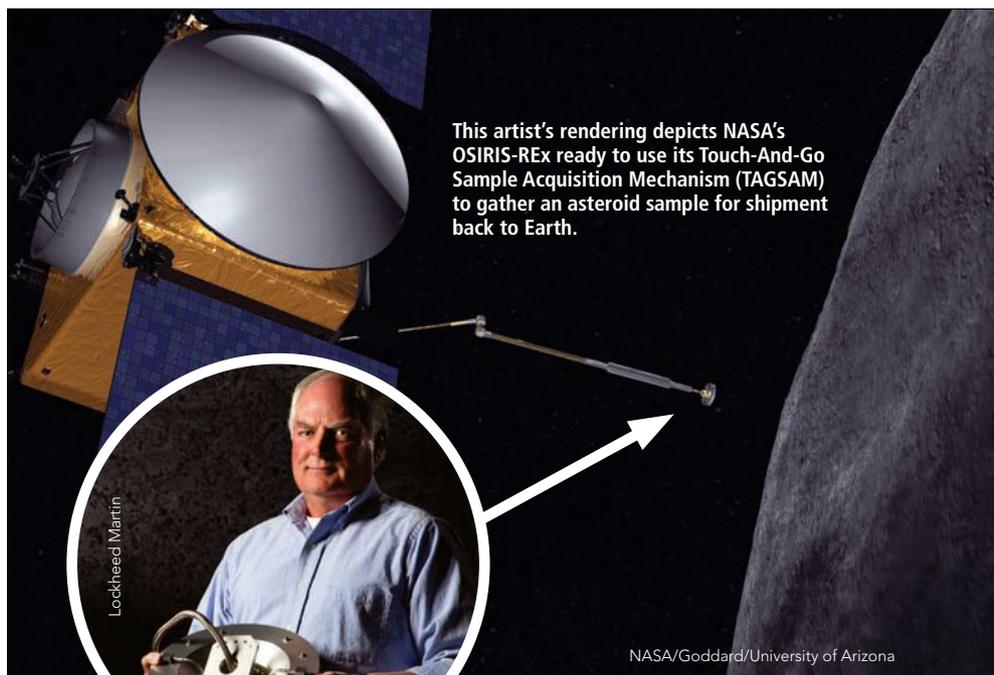
About 10 years ago, Jim Harris, an engineer at Lockheed Martin Space Systems Co., took part in an internal review focused on ideas about how to robotically grab material from an asteroid, stow it and carry it back to Earth.

At the time, NASA had not yet selected the mission we know as OSIRIS-REx, short for the Origins-Spectral Interpretation-Resource Identification-Security-Regolith Explorer.

Lockheed engineers considered a variety of sample options for OSIRIS-REx: clam shells, augers, scoops, even propellers at the end of a tube. During the search, Ben Clark, a Lockheed space scientist, gave Harris a paper that Clark had written in December 1986 as a senior staff scientist at what was then Martin Marietta. The document described how a pressurized gas might be released to lift particles off the surface of a celestial body and fluidize the particles into a gaseous mixture. Clark thought this would be a good way to quickly obtain samples for onboard analysis, or to bring back samples to Earth, without having to land on the asteroid. Harris wondered if the method might be adapted to collect regolith — surface dirt — from an asteroid for analysis back on Earth. That's when things took a creative, do-it-yourself turn.

Harris was anxious to give the method a quick trial. "It was just a question of how to do it and how much [material] could be collected," he recalls.

So one weekend, Harris and his son, Jimmy, now a mechanical engineering student at the University of Colorado, went out to his rock-and-dust driveway. His father placed the hose outlet of a home-shop air compressor into a hole at the small end of the cup, and Jimmy pressed the open end over a circle Harris had cut in a large piece of paper laid out on the driveway. When Harris flipped the switch, driveway dirt



This artist's rendering depicts NASA's OSIRIS-REx ready to use its Touch-And-Go Sample Acquisition Mechanism (TAGSAM) to gather an asteroid sample for shipment back to Earth.

NASA/Goddard/University of Arizona

Lockheed Martin's Jim Harris holds the OSIRIS-REx Touch-And-Go Sample Acquisition Mechanism, which was partly borne out of an experiment on his driveway.

accelerated out the side holes and fell onto the paper for later measurement. The test suggested that the technique could be used to push particles into a sample container.

"My son knew his dad was a little different. At the time, he was surprised that I get paid to do this kind of stuff," Harris says.

Back at the office, Harris and his space engineering colleagues were intent on building the OSIRIS-REx's Touch-And-Go Sample Acquisition Mechanism (TAGSAM), an articulated arm with a collection head at the end. Before settling on the TAGSAM design, Harris and his co-workers built several prototype collection heads. Sampling head testing was done within a closed container to hold simulated asteroid material onboard a NASA research aircraft — christened the Vomit Comet — to simulate microgravity. Throughout the testing history of TAGSAM, in place of asteroid bits and pieces, all types of materials were

used to show-off the ability of the asteroid collection apparatus.

"We've pretty much sampled just about everything you could think of," Harris said, such as lava rock, Mars simulated soil, Styrofoam peanuts, real peanuts, vermiculite, even cheese whiz.

When OSIRIS-REx sidles up to asteroid Benu in October 2019, TAGSAM will touch the collector head to the surface and spurt out a burst of pure nitrogen gas to push surface regolith into the sampler's chamber. "It's basically over in two seconds," Harris says.

The asteroid collection device will have three separate bottles of gas for three sampling attempts. Harris is banking that if the technique worked in his driveway and on the microgravity plane, and in extensive testing at the company, all will go well at Benu.

"Some people will be nail-biting but not me," Harris says. "It's going to work."

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