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NASA to return sample from Earth-bound asteroid

US$800 million OSIRIS-REx will head for asteroid that could collide with Earth in twenty-second century.

Robin Lloyd

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NASA has long wanted to send a mission to Mars to grab some of its surface and sling it back to Earth. But it looks like the agency will snag a sample from a measly asteroid before returning pieces of the Red Planet home. A US mission to return an asteroid sample is approved, funded and set to launch on an Atlas 5 rocket from Florida in September 2016 — similar missions to Mars are stuck as attachments to interminable e-mail threads.

The asteroid-return mission qualifies as sophisticated exploration, building on the US space agency's wildly successful two-decade run of robotic missions to Jupiter, Saturn and the terrestrial planets. But Japan's space agency JAXA already won the race to take home an asteroid sample. Hayabusa looked like a jinxed mission at several junctures with fuel, communications and engine troubles. But once it successfully dropped its collection canister in the Australian desert, a last-ditch dental-style scraping in 2010 yielded miniscule amounts of dust taken from the miniature asteroid Itokawa. JAXA might even beat the US to a second sample return as its Hayabusa 2 mission is in the works.

The engineers behind NASA's mission to Asteroid Bennu aim for a smoother mission. Its name is a mouthful even as an acronym — OSIRIS-REx, which stands for Origins Spectral Interpretation Resource Identification and Security Regolith Explorer.

The approval process for this US$800-million effort took so long that its initial primary investigator, Michael Drake, of the University of Arizona in Tucson, died at 65 before it came to fruition. The spacecraft is being built at Lockheed Martin in Denver, whereas the camera system is being designed and refined at Tucson, the academic home of ace planetary cameraman Peter Smith.

Smith brightened the days of many a space reporter covering NASA planetary mission briefings during the 1990s and 2000s with his straight talk and white hair not cut to government specifications. "In 2019 OSIRIS will touch Bennu's surface like a pogo stick, and a burst of gas will cause loose rock to flow into a collector," Smith explained in August to an Alaska-bound *Scientific American* Travel group operated by Insight Cruises.

Planetary scientists study asteroids (and meteorites, which is the term for asteroids and comet pieces that have fallen to Earth) because they are rocks left over from the formation of the Solar System's planets and can carry complex organic molecules. A great number of these fascinating time capsules also could strike and seriously damage Earth and its environment.

Bennu (also known as 1999 RQ36) is one of more than 500,000 known asteroids, with estimates of undiscovered ones in the millions, in our Solar System as of 2010. But Bennu is only one of five asteroids, Smith said, that met all these criteria: more than 200 meters across, carbonaceous and in an orbit that is both optimal for sample return and approaching ours to within one third the average Earth–Sun distance. OSIRIS-REx is set to return a sample by 2023.

The annals of asteroid probes revved up in 2000 when NASA's NEAR mission orbited and then landed on Eros, a potato-shaped rock measuring 33 kilometres on its longest dimension. Nearly a decade earlier the Jupiter-bound Galileo spacecraft flew by Gaspra, 18 kilometres in its longest dimension, as well as by Ida, 31 kilometres across, and its moon Dactyl. NASA's Dawn mission recently studied Vesta, one of the largest asteroids in our Solar System at 525 kilometres in diameter, and will arrive at Ceres next year. (Technically, the even larger Ceres earns the new designation of dwarf planet nowadays but not everyone got the memo.)

Smith's colleagues are working on three high-resolution cameras for OSIRIS. "We were asked to build cameras to take pictures of an asteroid that's darker than a piece of coal," Smith said. "It's like trying to take a picture of a black cat in a coal bin." Additional OSIRIS goodies under development include LiDAR, infrared spectrometers and other instruments that will help scientists determine the chemistry and true orbit of Bennu, which has a good shot at striking Earth in the twenty-second century. A wild, non-gravitational force called the Yarkovsky effect also will draw some special attention by OSIRIS. This bounce arises when a body reemits solar energy absorbed earlier in its day, causing a change to the object's semimajor axis.

In the meantime minor planet fans can look forward to another small-body landing attempt. The European Space Agency's Rosetta spacecraft, in orbit around Comet Churyumov–Gerasimenko is scheduled to deploy a lander on 3 November that will set down on the tiny comet (also known as 67P/C–G) measuring three by five kilometres. Its irregular shape resembles that of a rubber ducky, Smith said. "The comet has a lot orifices and volatiles on it," he continued, "and when it heats up near the Sun it will erupt with geysers that spew ice and dust and gases that make up the comet. [Rosetta] will be in a front row seat to see what happens."

So, stay tuned to observe the potential triumph of the tiny, at least on the scale of outer space.

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