Stardust spacecraft gives second glimpse of comet Tempel 1

A reporter
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The NASA spacecraft Stardust-NExT carried out a successfully fly-by of comet Tempel 1 on the night of February 14. It was the first ever revisit of a comet, giving scientists at Jet Propulsion Laboratory an unprecedented opportunity to observe the changes in a comet after its passage close to the Sun.

Comets are balls of ice and dirt with elongated orbits, spending most of their time in near-absolute zero, in the further reaches of the solar system, but making close approaches to the Sun, in some instances well inside the inner planets, Mercury, Venus, Earth and Mars.

Tempel 1 was first closely observed in 2005 by the spacecraft Deep Impact, so-called because the final portion of its mission was to send a large copper probe crashing into the surface of the comet, while the spacecraft and three telescopes in Earth orbit observed the collision.

The comet was then roughly as far from the Sun as the planet Mars. Since then, it has completed its closest approach to the Sun and swung back around and out again, to within 210 million miles of the Earth, and once again within range of a spacecraft.

The Stardust spacecraft was originally launched in 1999 for a different mission, the fly-by of comet Wild 2, which it completed successfully. NASA engineers reprogrammed the spacecraft to use its remaining fuel to make the close approach to Tempel 1, which brought it within 112 miles of the potato-shaped comet.

Because of the relative positions of the Sun, the comet, the Earth and the spacecraft, Stardust had to store the data about its encounter with Tempel 1, then turn its antenna toward Earth and upload the information after some delay. A total of 72 photographs, one shot every six seconds during the approach, were transmitted through a ground station in Spain.

According to project scientists, the images showed far more changes in the comet's surface than had been expected, as well as layering in the interior of the comet, something not detected in 2005. Mission principal investigator Joe Veverka enthused at a Tuesday press conference that the fly-by had been "one thousand percent successful."

Veverka noted that the visible changes on the surface of the comet involved the loss of material, likely because ice that accumulated on the surface while the comet was far out in orbit would have sublimated, turning directly from a solid into a gas without becoming a liquid, when heated during the period of closer approach to the Sun. The gas would then escape the weak surface gravity of the comet, going off into space.

The crater produced by Deep Impact was about 150 meters across and "subdued," according to Peter Schultz, a planetary geologist who spoke at the news conference. The term means that the crater's edges are not well defined. "The crater partly healed itself," he said. There was also a small mound in the center of the crater, formed by material tossed up by the initial collision.

The fly-by also gave a view of the opposite side of the comet from that observed by Deep Impact, and instruments on board Stardust performed a chemical analysis on dust particles associated with the comet, which turned out to be carbon and carbon-nitrogen.

Such chemical analysis is vital for understanding the origins of the solar system, since comets are believed to be remnants of the material that condensed into the Sun and planets about 4.5 billion years ago.

This second visit to Tempel 1 is particularly valuable from a scientific standpoint because it is makes it possible to observe changes in the comet over the

course of five and a half years, including the result of the collision with the Deep Impact probe.

The initial collision with the 820-pound copper probe fired from Deep Impact produced an unexpected result: a large cloud of powdery material that made it impossible to get a clear view of the impact crater. The return visit makes it possible to take a closer look.

In 2005, Deep Impact observed several depressions on the surface of the comet, but it was difficult to determine their age or significance. “We have no idea whether we’re talking about things that have been there for a hundred years, a thousand years, a million years,” Dr. Veverka said in a press interview before the fly-by.

The second viewing allows scientists to compare these depressions to a known impact crater—the one produced by Deep Impact—and thus help determine whether they are also impact craters or produced by some other internal chemical or geological process.