Stardust — Comet Sample Return

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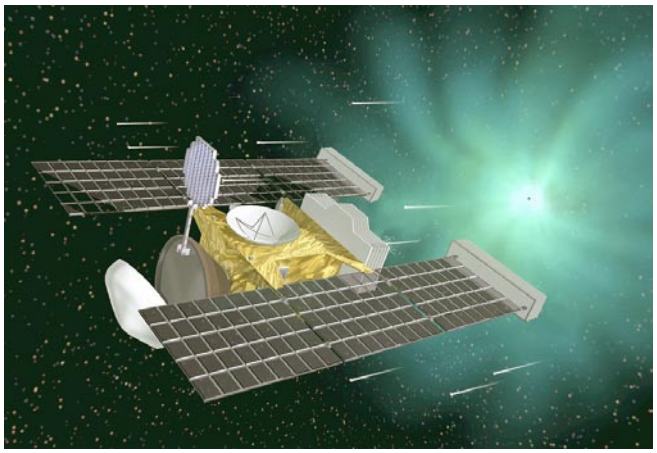
Comets are believed to be the oldest, most primitive bodies in the solar system, and are possibly made of some of the basic building blocks of life. They contain the remains of materials from the formation of stars and planets, and hold volatile, carbon-based rich elements that are likely to provide clues about the nature of the early solar system. Comets may have been the major source of water on Earth, Mars, and other worlds, making life possible.

With the prospect of comets offering this treasure house of ancient information, there is significant anticipation about what findings scientists will be able to extrapolate from a firsthand examination of cometary materials. Because the Stardust spacecraft will both return samples of material from a comet's dusty coma and provide real-time in-flight data about what it encounters, there is a real possibility of scientific findings that will change the way we view our origins.

The Stardust spacecraft was launched in February 1999. In January 2004, Stardust flew about 300 km in front of the nucleus of Comet Wild 2 through the comet's halo of gases and dust. During this passage, the spacecraft collected dust and volatiles. We expect the comet samples to consist of ancient pre-solar interstellar grains and nebular condensates incorporated into comets at the birth of the solar system.

In addition to the cometary samples, the spacecraft is also collecting interstellar grains during the cruise phase of the mission. This material flows into our solar system in a great river of dust and gas. Analysis of these grains will permit us to expand greatly our knowledge of the evolution of stars, the birth of the chemical elements, and the history of our galaxy. This mission was the first sample return mission launched in 30 years, and it collected the first material from deep space; yet, because it is traveling a much greater distance than its sister spacecraft, Genesis, it will return two years later with its precious cargo.

Astromaterials Research and Exploration Science scientists are key members of the Stardust Science Team. They helped develop and test the silica aerogel, the magic material that will capture and hold the comet coma grains. This team developed exacting techniques for the removal and analysis of captured grains from the silica aerogel. These scientists are also constructing the Johnson Space Center curation lab, which will receive the samples in the year 2006. They are preparing for the preliminary analyses, which for the first time will reveal the true nature of comets, their role in the early history of the solar system, and, possibly, the origin of water and organic matter on Earth and Mars.



Artist's rendering of the Stardust spacecraft.