

STARDUST

Bringing Cosmic History to Earth

Jet Propulsion Laboratory

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Billowing clouds of ice, dust, and gases, surveyors of the solar system, voyagers from places only dreamed of by humans — these are comets. The keys that unlock the mystery of the early formation of Earth may be found in comets. Striking Earth millions of years ago, comets created changes to our atmosphere and climate, at the same time introducing carbon-based molecules, a fundamental element to life on this planet. These cataclysmic changes may be responsible for the extinction of the dinosaurs. Through investigating comets, we can explore the mystery of life and the wonder of creation.

The STARDUST mission, sponsored by the National Aeronautics and Space Administration (NASA), plans to fly by comet Wild-2, and for the first time ever, bring samples of cometary material back to Earth.

In addition, STARDUST plans to collect and return grains from a newly discovered stream of particles from interstellar space. These samples may provide a window into the distant past, helping scientists around the world to unravel some of the mysteries surrounding the birth and evolution of the solar system and the emergence of life.



When a comet travels near the Sun, it sends out glowing tails of dust particles and ions driven off the nucleus by escaping gases.

The Trip There and Back

STARDUST plans to blast off on a Delta rocket early in 1999. To gain energy for the long trip to Wild-2, the spacecraft will loop back to Earth and use our gravity field to slingshot toward the comet. The encounter with Wild-2 will take place in 2004, at a distance of about 390 million kilometers (242 million miles) from Earth. En route to the comet, the spacecraft will make two loops around the Sun and will collect interstellar dust particles. STARDUST, with its intriguing cargo, is expected to return to our world in 2006.

During its closest approach to the comet, STARDUST should come within 150 kilometers (93 miles) of the comet nucleus and may be able to take detailed photographs of surface features. While flying through Wild-2's coma — the gas and dust envelope that surrounds the nucleus — the spacecraft

will make history by capturing materials spewed out from the Sun-activated comet.

On the return journey, STARDUST's samples will be stored in a capsule that will separate from the main body of the spacecraft, reenter Earth's atmosphere, and be collected on the ground by the STARDUST science team. The capsule will be protected from the fierce heat of reentry by a new, carbon-based shield developed at the NASA Ames Research Center, then descend gently through the atmosphere by parachute. The main body of the spacecraft will go on to travel in a long-lived orbit through space.

Powered by solar panels, the spacecraft will carry five different antennas for communicating with tracking stations on Earth. STARDUST will also carry a camera for navigation and for imaging the comet nucleus, as well as an impact mass spectrometer, provided by Germany, which will analyze the composition of the cometary and interstellar dust particles. The advanced spacecraft combines economy with the ability to carry out demanding mission activities. Its low mass (only about 350 kilograms or 772 pounds) and energy-gaining, roundabout flight path will help minimize the cost of launch. The spacecraft also uses spare parts from other deep space projects, such as lens shutters, camera components, and electronics.



Catching Bullets in Space

Collecting materials from a comet's coma as well as interstellar dust grains is no easy feat! When the STARDUST spacecraft flies past the comet, the impact velocity of the particles as they are captured will be up to 7 times the speed of a bullet fired from a rifle. Although the captured particles will each be smaller than a grain of sand, high-speed capture could alter their shape and chemical composition — or vaporize them entirely. To collect the particles without damaging them,

Aerogel, the remarkable “comet catcher,” is also known as “blue smoke.”

STARDUST will use an extraordinary substance called *aerogel*, a silica-based solid with a porous, sponge-like structure in which 99 percent of the volume is empty space. One thousand times less dense than glass, aerogel is sometimes called “blue smoke.” When a particle hits the aerogel, it will bury itself in the material. It will form a carrot-shaped track up to 200 times its own length as it slows down and comes to a stop, like an airplane coming in for a landing. Scientists will use these tracks to find the tiny particles.

A New Way to Do Space Missions

STARDUST is part of NASA's Discovery Program, a set of missions designed to explore deep space with exceptional scientific results at the lowest possible cost. In the true spirit of Discovery, STARDUST is a partnership — the Jet Propulsion Laboratory (JPL) of the California Institute of Technology is managing the mission for the National Aeronautics and Space Administration (NASA) and is also providing the optical navigation camera. JPL is NASA's lead center for the automated exploration of space and conducts a wide range of important cometary studies.

The principal investigator, Dr. Donald Brownlee, is from the University of Washington and leads a global team of scientists. Dr. Brownlee is well known for his work on

cosmic particles in the stratosphere, known as Brownlee particles. Lockheed Martin Astronautics (LMA), the industrial partner, brings years of experience in space missions to the project. LMA is building the lightweight, low-cost STARDUST spacecraft and sample-return capsule.

As a Discovery mission, STARDUST provides an opportunity for students to learn about exciting new scientific results and how they are achieved. We have established partnerships with the Challenger Centers for Space Science Education, the Jason Foundation, and the Omniplex Institute to provide hands-on learning experiences for students. STARDUST can also be found in local museums and planetariums. Check out our homepage to find STARDUST in your neighborhood.

Get Involved!

Join the unfolding adventure as we explore the mysteries of the universe.

STARDUST provides students with an exciting opportunity to learn about new scientific results and how they are achieved.

To learn more about this exciting journey to a comet, take a tour through the STARDUST Homepage on the World Wide Web —

*[http://
stardust.jpl.nasa.gov](http://stardust.jpl.nasa.gov)*

If you would like instructional materials for your school or organization, please contact:

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