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stardust

Stardust on the Internet — http://stardust.jpl.nasa.gov

By investigating comets, we can explore the mystery of life and the wonders of the universe.

Mission to a Comet

The STARDUST spacecraft was launched into space in early February 1999. Its destination — Comet Wild 2 (pronounced "Vilt 2"); its mission, to capture cometary material before returning to Earth in 2006.

STARDUST will encounter Wild 2 in 2004, while nearly 390 million kilometers (242 million miles) from Earth. En route to the comet, the spacecraft will collect interstellar dust particles. These samples will provide a window into the distant past, helping scientists around the world to unravel mysteries surrounding the birth and evolution of our Solar System.

The spacecraft was designed and built by Lockheed Martin Astronautics of Denver, Colorado, for the Jet Propulsion Laboratory (JPL), California Institute of Technology. JPL manages the STARDUST mission for the National Aeronautics and Space Administration (NASA).

During its closest approach to the comet, STARDUST should come within 150 kilometers (93 miles) of the comet nucleus and may have the opportunity to take detailed images of surface features.

While flying through Wild 2's coma (the gas and dust envelope surrounding the nucleus), the spacecraft will make history by capturing materials spewed out from the Sun-activated comet.

On the return journey to Earth, STARDUST's cometary and interstellar samples will be stored in a capsule designed to separate itself from the main body of the spacecraft and reenter Earth's atmosphere. The main body of the spacecraft will go on to travel a long-lived orbit through space.

STARDUST is the fourth of NASA's Discovery Missions. □

Significant Dates

• Launch	February 7, 1999
• Interstellar Dust Collection	March 2000–May 2000
• Interstellar Dust Collection	July 2002–December 2002
• Earth Flyby	January 2001
• Wild 2 Encounter	January 2004
• Sample Return to Earth	January 2006

Aerogel

A Little Bit of Almost Nothing

Catching comet dust is no easy task! When the spacecraft flies past the comet, the impact velocity of the particles to be captured will be about six times the speed of a rifle bullet. Although the particles will each be smaller than a grain of sand, high-speed capture could alter their shape and chemical composition — even vaporize them entirely. To collect the particles without causing major damage to itself, STARDUST will use an extraordinary substance called aerogel — a silica-based solid with a porous, sponge-like structure of which 99.9 percent of the volume is empty space. Mostly transparent, aerogel resembles blue smoke and thus was initially referred to as "solid blue smoke." Aerogel is

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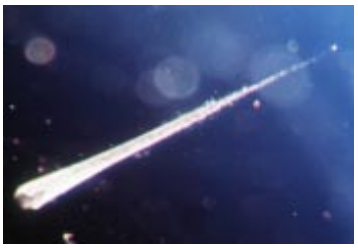

Example of particle collection.

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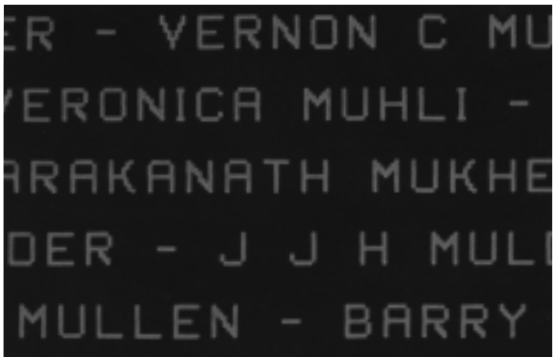
more than 100 times less dense than glass and other silica-based solids. When a cometary particle hits the aerogel, it will bury itself in the material, creating a carrot-shaped track up to 200 times its own length. It will then slow down and come to a stop, like an airplane setting down on a runway and braking to gradually reduce its speed. Scientists will use these tracks to find the tiny particles. □

Microchips — Names in Space

More than 1,136,000 names of people worldwide were collected and etched (see photo below) on two microchips that will return to Earth in 2006. Microchip #1 is attached to the inside of the Sample Return Capsule.

Microchip #2 is located on the back of the arm holding the aerogel dust collector. There are over one million names on the second chip, including the 58,214 names inscribed on the Vietnam Veterans Memorial in Washington, DC, as a tribute to those Americans who died in that war.

A list of all the names and photos may be found on the STARDUST home page at — http://stardust.jpl.nasa.gov □



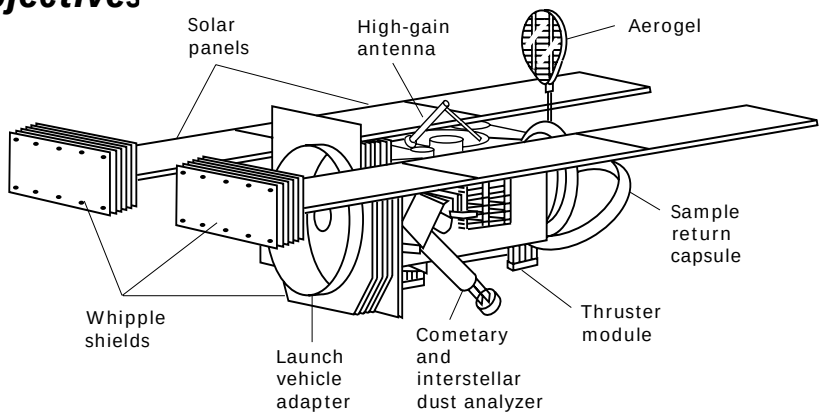
Names in the photo have been enhanced 6500 times.

STARDUST Science Objectives

The cometary samples that the STARDUST spacecraft will collect are made up of ancient, pre-solar interstellar grains and nebular condensates that were incorporated into comets at the birth of the Solar System.

During STARDUST's encounter with Wild 2 in 2004, the Cometary and Interstellar Dust Analyzer (CIDA) will intercept and perform real-time compositional analysis of dust as it is encountered by the spacecraft.

The Dust Flux Monitor Instrument (DFMI) will be used to monitor the dust particle impacts and to transmit information directly back to Earth.



The STARDUST flight system.

The onboard Navigational Camera will send back high-resolution pictures of the comet.

The spacecraft will return to Earth in January 2006 and drop off the samples using a streamlined, low-cost reentry capsule. □

Educators in Space

Twenty-six Educators Spread the Word About STARDUST and Comets

STARDUST Educator Fellows at the prelaunch workshop in Florida pose with STARDUST Principal Investigator Dr. Donald Brownlee and Chief Scientist Dr. Benton Clark (Lockheed Martin Astronautics), as well as famous comet hunter Carolyn Shoemaker and JPL astronomer Stephen Edberg (all at far left). Dr. and Mrs. Paul Wild of Switzerland are at far right. Dr. Wild discovered the comet that STARDUST will encounter. One Educator Fellow said that the experience was "the highlight of my 30 years of science teaching."

Imagine being a part of a mission that is hurling a spacecraft through the coma of a comet to collect particles that will be returned to Earth — and may hold the clues to the formation of our Solar System! Twenty-six educators from across the country were chosen from hundreds of candidates as STARDUST Educator Fellows, in a program managed for the STARDUST Project by the Challenger Center for Space Science Education. The Fellows gathered at Kennedy Space Center in Florida for a three-day STARDUST workshop in early February 1999.

STARDUST Educators and Education Outreach Team members have presented workshops for thousands of teachers, students, and members of the general public and will continue giving presentations through 2006.

To find out if an educator is giving a STARDUST presentation or workshop near you, visit the STARDUST Educator Fellows Web site at: http://www. challenger.org/fellows/stardust/index.html. Click on "Upcoming Events."

In conjunction with the JPL STARDUST Project, the Challenger Center created *A Little Bit of STARDUST* — a "nuts-and-bolts" introduction to comets for teachers, parents, and interested students.

STARDUST has also established educational partnerships with the JASON Foundation and Omniplex at the Kirkpatrick Planetarium. The JASON Project created the "JASON IX Curriculum," which studied life on Earth and in the oceans. Students worked with the NASA STARDUST mission to help find the answers to the three key questions of the JASON Project. Omniplex is the premier hands-on science center in Oklahoma. Each year, more than 350,000 visitors come to the Omniplex and over 80,000 students visit the museum. □

Educator Fellows

STARDUST

Bob Brazzle
Chicago, Illinois

Paul Crips
Cheyenne, Wyoming

Bob Crumley
Whittier, Alaska

Greg DiLisi
Cleveland, Ohio

Peggy Donahe
Aneth, Utah

Francis Gardner
Columbus, Georgia

Sherry Hair
Birmingham, Alabama

Martin Horejsi
Pocatello, Idaho

Anne Ireland
Alexandria, Virginia

Alan Landever
Litchfield, Connecticut

Carol Lutsinger
Brownsville, Texas

Linda McArthur
Oklahoma City, Oklahoma

DeLaura Kay McLellan
Columbia Heights, Minnesota

Dan Malerbo
Pittsburgh, Pennsylvania

Byron Montross
Fort Wingate, New Mexico

Linda Morris
Paramus, New Jersey

Gay Negus
Chattanooga, Tennessee

Alan Roth
Vancouver, Washington

Fred Salazar
Flagstaff, Arizona

Susan Solari
Lafayette, Colorado

Jamalee Stone
Lincoln, Nebraska

Adair Teller
Hawthorne, California

Heather Toomey
Seattle, Washington

Nancy Tashima
Captain Cook, Hawaii

Cheryl Wood
Orlando, Florida

Donna Young
Medford, Massachusetts

Photo courtesy of Boeing

STARDUST launched into a clear blue sky atop a Boeing Delta II launch vehicle on February 7, 1999, from Cape Canaveral, Florida.

From the Project Manager

The STARDUST mission, as part of NASA's Discovery Program of faster, better, and cheaper space projects, was in development for the last 3-1/2 years. It has been an extremely challenging project for the men and women involved in the design, development, test and launch. In a very true sense, they are the team of engineers, scientists and support personnel carrying the legacy of the great explorers of the past: Columbus, Magellan, Cook, and others. They are from Lockheed Martin Astronautics and here at the Jet Propulsion Laboratory. They are scientists from several universities. They have the audacity to attempt hurling a robotic machine into the unknown environment of a comet and then bring it back safely to Earth.

These technical experts are indeed engaged in "rocket science." And they have put a very significant part of their lives on the line for our nation to continue its leadership in the exploration of space. They are dreamers. They are explorers. They represent all of our society in their commitment to give their very best, showing the world what a spacefaring society can do — a society that can spend a part of its wealth to reach for the stars.

On February 7, 1999, with the roar of a Delta II rocket, they achieved a day to be remembered. STARDUST lifted from Cape Canaveral into a clear blue Florida sky and began the voyage to comet Wild 2. And, indeed this put spirits to the test. If everything did not go perfectly on that launch into the black unknown of space, the consequences would be high-profile public failure. Spaceflight is a risky business: there are many pictures of rockets exploding in the attempt.

But this day, victory was the outcome. STARDUST blasted smoothly into flight and terrific anxieties melted into the thrill of achievement. I know how it felt because as project manager I was there. Here was the moment when we as a team reached higher … reached for the stars.

I wish to honor and recognize the efforts and achievement of those scientist, engineers, and educators involved. Thank you for your support.

Dr. Kenneth L. Atkins
Project Manager,
STARDUST

STARDUST Mission Partners

- University of Washington — Dr. Don Brownlee, Principal Investigator
- Jet Propulsion Laboratory, California Institute of Technology — Dr. Kenneth Atkins, Project Manager (Optical Navigation Camera and Aerogel)
- Lockheed Martin Astronautics of Denver, Colorado — Joe Vellinga Program Manager (Spacecraft, Sample Return Capsule, and Mission Operations)
- Boeing — Delta II Launch Vehicle
- Max-Planck-Institut, Germany, and the firm of von Hoerner & Sulger — Cometary and Interstellar Dust Analyzer
- University of Chicago — Dust Flux Monitor Instrument
- NASA Ames Research Center, NASA Johnson Space Center, and NASA Langley Research Center — Sample Curators

STARDUST Education Outreach Team

- Jet Propulsion Laboratory: Aimee Whalen, Ron Baalke, and James D. Rose
- Educational Consultants: Barbara Sprungman (Editor) and Tom Meyer
- Challenger Center for Space Science Education: Danny La Bry, Traci Barnett, and Francene Basalyga
  Web site — http://www.challenger.org
- JASON Foundation: Katie James
  Web site — http://www.jasonproject.org
- Omniplex at Kirkpatrick Science & Air Space Museum, Oklahoma City: Beth Bussey, Tim Curry, Brent Beale, and Wayne Wyrick (planetarium)
  Web site — http://www.omniplex.org

National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California
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