NASA STARDUST Sample Return Mission
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35th COSPAR Scientific Assembly
Paris France
Salle 242 A
14:30
23 July 2004
4th NASA Discovery Project
  - Mars Pathfinder, NEAR, Lunar Explorer prior Missions
1st NASA Unmanned Planetary Sample Return Mission
NASA, Univ of WA, JPL and LMA Partnership
Prof. Donald Brownlee, University of Washington, PI
  - Co-I's
    - Drs. Martha Hanner, JPL, Fred Horz, JSC,
    - Tony McDonald, UK, Scott Sandford, ARC,
    - Zdenek Sekanina, JPL, and Mike Zolensky, JSC
  - Co-I's with Payload Instruments
    - Aerogel Collector - Dr. Peter Tsou, Deputy PI, JPL
    - CIDA - Dr. Jochen Kissel, MPI für Kernphysik,
    - DFMI - Dr. Anthony J. Tuzzolino, U of Chicago
    - NavCam - Dr. Ray Newburn, JPL
    - Radio Science - Dr. John Anderson, JPL
    - High Rate Attitude - Dr. Benton Clark, LMA
STARDUST SCIENCE OBJECTIVES

Primary Requirement: Collect 1000 Comet particles >15 μm at encounter velocity < 6.5 km/sec and return to Earth

Secondary Requirements: Collect 100 Interstellar particles >0.1 μm and return to Earth.

Provide ≥ 65 images of P/Wild 2, having a resolution of at least 67 μrad per pixel, taken within 2000 km of the comet nucleus through selected filters;

Provide in situ particle analysis for comet coma flythrough capable of resolving abundant elements in cometary solids;

Tertiary Requirements: Provide in situ particle analysis for interstellar and interplanetary dust;

Measure dust mass fluence, large particles and comet mass upper limit;

Provide dust flux measurement of $10^{-9}$ g to $10^{-4}$ g particles.
Trajectory Overview

Comet Wild-2

Assist Return Orbit

Earth Gravity Assist 01/15/01
Earth Return 01/15/06

Launch 02/07/99*

Loop 1 Loops 2 & 3

Wild-2 Encounter 01/02/04
$V_{inf} = 6.1 \text{ km/s}$
$R_{sun} = 1.9 \text{ AU}$
$R_{Earth} = 2.6 \text{ AU}$

Interstellar Particle Stream

Heliocentric Loops 1, 2 and 3
Feb 99-Jan 01, Jul 03, Jan 06

Interstellar Particle Collection A-B: Feb-May 00, Jul-Dec 02

Deep Space Maneuvers
1: Jan 2000, 2: Mar 2002
3: Jul 2003, 4: Feb 2004

* second day of launch period

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Stardust Sample Return Capsule (SRC)

- Backshell
- Parachute
- Avionics Deck
- Sample Canister
- Heatshield 2.29 in PICA
- Canister Filter
AREOGEL

Coma & Interstellar Dust Collection

To collect the particles without damaging them, STARDUST will use an extraordinary substance called aerogel - a silicon-based solid with a porous, sponge-like structure in which 99 percent of the volume is empty space. Aerogel is 1,000 times less dense than glass, another silicon-based solid. When a particle hits the aerogel, it will bury itself in the material, creating a carrot-shaped track up to 200 times its own length, as it slows down and comes to a stop - like an airplane setting down on a runway and braking to reduce its speed gradually. Since aerogel is mostly transparent - sometimes called blue smoke - scientists will use these tracks to find the tiny particles.

Dr. Peter Tsou, Deputy PI

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Dr. Jochen Kissel with CIDA
Dust Flux Monitor Instrument

FIGURE 3.3.1.1-1 DFMI LAYOUT ON SPACECRAFT
(NO SCALE)
**JPL CAMERA**

**CHARACTERISTICS**
- 200 mm VGR WA Optics
- 1024 x 1024 Cassini CCD
- 60 µrad / pixel
- 1 Deg-of-freedom Mirror (200 deg)
- 8 Filters
  - $5140 \pm 60$ C$_2$ (Blue)
  - $5800 \pm 20$ Yellow Continuum
  - $5900 \pm 1000$ Hi Res (Nucleus)
  - $6340 \pm 60$ O[1D]
  - $6650 \pm 75$ NH$_2$
  - $7000 \pm 2000$ Navigation
  - $7130 \pm 30$ Red Continuum
  - $8700 \pm 150$ Near IR
- Periscope - protect optics during approach

**Diagram Description**
- **MIRROR**
- **PERISCOPE**
- **WILDCAM** during approach
- **WILDCAM** mirror tracking during flyby
- **WHIPPLE SHIELD**
- **DUST**

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Earth Gravity Assist

EGA ON 15 Jan 2001 03:15 am PST

Stardust flyby 2001 01 15 10:04UT
Range 31720km,
Copyright Gordon Garradd

Nave Espacial Stardust

Dr. Pedro Valdez Sada
Universidad de Monterrey

STARDUST in Taurus 2001 jan 14, 21:00-21:05UT (C) Erneszy Zsold

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Post EGA Lunar Images

- 21 Lunar & 4 Dark Current Images
  - Perfectly Exposed & Pointed
P/WILD 2 ENCOUNTER
RELEASE OF PROJECT DATA
to the
PLANETARY DATA SYSTEM

- Launch
- Cruise 1
- Earth Gravity Assist
- Cruise 2
- Wild 2 Encounter
- Cruise 3

JPL NAIF-lead Data Management and Archive

PDS Delivery

1999 2000 2001 2002 2003 2004 2005 2006

#1 #2 #3 #4 #5 #6 #7 #8

Particles to be Delivered to JSC Office of Curation
International Analysis Program will Follow

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