STARDUST

STARDUST - Capture and Return of Wild-2 and Interstellar Samples

IAU 181 Colloquium, University of Kent at Canterbury, UK
STARDUST

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STARDUST

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Anthony J. Tuzzolino (University of Chicago) DFM Lead
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MISSION SCIENCE SUMMARY

COMET ENCOUNTER

- Aerogel Collector, Tsou
  Wild 2 sample collection/return to Earth
  >1000 particles >15μm
- Comet Interstellar Dust Analyzer (CIDA), Kissel
  Mass spectra of individual particles
- Imaging Camera, Newburn
  - High resolution nucleus images
- Dust Flux Monitor (DFMI), Tuzzolino/McDonnell
  - Dust flux with PVDF and acoustic sensors
- Dynamics Science, Anderson
  - Integrated and individual dust flux
  - May be cometary mass
MISSION SCIENCE SUMMARY CRUISE

- Collection of interstellar dust
  - Contemporary interstellar dust > 100 particles
- CIDA mass spectra of interstellar dust
- Interplanetary and IS dust detection with DFMI
- Earth anomaly and solar conjunctions
SCIENCE RETURN HOPES
CIDA

- WILD-2
  - Comet dust composition
  - Comparison with collected samples
  - What volatiles are lost in collected samples
  - Composition of particles too small to collect
  - The nature of CHON
  - Comparison with Halley and interplanetary dust spectra

- Interstellar Dust Composition
  - Major elemental composition
  - Relationship between CHON and silicate materials
  - Importance of SiC and grains formed in high C/O environments
SCIENCE RETURN HOPES
Imaging & Dust Flux

- Imaging Camera
  - Gas/dust source regions
  - Crust structure and surface processes
  - Detection of impact craters on an unusually old SP comet surface
  - Coma structure

- DFMI
  - Size distribution and flux at Wild-2
  - Meteor stream discovery during cruise
  - Radial distribution of interplanetary dust
CIENCE RETURN HOPES

Samples

- How do cometary solids compare with compositional fractionation trends seen in meteorites?
  - Volatiles
  - Refractories Ca, Al, Ti
  - Fe/Si

- Comparison with IDPs and meteorites
  - What fraction of comet dust is composed of preserved IS grains
CIENCE RETURN HOPES

Samples

- Performance of Aerogel Collectors
  - Captured dust flux
  - Degree of capture modification
  - Survival of volatiles

- Performance of Foil Collectors
  - Degree of particle capture
  - Capture modification
Mission Scenarios (Loop 1)

Science
CIDA #1
- L+45 - 144 d
- Dur: 99 d, Unit area: 52 d
- Vimp: 58.7 - 42.1 km/s

ISP #1
- L+403 - 469 d
- Dur: 66 d, all full grid
- Vimp: 11.7 - 9.9 - 10.1 km/s

DFMI
- EGA, L+709
- dust particles exp.
- +x // sc velocity
Mission Scenario (Loop 2)

TCM-8 = DSM3
70 m/s, 7/4-6/03

TCM-9
17 days

Earth

STA R DUST

EGA

TCM-6

CIDA-2
145 days

Anne frank

ISP-2
135 days

9.5d

TCM-7

science

CIDA #2
- L+769 - 914 d
- Dur: 145 d, Unit area: 74 d
- Vimp: 57.1 - 41.1 km/s

ISP #2
- L+1267 - 1402 d
- Dur: 135 d, Full grid: 127 d
- Vimp: 14.8 - 9.3 - 9.6 km/s

Annefrank
- L+1364
Instrument Objectives

INTACT CAPTURE OF
COMETARY DUST
ELEMENTAL COMPOSITION
MORPHOLOGY
ISOTOPIC COMPOSITION
MINERALOGY
REFRACTORY ORGANICS

INTERSTELLAR DUST
ELEMENTAL COMPOSITION
MORPHOLOGY
ISOTOPIC COMPOSITION
MINERALOGY
Spacecraft
Sample Return Capsule Canister/Sample Trays

STOWED

DEPLOYED

Clamshell Hinge

Boom Drives

Collector

STARDUST Sample Instrument

SM@L - 7
Dust Collection Modes

Interstellar Dust

Cometary Dust
Gradient/Graded Aerogel

Foil 100μ
1100 Al

Tray Rib
Bare 6061-T651 Al

3 cm

1 cm

.3 cm

Interstellar Particles

.3 cm

Gradient SiO₂ Aerogel

50 mg/ml, Base
20 mg/ml, Base
~5 mg/ml, Surface

~5 mg/ml, Surface

Cometary Particles

Graded SiO₂ Aerogel

2 cm

4 cm

STARDUST Sample Instrument

SM@L - 13
THE UNIVERSITY OF CHICAGO DUST FLUX MONITOR INSTRUMENT (DFMI) FOR THE STARDUST MISSION

DFMI CHARACTERISTICS

WEIGHTS

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronics Box</td>
<td>1.200 kg</td>
</tr>
<tr>
<td>Sensor Unit</td>
<td>0.332 kg</td>
</tr>
<tr>
<td>Acoustic Sensors</td>
<td>0.064 kg</td>
</tr>
<tr>
<td>Harness</td>
<td>0.165 kg</td>
</tr>
<tr>
<td>Total</td>
<td>1.761 kg</td>
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</tbody>
</table>

POWER

1.8 W

ELECTRONICS BOX (EB)  DUST SENSOR UNIT (SU)

TWO ACOUSTIC SENSORS

PVDF Sensor

Sensitive area = 200 cm²
Sensor thickness = 28 µm
Sensitive area dia. = 15.94 cm

Sensitive area = 20 cm²
Sensor thickness = 6 µm
Sensitive area dia. = 5.04 cm