

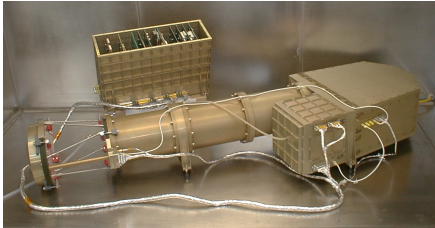
# CIDA

# Cometary and Interstellar Dust Analyzer for the NASA Mission STARDUST

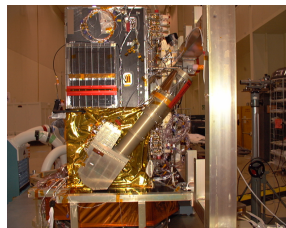
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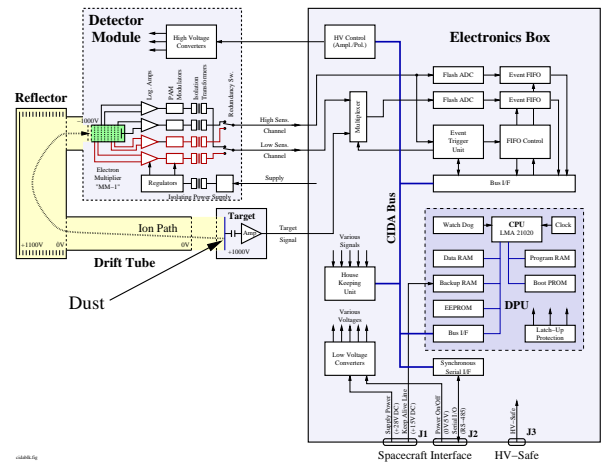
### CIDA Sensor and E-Box



### CIDA on STARDUST S/C



### CIDA Block Diagram



### CIDA's Scientific Objectives

Analysis of the elementary and molecular composition of interstellar and cometary dust grains.

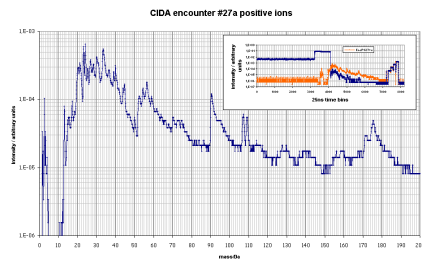
**Target: Comet Wild 2 at 2 Jan. 2004**

During cruise, CIDA measured 10 spectra of pos. ions, and 35 spectra of neg. ions—the first ever neg. dust spectrum! During encounter there were 27 pos. and 2 neg. spectra.

### CIDA Specifications

Mass sensitivity	$1 \times 10^{-13} \text{ g}$	@ 6 km/s
Atomic mass range	1...350 Da	
Target area	130 cm <sup>2</sup> or 8 cm <sup>2</sup>	automatic
Relative atomic mass resolution m/dm	>200	m = 100
Sustained event rate	>40 spectra/s	
CIDA instrument mass	10.4 kg	
Power consumption from 28 V DC	max. 15 W	

### CIDA Spectrum (Encounter)



### STARDUST Launch



NASA photo

### CIDA Timeline

- End 1994** Study on Large Area Dust Impact Spectrometer (LADIS) by vh&s on DLR contract.
- June 1996** First CIDA interface meeting of vh&s with Lockheed-Martin Astronautics (LMA) in Denver, CO.
- May 1998** vh&s delivers the CIDA flight model to LMA.
- 7 Feb. 1999** STARDUST launch from Cape Canaveral.
- 2 Jan. 2004** Comet Wild 2 encounter.
- 15 Jan. 2006** Return of STARDUST's dust sampling capsule to Earth.

### CIDA Measurement Principle

CIDA is a Time-Of-Flight (TOF) mass spectrometer with impact ionization:

$$1 \text{ impact} \Rightarrow 1 \text{ spectrum!}$$

- Cometary or interstellar dust hits a flat silver target, which is exposed to space.
- The high-velocity impact leads to instantaneous decomposition and ionization of the dust particle.
- The generated ions (pos. or neg.) are accelerated by electrical fields (polarity selectable), and travel fixed distance through drift tube and ion reflector.
- A stacked dynode multiplier (MM-1) with set of logarithmic amplifiers is used to detect the ions.
- The arriving ion charge is digitised by a pair of fast transient recorders.
- The mass spectra are calculated from the time-of-flight spectra.

### Technical Highlights

- Ion detector MM-1** Electron multiplier stack of 20 dynodes. Advantages: Flat surface → precise end-of-flight. Excellent pulse handling due to high electrode conductivity. Access to intermediate dynodes.
- Logarithmic amplifiers** Log. stage by UHF transistor arrays. Redundant design, two low/high sensitive channel pairs. Integrated test pulses.
- Triggering** Weighted integral and pulse trigger modes.
- Bipolar Stacked HVCs** Polarity switchable for analysis of pos. or neg. ions.
- Software** Totally and automatically relocatable software to survive memory errors. Hand optimized Rice compression for the spectra.

### CIDA Contact, Links

- CIDA Info** von Hoerner & Sulger GmbH, Schlossplatz 8, D-68723 Schwetzingen, Germany, <http://www.vh-s.de>, Tel.: (+49) 62 02 / 57 56-16, E-mail: [henkel@vh-s.de](mailto:henkel@vh-s.de). This poster is available at: <http://www.vh-s.de/projects/cida-stardust/press/cidaposter-a4.pdf>
- FMI CIDA Homepage** <http://www.geo.fmi.fi/PLANETS/cida.html>
- STARDUST Homepage** <http://stardust.jpl.nasa.gov>

### Literature

- "Assignment of quinone derivatives as the main compound class composing 'interstellar' grains based on both polarity ions detected by the 'Cometary and Interstellar Dust Analyzer' (CIDA) onboard the spacecraft STARDUST". F. R. Krueger, W. Werther, J. Kissel, and E. R. Schmidt, In: Rapid Commun. Mass Spectrom. 2004; 18: 103-111.
- "The Probable Chemical Nature of Interstellar Dust Particles Detected by CIDA Onboard STARDUST". J. Kissel, F. R. Krueger, J. Silén, and G. Haerendel, In: Proc. COSPAR Coll. Potsdam, July 2000. (Eds.) K. Scherer et al. Vol., Pergamon Press, 351-359, 2001.
- "Cometary and Interstellar Dust Analyzer for comet Wild 2". J. Kissel, A. Glasmachers, E. Grün, H. Henkel, H. Höfner, G. Haerendel, H. von Hoerner, K. Hornung, E. K. Jessberger, F. R. Krueger, D. Möhlmann, J. M. Greenberg, Y. Langevin, J. Silén, D. Brownlee, B. C. Clark, M. S. Hanner, F. Hoerz, S. Sandford, Z. Sekanina, P. Tsou, N. G. Utterback, M. E. Zolensky, C. Heiss, In: Journal of Geophysical Research, Volume 108, Issue E10, pp. SRD 4-1, 10/2003.

### The CIDA Team

- vh&s** The von Hoerner & Sulger GmbH is prime contractor and responsible for the overall design, management, production, and qualification testing.
- MPE** The Max-Planck-Institut für extraterrestrische Physik (MPE), Garching, Germany, then with Director Prof. G. Haerendel, hosted the PI Dr. Jochen Kissel, and contributed mechanics.
- BUGH** The Bergische Universität und Gesamthochschule Wuppertal (BUGH) participated in development of the detector amplifiers and the data acquisition unit FDAQ.
- FMI** The Finnish Meteorological Institute (FMI), Helsinki, Finland, provided the CIDA flight software, the GSE, and operational support.
- Krueger** The Ingenieurbüro Dr. Franz Krueger, Darmstadt, Germany, provided cleanliness analyses, scientific methods for spectra interpretation, and developmental effort for the target.
- IAS** The Institut d' Astrophysique Spatiale (IAS), Orsay, France, provided the low voltage converters.
- JPL** The Jet Propulsion Laboratory (JPL), Pasadena, USA, contributed electronic components.
- Utterback** Nyle Utterback †, Santa Barbara, CA, did the ion optics design.

### Happy PI with CIDA



### The CIDA Project

The PI Dr. Jochen Kissel proposed the CIDA experiment, and is leading the overall investigation. CIDA has been developed, manufactured, tested, and delivered by company vh&s as prime contractor.

The CIDA Project has been funded by the DARA/DLR, and the national space agencies of the team members.