The Exploration of Asteroid Annefrank by STARDUST

The NASA Discovery STARDUST spacecraft is set to flyby the vicinity of the main belt asteroid Annefrank in November of this year on its way to encounter the comet P/Wild 2 in January 2004. Plans are being put in place to target a close flyby of Annefrank as an operational test for the comet P/Wild 2 encounter. The spacecraft is carrying the JPL Aerogel Dust Collector, the Max Planck Institute Cometary and Interstellar Dust Analyzer (CIDA), the University of Chicago Dust Flux Monitor Instrument (DFMI), the JPL camera and radio science. If approved, the mission will implement approach operations for a close flyby and then execute the P/Wild 2 encounter sequence involving all instruments and radio science during the Annefrank flyby. The flyby speeds between Annefrank and P/Wild 2 are similar while Annefrank will be viewed at much lower phase angles during approach. The flyby will occur when the aerogel collector is already deployed, collecting interstellar dust at that time. Details of this flyby and expected activities will be given.

Solar System Planetary Missions JPL

Exploration of Asteroid Annefrank by STARDUST

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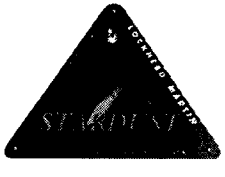


STARDUST

JPL

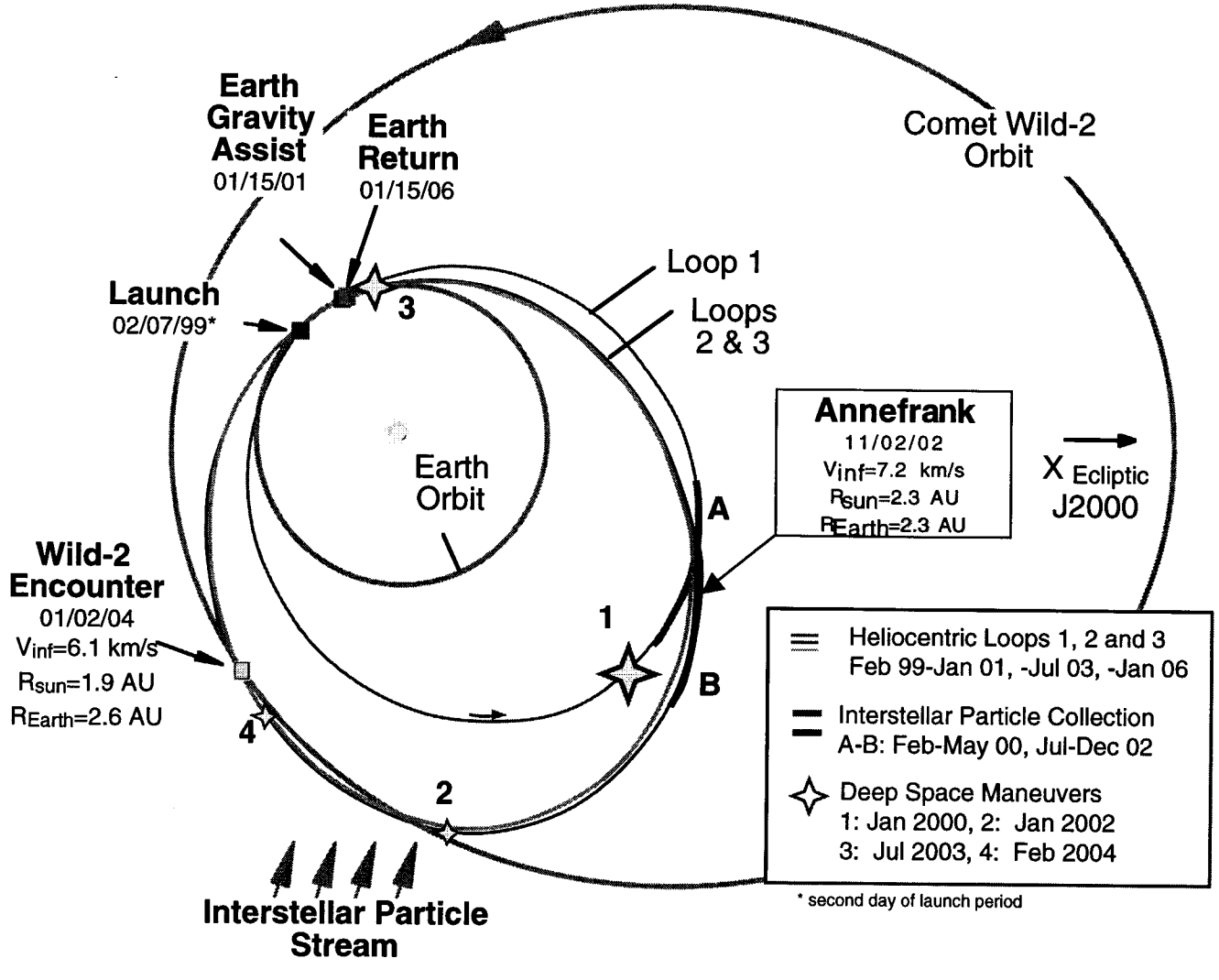
- *4th NASA Discovery Project*
  - *Mars Pathfinder, NEAR, Lunar Explorer prior Missions*
- *1st NASA Unmanned Planetary Sample Return Mission*
- *NASA, Univ of WA, JPL and LMA Partnership*
- *Prof. Donald Brownlee, University of Washington, PI*
  - *Co-I's*
    - *Drs. Martha Hanner, JPL, Fred Horz, 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 fur 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

JPL

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



Annefrank

- **Main Belt Asteroid**
- **C - Type**
- **~1 km Radius**
- **Discovered by French, et al., 1983**
- **3.3 yr Period**
- **Near Circular orbit with Semi-major Axis - 2.3 AU**

ENCOUNTER OBJECTIVES

JPL

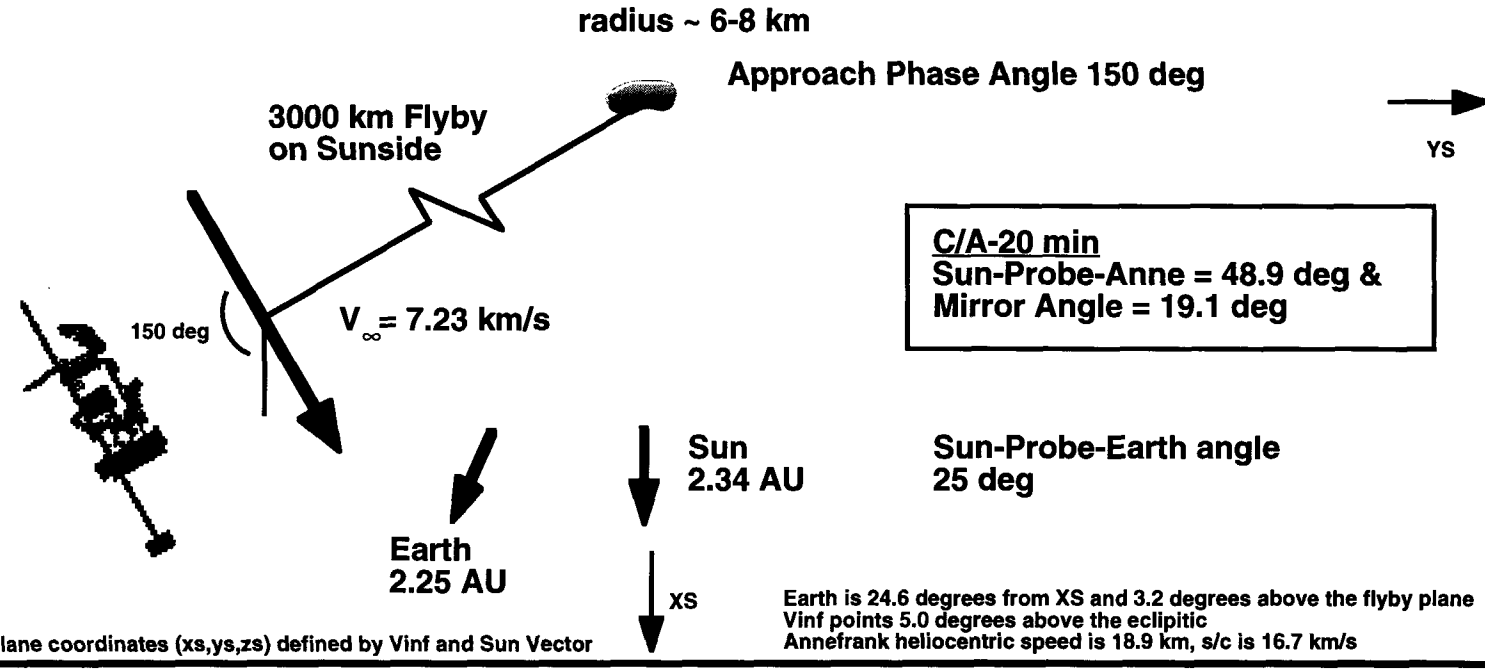
- **Perform Flight Test of Wild 2 Encounter Operations**
  - **Full Approach and Departure Navigation**
    - **Radio and Optical Navigation**
    - **Trajectory Correction Maneuvers**
    - **Fast Computation Turn Arounds**
  - **Implement Go / No Go Procedures for Contingency Maneuver**
  - **Implement Full Wild 2 Encounter Sequence**
    - **Closed-loop Nucleus Tracking**
    - **Areogel Dust Collector Deployed**
    - **Full Image Sequence**
    - **U of Chi Dust Flux Monitor On**
    - **MPI Dust Mass Spectrometer On**
    - **Safe Mode Entry Inhibited**
  - **Full DSN Tracking Schedule for Uplink / Downlink with Contingency**
- **Use Lessons Learned to Increase Probability of Success at Comet P/Wild 2, the Primary Science Target**

ANNEFRANK ENCOUNTER

JPL

Annefrank Flyby Geometry

closest approach: 11/02/2002 04:44:47 UTC [010926 SPK]



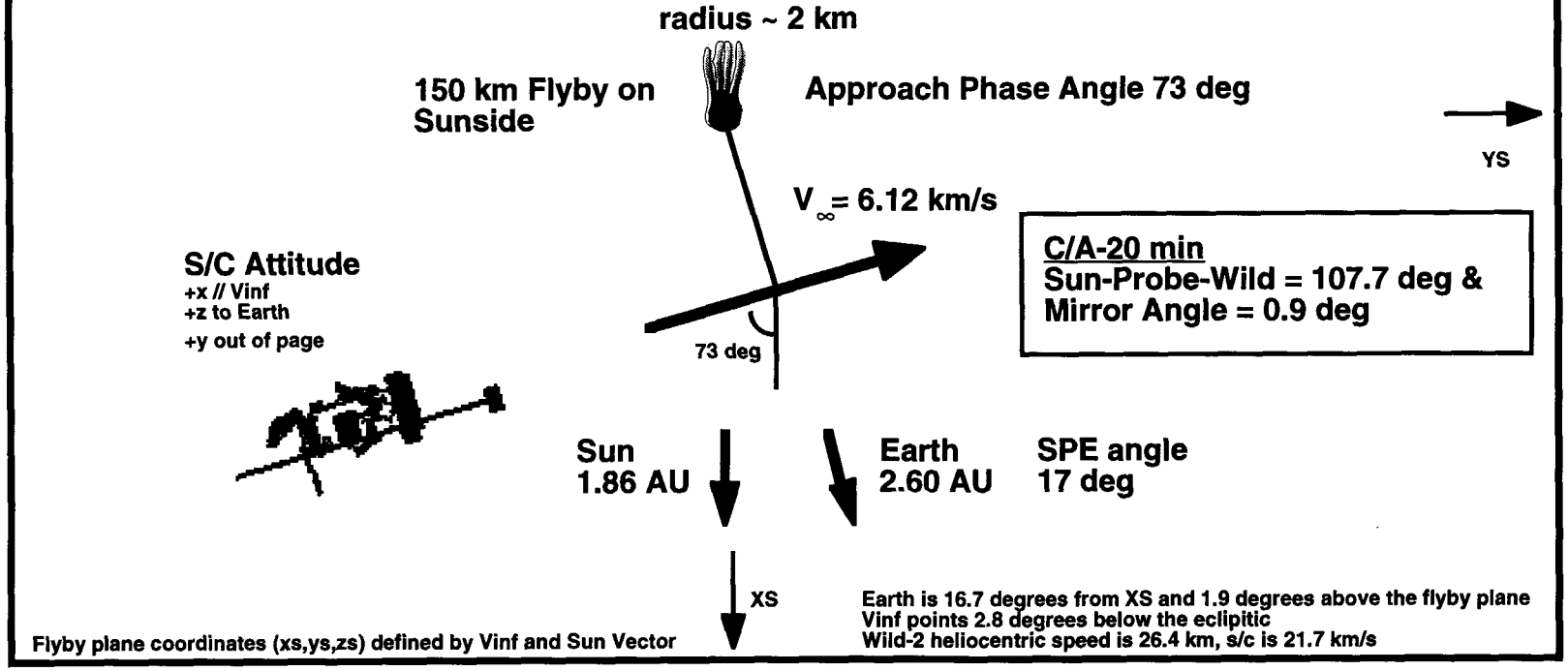
LOCKHEED MARTIN

COMET P/WILD 2 ENCOUNTER

JPL

Wild-2 Encounter Geometry

closest approach: 01/02/2004 19:18:56 UTC



LOCKHEED MARTIN

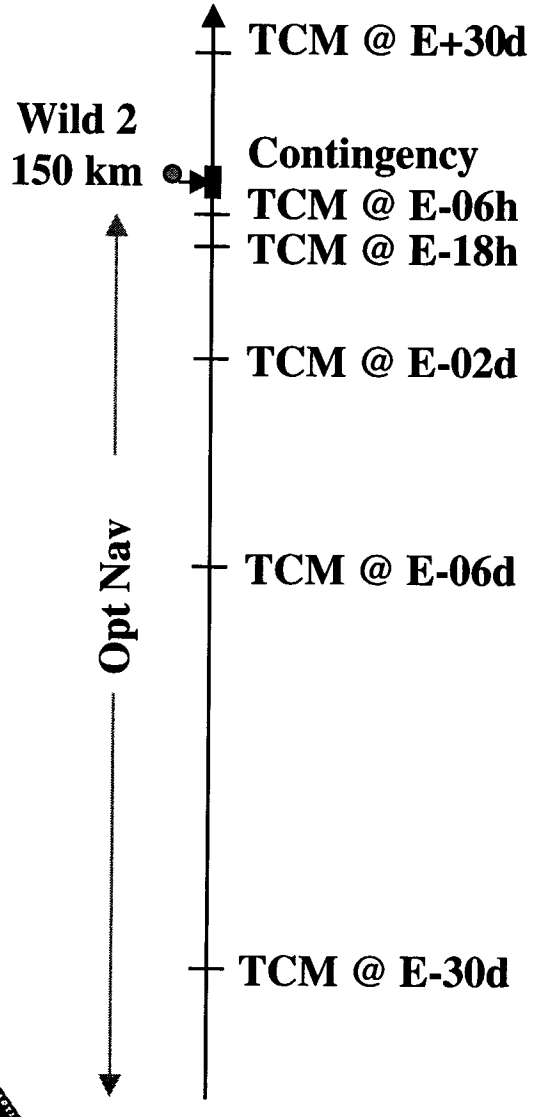
ENCOUNTER TIMELINES

JPL

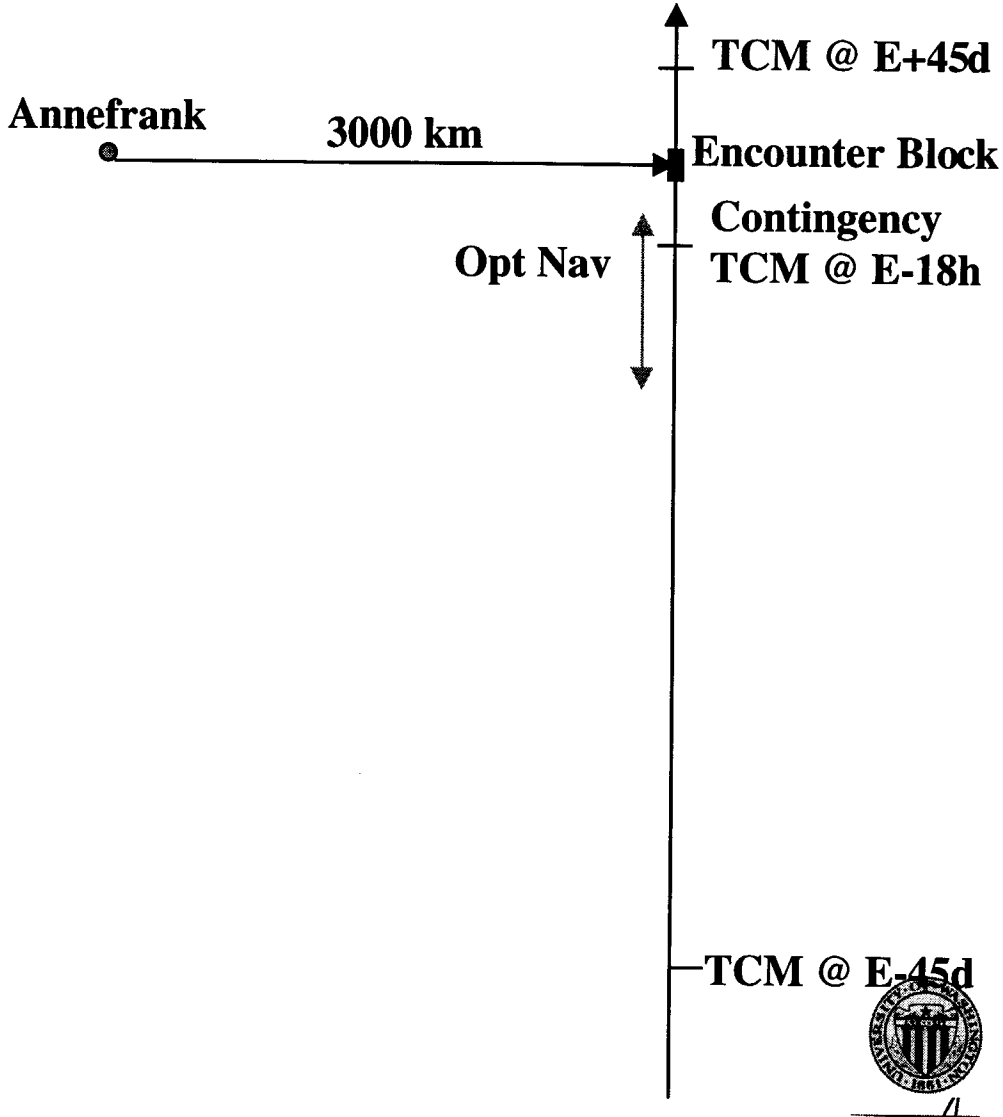
WILD 2	ANNEFRANK
TCM @ E-30d	TCM @ E-45 d
TCM @ E-10d	X
TCM @ E-2d	X
Opt Nav to E-28h	Opt Nav @ E-28h
TCM @ E-18h	Cont TCM @ E-18h
Opt Nav to E-12h	Opt Nav to E-20h
Cont TCM @ E-6h	Cont TCM Pract @ E-6h
Enc Seq E-30 to E+5m	Enc Seq E-30 to E+5m
TCM @ E+31d	TCM @ E+48d

Wild 2 / Annefrank Comparison

(Science)



(Risk Reduction)



STARDUST WEB PAGE

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LOCKHEED MARTIN