Stardust Extended Mission Option Overview

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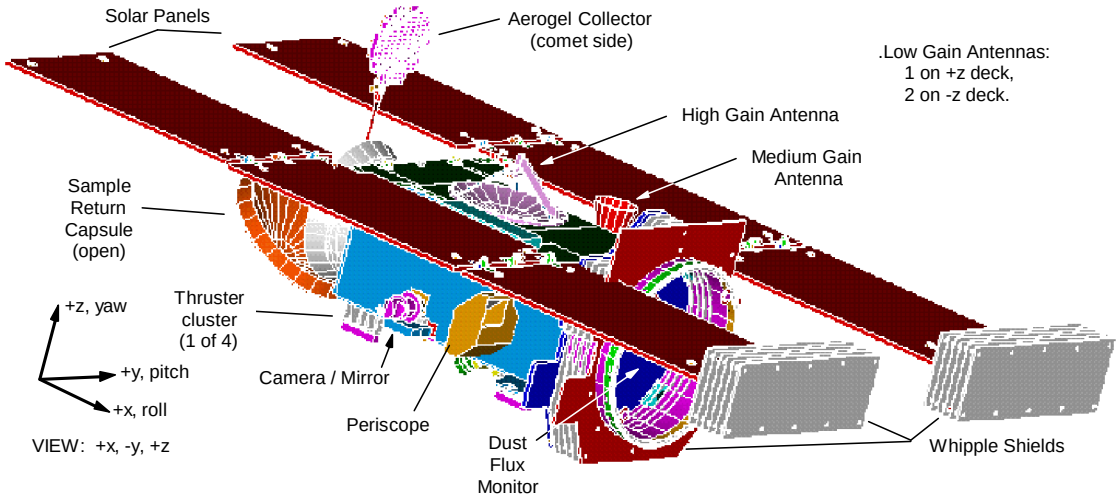
Spacecraft Overview

- Stardust, the 4th NASA Discovery mission, was launched February, 7 1999.
- Stardust flew by Comet 81P/Wild 2 on January 2, 2003, sampling the coma.
- The mission will return to Earth, January 15, 2006 to release the Sample Return Capsule (SRC) while the mother craft returns to space.
- The spacecraft, shown below with the SRC, includes three instruments:
- The Stardust Imaging Camera (SIC); a Cometary and Interstellar Dust
- Analyzer; and a Dust Flux Monitor.
- The image also shows the 2 solar arrays, the high-gain and medium gain antennas, one of the 4 4-thruster clusters, and the Whipple shields designed for the encounter conditions at Wild-2.
- SIC filter wheel stuck in broad-band position.
- Expect 20.2 Kg of fuel (161 m/s) after divert.
- Discovery Web site will provide post-release S/C orbit, and post-release S/C performance following SRC Entry/Descent/Landing and spacecraft divert (15/Jan).



Spacecraft Overview-cont.

Double-sided, 3-axis stabilized spacecraft with subsystem redundance and cross-strapping.

- **Monoprop. propulsion with 8 4.8N thrusters and 8 1.0 N. Thrusters grouped in 4 clusters.**
- **Attitude determination is via star trackers and the inertial measurement units (IMU), provide primary attitude determination backed up by analog sun sensors.**
- **IMUs needed only during trajectory correction maneuvers (TCM), and cometary encounters, otherwise, the vehicle in an all-stellar mode.**
- **Two non-gimbaled solar arrays (6.6 m^2) with nickel-hydrogen (NiH_2) 16 amp-hour battery using common pressure vessel (CPV) cell pairs.**
- **Thermal control subsystem uses passive methods and louvers for thermal control.**
- **RAD6000 central processing 32-bit unit embedded in the spacecraft's Command and Data Handling (C&DH) subsystem with128Mb of data storage.**
- **Primary communication through DSN X-band (up/down) link and deep space transponder, 15 Watt RF solid state amplifier, and a 0.6 m. dia. fixed high gain parabolic antenna.**
- **Medium (Xsmit only) and 3 low gain antennas (Receive only) available.**

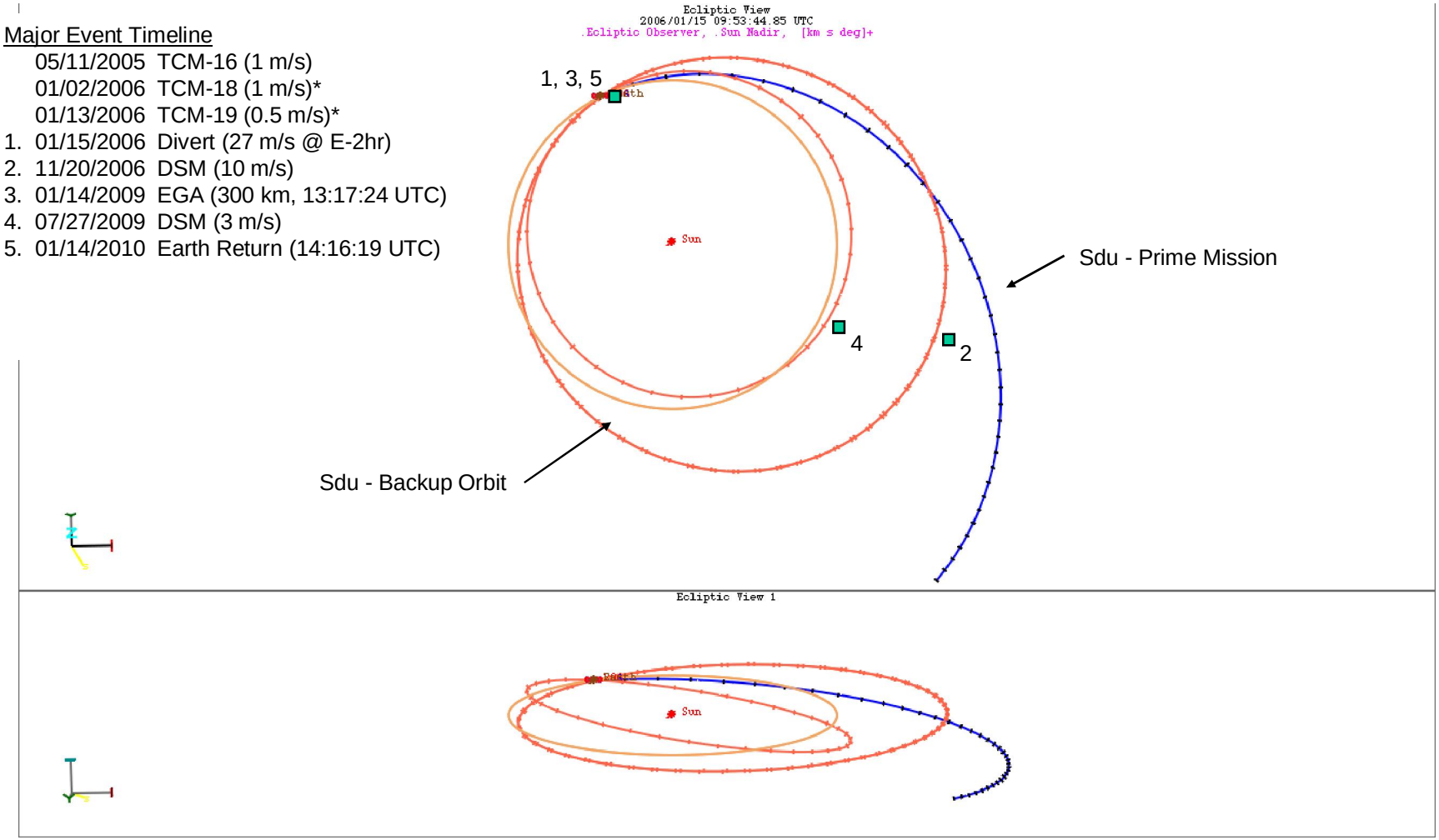
Jan 15, 2006 Night to Backup : 4 years

Heliocentric Orbit

Major Event Timeline

05/11/2005 TCM-16 (1 m/s)
01/02/2006 TCM-18 (1 m/s)*
01/13/2006 TCM-19 (0.5 m/s)*

1. 01/15/2006 Divert (27 m/s @ E-2hr)
2. 11/20/2006 DSM (10 m/s)
3. 01/14/2009 EGA (300 km, 13:17:24 UTC)
4. 07/27/2009 DSM (3 m/s)
5. 01/14/2010 Earth Return (14:16:19 UTC)



10 day ticks

Spacecraft Component Lifetime

- Most subsystem documentation affirms components are suitable for 7 year mission; Lifetime not documented.
- Attitude and Articulation control System(AACS) components performing well after 6 years.
  - Inertial Measurement Unit (IMU) A-side use will leave ~15 days margin of 1.5 year lifetime.
  - B-side not used since pre-Launch testing; 1.5 years available
  - B-side usable only with Command and Data Handling (C&DH) side swap.
  - B-side components not calibrated.
- Power subsystem
  - Solar Array degradation pre-Launch estimate 2% per year.
  - Flight performance better; < 7% degradation total to date (6 years).
- Thermal control
  - Louvers have been operated sparingly compared to other spacecraft with similar systems; no lifetime concerns.
  - Experience at 1 AU.
    - Earth Gravity Assist (EGA 2001): Used 45 deg offpoint to reduce temperatures 30%.
    - 1AU 2003: Calibration opportunity, temperatures acceptable.

References

- **"Stardust; Comet and Interstellar Dust Sample Return Mission", D. E. Brownlee, *et al*., *Journ. Geophys. Res*., Vol. 108, 8111, 2004.**
- **"Cometary and Interstellar Dust Analyzer for comet Wild 2", J. Kissel, *et al*., *Journ. Geophys. Res*., Vol. 108, 8114, 2004.**
- **"Dust Flux Monitor Instrument for the Stardust mission to comet Wild 2", A. J.Tuzzolino, *et al*., *Journ. Geophys. Res*., Vol. 108, 8115, 2004.**
- **"Stardust Imaging Camera", R. L. Newburn, *et al*., *Journ. Geophys. Res*., Vol. 108, 8114, 2004.**
- **"Surface of a Young Jupiter Family Comet 81P/Wild2:View from the Stardust Spacecraft", D. E. Brownlee, *et al*., *Science*, Vol 304, 1764, 2004.**