HYPERSEED MAC: AN AIRBORNE AND GROUND-BASED CAMPAIGN TO MONITOR THE STARDUST SAMPLE RETURN CAPSULE REENTRY ON 2006 JANUARY 15.

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Introduction: The reentry of the Stardust Sample Return Capsule on 2006 January 16 is the fastest entry of a NASA space craft in NASA history and the first > 11 km/s since the Apollo era. The hypervelocity entry of a sample return capsule is an artificial meteor with flow conditions similar to natural asteroids for studies of the shock emissions and ablation process, without the confusion of fragmentation and the obscuring emissions from the ablated meteoric metals of natural fireballs. The entry is also a real-life test of key risk drivers for future Thermal Protection System (TPS) design: the amount of radiative heat flux and the response of the TPS.

Fig. 1: Genesis SRC entry.

Results from the Genesis SRC Entry campaign: The Stardust SRC entry follows the return of the Genesis SRC at the Utah Test and Training Range (U.T.T.R.) on September 8, 2004. That entry was observed in a first Hyperseed MAC mission, during which broadband optical emissions and infrasound signatures were detected. The anticipated emissions were calculated from a flow and radiation model, and were expected to be dominated by blackbody emission, but with measurable signatures from the shock wave [1]. The observations were only partially successful, because the spectrograph and imagers that needed to be aimed at the meteor did not acquire the object in the daytime sky due to a simple, yet significant, error in the instrument pointing simulation. Staring cameras did detect the bright SRC, as did ground-based infrasound detectors at Wendover and a handheld video camera. The results from the observations show that the surface-averaged brightness temperature was close to that predicted [2]. The infrasound signal was only a factor of two different from that calculated based on Apollo data [3].

The Stardust SRC entry: Stardust will be a night time reentry which permits intensified spotting cameras with a large field of view. The star background will provide a coordinate frame. We will now also have central access to the latest trajectory files from the Stardust mission navigators.

Stardust will enter Earth's atmosphere at a shallow angle of 8.2^o, spin at 15 rates per minute, and experience a surface heat rate of about 1200 W/m^2. The peak deceleration in Earth's atmosphere will be 34 g. The phenolic impregnated carbon ablator (PICA) heat shield will bear the brunt of the entry.

The Genesis SRC was larger than the Stardust SRC (1.52m compared to 0.811m), but arrived at lower speed (11.0 km/s versus 12.9 km/s @ 135 km). Stardust's kinetic energy will be 1/4 that of Genesis, making the reentry 1.4 magnitudes fainter, but the higher speed will induce more intense shock emissions. Preliminary calculations show that the emission lines should stand significantly above the continuum emission from the hot surface area. The peak brightness (from a distance of 100 km) will be about -5 magnitude panchromatic and brighter at red and near-infrared wavelengths.

Hyperseed MAC: We will report on how results from the Genesis Hyperseed MAC mission help guide the ongoing efforts to bring together a second airborne mission using NASA's DC-8 Airborne Laboratory. This will enable a large team of researchers to view the entry above clouds and in a low-water-vapor line-of-sight. This airborne mission will be supported by ground-based observations.

References: [1] Jenniskens P., *et al.* (2005) *EMP (in press).* [2] Jenniskens P., *et al.* (1997) *AIAA Reno meeting. (submitted).* [3] ReVelle D.O., Edwards W., Sandoval T.D. (2005) *Met. & Planet. Sci. (in press).*

Additional Information: More information will be provided at the website http://reentry.arc.nasa.gov while the campaign unfolds.