



## Stardust



### Protecting a Cometary Probe

The Stardust is a comet probe whose primary mission is to collect cometary particulates from the comet 81P/Wild-2 while passing within 100 km (62 miles) of its nucleus head in early 2004.

The probe will be launched from a Delta rocket in February of 1999. In order to gain enough orbital energy for the long journey to Wild-2, where the comet rendezvous will occur at a distance of about 400 million km from Earth, the spacecraft will effectuate a gravity assist maneuver around the Earth.

When the spacecraft encounters comet Wild-2 in January of 2004, it will have an opportunity to take detailed photographs of its nucleus surface. As it travels through the comet's coma, spewed samples of comet dust will be collected. Stardust will attempt to collect these particles using a special material called Aerogel. The samples will be stored in Stardust's Return Capsule (SRC) which is designed to separate from the main body prior to reentering the Earth's atmosphere. The returned samples will be brought to a laboratory where a thorough chemical analysis can be performed.



## Stardust

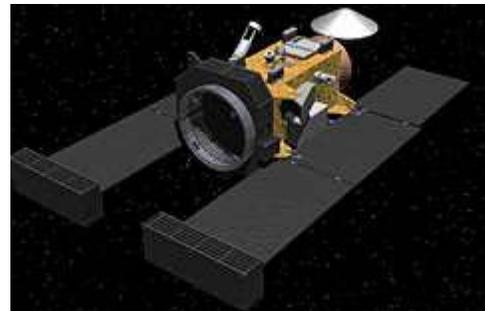
### Stardust Shielding Systems

This illustration depicts Stardust's high-level features, including the cometary multi-layer shields used to protect two of its critical systems, specifically the main body and solar arrays.

In order to defend the Stardust spacecraft from cometary hypervelocity impacts originating from its encounter with comet Wild-2, it is necessary to implement complex shielding systems which protect vital Stardust subsystems. The current Stardust shield design involves 4 separate shielding systems:

- Stardust Main Shield
- Stardust Solar Array Shield
- Stardust Collector Wrist Shield
- Stardust NavCam Periscope Shield

Each shield is specifically designed to protect Stardust's main body, solar arrays, Aerogel collector wrist, and the navigation camera periscope, respectively, over the course of its long journey and specifically during its encounter with comet Wild-2.



*Front view of Stardust spacecraft*



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### Some Test Results

In order to meet survivability requirements, probability of impact and failure analysis has led to [ballistic limit thresholds](#) (cometary particle diameter and velocity) for which a Stardust shield must be infallible. For example, the Stardust Main Shield (SMS) shown at right, was tested to determine its ballistic limit.

The SMS with dual layer Nextel and Launch Vehicle Adapter shield configuration was capable of withstanding an impact by a 3.57 mm (9/64") nylon projectile traveling at 5.92 km/s, which is within the predefined requirement.

The SMS with dual layer Nextel offers inadequate protection against a 10 mm nylon projectile traveling a 6 km/s. In the first of two tests, no perforating debris was generated and the target was deemed to pass. In the confirmation test, the projectile inflicted significant damage to the rear wall. Hence, it was decided to augment the SMS with an additional layer of Nextel.

The SMS with triple layer Nextel offers adequate protection against a 10 mm nylon projectile traveling near 6.1 km/s. The target was able to repeatedly withstand such impacts in three separate tests.



*Side view of the Stardust Main Shield with Launch Vehicle Adapter (SMS)*