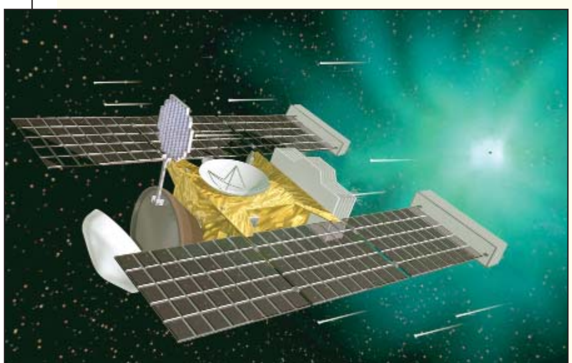
SPECIAL SECTION

Sweet Dreams Are Made of These

Question: How close can you get to a comet? Answer: In this special section, the Stardust spacecraft will take you within 236 kilometers of the nucleus of comet Wild 2. Stardust's primary mission was to collect interstellar dust particles and cometary dust particles. These micrometer-sized particles represent the building blocks of the solar system as well as samples of other stars.

The particles were collected in aerogel, an extremely low-density microporous silica. Aerogel can capture particles only at slow relative velocities; however, most previous spacecraft encounters occurred at much higher relative velocities, so the mission engineers designed an orbital path to ensure slow encounters. Launched in February 1999, Stardust collected interstellar particles in May 2000. After coming close to Earth at the end of its first orbit to get a gravity assist, Stardust collected more interstellar dust particles in 2002. Finally, in January 2004, Stardust encountered comet Wild 2 at a relative velocity of about 6 kilometers per second and a breathlessly close distance of 236 kilometers. Besides capturing cometary particles, the Stardust spacecraft used its scientific payload to obtain highly spatially and temporally resolved data on this extremely slow encounter of a unique kind.



As described by Brownlee *et al.* (p. 1764), the optical navigation camera took 72 images (one every 10 seconds) and found an oddly shaped nucleus, pockmarked with depressions and ridges. The feature-rich surface suggests that this comet has cohesive strength and is not a porous ball of ice that would fall apart at the slightest perturbation [see the Perspective by Weaver for more details (p. 1760)]. As described by Tuzzolino *et al.* (p. 1776), the dust flux monitor found unexpected swarms of particles, suggesting fragmentation of larger chunks of the comet. As described by Kissel *et al.* (p. 1774), the time-of-flight mass spectrometer recorded spectra and found organic-rich matter as well as nitrogen- and sulfur-rich species. The images also showed jets coming out in all directions, and Sekanina *et al.* (p. 1769) concluded that these jets are narrow sheets of particles that burst forth from small sources on the tumbling comet. Levasseur-Regourd (p. 1762) puts these jets and their sources into perspective.

Now that the flyby is complete and the unexpectedly ugly but strong surface of Wild 2 has been revealed in the finest detail possible, scientists can ponder what all of this means for the origin of the solar system, while the mission scientists have sweet dreams made of fluffy particles of comets, the solar nebula, and other stars cushioned in aerogel until the return of the samples in 2006. Then scientists can get really close to actual particles captured from comet Wild 2. Chemical analyses of the particles, combined with the flyby data, should help clear up any nightmares about the origin of the solar system and the dynamics of comets.

Linda Rowan

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PERSPECTIVE

Not a Rubble Pile?

Harold A. Weaver

New in situ observations of a comet are demonstrating once again how little we understand about these dark and mysterious planetesimals. Just when a consensus was being reached that cometary nuclei are gravity-dominated "rubble piles" (*1*), stunning images of the nucleus of comet Wild 2 (pronounced "vilt 2") taken by the camera onboard NASA's Stardust spacecraft (*2*) and presented on page 1764 of this issue are challenging that paradigm. The analysis of the many jets detected in these images (*3*) on page 1769 and results derived from the Stardust instruments that sampled dust in the coma of Wild 2 (*4*, *5*) on pages 1776 and 1774 are also providing valuable new insights into the nature of comets. [For a discussion of the unusual dust flows, see the Perspective by Levasseur-Regourd on page 1762 (*6*).]

The Stardust encounter with Wild 2 on 2 January 2004 passed virtually unnoticed by most of the public, partly because the Mars rover Spirit was heading for a landing on Mars the next day and its twin Opportunity was scheduled to land 3 weeks later. It was difficult for Stardust to compete with nifty little robots crawling around on our neighboring planet. Nonetheless, I sat at home that Friday evening in front of my computer anxiously awaiting the first images from the optical navigation (OpNav) camera on Stardust. There was certainly no guarantee that I would see anything that night. Flyby encounters are the ultimate fire drill, requiring high precision and unforgiving of mistakes, and the Stardust OpNav camera had problems in the past with a sticky filter wheel and contamination that fogged its view (*7*). Fortunately, the flyby of Wild 2 was executed perfectly, and NASA released some preliminary OpNav images soon after they were received on the ground.

I was mesmerized by the first publicly released Stardust image of the nucleus of Wild 2, which was so eerie-looking with its pockmarked surface and fuzzy edges. Were the depressions in the surface im-

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