



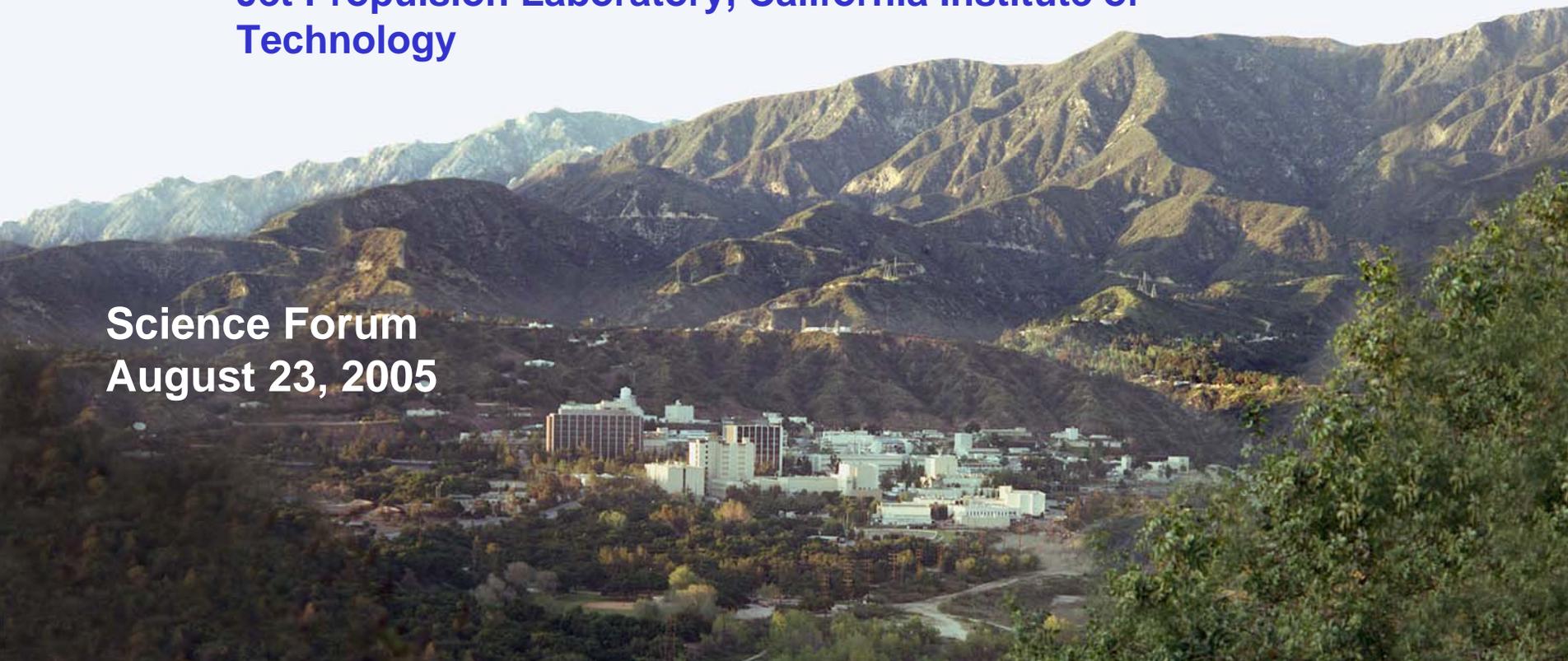
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JPL's Science Missions: New Places, New Worlds

**Paulett Liewer, Associate Chief Scientist
Jet Propulsion Laboratory, California Institute of
Technology**

**Science Forum
August 23, 2005**





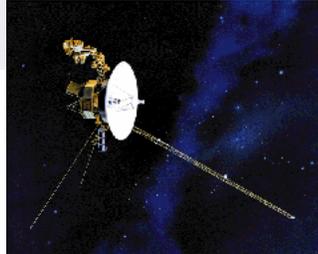
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Sixteen JPL spacecraft - and three major instruments- now operating across the solar system

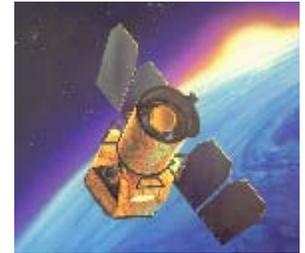
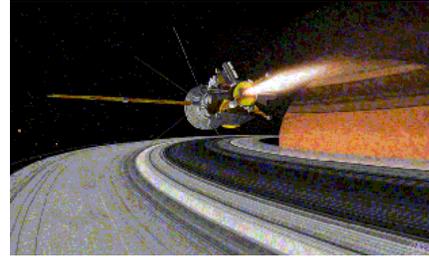


Spitzer studying stars and galaxies in the infrared



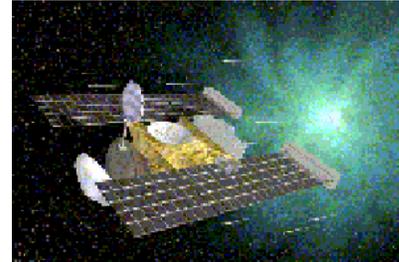
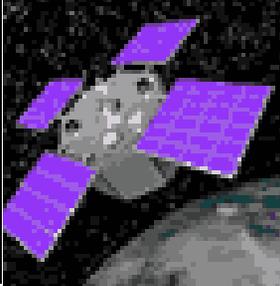
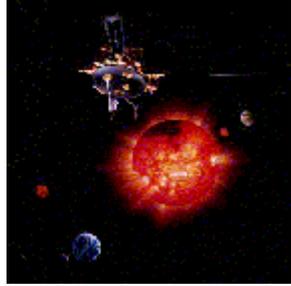
Two Voyagers on an interstellar mission

Cassini studying Saturn and its moons



GALEX studying UV universe

Ulysses and ACRIMSAT studying the Sun



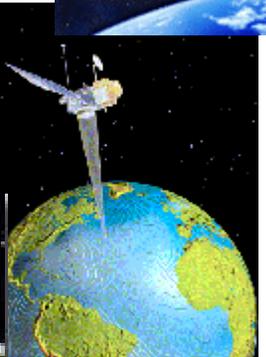
Stardust returning comet dust



Mars Global Surveyor and Mars Odyssey orbiters; "Spirit" and "Opportunity" on Mars; Mars reconnaissance Orbiter now en route

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Topex/Poseidon, QuikSCAT, Jason 1, and GRACE (plus ASTER, MISR, and AIRS instruments) monitoring Earth





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JPL's Science Missions: New Places, New Worlds

- **Highlight Four New Places or Worlds Visited This Year**
 - Voyager 1 Reaches the Edge of the Solar System (December 2004)
 - Deep Impact (July 4, 2005) -- Hitting a comet and seeing the result
 - *Cassini-Huygens mission to Saturn*
 - First Landing on Titan, Saturn's Largest Moon (January 14, 2005)
 - Closeup of another amazing Saturnian Moon: Enceladus (July 14, 2005)
- Missions now under development
- Close with a 5 minute HDTV Video (*Mars Exploration Rover & Cassini*)



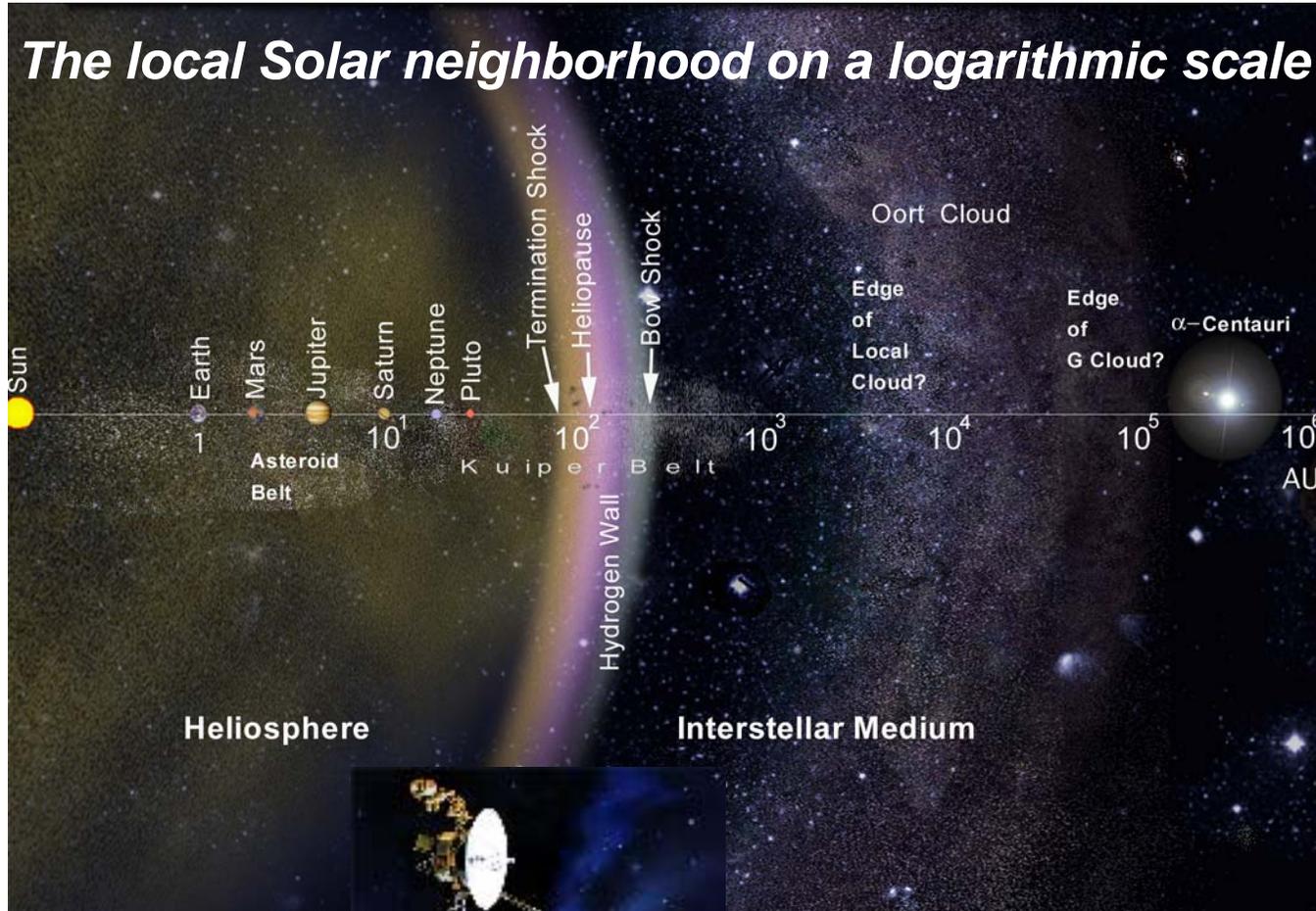
The Rover that didn't get to go to Mars



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Voyager 1, now 27 years after launch: Reaches the Edge of the Solar System



Voyager 1 has now crossed the Solar Wind Termination Shock and is heading to the region beyond the influence of the Sun⁴

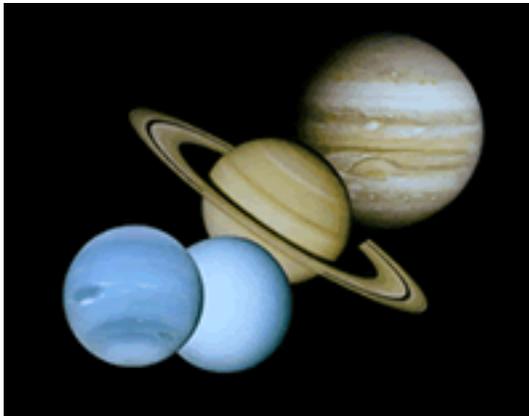


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Voyager Spacecraft Enters Solar System's Final Frontier

- From the Press Release in April: *NASA's Voyager 1 spacecraft has entered the solar system's final frontier. It is entering a vast, turbulent expanse where the Sun's influence ends and the solar wind crashes into the thin gas between stars.*
- The Voyagers may reach the *interstellar medium* before losing power in about 2020. Interstellar medium is gas from other stars.



The Voyagers hold the record for the most new worlds visited: All the gas giants (left to right) Neptune, Uranus, Saturn, Jupiter (1977-1989)



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Deep Impact Mission

Spacecraft carries the Impactor to the comet,
then flies on by to observe the results

Launched in January 2005



Impactor separates from
spacecraft 24 hours prior
to encounter -- Impact was
July 4, 2005



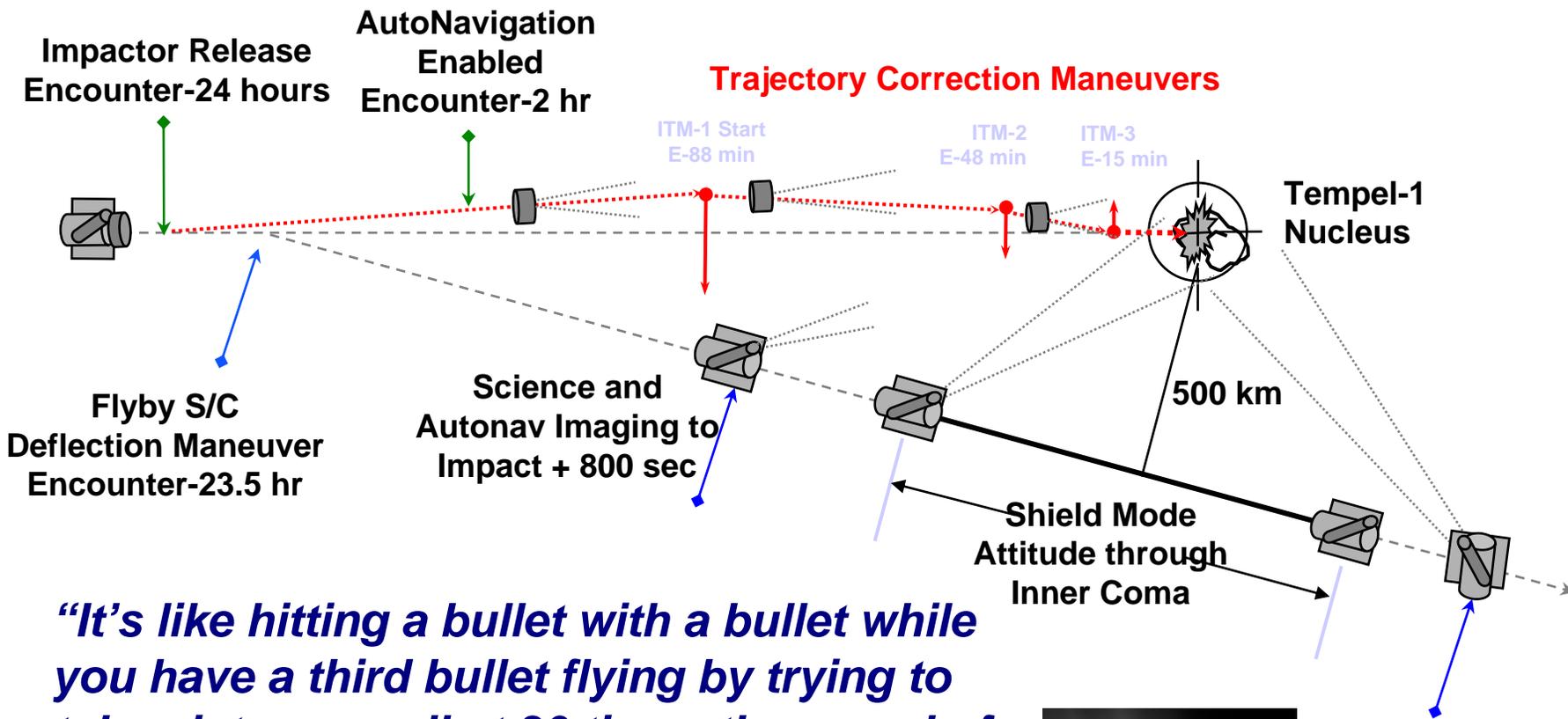
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Deep Impact Encounter Timeline



“It’s like hitting a bullet with a bullet while you have a third bullet flying by trying to take pictures -- all at 30 times the speed of real bullets,” said Rick Grammier, Deep Impact Project Manager





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Movie of the comet taken from the Impactor

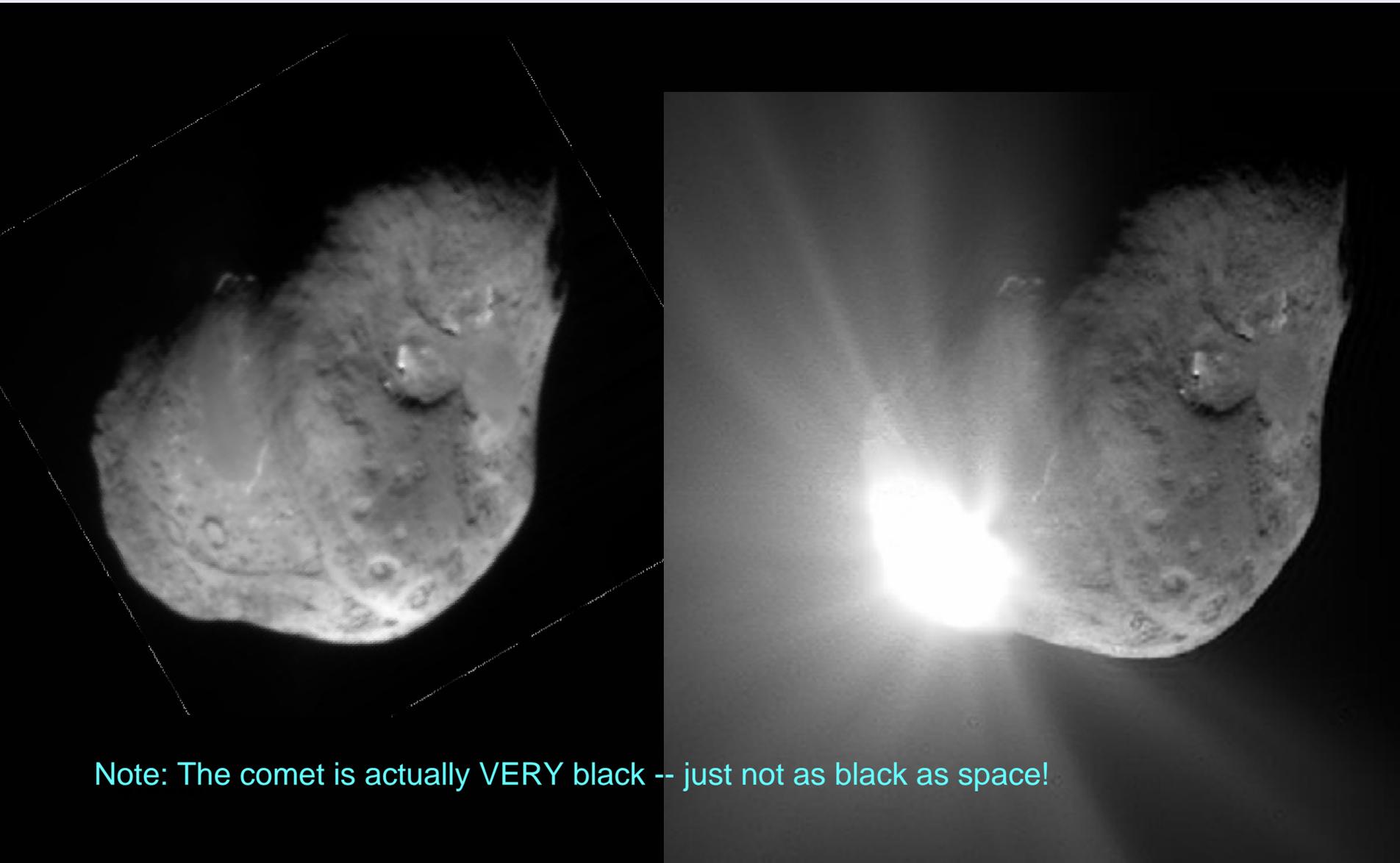
QuickTime™ and a
Sorenson Video 3 decompressor
are needed to see this picture.



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NASA'S DEEP IMPACT TELLS A TALE OF THE COMET



Note: The comet is actually VERY black -- just not as black as space!



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NASA's Deep Impact tells a tale of a comet

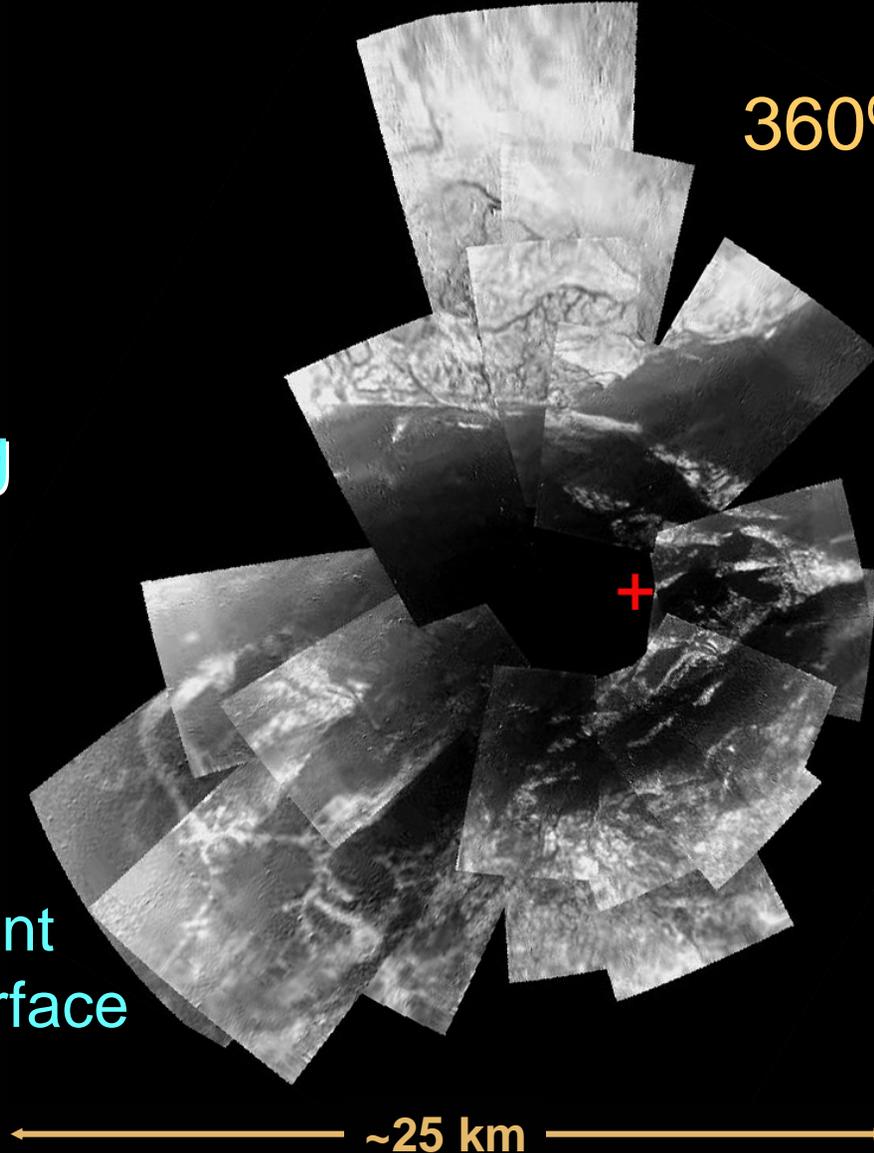
- Probe slammed into the nucleus of the comet at 6.3 miles per second and created an immense cloud of fine powdery material.
- *"That suggests the dust excavated from the comet's surface was extremely fine, more like talcum powder than beach sand. And the surface is definitely not what most people think of when they think of comets -- an ice cube,"* said Deep Impact Principal Investigator Dr. Michael A'Hearn of the University of Maryland, College Park.
- How can a comet hurtling through our solar system be made of a substance with less strength than snow or even talcum powder? *"You have to think of it in the context of its environment,"* said Pete Schultz, Deep Impact scientist from Brown University, Providence, R.I. *"This city-sized object is floating around in a vacuum. The only time it gets bothered is when the sun cooks it a little or someone slams an 820-pound wakeup call at it at 23,000 miles per hour."*

Cassini Spacecraft Delivers ESA's Huygens Probe to Titan's Surface

360° Panorama of landing spot

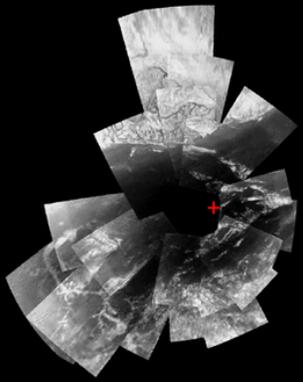
Images from Probe during descent

2h 27 m descent
1h 12 m on surface

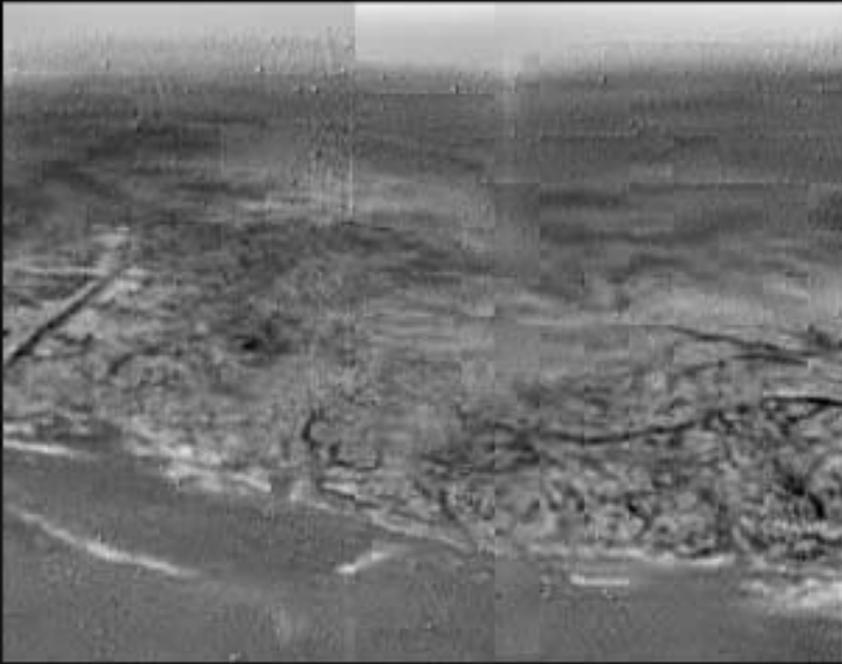


Images from Titan Probe

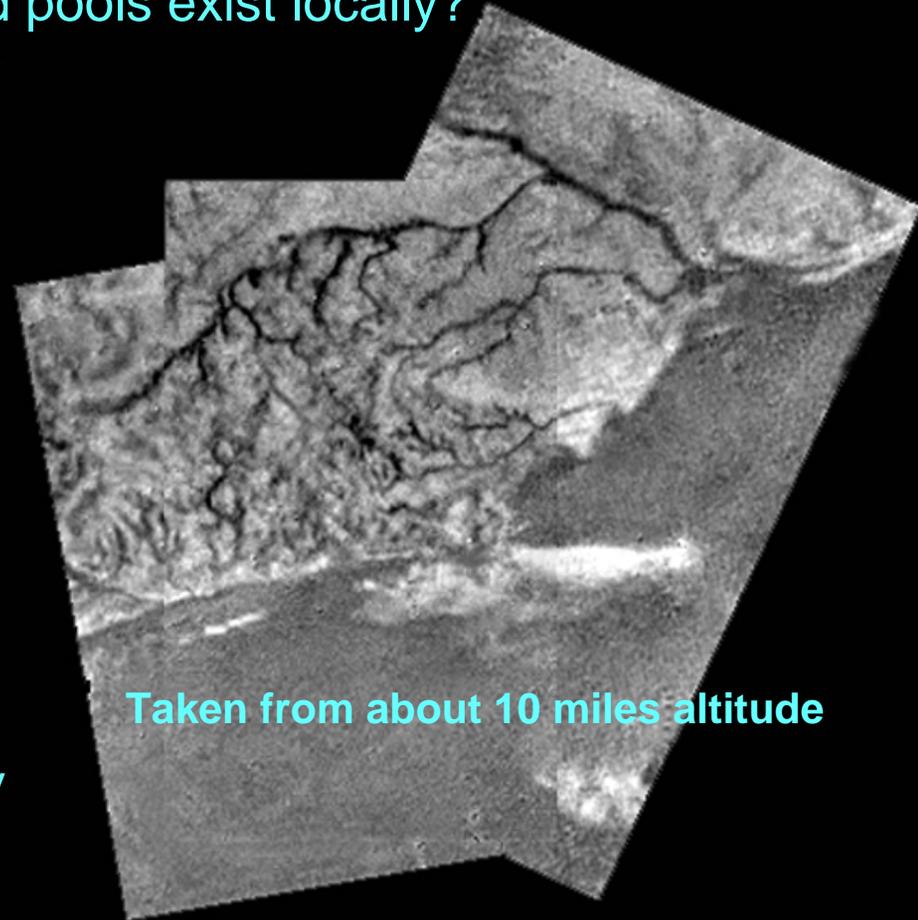
showing flow into a major river channel from different sources---is methane rain required?



Are dark channel floors full of organic sludge washed off the brighter highland?
Could liquid pools exist locally?

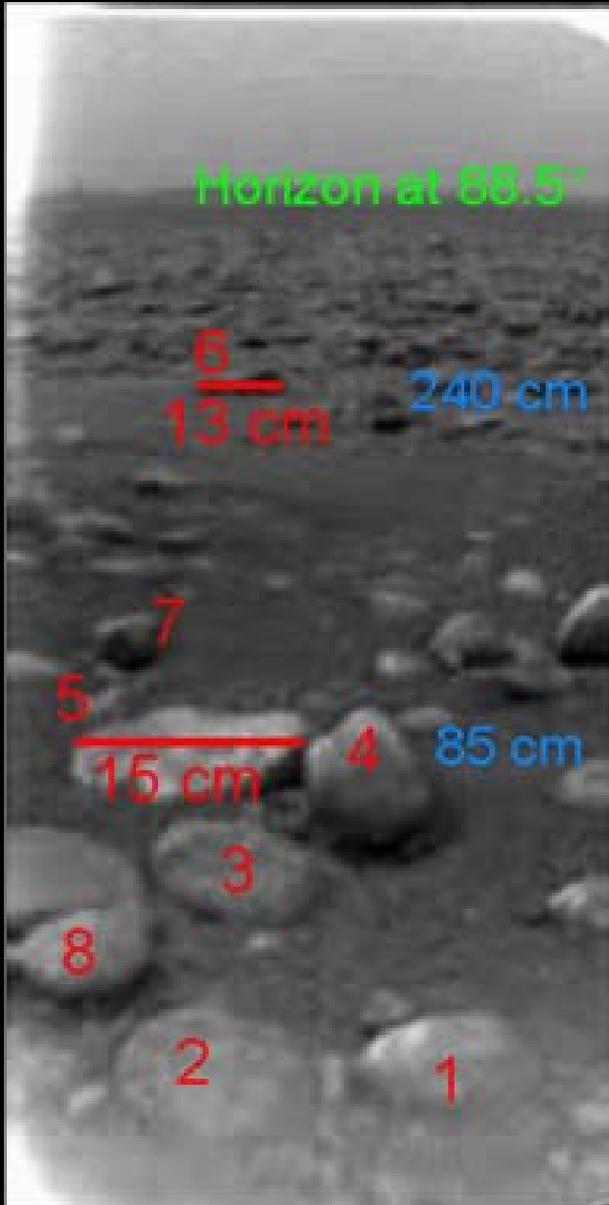


Early pre-biotic (before life) Earth may have had an atmosphere like Titan's!



Taken from about 10 miles altitude

Titan's Surface!



The surface is darker than originally expected, consisting of a mixture of water and hydrocarbon ice.

There is also evidence of erosion at the base of these objects, indicating possible fluvial activity.

Cassini visits Saturn's Moon Enceladus, July 14 and finds an active, watery world

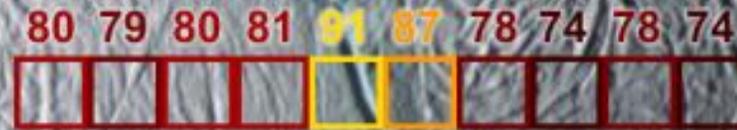
Heavily
cratered
on top



175 km
flyby!!

Few craters on
bottom- evidence
for active ice
volcanism

The Fractures are WARMER!



Temperatures in degrees Kelvin

Squares ~4 miles across

Cassini found a huge cloud of water vapor over Enkeledeus' south pole - probably supplied by ice evaporating from the warm fractures



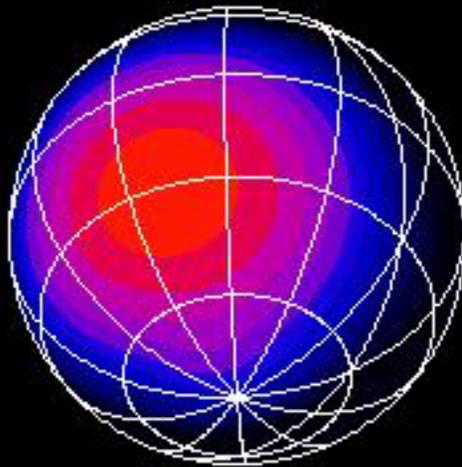


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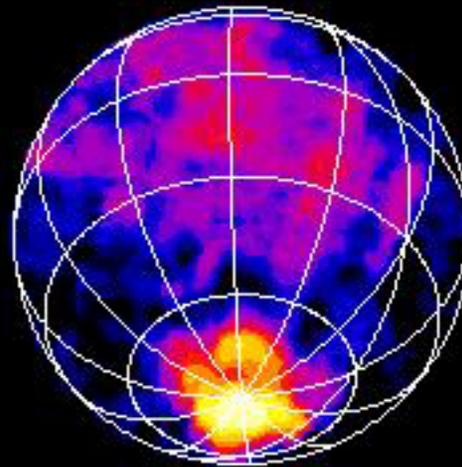
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South Pole of Enceladus is much warmer than expected

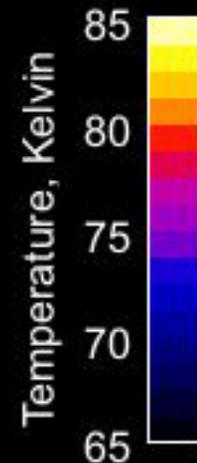
Enceladus Temperature Map



Predicted
Temperatures



Observed
Temperatures



Cassini also confirmed Enceladus is the major source of Saturn's largest ring, the E-ring

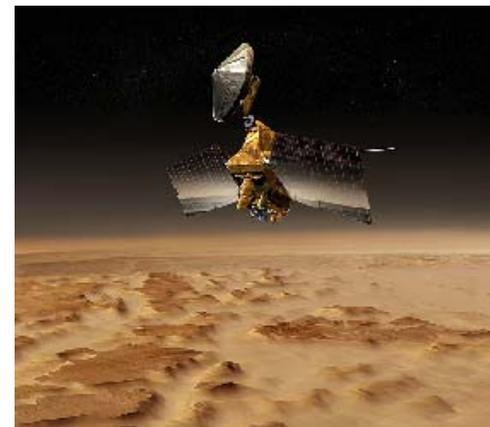
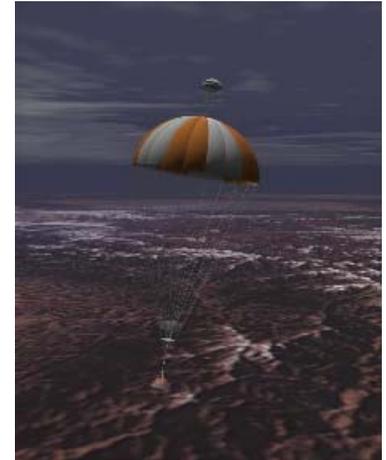


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Upcoming JPL events

- **September 2005:
Cloudsat launch**
- **January 15, 2006:
Stardust Earth landing-
returning a sample of a
comet's tail**
- **March 2006 - Mars
Reconnaissance Orbiter
arrives and begins
aerobraking (launched
August 12)**





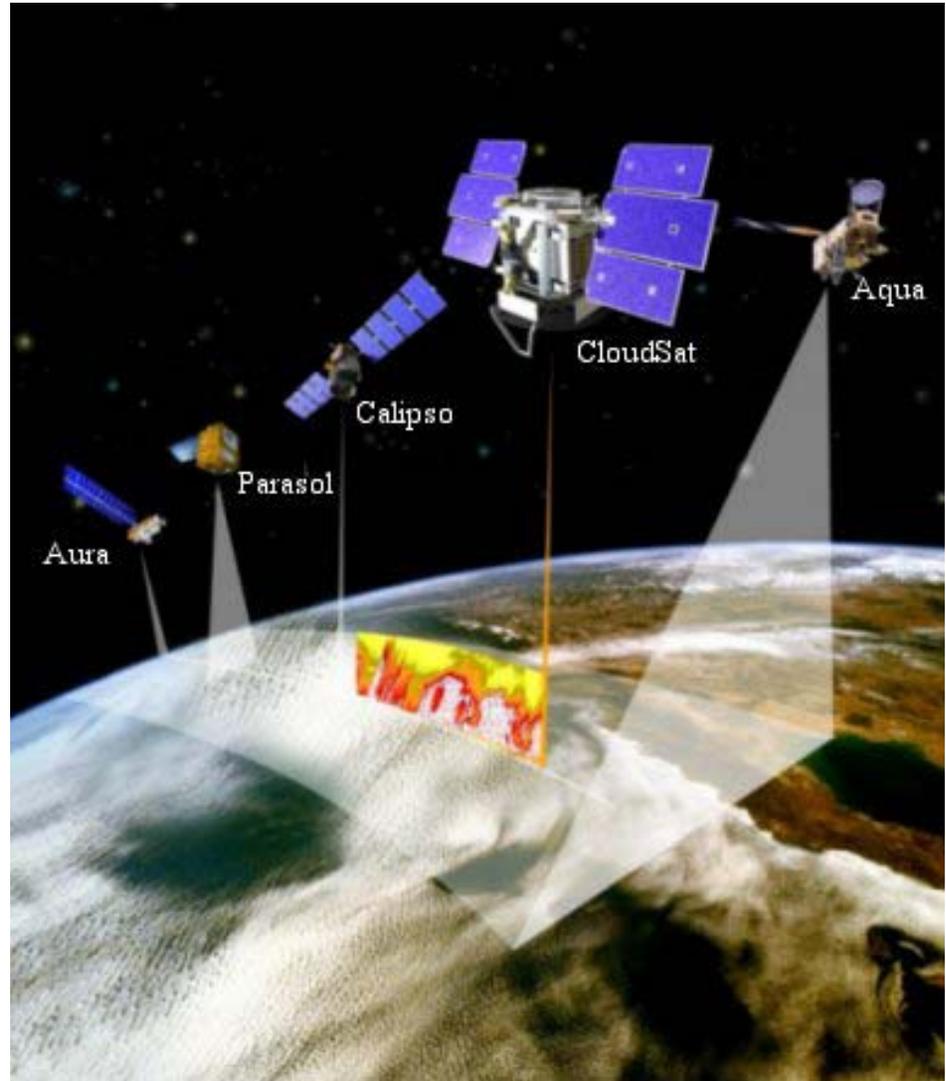
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Cloudsat ready to launch on September 27

- Measure vertical structure of clouds, and cloud properties using 94GHz profiling radar.
- Quantify global and seasonal variations of clouds.
- Relate clouds to Earth's energy budget.
- Fly in formation with Aura, Parosol, Calypso, and Aqua.

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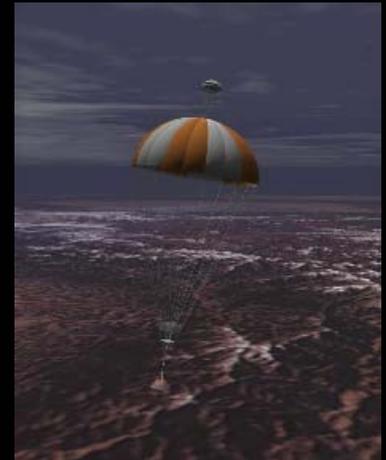
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Stardust will return first sample of a comet to Earth



On January 2, 2004, Stardust flew within 236 kilometers of Comet Wild 2 and captured thousands of particles in its aerogel collector for return to Earth on January 15, 2006





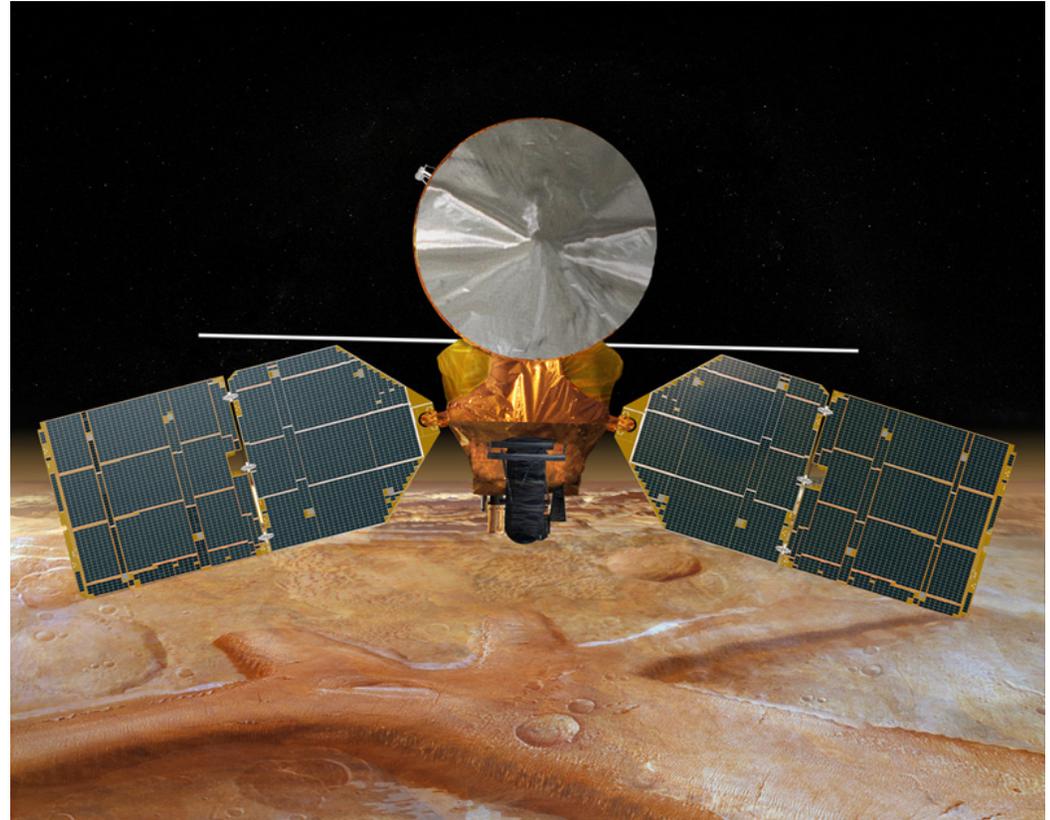
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Mars Reconnaissance Orbiter

Arrives at Mars in March 2006 Aerobrakes until November

- Study history of water on Mars.
- Seek evidence of sub-surface water.
- Seek water-formed minerals.
- Study atmospheric dust and water distribution.
- Monitor daily global weather.
- 5.6 Mb/s maximum data rate enables 1 meter resolution over large areas.





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JPL science missions under development for launch 2006–2011

- *Dawn: May 06*
- *Kepler: Jun 08*
- *Phoenix: Aug 07*

- *Orbiting Carbon
Observatory: 08*
- *Ocean Surface Topography
Mission: 08*
- *Wide-Field Infrared Survey
Explorer (WISE): 09*

- *Aquarius: 09*
- *Mars Science Laboratory:09*
- *NUSTAR (Nuclear
Spectroscopic Telescope
Array): 10*

- *Hydros: 10*
- *Space Interferometer
Mission (SIM): 10-11*
- *Juno : 10-11*

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Above all else, the people of JPL are explorers.

We hope you can join us

