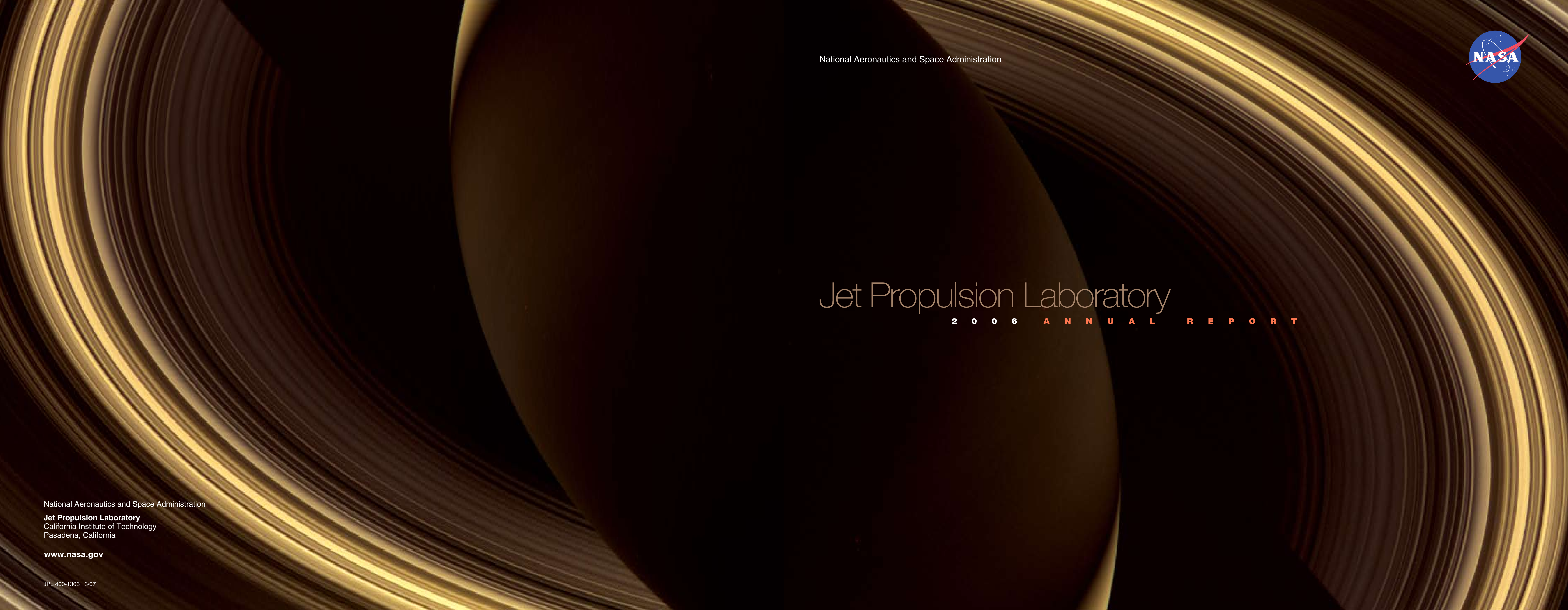

National Aeronautics and Space Administration

Jet Propulsion Laboratory

2006 ANNUAL REPORT

National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

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Mars Exploration Rover Spirit captured this view, called the McMurdo panorama, of the spot where it spent the Martian winter in 2006.

2006

Director's MESSAGE

Nothing is as gratifying in space exploration as when we are surprised by the unexpected. Much of our work progresses in an orderly way, from concept to plan to creation to finding. But now and then we are caught off-guard by something startlingly new, and it is these moments that make our hearts race and leave us with many of our most compelling memories.

And 2006 was an exceptional year for the unforeseen. One of our orbiters shocked many with stark proof that liquid water, the seemingly long-gone force that reshaped so much of the scenery of Mars, still flows there today — at least in occasional bursts. Another spacecraft caught us by surprise with photos of Yellowstone-like geysers on one of Saturn's seemingly non-descript moons, Enceladus. A spaceborne observatory created to plumb the life histories of stars and galaxies showed off a completely unexpected talent when it revealed the day and night faces of a fire and ice planet far beyond our solar system 40 light-years away. A newly launched Earth observer revealed that the clouds that decorate our own planet are not what we thought them to be in many ways.

Of course, not all of the high points of the year arrived on our doorstep in such unexpected ways. There was also great drama when missions came off exactly as planned — such as when Stardust's sample return capsule made a flawless landing in the Utah desert, bringing home samples of cometary and interstellar dust. Mars Reconnaissance Orbiter slipped into orbit around the red planet exactly as planned. Numerous other missions and technology programs likewise made great achievements during the year. In all, 17 spacecraft and six instruments were stationed across the solar system, studying our own world, other planets, comets and the deeper universe.

All of these achievements were enabled by many teams and systems at the Laboratory. The Deep Space Network of communications complexes across three continents supported all of NASA's solar system missions, and several from our international partners, while looking ahead to re-invent itself for the future. Technologists were at work creating innovations both for NASA missions and terrestrial uses. JPL's community of

CHARLES ELACHI

scientific researchers was equally busy coordinating the science activities of our missions and pursuing independent investigations. None of this would be possible without the support of business and administrative teams dedicated to making the Laboratory's institutional environment as world-class as its technical face — or the public engagement specialists who bring the experience of space to the country's diverse publics. All of our missions in one way or another support our nation's Vision for Space Exploration, which envisages a gradually widening robotic and human presence across the solar system in the years ahead.

We also sought to sustain and enrich JPL's connection to its parent organization, the California Institute of Technology. It was my great pleasure this year to welcome Caltech's new president, Jean-Lou Chameau, who came from Georgia Tech. At the same time, we expressed our deep appreciation to outgoing president David Baltimore for his strong support of JPL during the years that we worked closely with him. Among many other initiatives joining JPL and the campus, a new graduate program in aerospace engineering continued to flower with significant involvement of Laboratory personnel. JPL's unique identity as a NASA facility staffed and managed by Caltech is one of the Laboratory's greatest strengths.

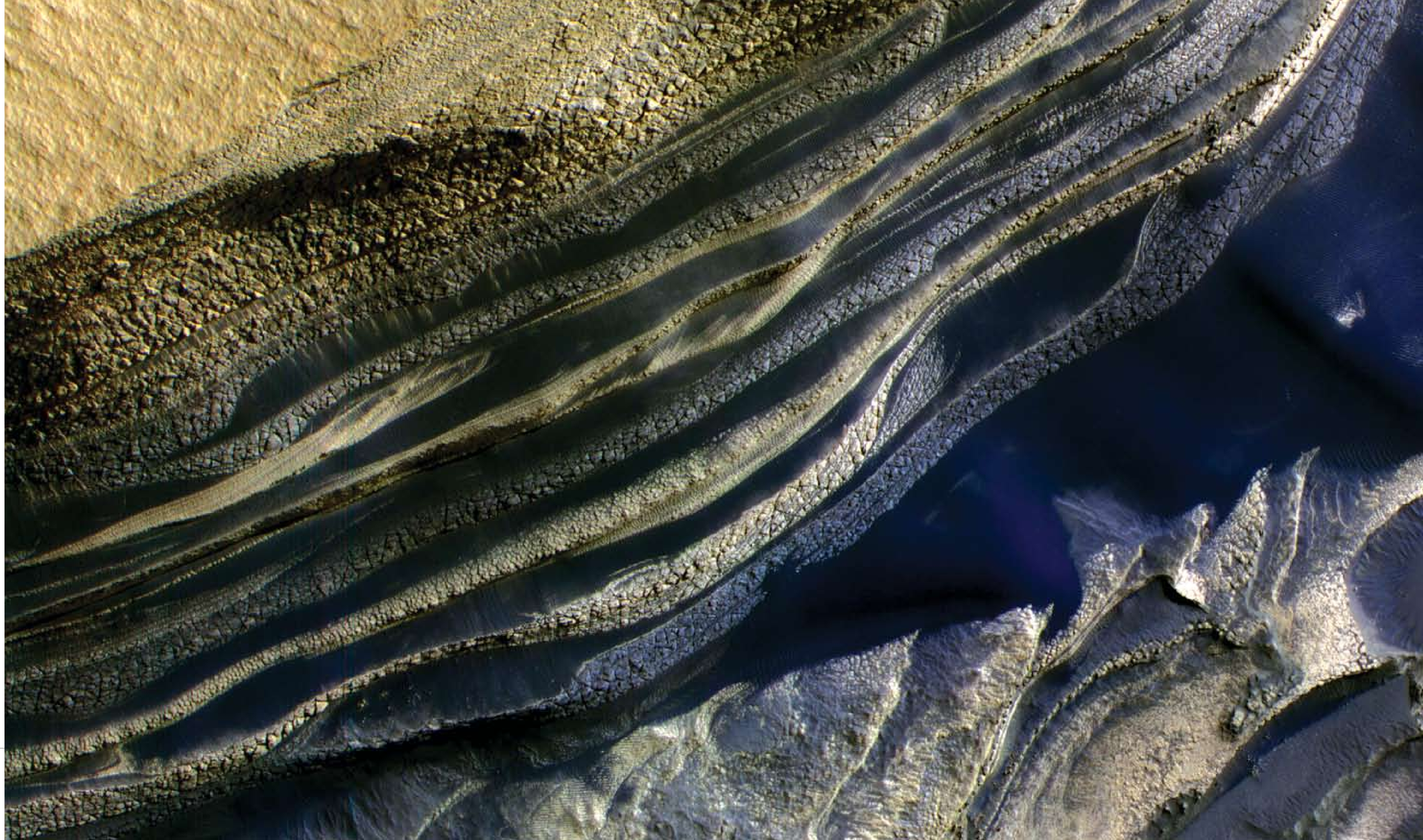
And still — as fulfilling as the events were that the year brought to us, there are yet wondrous things to come. I am greatly impressed by the remarkable milestones achieved in technologies that will enable space-based platforms to search for Earth-like planets around other stars. Our technical visionaries are fashioning concepts as well for missions to Europa and Titan, not to mention new generations of Earth observers. Henry David Thoreau once remarked, "If one advances confidently in the direction of his dreams, and endeavors to live the life which he has imagined, he will meet with success unexpected in common hours." That is the reality we are creating at JPL everyday.

A colorful portrait of the M82 galaxy, created by combining images from the Spitzer Space Telescope and two other space-based observatories.

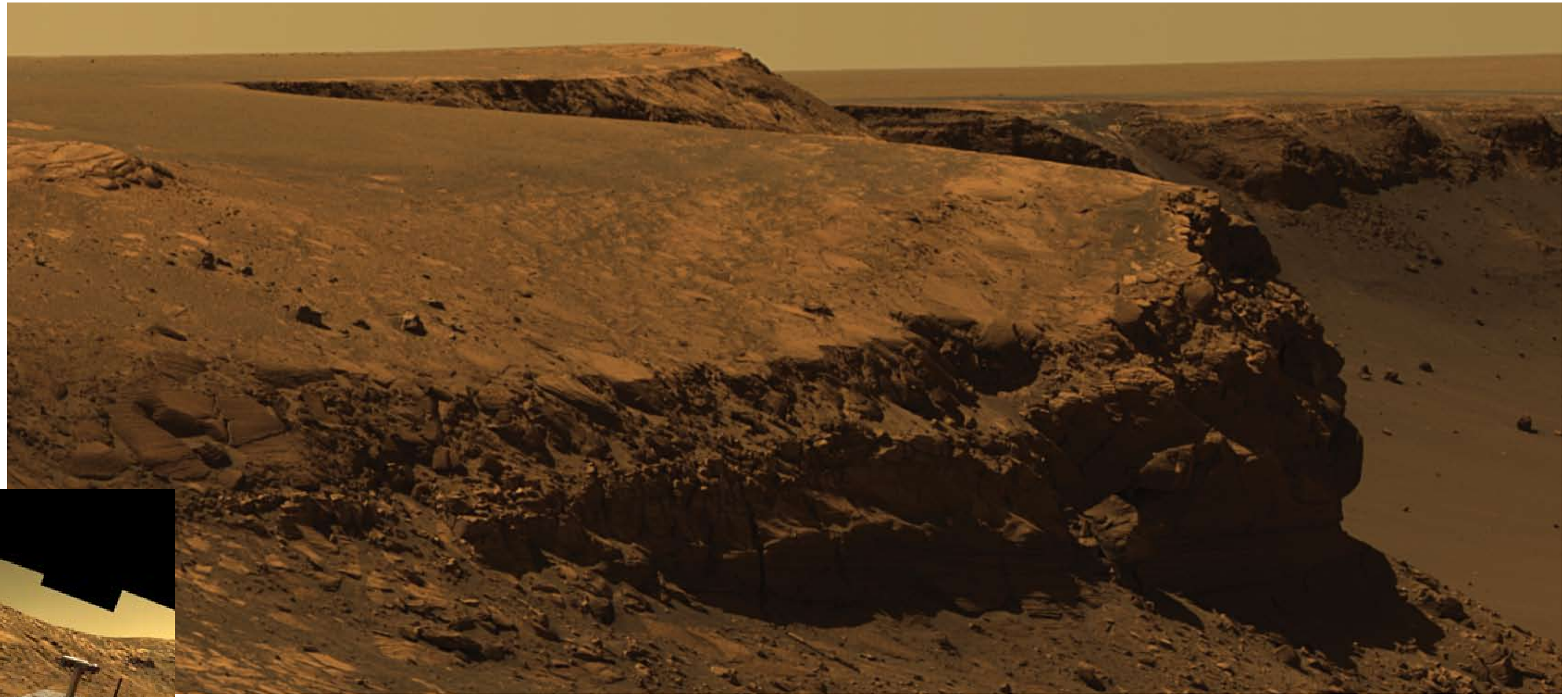
In movie-makers' parlance, you might say that Mars has been coming into focus in a slow dissolve — in fact, one that's four decades long. The first craft to fly by the planet in 1965 sent home photos that were newsmaking for the time, but crude by today's standards — grainy, black-and-white glimpses of craters, hand-colored by scientists on the ground. By contrast, the radically sharper views we have of the red planet today are nothing short of astonishing.

That is thanks in large measure to Mars Reconnaissance Orbiter, the latest NASA craft sent to the planet under the JPL-managed Mars program. Launched in 2005, the orbiter entered orbit in March 2006 and spent several months refining its orbit before embarking on its science mission. Equipped with the highest-resolution camera ever sent to another planet, the orbiter promptly began wowing scientists with the enormous detail and crispness of its photos. Those have included orbital shots of several landed spacecraft on the surface, including the Mars Exploration Rovers, Mars Pathfinder and the Vikings.

MAPPING Mars

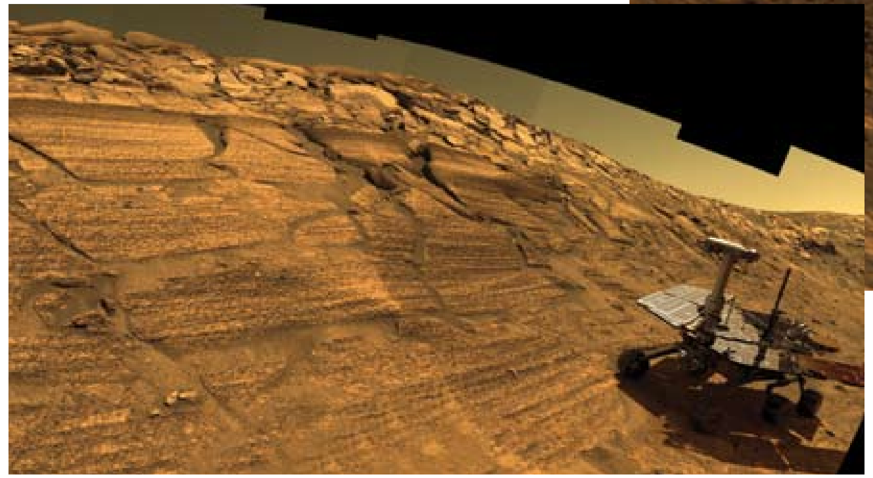


This scarp at the head of Chasma Boreale near Mars' north pole reveals layers of icy materials over dark sand dunes, as seen by Mars Reconnaissance Orbiter.



the 970th day

The dramatic promontory Cape Verde jutting over Mars' Victoria Crater, the destination of a months-long journey for Mars Exploration Rover Opportunity.



A simulated view of the Mars Exploration Rover Opportunity at Endurance Crater.

Perhaps the biggest news of the year, however, came from Mars Reconnaissance Orbiter's more senior robotic colleague, Mars Global Surveyor. Scientists comparing photos taken several years apart by Global Surveyor noticed bright new deposits in two gullies that suggest water carried sediment through them sometime during the past seven years. Since Mars' atmosphere is so thin and cold, liquid water doesn't last long at the surface — it either freezes or evaporates. But the photographic evidence left scientists intrigued by the notion that water could occasionally emerge from a subsurface habitat that could be conducive to life.

The gully announcement came as ground controllers worked to reestablish communication with Global Surveyor after contact was lost with it. By year's end, that possibility was seeming increasingly remote. Even so, the news capped nearly a decade in orbit at the planet for Global Surveyor that spawned volumes of science results.

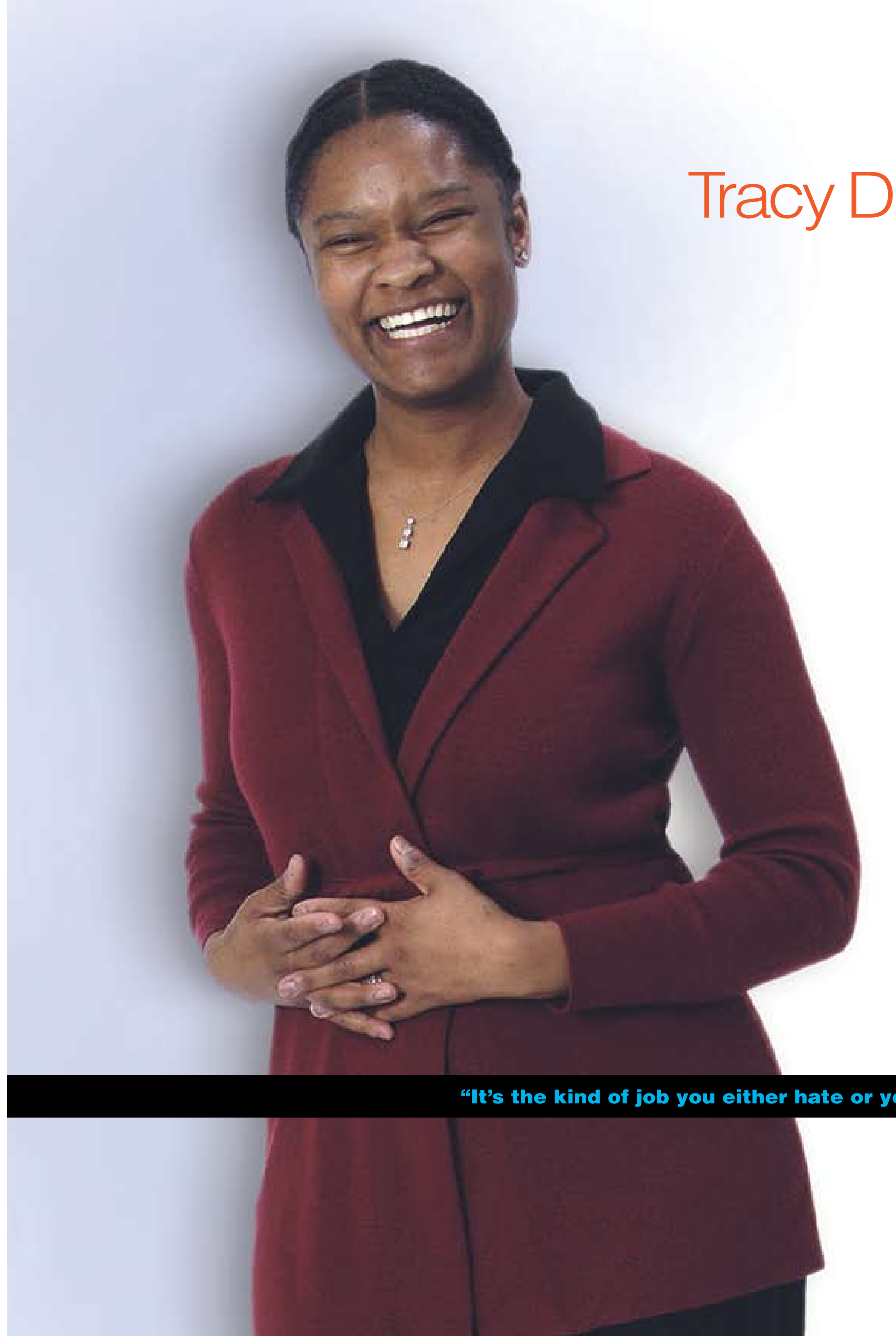
Yet another orbiter, Mars Odyssey, spent a highly productive year circling the planet. Among its most notable products was a high-resolution portrait of Valles Marineris, the sprawling canyon that as the solar system's largest known crevice stretches nearly a quarter of the way around the planet.

The stalwart Mars Exploration Rovers, meanwhile, kept logging distance records on their odometers as they spent their third year roaming hillsides and crater rims. The rover Opportunity achieved a major goal when it reached the edge of the half-mile-wide Victoria Crater after driving toward it for more than 20 months. Like an artist producing a career masterwork, Spirit beamed

home a long-anticipated mosaic image called the McMurdo panorama — a full-color, 360-degree view of the rover's winter haven amid the Columbia Hills in Gusev Crater. Both rovers ended the year in reasonably good health given their age, with nothing in sight that would cut short their missions, which have already lasted vastly longer than the original 90-day foray at Mars.

Back home on Earth, the next spacecraft bound for the red planet, Mars Phoenix, was nearing completion at Lockheed Martin in Denver with all its science instruments installed. Both Mars Reconnaissance Orbiter and Odyssey were busy taking pictures to assist with the selection of a landing site for Mars Phoenix. The new craft, due for launch in the summer of 2007, will land on the icy northern pole of Mars and use a robotic arm to dig trenches into the layers of water ice in search of organic compounds that could be the building blocks of life. Design work also progressed on Mars Science Laboratory, a next-generation rover that will search for subsurface water during its mission in 2009.

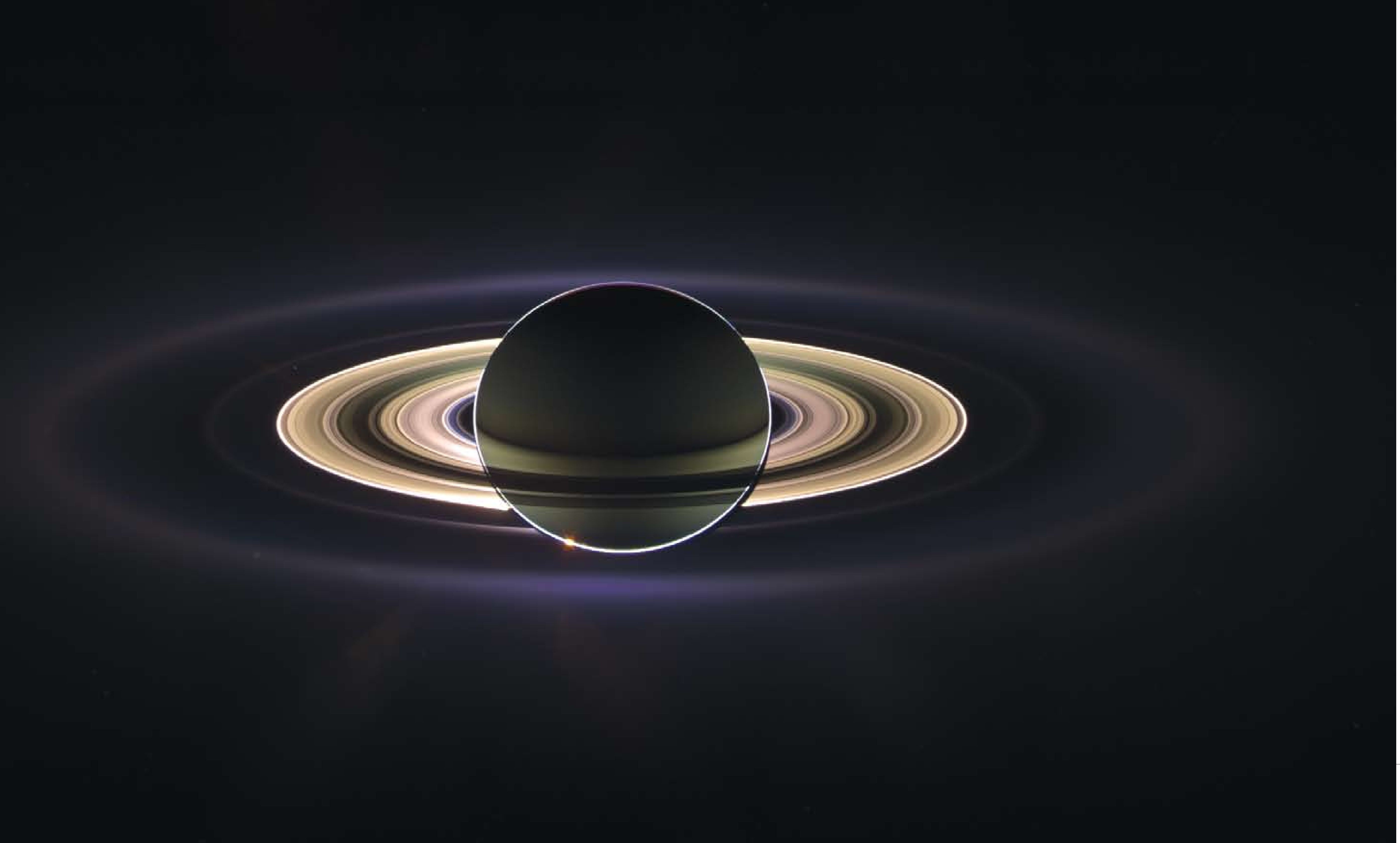
Mars' Victoria Crater at the time of Mars Exploration Rover Opportunity's arrival, imaged from above by Mars Reconnaissance Orbiter.



Tracy Drain

Wanted: Jack-of-all-trades engineer to wear many Martian hats. Will build command sequences, supervise their upload to the spacecraft, support readiness tests, lead planning for transition phase after aerobraking. Serve as voice of mission control for major spacecraft events. Etc., etc. • Tracy Drain never saw a posting in so many words for all the roles she would play on Mars Reconnaissance Orbiter — but if she had, it might have run something like that. Joining JPL in 2000 after earning a master's from Georgia Tech in mechanical engineering ("I was a wimp for not going straight for the aero degree," she now jokes), Drain spent a year helping to plan advanced mission concepts before getting onboard the Mars orbiter team. • During the spacecraft's orbit insertion, Drain graced television screens as the mission's spokesperson explaining play-by-play maneuvers to the viewing public. Many mission events later, the orbiter has now settled into routine science operations, and Drain likewise has shifted hats. She has also been accepted into an on-the-job training program for systems engineers that will pair her with senior mentors such as Viking veteran Gentry Lee. • Which of her roles has been the most memorable? "The one with the most immediate cool factor was serving as an 'ace,' because I got to actually send commands to the spacecraft," she says. "It's an important function, and it taught me a lot about the Deep Space Network. But a lot of people don't like to do it because it involves strange hours. It's the kind of job you either hate or you love."

"It's the kind of job you either hate or you love."



It had all the built-in excitement and tension of JPL's most daring space feats. Soon after the year began, a robotic spacecraft streaked toward Earth and jettisoned a cargo-toting paratrooper in the form of a sample return capsule filled with bits of comet dust and interstellar wind. Diving into Earth's atmosphere, the capsule plunged toward the salt flats of the Utah desert. The event was especially riveting because of the hard landing of another sample capsule from the Genesis mission a year earlier.

Held breaths and racing hearts later gave way to relief as the mission clocked out with faultless precision. Braked by parachutes, the capsule made a soft landing in the middle of the night, carrying samples collected during a seven-year mission by the Stardust spacecraft. Scientists soon confirmed that the capsule indeed contained good dust samples from Stardust's 2004 flyby of Comet Wild 2. As scientists conducted more detailed analysis of the samples as the year progressed, they announced findings suggesting that comets are more complex than previously thought. The formation of at least

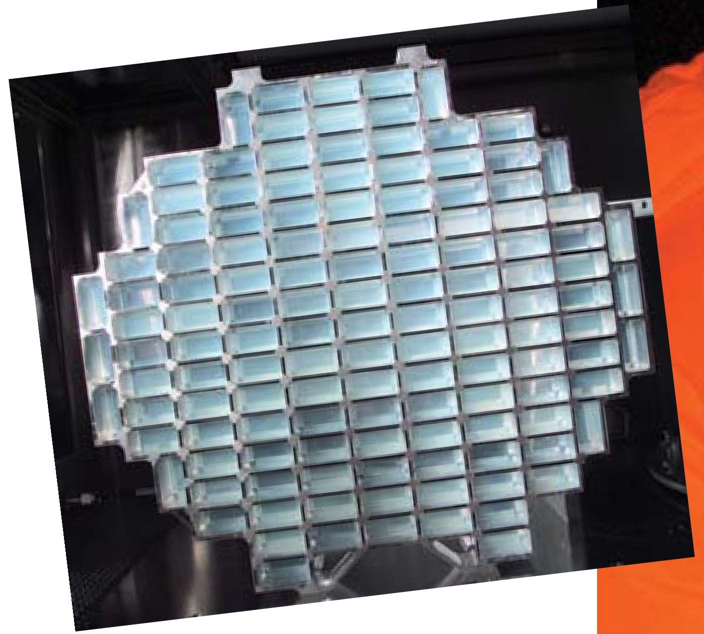
Solar System EXPLORATION

As the sun passed behind Saturn from the spacecraft's point of view, Cassini captured a remarkable view of the giant planet's rings.

some comets, they said, may have included materials ejected from the inner solar system to the far and cold outer edge of the solar nebula. Scientists also reported finding in the samples a new kind of organic material never before seen in extraterrestrial materials.

It was a banner year, meanwhile, for the Cassini spacecraft, which continued its orbital tour of the giant planet Saturn and its rings and moons. No finding was bigger news than an announcement that Enceladus — Saturn's sixth-largest moon — may have liquid water reservoirs that erupt in Yellowstone-like geysers. Studying Cassini photos that show icy jets and towering plumes ejecting large quantities of particles at high speed, one group of scientists concluded it could be the result of an exciting scenario — the jets might be erupting as liquid water from near-surface pockets where temperatures might be above freezing. Not all scientists agreed with this interpretation; others argued that the geysers could simply be crystals of ice.

Just as captivating to scientists and the public was Saturn's largest moon, Titan. The focus of a descent mission by the Cassini-delivered Huygens probe the previous year, Titan was visited by Cassini itself in numerous ongoing flybys, in which the orbiter deployed its imaging radar, camera and other instruments to scrutinize the haze-shrouded world. During a July flyby, the radar imaged a collection of lakes near Titan's north pole. But they are far from a suitable holiday spot for water skiing — at the frigid temperatures on



The Stardust spacecraft collected cometary and interstellar dust with a catchers-mitt-like array of a special material called aerogel.

2:10 am

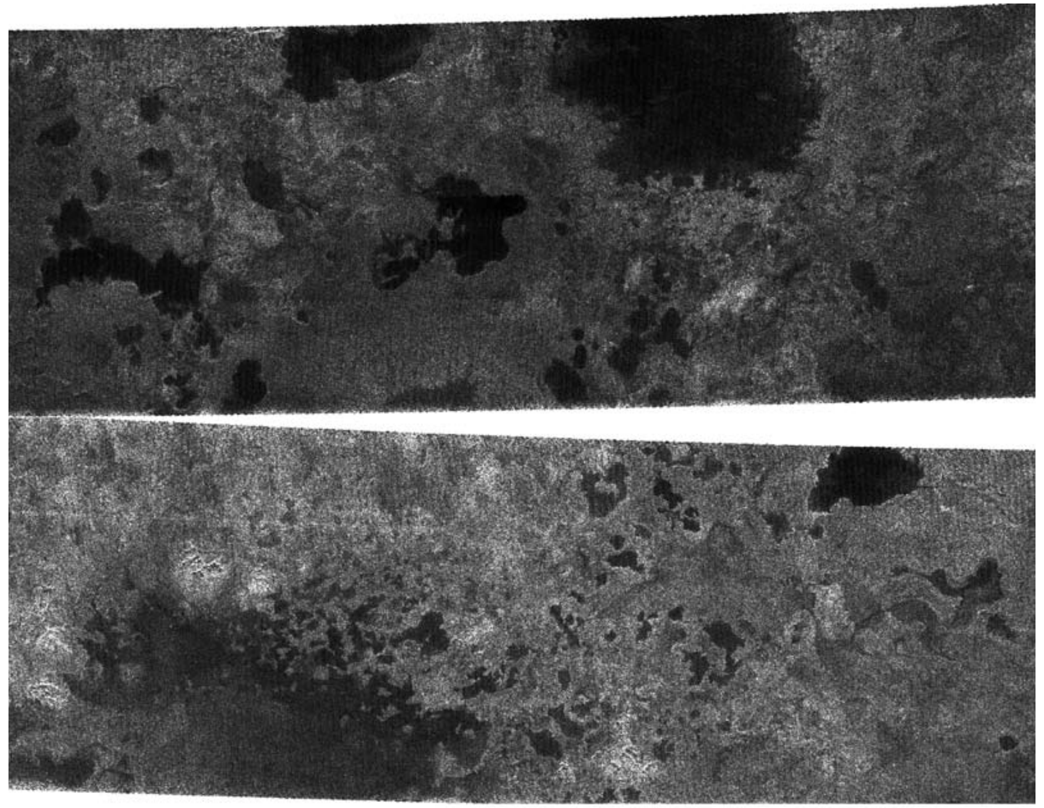
A ground crew hurries to retrieve Stardust's sample return capsule after it made a middle-of-the-night landing on the Utah desert.

Dan Crichton

It's a funny thing about spacecraft missions. They don't just sail off into the sunset, but have a way of leaving around lots of data. In recent times, that can be lots and lots of data. • To manage such intellectual wealth, NASA for decades has looked to its Planetary Data System, a network of online archives at a handful of agency and academic institutions around the country. In recent years, the data system experienced growing pains as it struggled to adapt to the demands of current-day missions. • Enter Dan Crichton, a second-generation JPL software designer (his father, Gerald, retired in 2000). He has won kudos from the science community for revamping the aging system, creating a new architecture that will allow it to grow. • And the appreciation has gone beyond the space world. After hearing a presentation on his software approach, the National Institutes of Health asked him to help them adapt it for their own archives of cancer research data. • "The world has changed a lot," says Crichton, who when not working might be found camping with his family or riding a tandem bicycle with his 5-year-old son. There was a time, he says, when a researcher looking for data from a space mission might receive a CD in the mail. "What we're creating now is something like Google."

"The world has changed a lot . . . "

Cassini's imaging radar revealed lakes of liquid hydrocarbons sprinkled across the northern latitudes of Saturn's moon Titan.



Titan is the only body in the solar system besides Earth known to possess lakes.

Titan, water is a solid and the lakes are almost certainly composed of liquid methane, or a combination of methane and ethane.

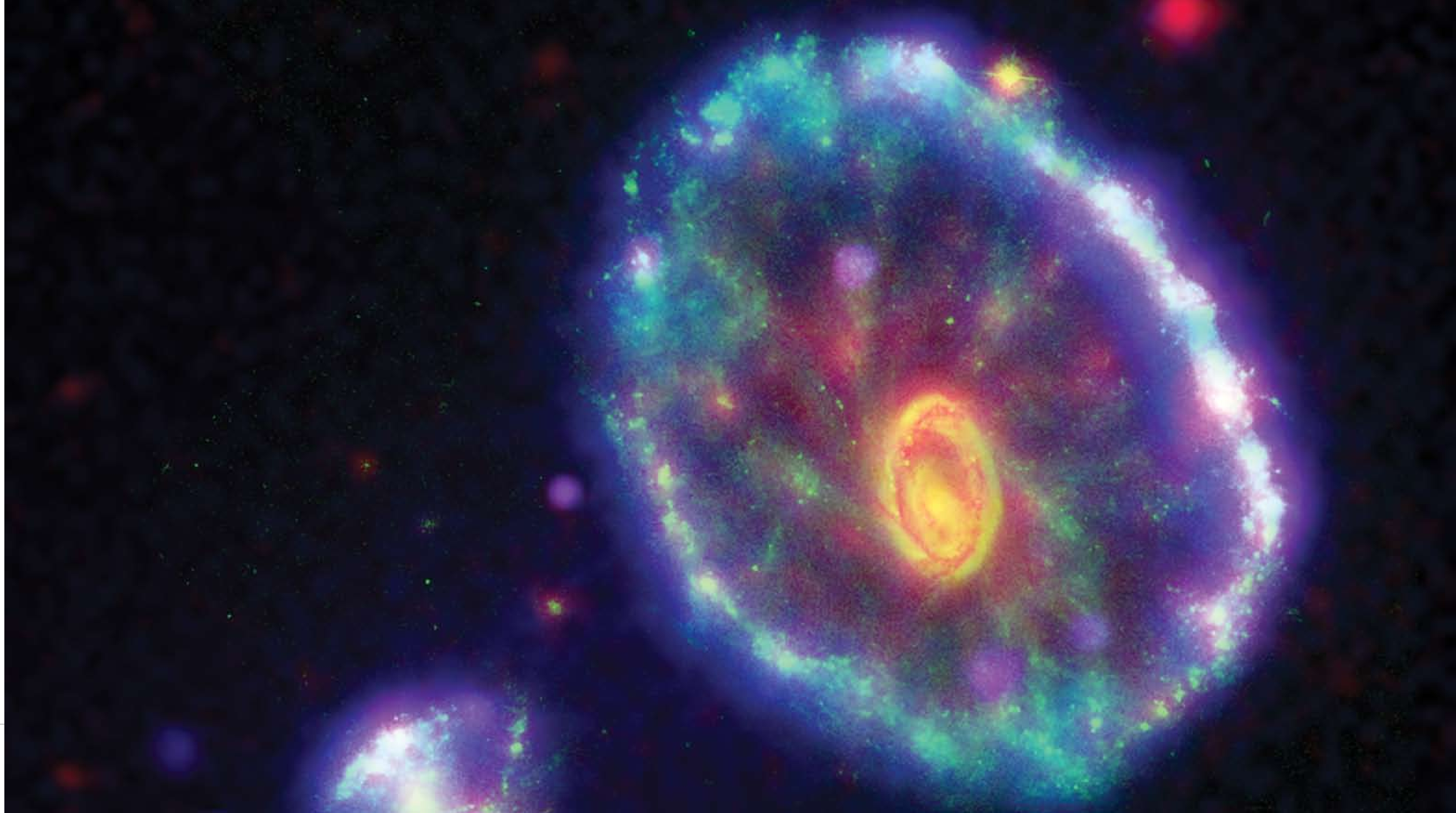
During one Saturn pass in which the ringed planet eclipsed the sun, Cassini captured a remarkable photo that revealed new rings as well as much detail in all the rings. And there was one other bystander in the image — a tiny speck of a pale blue dot that was in fact Earth. During another pass, Cassini collected a three-hour movie of a hurricane-like storm at Saturn's south pole. The storm, circling around a well-developed eye, was ringed by towering clouds some 8,000 kilometers (5,000 miles) across, or two-thirds the diameter of Earth. Such distinctive "eye-wall" clouds had not been seen on any planet other than Earth; even Jupiter's Great Red Spot, much larger than Saturn's polar storm, has no eye and is relatively calm at the center.

Among other missions, Voyager 1 — already the most distant human-made object in the cosmos — reaches 100 astronomical units from the sun in August. The spacecraft and its twin, Voyager 2, are beyond the planets traveling out of the solar system in a realm where the sun is only a bright point of light. And sixteen years after its launch in 1990, the U.S.–European Ulysses spacecraft began its third passage by the poles of the sun.

Across the expanses of space charted by JPL's robotic explorers, many reconnoiter the planets and moons that are inhabitants of our immediate neighborhood, the solar system. But the sights of a pair of spacecraft and several ground-based projects were set on far more distant horizons — other stars, galaxies and the depths of the universe.

Now a seasoned explorer with two and a half years in space, the Spitzer Space Telescope delivered a prolific stream of observations under the direction of astronomers from around the world. Although designed primarily to study stars and galaxies, the infrared telescope proved its value in studying planets orbiting other stars when it imaged a world orbiting the star Upsilon Andromedae. Spitzer revealed that the Jupiter-like gas giant planet circling very close to its sun is always as hot as fire on one side, and potentially as cold as ice on the other. Scientists proclaimed it a spectacular result — one that could revolutionize the science of extrasolar planets in a way they did not anticipate when they designed Spitzer.

Astronomy and Physics



The Cartwheel galaxy, as seen by Galaxy Evolution Explorer and the Spitzer Space Telescope together with two other spaceborne observatories.

2.5 million

L I G H T - Y E A R S   A W A Y

Hot and relatively cool regions of our neighboring Andromeda galaxy combine in this view from Galaxy Evolution Explorer and the Spitzer Space Telescope.

Peering far deeper into space, Spitzer delivered pictures of infrared light that astronomers believe may originate from clumps of the very first objects of the universe. This patchy light is splattered across the entire sky and comes from clusters of bright, monstrous objects more than 13 billion light-years away — close to the era of the Big Bang. The team that made the observations believes the objects are either the first stars — colossal ones more than a thousand times the mass of our sun — or voracious black holes that are consuming gas and spilling out tons of energy. If the objects are stars, then the clusters seen by Spitzer might be the first mini-galaxies that merged to create galaxies like our own Milky Way.

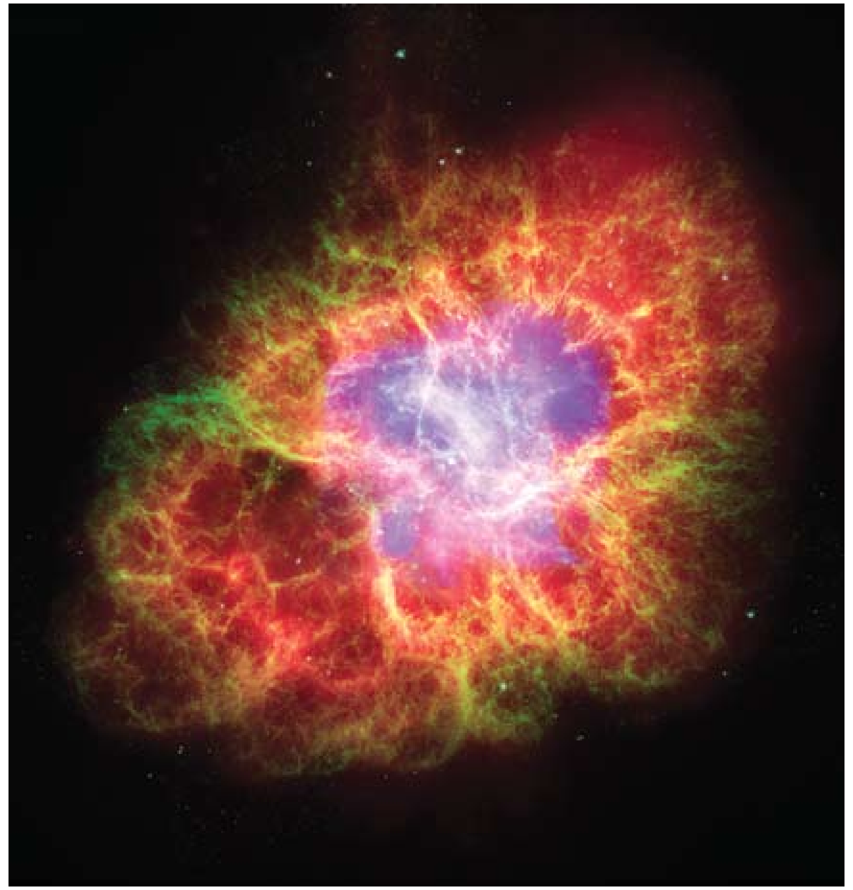
During the year, Spitzer made news with a pair of observations of dead stars. In one, Spitzer found a disc of rubble thrown out by a pulsar, the remnant of an exploded star, that would ultimately stick together to form planets. In another observation, Spitzer spotted what may be comet dust sprinkled around a white dwarf star called G29-38, which died some 500 million years ago. The findings suggest the dead star, which most likely consumed its inner planets, is still orbited by a ring of surviving comets and possibly outer planets.

But not all of Spitzer's targets lay in the realm of other stars and galaxies. Within our own solar system, the telescope snapped a picture of the bits and pieces making up Comet 73P/Schwassmann-Wachmann 3, which is continuing to break apart on its periodic journey around the sun. The new infrared view shows several chunks of the comet riding along its own dusty trail of crumbs.

While Spitzer plumbed the infrared, at the other end of the wavelength spectrum the Galaxy Evolution Explorer peered out into the universe in the ultraviolet. In one notable observation, the telescope captured a view of a black hole consuming a star. Torn to shreds as it ventured too close to the black hole, the star plunged toward the object triggering a bright ultraviolet flare that the spacecraft was able to detect.

During the year, Galaxy Evolution Explorer also captured a memorable image of the enormous Cartwheel galaxy after a smaller galaxy plunged through it, triggering ripples of sudden, brief star formation.

Engineers and scientists made progress with plans for the Space Interferometry Mission — or "SIM PlanetQuest" — a spacecraft designed to probe for Earth-like planets around other stars. After successfully developing the technologies needed for the mission over several years and a major mission redesign in 2005, the project team in 2006 set out on a nine-point program to reduce engineering risks. The team also conducted requirements reviews for the spacecraft and science instrument. When they become a reality, they could bring us some of the most profound findings in astronomy — views of worlds like our own.

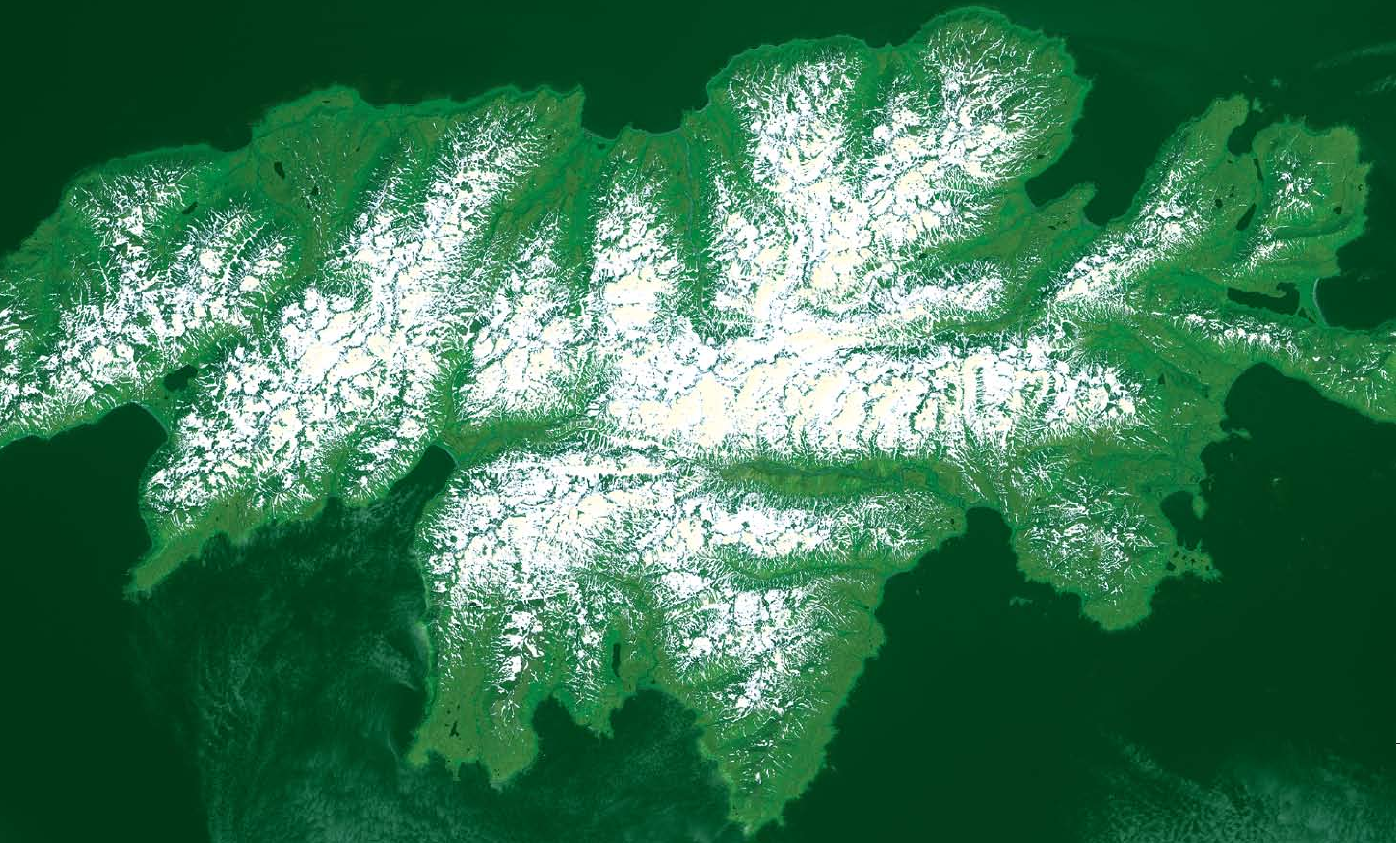


A superdense neutron star left behind by a supernova a thousand years ago spews out a blizzard of particles in this scene created with images from the Spitzer Space Telescope and two other NASA spacecraft.

Jason Rhodes

Six years ago with a fresh PhD in physics from Princeton, Iowa native Jason Rhodes took a year off to focus on running. A specialist in half-mile or 800-meter races, Rhodes was sponsored by a sports shoe company and trained for the Olympic trials, missing only barely. • The athletic world's loss was astronomy's gain. After a stint at NASA Goddard as a National Research Council research associate, Rhodes came to JPL and Caltech, where he has since divided his time between the Laboratory and campus. • Rhodes's specialty is dark matter — all the mass in the universe that scientists predict must be there, but which telescopes cannot directly see. And he has become a prominent figure in what is known as weak lensing — detecting the presence of dark matter by the way it subtly bends light from stars and galaxies. Working with Hubble Space Telescope data, he also has a hand in several proposals for future missions that would concentrate on the dark side of the universe. • "In a way I have the best of both worlds," he says of his dual status at JPL and Caltech. "On any given day I might spend time at one or the other. It combines the benefits of being at a facility like JPL and of being at a university."

Rhodes's specialty is dark matter . . .



The biggest story of the year for JPL's teams monitoring the home planet came not from a single mission or discovery. Rather, it was a story assembled from findings across multiple teams and missions: Evidence continues to amass that ice near Earth's poles is melting at an alarming rate, apparently due to global warming.

One piece came in February, when scientists announced their finding that the loss of ice from Greenland doubled between 1996 and 2005, as its glaciers flowed faster into the ocean in response to a generally warmer climate. Working with radar data from Canadian and European satellites, the team concluded that the changes to Greenland's glaciers in the past decade are widespread, large and sustained over time.

The following month, the first-ever gravity survey of the entire Antarctic ice sheet showed that the sheet's mass decreased significantly from 2002 to 2005. Most of the loss came from the West Antarctic ice sheet, according to a study by another team. The survey was created with data from the JPL-managed Gravity Recovery and Climate Experiment, or Grace, mission.

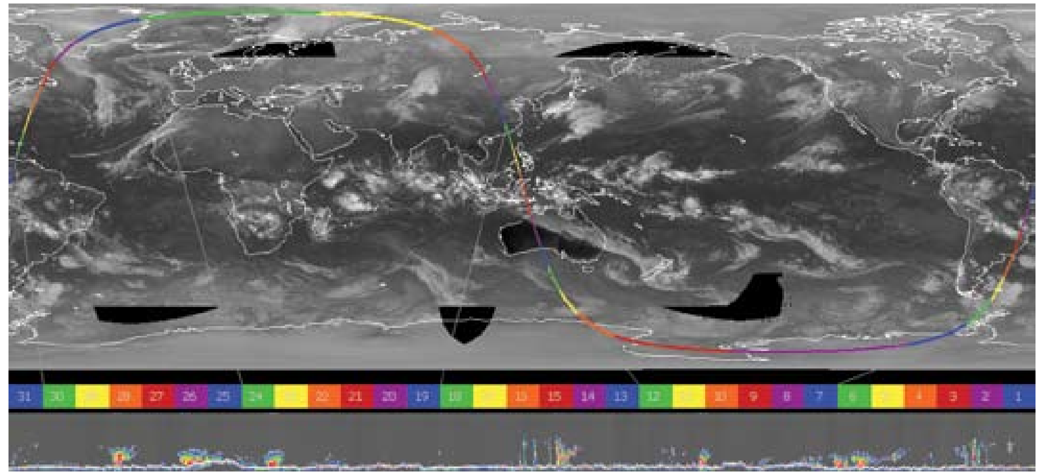
MONITORING Earth

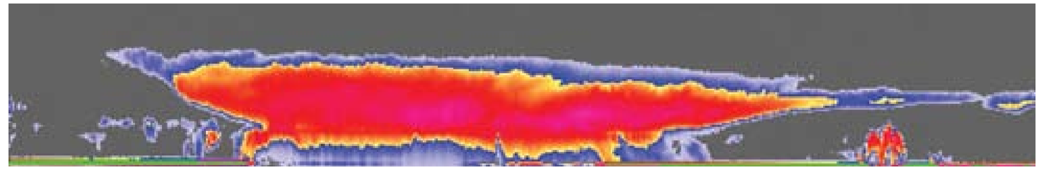
Attu, the westernmost Aleutian island off Alaska, imaged by JPL's Advanced Spaceborne Thermal Emission and Reflection Radiometer on NASA's Terra satellite.

Isabella Velicogna

When Isabella Velicogna was growing up in northern Italy, physics didn't sound like a promising career to her mother. "She tried to get me to do something else," Velicogna recalls of the time her interest in math and physics was blossoming in high school. "She didn't think I could get a job." • Fortunately her mother's fears proved to be unfounded. Several college degrees later, including a doctorate in applied geophysics from the University of Trieste, Velicogna has recently joined JPL and has plenty of work. Her specialty: studying the loss of ice in polar regions as Earth's climate warms. • Velicogna's approach to ice is via the Gravity Recovery and Climate Experiment, or Grace — a pair of satellites that make extremely accurate measurements of Earth's gravity as they circle the planet. The measurements are so precise, in fact, that they allow scientists to detect changes such as ice loss in the Antarctic. • In the future Velicogna — who pursues painting abstract art in her spare time — hopes to combine data from more satellites and ground studies to create a more complete portrait of ice around the planet, or Earth's cryosphere. "Antarctica is Earth's largest reservoir of fresh water," she says. "Understanding the behavior of the ice sheets has important societal and economic impacts."

"She didn't think I could get a job. "





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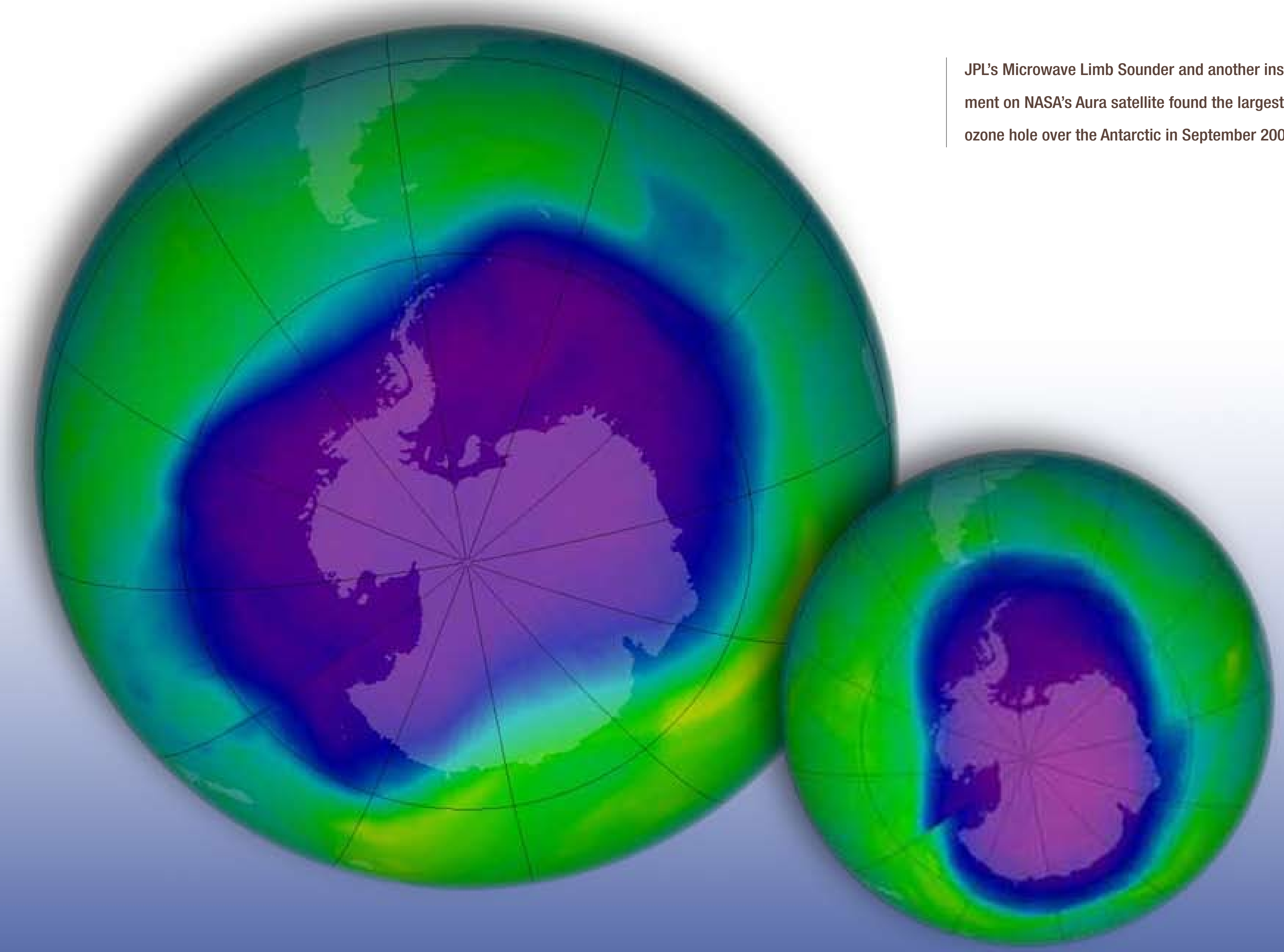
Top: A typical orbit for the CloudSat satellite carries it past many clouds across Earth's surface. Above: CloudSat's three-dimensional view of its first tropical storm, Alberto, in June 2006.

The final piece arrived in September, when a team using data from JPL's QuikScat satellite announced that the year-round ice in the Arctic ocean had shrunk by an amount equivalent to the size of Texas. The JPL scientist who led that study said that if the trend continued, a vast ice-free area could open up with profound impacts on the environment, as well as on marine transportation and commerce.

Among other Earth-observing efforts, the stable of spacecraft monitoring the home planet gained a new member with the launch of the CloudSat satellite in April. It immediately set about using radar to collect three-dimensional profiles of clouds in the atmosphere. Scientists reported that the radar worked flawlessly and was delivering unprecedented views of clouds that will help improve weather forecasting and climate prediction.

One surprising piece of news came when a team of scientists found that the average temperature of the water near the top of Earth's oceans had significantly cooled since 2003. Still, the cooling was only about one-fifth of the amount that oceans had warmed overall since the 1950s. Scientists view it as a "speed bump" in global warming.

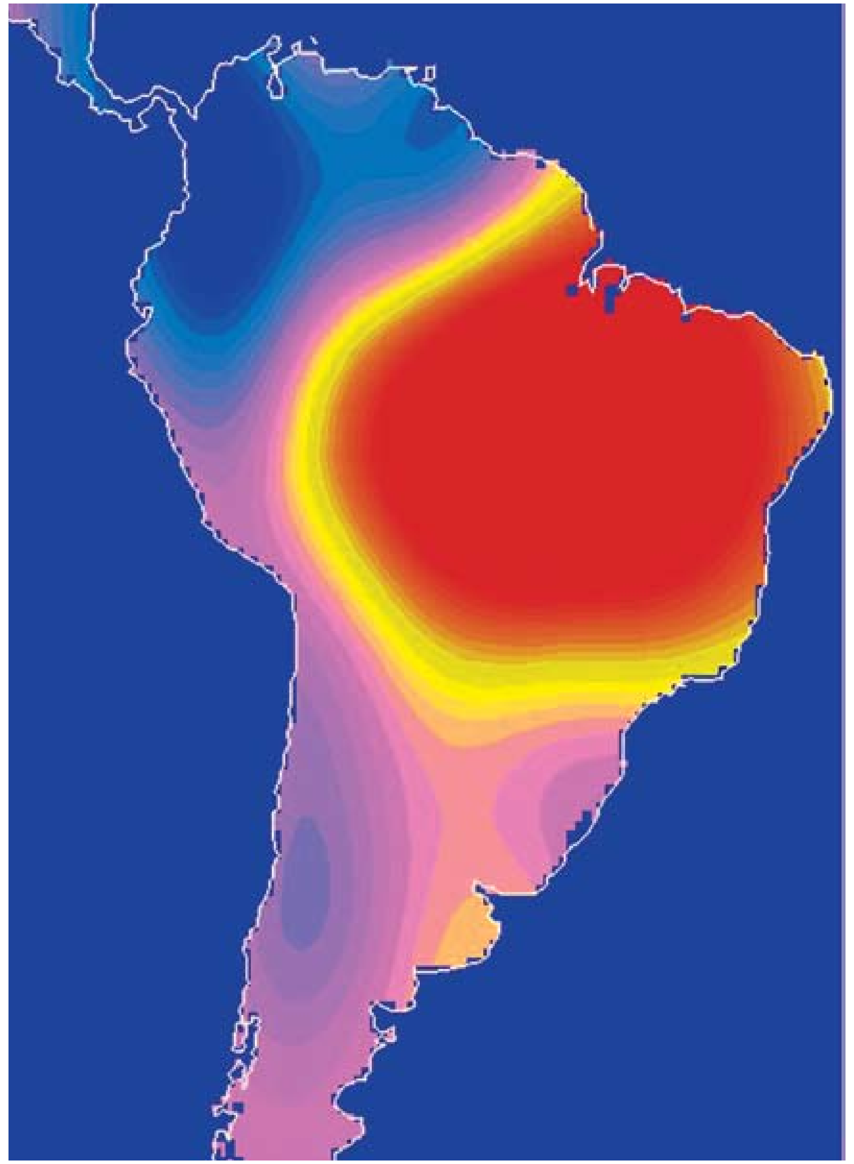


JPL's Microwave Limb Sounder and another instrument on NASA's Aura satellite found the largest-ever ozone hole over the Antarctic in September 2006.

O Z O N E   M O N I T O R I N G

A piece of good news came with the announcement that Earth's ozone layer is on the mend. One team used data from balloons, satellites and instruments on the ground to conclude that ozone in the stratosphere is coming back after it hit bottom in the 1990s — thanks to the phasing-out of human-produced ozone-destroying gases such as chlorofluorocarbons. Still, many of those long-lived gases remain over Antarctica, where JPL's Microwave Limb Sounder found that the 2006 ozone hole was the largest ever.

Still other pictures of the state of the planet were delivered by other missions. Two JPL satellites — Grace and QuikScat — built a significant picture of the water cycle in South America, confirming for the first time that water flowing into the continent as rain or snow is in balance with the amount flowing out to the oceans — a key finding for South America's long-term environmental health. Two JPL instruments on NASA's Aura satellite — the Tropospheric Emission Spectrometer and Microwave Limb Sounder — delivered significant data on air quality. The Jason satellite, which marked its fifth year in orbit, made precise measurements of the heights of Earth's ocean surfaces, chronicling the steady rise of sea level across years. With the health of Earth's environment among the top concerns facing human society, each of the missions in its own way contributed an important perspective.



Subtle changes in Earth's gravity field allow the twin Grace satellites to track month-to-month changes in the distribution of water across South America.

From millions of miles away, NASA robotic spacecraft maintain contact with their home planet via radio — signals that amount to nearly indiscernible whispers by the time they reach Earth. Teasing out those signals and managing the two-way communication is the business of the Deep Space Network.

The network's complexes on three continents provided the critical link with home for such key JPL events in 2006 as the Earth return of Stardust's sample return capsule and Mars Reconnaissance Orbiter's arrival at the red planet. Critical support was provided during orbit insertion of the European Space Agency's Venus Express. In addition, the network supported the launches of several NASA spacecraft including the Space Technology 5, the Geostationary Operational Environmental Satellite-N and the Solar Terrestrial Relations Observatory. In all, the network tracked, sent commands to and received data from more than 38 spacecraft over the year.

Deep Space NETWORK

The Deep Space Network's complex near Madrid, Spain.

While current missions occupied many personnel, others were working to get the most out of the aging network as they planned for its refurbishment and, eventually, the creation of a network of the future. In recent years, Deep Space Network engineers have been considering the idea of shifting away from dependence on the single, large dish antennas that have been the iconic images of the network for decades. Instead, the network of the future could be based on collections of smaller antennas that are arrayed together electronically to produce the same results as one of the giant dishes. Such arrays could give network operators more flexibility to change configurations for different events, and would offer more redundancy in case one antenna went down. In addition, the system overall could be less expensive to build and maintain by using more off-the-shelf products in place of custom hardware.

In 2006, engineers continued to gauge the feasibility of the array approach by running tests on sets of relatively small antennas. In one test, technicians obtained a low-cost 12-meter-diameter (39-foot) antenna from a commercial vendor, assembled it quickly and arrayed it with a pair of smaller antennas to simulate receiving signals from a spacecraft. They tested two different microwave bands — X-band, which is used by many current spacecraft, and Ka-band, which will be used increasingly by spacecraft of the future. Engineers found that overall the antenna performed well, and identified improvements that would be needed to adapt it to the conditions under which the network's antennas must operate.

Technologists extended the Deep Space Network's capabilities in other ways as well. Working with the Mars Reconnaissance Orbiter spacecraft, they showed they were able to increase data transfer rates up to 6 megabits per second, more than two and a half times faster than previously possible. This will allow that mission and others in the future to send significantly more data to Earth. In addition, the network finished upgrading its global complexes to listen for spacecraft in the Ka-band when it added this capability at Spain. Spacecraft are able to send data significantly faster in Ka-band than in lower-frequency microwave bands.

An ultra-precise space clock that could be carried by spacecraft of the future was the focus of another research effort. Under current-day tracking techniques, ground controllers must send signals to a spacecraft and listen for its response in order to get a precise fix on the craft's speed and range in space. Spacecraft equipped with their own super clocks, by contrast, could send signals that allow ground controllers to pinpoint them without the need for two-way signaling. The space clock under development at JPL, based on mercury ion technology, is a hundred times more precise than the clocks carried on the government's Global Positioning System satellites, and smaller in weight and size. In 2006, a prototype of the super clock was put through

34-meter

THE NEW WORKHORSE

Much communication from spacecraft comes in on the Deep Space Network's 34-meter-diameter (112-foot) antennas, like this one at Goldstone in the California desert.

its paces in vacuum tests at JPL to demonstrate that it is feasible to fly on 10-year missions. If adopted by enough future spacecraft missions, it could save a significant amount in Deep Space Network operations costs.

And the network's antennas served not only as communication portals but also as the instruments of science. Astronomers regularly use the 70-meter-diameter (230-foot) antenna at Goldstone in California's Mojave Desert to bounce radar pulses off of objects in space such as near-Earth asteroids to obtain high-resolution images and topography. In 2006, engineers used the radar to obtain the finest-detail data ever of the topography of the moon's southern polar region, and tested a new radar system that can produce radar images with five times better resolution.

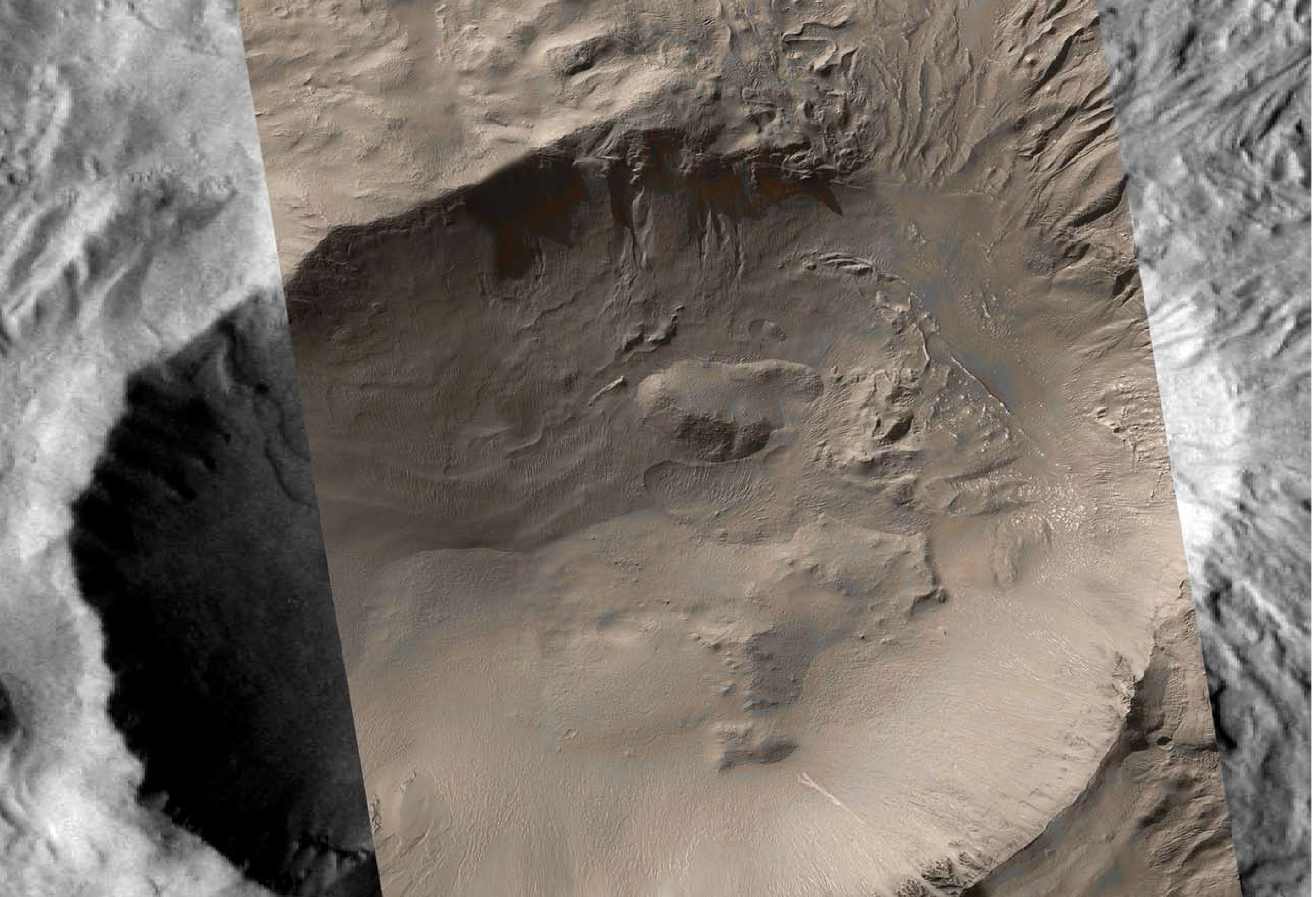
Beyond the Deep Space Network, engineers responsible for JPL's advanced multi-mission operations system completed a five-year effort replacing a decades-old navigation system. Mars Phoenix will be the first mission to use the new system; eventually all flight projects will migrate to it. Also in 2006, a major effort was begun to extend JPL's multi-mission operations system so that it can handle day-to-day control of "in situ" missions such as landers and rovers; Mars Phoenix again will be the first mission to use it.

A prototype antenna undergoing tests on the mesa overlooking JPL's main facility in Southern California.

Jon Hamkins

How is a Mars rover like a CD player clipped to a jogger's shorts? Both rely on technologies developed decades ago to deliver their digital data safely despite environments in which it's easy for bits and bytes to get scrambled. • To get the sharpest and greatest number of pictures of Martian gullies or Saturnian rings out of space missions, JPL software experts long ago developed techniques of compression and error-correction — technologies that Jon Hamkins is working to refine. • In recent years, Hamkins and his group have created new error-correction codes that allow more images and other data than ever to be packed into a finite pipeline between spacecraft and the Deep Space Network's antennas. • Hamkins, who came to JPL after a bachelor's at Caltech and master's and doctorate degrees from the University of Illinois at Urbana-Champaign, felt like he was stepping into big shoes when he took the job as supervisor of the information processing group five years ago. "This is a group with a very long history," he says. "The org charts go back to 1960. There are people who have been a part of it who have gone on to become very famous, like Andrew Viterbi. I'm very honored just to be a part of it."

"I'm very honored just to be a part of it."



Science and technology are intertwined at the core of JPL's enterprise. The questions put forward by scientists help define the Laboratory's focus and direction — the puzzles that it exists to solve. The pathways devised by technologists create the maps of how we get there.

JPL's cadre of scientists conduct research in fields ranging from planetary science and life detection to Earth sciences, astrophysics and space sciences — often on the Laboratory's flight projects, but sometimes in independent efforts. Technologists occupy many niches around JPL, working in specialties ranging from microdevices to electric propulsion to radar. During 2006 these communities became closer-knit, as JPL's chief scientist and chief technologist pursued a variety of efforts to bring the Laboratory's research communities together.

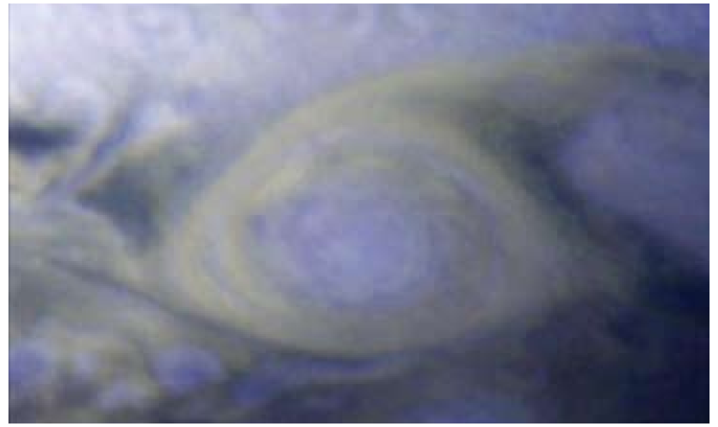
Science AND Technology

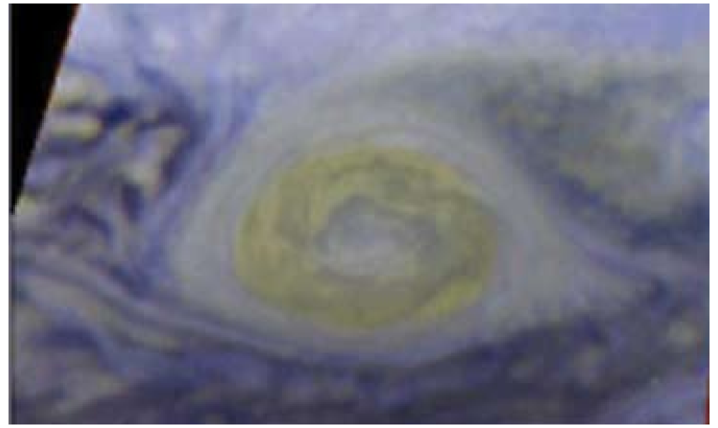
Gullies in craters like this one in Mars' Centauri Montes region are one of a vast diversity of research topics pursued by JPL scientists.

Amanda Hendrix

"Twenty years from now," a student at Pasadena's John Muir High School once predicted in a message written in a friend's yearbook, "I'll be working at JPL." • That proved to be a spot-on bet for Amanda Hendrix — who, two decades later, now hangs her hat at the Laboratory as a staff scientist. Her career direction perhaps was predictable, given the fact that she had a life-long interest in the solar system's bodies "ever since second grade, when we learned about the planets." • After earning a bachelor's degree at Cal Poly San Luis Obispo, graduate school took her to the University of Colorado, where she became steeped in the use of ultraviolet light to study small bodies like asteroids and icy moons. It also brought her onboard the team responsible for the ultraviolet instrument on Galileo to Jupiter. • Since then she has moved on to the Cassini mission — remaining with the ultraviolet specialty — and also uses other observing platforms such as the Hubble Space Telescope. She is most proud of her work on asteroids, using ultraviolet observations to discover evidence of how the rocky bodies are weathered. • But her interests don't stop at asteroids. "Eventually I'd like to put an ultraviolet instrument on a Europa mission," says Hendrix, who in her spare time is fixing up a vintage Mercedes to run on vegetable oil as fuel. "We might detect venting of gas from the subsurface — which would be further evidence for a subsurface ocean, an important step forward in the search for life."

"Eventually I'd like to put an ultraviolet instrument on a Europa mission."





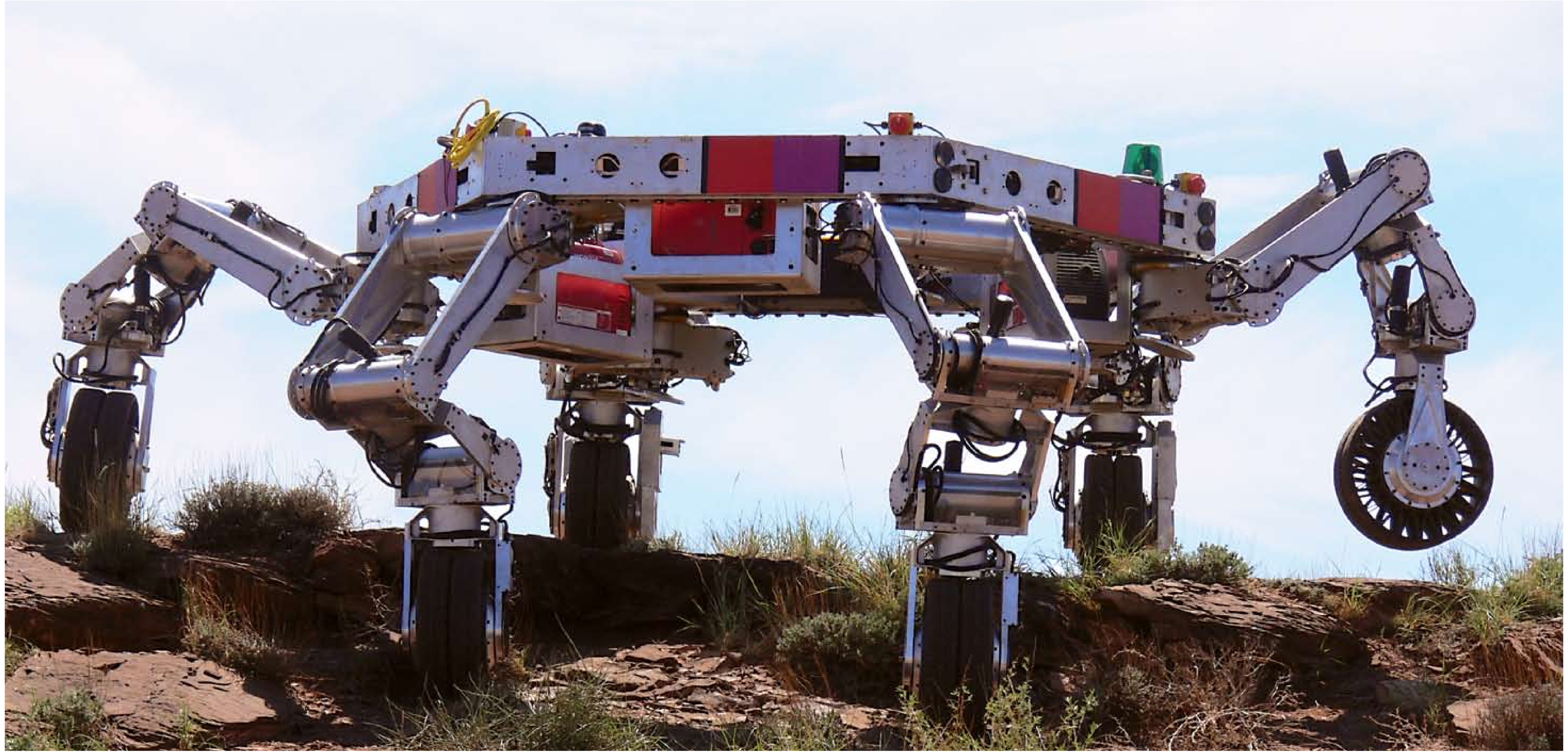
2005/2006

Hubble Space Telescope images of Jupiter from 2005 (top) and 2006 (above) reveal a striking color change in the feature called "Oval BA" studied by JPL scientists.

Many JPL scientists base their work on data that cut across the Laboratory's flight projects. One team, for example, used imagery from Mars Global Surveyor and Mars Odyssey to make a new systematic survey of the northern hemisphere of Mars. They found that gullies and mantled terrain in the north appear quite different than at temperate latitudes, suggesting they are created by seasonal cycles of snow formation and melting.

Using the Hubble Space Telescope, a JPL scientist led a team that conducted a campaign to observe a vast storm system in Jupiter's atmosphere, known as "Oval BA," as it was changing from a white to a reddish color. Coupled with ground-based observations, they were able to show that the cold temperatures in the storm had become more extreme during the color change — offering clues to Jupiter's enigmatic cloud color properties. An amateur astronomer first observed the color change that triggered the interest in the investigation.

JPL technologists were no less busy in 2006. The Laboratory again won a record dollar amount of NASA Space Act Awards which the agency bestows on innovators — 45 percent, in fact, of all the total awards to all NASA centers, a threefold increase over the last five years. More than 1,300 individual awards were received by JPL's staff; overall, 51 patents were issued to Caltech or NASA based on JPL technologies.



About eight percent of JPL's budget is accounted for by work the Laboratory performs for sponsors other than NASA, such as the Department of Defense or other federal or industry customers. In one Defense project, JPL completed development of a new lightweight mirror, the lightest ever designed for space. The system actively controls the shape of the mirror to compensate for atmospheric distortion or any issues in the remainder of the optical path.

In another effort, JPL refined and improved an airborne imaging instrument called the Mapping Reflected Energy Spectrometer for the National Geospatial-Intelligence Agency. Flown on campaigns in 2006, the device can be used to monitor many types of chemicals such as emissions from factories or acid rain, with potential uses for public safety.

JPL continued to work with the National Science Foundation under the Ocean Observatory Initiative to design and develop systems that will collect continuous underwater observations and measurements to monitor our coastal, regional and global oceans. This includes earthquakes and tsunami detection and notification via a network of instruments in the United States' Pacific Northwest.

The robotic vehicle Athlete could ferry equipment for future astronauts exploring the moon.

JPL's innovations for use on Earth include this fiber-optic nerve guidance device that might repair spinal cord injuries.

In order to maintain the Laboratory's technical edge, the leadership of JPL's technology programs for non-NASA sponsors have identified several breakthrough technology areas they will focus resources on in the coming years. They include full-spectrum imaging, large lightweight adaptive structures, quantum imaging and quantum information capabilities, advanced radar techniques and unique applications.

JPL has several roles in supporting Constellation, NASA's program to create new space vehicles to take humans back to the moon and beyond. In 2006, JPL conducted two significant tests of Athlete, a robotic vehicle that astronauts could use to transport equipment on the lunar surface. JPL also worked on two instruments to analyze air quality within the International Space Station, and provided about 80 systems engineers to work in a number of technical areas for Constellation.

To support all of JPL's technology efforts for both NASA and non-NASA customers, the Laboratory continues to grow its advanced research and technology development program. This effort, designed to fuel new technology business at JPL, funded more than 165 tasks during the year. The laboratory also created a strategic technology plan that defines a baker's dozen of critical technology areas that JPL will be focusing on nurturing in the years ahead.

Dave Redding

You might call Dave Redding JPL's optician to the stars. Literally. • When NASA's Hubble Space Telescope proved to have a defective mirror after its launch in 1990, Redding was part of the JPL team brought in to create a fix. The optics they devised were a fantastic success, enabling the space telescope to make a comeback and go on to a mission that dazzled the world with scores of magazine-cover images. • Since then, Redding has gone on to shape and deploy ever more sophisticated technologies for optical systems, both in space and on the ground. He was one of the original architects of the optical system for NASA's planned James Webb Space Telescope. • A controls engineer by training ("I'm a classic JPL type — aeronautics-astronautics"), Redding came to the Laboratory in 1986 following an undergraduate degree at Tufts University ("where my real major was rock climbing") and a doctorate from Stanford. "I picked up optics on the job," he recalls. • What excites Redding today are futuristic space telescopes using precision-made composite mirrors that actively control the surface to adapt to observing conditions. "These can be made quickly and relatively inexpensively, and can be assembled in segments to create a telescope on orbit that wouldn't fit in a launch vehicle," he says. Telescopes with lenses and mirrors made of glass, he says, are "old-fashioned." Redding not only has his eyes on the stars but, clearly, new ways of seeing them.

"Telescopes with lenses and mirrors made of glass are old-fashioned."

Engaging THE Public

One day in the spring, a group of researchers explorers sat down to consider which moon of Saturn to focus on in their work. They eventually chose Enceladus — a decision that seemed prescient when, a week later, an announcement came out about the possibility of liquid water geysers on the exotic moon.

It would have been fortuitous timing for any scientists. But these explorers weren't members of the mission's science team — they were a group of high school students participating in an outreach project called Cassini Scientist for a Day.

That effort is emblematic of many public engagement initiatives at JPL, which in 2006 sought new and creative ways to bring the excitement of space exploration to the general public and the next generation of explorers. And putting students in the roles of scientists and engineers was a frequent and popular way of making space real for them. While the Cassini youth pon-

JPL's annual open house offers many opportunities for the public to experience science and technology, such as telescope viewing of the sun's disc.

Making models of comets is one way JPL brings the excitement of science to young people.

266,390 students

PARTICIPATED IN EDUCATIONAL PROGRAMS

dered Enceladus, high schoolers in a Mars student imaging program chose sites on the red planet for Mars Odyssey to photograph, and still others conducted radio astronomy studies with one of JPL's giant dish antennas at Goldstone, California.

Education was a major component of JPL's broader public outreach, with formal and informal education programs that engaged 37,263 teachers and 266,390 students during the year. In January, JPL hosted a joint hearing of education committees from the California State Senate and Assembly. JPL and the California State University Chancellor's Office co-hosted a state education summit in March, which brought together representatives of the Cal State system, the University of California, private universities and JPL's education leadership. Other educational initiatives ranged from workshops for high school and college astronomy instructors to helping teams from NASA Explorer Schools prepare to fly on the agency's "Weightless Wonder" reduced-gravity aircraft. Many students got their first exposure to JPL in summer programs at the Laboratory, which brought in more than 450 participants in 2006.

Driven by major events such as Stardust's Earth return, Mars Reconnaissance Orbiter's arrival at the red planet and Cassini's ongoing mission, JPL stories enjoyed wide coverage in the external news media throughout the year, with front-page treatment of many breaking stories. More than 2,500 stories on JPL appeared in the top 50 U.S. media markets, with a reach of nearly 800 million potential reader/viewer impressions. Particularly noteworthy was National Geographic's cover story on Saturn in December, which spotlighted the Cassini mission for its global circulation of 8.5 million in 29 languages.

Keeping the process of talking about science open was an important theme against the backdrop of the year's news headlines. After questions came up about the right of NASA scientists to express their own views on topics such as climate change, JPL took part in a task force to create a policy on the topic. The result was a set of NASA and JPL rules that reaffirm the openness of the science communication process.

Beginning in 2006, the first voice many visitors to JPL hear explaining the Laboratory's projects is that of Harrison Ford. The actor volunteered to narrate "Journey to the Planets and Beyond," a new high-definition video production shown to visitors and other public groups.

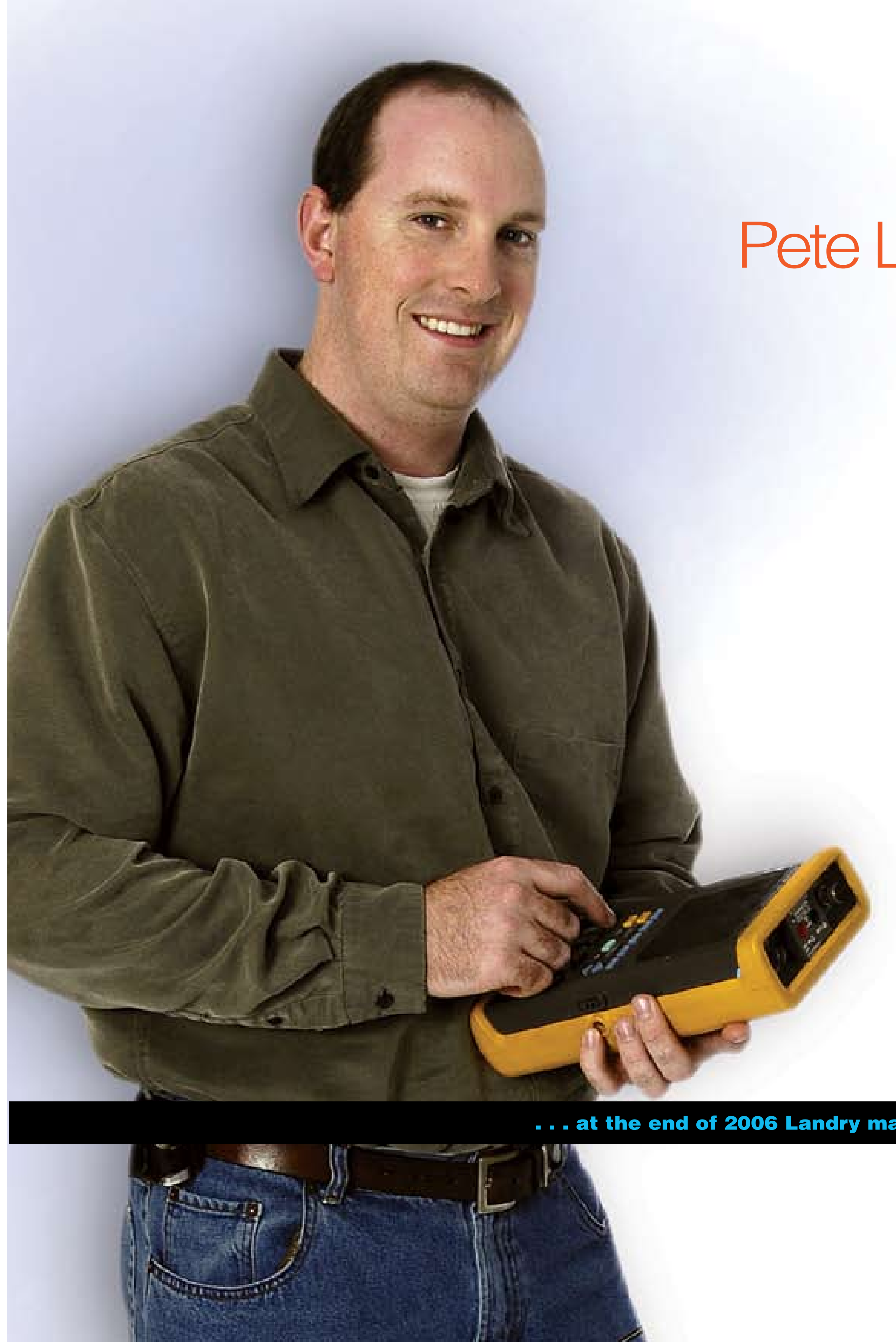
JPL's Web presence kept pace with the explosion of Internet activities in 2006. Seeking innovative paths to the public, JPL started distributing videos and podcasts to non-traditional distribution channels — among them Apple's iTunes site and Google's video site. JPL's multimedia content was also a major component of the video and podcast pages on NASA's Web portal. For the year, JPL Web videos were downloaded more than 2.5 million times,

Students get an up close and personal view of robot rovers.

while audio podcasts were played half a million times. JPL's home page, with 24 million visitor sessions for the year, earned a Webby nomination and was a silver winner in the W3 Awards; the site's podcasts also won W3's silver award. Combined with major flight project home pages, JPL Web sites experienced more than 90 million visitor sessions.

Technologies from the video gaming industry began allowing the public to "see" in space as if they were riding aboard one of NASA's spacecraft. A group of JPL visualization specialists set about creating software to bring space to the general public, delivering educational content in a way that appeals to generations brought up on video games. In 2006 the team put together a package that depicts a future mission to Jupiter's moon Europa.

Alliances with outside partners continued to prove a highly effective way of leveraging JPL's public reach. JPL's nationwide alliance with museums and science centers was the conduit for many major visualization products, as well as daily rover image deliveries. An initiative with the national parks kicked off with a joint Earth/Mars comparison project at Grand Canyon National Park. JPL's Night Sky Network, a coalition of more than 220 amateur astronomy clubs in all 50 states, reached the 5,000-event mark, which represented interactions with more than 420,000 people since the program's inception just three years ago. Taken together, such initiatives provide many routes for sharing the experience of space with the public.



Pete Landry

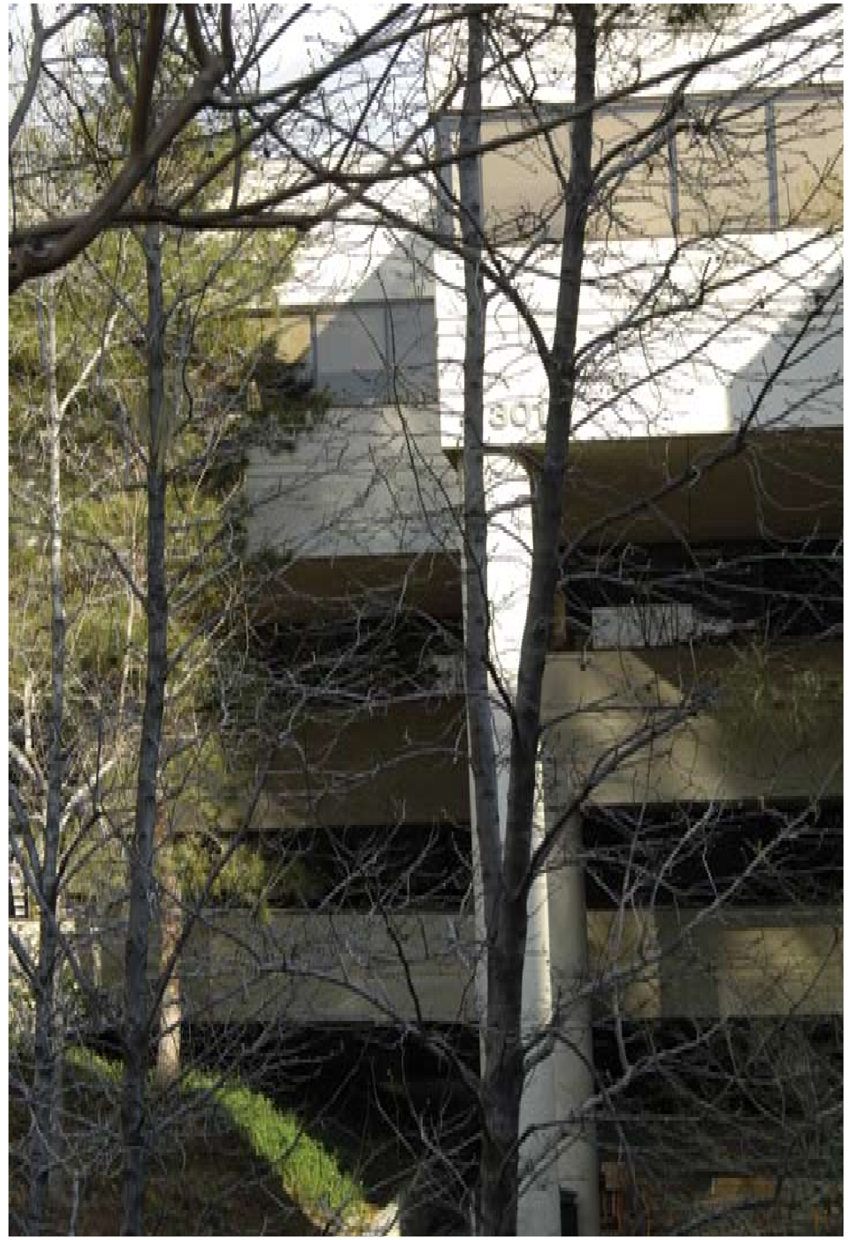
Shepherding a busload of second-graders may seem a far cry from shaking components apart on a laboratory bench. But they've both been part of the job description for Pete Landry. • When Landry graduated from high school in nearby Eagle Rock six years ago, connections he made through Boy Scouts landed him an academic part-time job as a tour guide at JPL — "What I was doing with the Scouts," he says, "showed them I could speak in front of a crowd." For the next six and a half years, he's been one of several guides who were the main faces that would greet thousands of JPL visitors a year, from elementary school children to working professionals to senior citizens. • With a freshly minted degree in engineering technology from Cal Poly Pomona, at the end of 2006 Landry made the jump to JPL's technical side — hired as an instrumentation engineer in the environmental test laboratory. There he helps test prototype hardware for Mars Science Laboratory and Orbiting Carbon Observatory by subjecting it to shake tests. • When not at work, Landry might relax with mountain biking or playing violin in a rock band with co-workers — or practicing archery in the Arroyo Seco, a skill that resulted in him being featured in a recent video on spacecraft navigation. Clearly for Landry, his job progression at the Lab is hitting a bulls-eye.

. . . at the end of 2006 Landry made a jump to JPL's technical side.

JPL's aspirations to excellence are not limited to its space missions and research. In 2006, many teams were active applying the same focus on quality to the Laboratory's institutional wings.

In recent years, JPL has been working on implementing a project management process known as earned value management. This approach helps project managers assess and check status of work accomplished on their projects by analyzing integrated cost and schedule performance data, as well as identifying and evaluating any risks in completing the effort on time and within budget. The effort responds to a NASA initiative to make earned value management a standard across the agency. In 2006, JPL passed a review by NASA and government auditors that ensured that the Laboratory's approach to earned value management meets established standards. JPL expects formal signoff by NASA in 2007, which would make the Laboratory the first NASA center to achieve validation. Earned value management is now being used by a number of JPL's flight projects in development including Mars Phoenix and Mars Science Laboratory, the Orbiting Carbon Observatory, Aquarius, Dawn and Kepler.

Institutional
A C T I V I T I E S



Throughout the year, human resources, business and information technology specialists worked together to create or enhance many online systems to make employees' jobs easier. This year JPL rolled out an online information center giving employees better access to details about their job status, work history, benefits and awards. Enhancements were also made to an online information center for managers that offers a similar centralized location for information they need to do their jobs. These included a new workforce planning tool offering a capability inventory designed to help managers find needed skill sets within their teams. Another new online system was debuted that streamlines tasks such as getting a new employee or affiliate onboard, as well as giving external partners needed access to systems. A new automated travel system replaced a largely paper-driven process.

Information technology was the center of many other innovations. Following the hiring of a chief information officer the previous year, staffs were reorganized and merged to create a new Office of the Chief Information Officer. New applications were introduced to reduce costs and to improve employee effectiveness and productivity, and to help support collaborations in numerous areas including the expansion of a planning, inventory and costing system. JPL network backbone capacity was increased by a factor of ten. Wireless network access was added to all JPL public areas, and guest network access for visitors was enabled.

Steve Alfery

Going to Mars, and need a thruster? Steve Alfery may be able to work out a hot deal for you. • When JPL flight projects look to industry to supply the parachutes and antennas and myriad other pieces of hardware to create the mission, Alfery and his colleagues in acquisitions make it happen. • "It can be a very complex process," says the 21-year Laboratory veteran, who served as project acquisition manager for the Mars Exploration Rovers and currently does the same on Mars Science Laboratory. "The goal is to obtain products and services that meet the project's requirements on-time for reasonable cost. My role is to guide the project through this process as efficiently as possible." • JPL held another dividend for Alfery, who came to JPL directly out of school after receiving a business degree at UC Santa Barbara. His first day on the job, Alfery's supervisor introduced him to a co-worker, Teresa, who introduced him to the JPL acquisition process. After four years as friends they married, and recently celebrated their 17th anniversary.

Going to Mars, and need a thruster?

To ensure ongoing revitalization of its workforce, JPL took steps to make more early career hires when recruiting technical staff. Approximately 80 such hires were made during the year.

JPL's Rideshare Program was commended by local transportation agencies as a model program for its breadth, creativity and regulatory compliance. The South Coast Air Quality Management District Inspector conducted a surprise inspection and found JPL in complete compliance with district rules on average ridership levels for employee commuters. In addition, by year's end, alternative fuel vehicles constituted 40 percent of JPL's fleet, following the addition of five compressed natural gas vehicles.

Helping to foster relationships with industry was the focus of the Laboratory's eighth Briefing for Industry, which drew more than 200 business representatives from across the country. The Laboratory also successfully coordinated its 18th annual High-Tech Small Business Conference with a total attendance of more than 1,000, as well as its ninth annual Small-Business Round Table.

Two significant construction projects continued to progress. JPL prepared to issue a contract to construct a Flight Projects Center, while preliminary design began on a dual-use Administration Building and Educational Center.

Prompted by an employee survey that identified a flexible workweek as the most popular desired job feature, JPL prepared to roll out an alternate workweek in early 2007. Called "9/80," the new schedule allows employees to complete 80 hours of work in nine workdays every two weeks, giving them every other Friday off. In order to offer the new schedule, considerable work was completed in 2006 to implement a new timekeeping system and train the workforce in its use. As the year concluded, polls of the staff indicated that 70 percent of JPL employees planned to go on the new schedule. The alternate workweek is one of many ways that JPL is working to create an environment that best supports its scientific and engineering talent.

JPL network backbone capacity was increased by a factor of ten.

Major External
AWARDS

Cassini-Huygens Team
Laurel Award, Aviation Week and Space Technology
Nelson P. Jackson Aerospace Award, National Space Club

Deep Impact Team
Laurel Award, Aviation Week and Space Technology

Andrea Donnellan
Woman of the Year, California Science Center Muses

John Duxbury
Alumni Achievement Award, Valparaiso University

Charles Elachi
America's Best Leaders, U.S. News & World Report
Lebanon Order of the Cedar Medal

Kay Ferrari
Astronomy Outreach Award, Astronomical League

Samuel Gulkis and Michael Janssen
Cosmology Prize, Gruber Foundation/International Astronomical Union

Gerald Holzmann
Paris Kanellakis Award, Association for Computer Machinery
Honorary doctorate, University of Twente, The Netherlands

Eastwood Im
Elected fellow, Institute of Electrical and Electronics Engineers

iRobot PackBot Tactical Mobile Robot Team
Space Technology Hall of Fame, Space Foundation

Jet Propulsion Laboratory
Jack Swigert Award for Space Exploration, Space Foundation

JPL Annual Report Team
Gold Award, Best Annual Report, Mercury Communications Awards

Olga Kalashnikova
Zeldovich Medal, Committee on Space Research and Russian Academy of Sciences

Gentry Lee
Harold Masursky Award, Division for Planetary Sciences, American Astronomical Society

Rosaly Lopes-Gautier
Medal of Excellence, Women at Work

Mars Exploration Rover Team
National Air and Space Museum Trophy

Thomas May
Selectee, 50 Influential Minorities in Business, Minority Business and Professional Network Inc.

Zdenek Sekanina
Nusl Prize, Czech Astronomical Society

Anita Sengupta
Woman Engineer of the Year, American Society of Engineers of Indian Origin

Audrey Steffan
Gold Award, Best Annual Report Design, Mercury Communications Awards

Charles Thompson
Alumni Hall of Fame, Watsonville High School Foundation

Two-Micron All Sky Survey Team
Award for Excellence in Astronomy Research and Education, Astronomical Society of the Pacific

Michael Werner
Invited Lecturer, Royal Astronomical Society

Mark Whalen, Universe Team
Grand Award, Best Employee Publication, Mercury Communications Awards

Jim Williams
Brouwer Award, Division on Dynamical Astronomy, American Astronomical Society

Pascal Willis
Prix Antoine d'Abbadie, French Academy of Science

Major Contractor
PARTNERS

Lockheed Martin Space Systems
Mars Science Laboratory, Mars Global Surveyor, Mars Reconnaissance Orbiter, Odyssey, Phoenix, Juno, Spitzer, Stardust

Orbital Sciences Corp.
Dawn, Space Technology 8, Orbiting Carbon Observatory

Ball Aerospace & Technologies Corp.
Spitzer Space Telescope, Kepler, Terrestrial Planet Finder, Mid-Infrared Instrument, Wide-field Infrared Survey Explorer, Mars Science Laboratory

ITT Industries
Deep Space Network Operations

Raytheon
Science Data Systems Implementation and Operations

Northrop Grumman Space & Mission Systems Corp.
Space Interferometry Mission, Mid-Infrared Instrument

Lockheed Martin Information Technologies
Desktop Computer Support

Hamilton Sundstrand Corp.
Orbiting Carbon Observatory

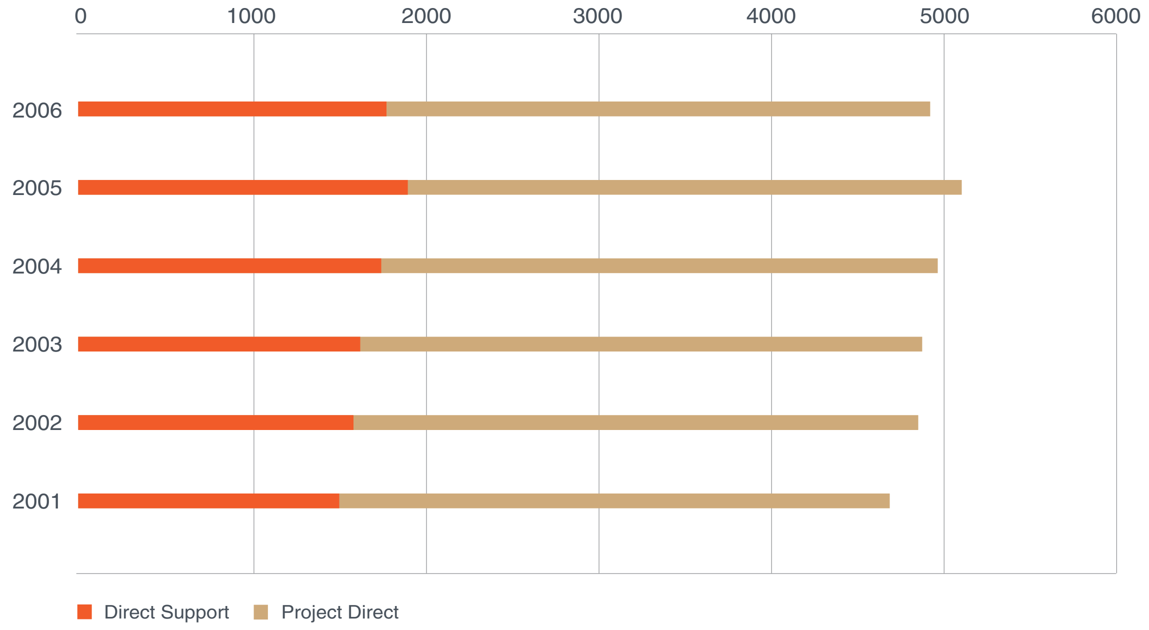
Computer Sciences Corp.
Institutional Services, Information Technology Infrastructure

All Star Maintenance
Facilities Maintenance

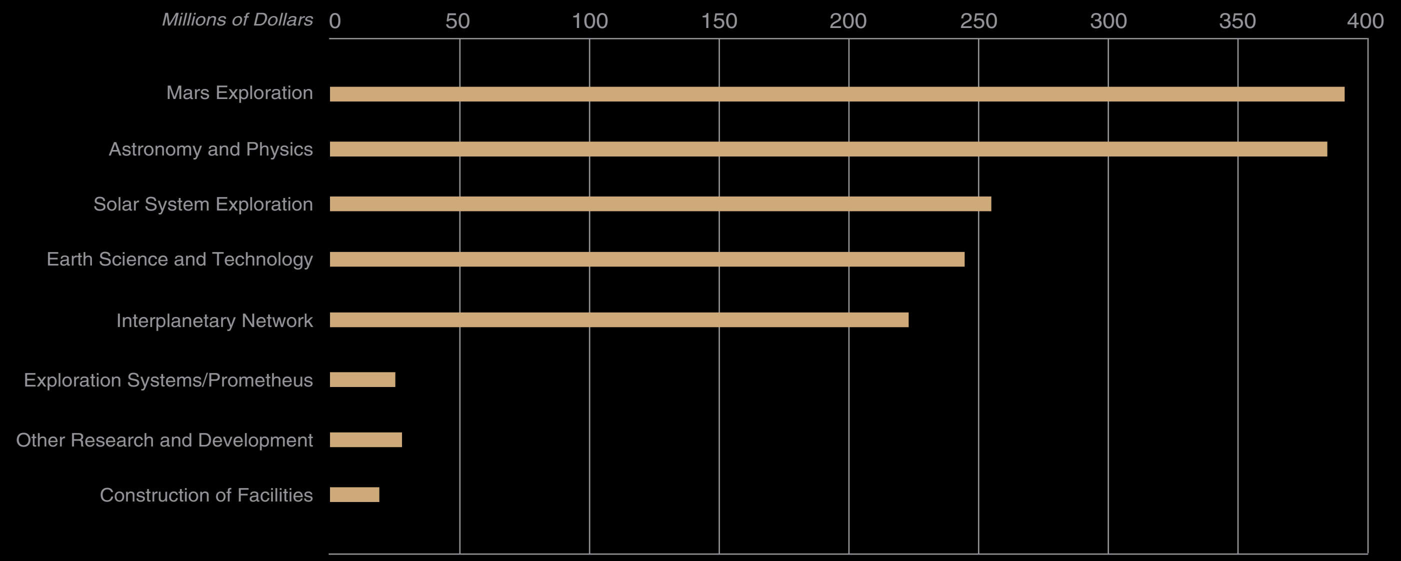
Personnel & Costs

C H A R T S

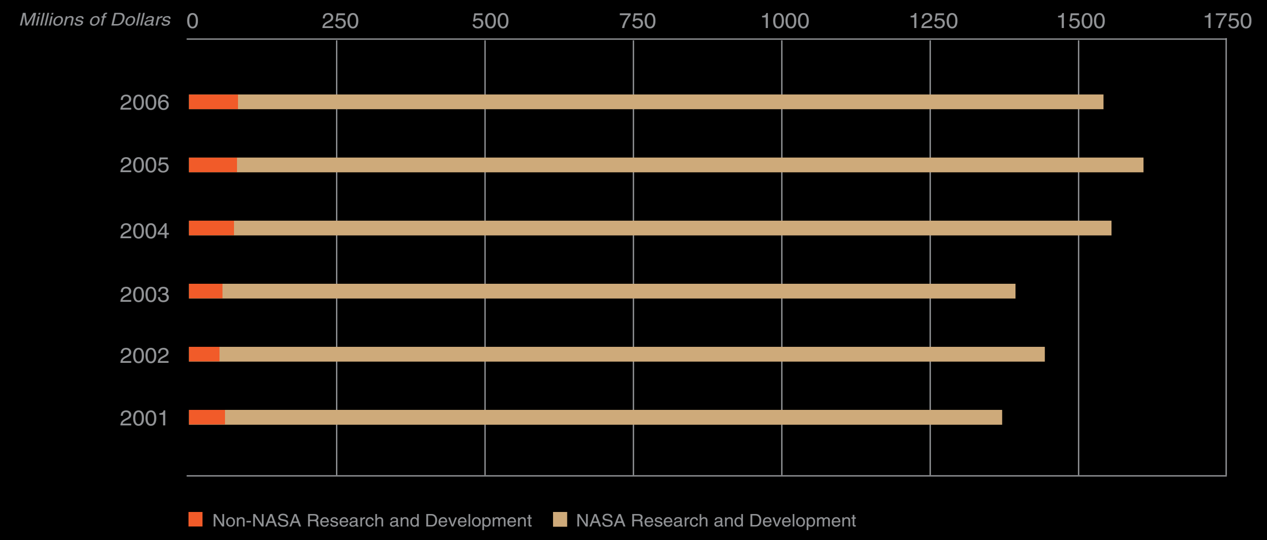
Total Personnel

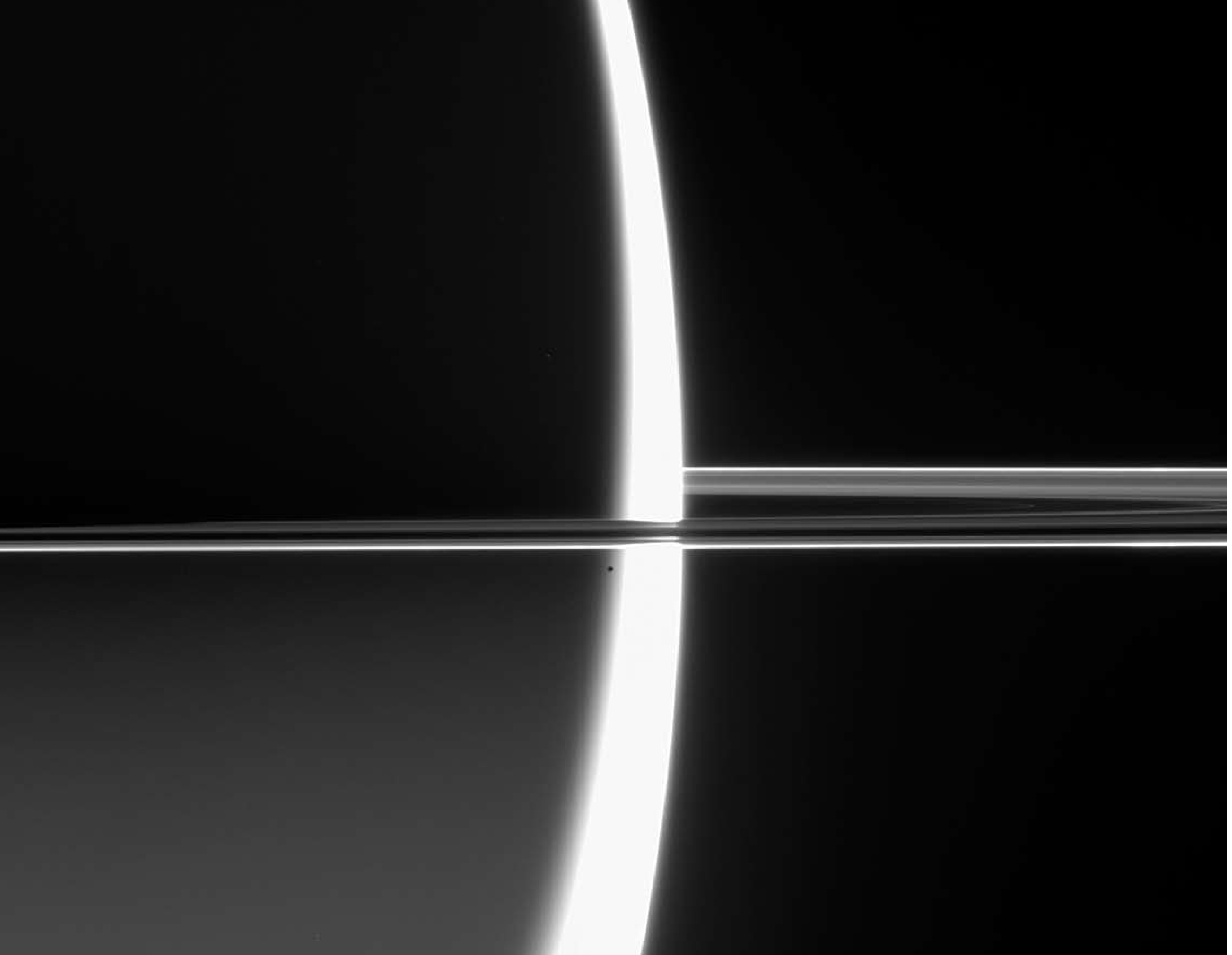


Fiscal Costs 2006



Total Costs





Advisory & Oversight
COMMITTEES

Saturn's tiny moon Epimetheus, which skirts the outside of the planet's narrow F ring, is caught by Cassini just before it crosses into the glare of the planet's sunlight crescent.

Standing Attendees

Dean W. Currie
Vice President for Business and Finance, Caltech

Hall P. Daily
Director of Government and Community Relations, Caltech

Charles Elachi
Director, JPL

Paul C. Jennings
Provost, Caltech

Robert L. O'Rourke
Vice President for Public Relations, Caltech

Richard P. O'Toole
Executive Manager,
Office of Legislative Affairs, JPL

Harry M. Yohalem
General Counsel, Caltech

JPL Advisory Council

Mark Abbott
Oregon State University

Susan Avery
University of Colorado

William Ballhaus, Jr.
Aerospace Corporation

Bobby Braun
Georgia Institute of Technology

Donald S. Burnett
Caltech

Claude Canizares
Massachusetts Institute of Technology

Vint Cerf
Google, Inc.

Natalie Crawford
Rand Corporation

Steve Dorfman
Hughes Electronics, Ret.

Ken Farley
Caltech

Scott Fraser
Caltech

Lennard A. Fisk
University of Michigan

John Grotzinger
Caltech

Brad Hager
Massachusetts Institute of Technology

Alice Huang
Caltech

Wesley T. Huntress, Jr.
Carnegie Institution of Washington

Andrew H. Knoll
Harvard University

Laurie Leshin
NASA Goddard Space Flight Center

Jonathan Lunine
University of Arizona

Richard Malow
Association of Universities for Research in Astronomy, Inc.

Berrien Moore
University of New Hampshire

Richard M. Murray
Caltech

Bradford W. Parkinson (Chair)
Stanford University

Elisabeth Paté-Cornell
Stanford University

Frank Press
Washington Advisory Group

Ares Rosakis
Caltech

Jason Speyer
University of California, Los Angeles

Steven W. Squyres
Cornell University

David Stevenson
Caltech

Thomas A. Tombrello
Caltech

Rochus E. Vogt
Caltech

Paul Wennberg
Caltech

Brian Williams
Massachusetts Institute of Technology

A. Thomas Young
Lockheed Martin Corporation, Ret.

Maria Zuber
Massachusetts Institute of Technology

A celebration on JPL's mall provided the opportunity for JPL Director Charles Elachi (right) and other employees to convey their appreciation to outgoing Caltech President David Baltimore and his wife, Alice Huang.

Caltech Visiting Committee on JPL

Shirley M. Hufstedler
Senior Of Counsel, Morrison & Foerster LLP

Wesley T. Huntress, Jr.
Carnegie Institution of Washington

Admiral Bobby R. Inman
U.S. Navy, Ret.; University of Texas, Austin

Charles F. Kennel
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Infant stars glow gloriously in an infrared image of a star-forming region in the constellation Serpens, viewed by the Spitzer Space Telescope.