The spectacular image of comet Tempel 1 was taken 67 seconds after it obliterated Deep Impact’s impactor spacecraft July 4. The image was taken by the high-resolution camera on the mission’s flyby craft. Celebrating the achievement are, from left, NASA’s Al Diaz, JPL’s Francy Becher, Lee, Dr. Charles Elachi and Tom Garcia, and NASA’s Dr. Orlando Figueroa. At bottom, Deep Impact Project Manager Rich Crammier (left), Deputy Project Manager Kaye Nath and Principal Investigator Dr. Mike A’Hearn at post-impact press conference.

Deep Impact blasts celestial fireworks

SMASHING!

AFTER 172 DAYS AND 431 MILLION KILOMETERS (268 MILLION MILES) OF DEEP-SPACE STALKING, Deep Impact successfully rendezvoused and touched comet Tempel 1. The collision between the coffee-table-sized impactor and city-sized comet occurred at 10:52 p.m. Pacific time on July 4. “What a way to kick off America’s Independence Day,” said Deep Impact Project Manager Kirk Grammier of JPL. “The challenges of this mission and teamwork that went into making it a success should make all of us very proud.”

This is one of the most daring and risky missions JPL has ever undertaken,” added JPL Director Dr. Charles Elachi. “We have blazed a new trail for future generations to follow.”

NASA Administrator Mike Griffin conveyed to the JPL/Ball Aerospace team his “warmest congratulations and heartfelt appreciation for a mission well done. ‘They’re making us proud once again.’

In the week following the celestial collision, data from Deep Impact’s instruments indicated an immense cloud of fine powdery material was released when the probe slammed into the nucleus of comet Tempel 1 at 6.3 miles per second.

The cloud indicated the comet is covered in the powdery stuff. The Deep Impact science team continues to wade through gigabytes of data collected during the encounter with the 3-mile-wide by 7-mile-long comet.

“The major surprise was the opacity of the plume the impactor created and the light it gave off,” said Deep Impact Principal Investigator Dr. Michael A’Hearn of the University of Maryland. “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.

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, a Deep Impact scientist from Brown University. ‘This comet 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 mph.’

The data review process is not overlooking a single frame of approximately 4,500 images from the spacecraft’s three imaging cameras taken during the encounter. “We are looking at everything from the last moments of the impactor to the final look-back images taken hours later, and everything in between,” added A’Hearn. “Watching the last moments of the impactor’s life is remarkable. We can pick up such fine surface detail that objects that are only 4 meters in diameter can be made out. That is nearly a factor of 10 better than any previous comet mission.”

The final moments of the impactor’s life are important, because they set the stage for all subsequent scientific findings. Knowing the location and angle the impactor slammed into the comet’s surface is the best place to start. Engineers have established the impactor took two not-unexpected coma particle hits prior to impact. The impacts slewed the spacecraft’s camera for a few moments before the attitude control system could get it back on track. The penetrator hit at an approximately 25-degree oblique angle relative to the comet’s surface. That’s when the fireworks began.

The fireball of vaporized impactor and comet material shot skyward. It expanded rapidly above the impact site at approximately 1.1 miles per second, and the crater was just beginning to form. Scientists are still analyzing the data to determine the exact size of the crater. Scientists say the crater was at the large end of original expectations, which was from 50 to 250 meters.

The geological collision and ensuing data collection by the nearby Deep Impact mothership was the climax of a very active period for the mission, which began with impactor release about 24 hours before impact. Deep-space maneuver by the flyby craft, final checkout of both spacecraft and comet imaging took up most of the next 22 hours. Then, the impactor got down to its last two hours of life.

“The impactor kicked into its autonomous navigation mode right on time,” said JPL’s Sivan Bhaskaran, the Deep Impact navigator. “Our preliminary analysis indicates the three impactor targeting maneuvers occurred on time at 90, 35 and 12.5 minutes before impact.”

At the moment the impactor was vaporizing itself in its collision with comet Tempel 1, the Deep Impact flyby spacecraft was monitoring events from nearby. For the following 14 minutes the flyby craft collected and downlinked data as the comet homed ever closer. Then, as expected at 11:05 p.m., the flyby craft stopped collecting data and entered a defensive posture called shield mode, where its dust shields protected the spacecraft’s surface from any additional crater threats.

The year was 1957. Margaret Dix was a teenager, living in her hometown of London, England. An avid Bill Haley and the Comets fan since the early ‘50s, it was to be almost delighct that she won a contest that allowed her to travel on ‘The Rock & Roll Express’ train from Waterloo Station to greet the renowned rockers as they arrived for their English tour. On the train to the event, caught up in the moment, the young girl spontaneously decided to get Bill Haley’s name tattooed on her left arm.

Flash forward about 50 years. Dix (now Porter) is the administrative secretary for JPL’s Public Services Office. “Of course the tattoo has faded a little over the years, but it’s still there, and I’m still proud of it,” Porter said. “It was wonderful to hear The Comets again, and to see them in person after all these years, and I feel especially honored having my picture taken with the group.”

Margie Porter of JPL’s Public Services Office with members of the Comets. From left: Marshall Lytle, Johnny Grande, Dick Richards, Joey Ambrose, Frankie Beaver.
**Sea-level changes noted for first time**

For the first time, NASA has the tools and expertise to understand the rate at which sea level is changing, some of the mechanisms that drive those changes and the effects that sea-level change may have worldwide.

"It's estimated that more than 100 million lives are potentially impacted by a one-meter increase in sea level," said Dr. Walter Meier, head of the Cryospheric Sciences Branch at NASA's Goddard Space Flight Center. "When you consider this information, the importance of learning how and why these changes are occurring becomes even more urgent.

"Although scientists have directly measured sea level since the early part of the 20th century, it was not known how many of the observed changes in sea level were real and how many were related to upward or downward movement of the land. Now satellites have changed that by providing a reference by which changes in ocean height can be determined regardless of what the land area is doing. With new satellite measurements, scientists are able to better predict the rate at which sea level is rising and the cause of that rise.

"We've found the largest likely factor for sea-level rise is changes in the amount of ice that covers the Earth. Three-fourths of the planet's fresh water is stored in glaciers and as the equivalent of about 220 feet of sea level," said Dr. Eric Rignot, principal scientist for the Radar Science and Engineering Section. "Ice cover is shrinking much faster than we thought, with over half of recent sea-level rise due to the melting of ice from Greenland, West Antarctica's Amundsen Sea and mountain glaciers," he said.

"In the last 50 years sea level has risen at an estimated rate of 0.07 of an inch per year, but in the last 12 years that rate appears to be 0.12 of an inch per year," said Dr. Steve Nerem, Associate Professor, Colorado Center for Astrodynamics Research, University of Colorado. "Roughly half of that is attributed to the expansion of ocean water as it has increased in temperature, with the rest coming from other sources.

Another source of sea-level rise is the increase in ice melting. Evidence shows that recent sea-level rise is largely due to ice on land growing and shrinking. With the new measurements now available, it's possible to determine the rate at which ice is growing and shrinking. Also, NASA and its partner researchers now are able to measure and monitor the world's waters globally in a sustained and comprehensive way using a combination of satellite observations and sensors in the ocean. By integrating the newly available satellite and surface data, scientists are better able to determine the causes and significance of current sea-level changes.

"Now the challenge is to develop an even deeper understanding of what is responsible for sea-level rise and to monitor for possible future changes," said Dr. Larry Milly, Chief of the National Oceanic and Atmospheric Administration (NOAA) Laboratory for Satellite Altimetry. "That's where NASA satellites come in, with global coverage and ability to examine the many variables involved."

NASA works with agency partners such as NOAA and the National Science Foundation to explore and understand sea-level change. Critical NASA resources on this issue include such satellites as the JPL-managed TOPS/ Poseidon, Jason and Gravity Recovery and Climate Experiment (GRACE) missions as well as the Ice, Cloud and Land Elevation Satellite (ICESat).

**Deep Impact**

**The view from Deep Impact’s flyby spacecraft as it turned back to look at comet Tempel 1. Fifty minutes earlier, the spacecraft’s probe was run over by the comet.**

Vital components during its closest passage through the comet’s innermost shield mode ended when mission control re-established the link with the flyby spacecraft.

The hyperspectral demise of Deep Impact’s probe generated an immense flash of light, which provided an excellent light source for the two cameras on the mothership. The collision created by the impact was just one of the visual surprises that confounded the Deep Impact team. Preliminary assessment of the images and data downloaded from the flyby spacecraft have provided an amazing glimpse into the comet's structure.

"They say a picture can speak a thousand words," Grammer said. "But when you take a look at some of the ones we captured in the early morning hours of July 4, 2005, you think we write a whole encyclopedia."

At a news conference held on July 4, Deep Impact team members displayed a movie depicting the final moments of the impactor’s life. The

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**Special Events Calendar**

**Wednesday, July 20**

JPL Literature Orientation—Stop by Building 111-104 at 11:30 a.m. for an overview of the Library’s products and services, and learn how to access numerous electronic resources from your desktop. For more information, call Public Services at ext. 4-4100.

**Thursday, July 21**

Deep Impact Project Manager Rick Grammer will present “Comets: Use Capabilities of the Solar System Past” at 7 p.m. Thursday in von Kármán Auditorium and Friday in Pasadena City College’s Vosloh Forum. 1570 E. Colorado Blvd., Pasadena. 626-793-3000. Follow the link for more information.

**Saturday, July 16**

Cassini Talk, Star Gazing Party—Dr. Kevin Grady, Cassini investigation scientist, and Steve Edberg, JPL astronomer, will present a Cassini lecture followed by telescope viewing. To be held at 9:30 p.m. at the Eaton Canyon Nature Center, 1750 N. Avenue 36, Burbank. Tickets are $5 per person under 2 and $10 per person over 2. Reservations are required for groups of 10 or more. Call (626) 398-5420 or visit www.cws.org.

**Sunday, July 17**

Lambia Gay, Lesbian, Bisexual and Transgender Networking Group—Meets the first Friday and third Thursday at 6 p.m. in von Kármán Auditorium. For more information, call Randy Hester at 3-6464.

Parents Group for Children With Special Needs—Meets the second Thursday of the month at noon in Building 167-111. For more information, call Andrea Beausoleil at 3-64412.

For more information on any of the support groups, call the Employee Assistance Program at ext. 4-5460.

**Saturday, July 23**

Cassini Talk, Star Gazing Party—Dr. Kevin Grady, Cassini investigation scientist, and Steve Edberg, JPL astronomer, will present a Cassini lecture followed by telescope viewing. To be held at 9:30 p.m. at the Eaton Canyon Nature Center, 1750 N. Avenue 36, Burbank. Tickets are $5 per person under 2 and $10 per person over 2. Reservations are required for groups of 10 or more. Call (626) 398-5420 or visit www.cws.org.

**Friday, July 29**

Kitt Peak National Observatory—Call (626) 793-3000 for more information on the Observatory's products and services, and learn how to access numerous electronic resources from your desktop. For more information, call Public Services at ext. 4-4100.

**Wednesday, July 27**

JPL Leadership Orientation—Stop by Building 111-104 at 11:30 a.m. for an overview of the Library’s products and services, and learn how to access numerous electronic resources from your desktop. For more information, call Public Services at ext. 4-4100.

**Monday, July 18**

Career Development—Daily events will be held in von Kármán Auditorium. On Monday, leadership and organizational consultant Mary Eberl-Herr will give a briefing on resume tips and techniques at noon. Tuesday's and Wednesday’s open forums will feature career opportunities in various JPL organizations. Tuesday's career fair from 9 a.m. to noon will be an opportunity for students to bring their resumes and meet with recruiters from technical and business organizations.

**Tuesday, July 19**

UCAL Armstrong Lecture Series—Professor Marc Rayman, JPL chief engineer for missions to the outer solar system, will present "Cassini’s Exploration of the Kuiper Belt Object Orcus in the Saturn System." For more information, call the Public Reference Desk, ext. 4-4200.

**Wednesday, July 20**

Women's Career Panel—The Advisory Committee on Equal Employment Opportunity meets the first Friday and third Thursday at 6 p.m. in von Kármán Auditorium. For more information, call Randy Hester at 3-6464.

**Thursday, July 21**

Deep Impact Project Manager Rick Grammer will present “Comets: Use Capabilities of the Solar System Past” at 7 p.m. Thursday in von Kármán Auditorium and Friday in Pasadena City College’s Vosloh Forum. 1570 E. Colorado Blvd., Pasadena. 626-793-3000. Follow the link for more information.

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**Continued from page 1**

Deep Impact

For movies, multimedia, images and other information on Deep Impact, log on to www.jpl.nasa.gov/news
A YEAR AFTER CASSINI-HUYGENS ENTERED ORBIT AROUND SATURN, the mission team is looking back at a string of remarkable discoveries. Numerous discoveries have been made about Saturn's surface and atmosphere. Saturn's magnificent rings, its amazing icy satellites, dynamic magnetosphere and the planet itself. The highlight of the mission so far is clearly the lifting of the veil on unexplored Titan. The two remarkable instruments provided the first glimpses of the surface and the global picture of the hazy world. The Huygens probe descent through the atmosphere to the surface provided a close-up look at a whole new world.

What we expected to see and did not see is equally interesting. Our original ideas for Titan's surface included global oceans and lakes of liquid hydrocarbons. The Huygens probe was even designed to briefly float, because we deemed a liquid landing to be very likely. Small lakes may exist but global oceans are just not there. This lack of large bodies of liquid may cause us to rethink the age and origin of Titan's atmosphere.

Spokes in Saturn's rings, as seen by NASA's Voyager spacecraft, were also anticipated. To date, we have not seen spokes in geometries where they should have been seen if their associated dust clouds were present. This lack of spokes shows that important electrostatic or electrodynamic effects, like photoelectric charging of the rings, vary seasonally.

Upcoming events include our closest flyby so far of the icy moon Enceladus as Cassini flies within 175 kilometers (109 miles) of this world on July 14, 2005. We will be looking for clues to the source of Saturn's E ring, which is most likely supplied by material from Enceladus. Other exciting events include six flybys in 90 days, including two flybys of Titan and one each of the moons Tethys, Hyperion, Dione and Rhea. During the October flyby of Titan, we will obtain a radar swath over the Huygens landing site, which will help us put the portion examined by the probe into the broader context of the rest of Titan. Some science discoveries and other highlights from our first year at Saturn include:

1. Closest-ever observations of Saturn's rings: The Cassini cameras took the highest-resolution images ever of Saturn's rings, and Cassini fields and particles instruments measured the in-situ ring environment as the spacecraft skimmed above Saturn's rings just after Saturn orbit insertion. Discoveries included straw-like clumps several kilometers long in the A ring, an oxygen atmosphere just above the rings, signatures of marble-sized meteoroids impacting the rings and evidence for slowly rotating ring particles.

2. Saturn's dynamic atmosphere: The entire northern hemisphere of Saturn has a complete new look since the Voyager encounters. It now appears deep blue, much like the deep, clear atmospheres of Uranus and Neptune. The shadow of the rings on the northern hemisphere probably clouds it down, so the thin clouds sink to depths where they are no longer visible. Nothing like this had ever been suspected from previous observations. Powerful lightning storms—10,000 times stronger than on Earth—occur in huge, deep thunderstorm columns nearly as large as the entire Earth. The storms occasionally boil up to the visible surface.

3. Fractured Dione: Dione's mysterious wispy terrain is revealed to be tectonic fractures.

4. Phoebe, a captured world from the outer solar system: Phoebe is a crater-covered moon, with large landslides revealing bright water ice on crater walls and patchy clustering of silicate and organic material. The volcanic ices tell us that Phoebe must have formed in the outer solar system before being captured by Saturn's gravity.

5. Enceladus atmosphere: Icy Enceladus seems to have a tenuous atmosphere, discovered in magnetic field data that may imply internal activity. It may help explain the source and variability of Saturn's F ring.

6. New radiation belt: A new and completely unexpected radiation belt was discovered around Saturn between the inner edge of the D ring and the top of Saturn's atmosphere.

7. Saturn's rotation period puzzle: Cassini took readings of the day-length indicator regarded as most reliable, the rhythm of natural radio signals from the planet. The results give 10 hours, 43 minutes, 43 seconds (plus or minus 36 seconds) as the length of time it takes Saturn to complete each rotation. Here's the puzzle: That is about 6 minutes, or 1 percent, longer than the radio rotational period measured by the Voyager 1 and Voyager 2 spacecraft, which flew by Saturn in 1980 and 1981. Cassini scientists are not questioning Voyager's careful measurements. And they definitely do not think the whole planet of Saturn is actually rotating that much slower than it did two decades ago. Instead, they are looking for an explanation based on some variability in how the rotation deep inside Saturn drives the radio pulse.

8. Saturn's rotation period puzzle: Cassini takes readings of the day-length indicator regarded as most reliable, the rhythm of natural radio signals from the planet. The results give 10 hours, 43 minutes, 43 seconds (plus or minus 36 seconds) as the length of time it takes Saturn to complete each rotation. Here's the puzzle: That is about 6 minutes, or 1 percent, longer than the radio rotational period measured by the Voyager 1 and Voyager 2 spacecraft, which flew by Saturn in 1980 and 1981. Cassini scientists are not questioning Voyager's careful measurements. And they definitely do not think the whole planet of Saturn is actually rotating that much slower than it did two decades ago. Instead, they are looking for an explanation based on some variability in how the rotation deep inside Saturn drives the radio pulse.

9. Lapetus, a moon with a bulging waistline: Lapetus, the two-faced moon, has an equatorial mountain range 20 kilometers (12 miles) high in some places, twice the height of Mt. Everest.

10. For more Cassini images, visit http://photojournal.jpl.nasa.gov/targetFamily/Saturn

By Linda Spilker, Cassini deputy project scientist
In appreciation

I would like to express my thanks to my friends and co-workers at JPL who send me support and encouragement while I was deployed in Iraq. I was deployed to Iraq in April 2004, and I am currently on extended leave. I am grateful for the support and encouragement of my friends and co-workers at JPL who have been there for me during this difficult time.

Erik L. Thiemeyer

Section 511 Administrator

Erik L. Thiemeyer kept a little bit of JPL with him during his tour of duty in Iraq.
Striking images of Enceladus revealed by Cassini

By Carolina Martinez

JPL’s Cassini spacecraft has obtained new detailed images of the south polar region of Saturn’s moon Enceladus. The data reveal distinctive geological features and the most youthful terrain seen anywhere on the satellite, which also supports the notion of a young surface at southern latitudes. Some of the latest images may hint at the answer. The images revealed additional examples of a distinctive “Y-shaped” tectonic feature on Enceladus. In this unusual element, parallel ridges and valleys appear to systematically fold and deform around the south polar terrains.

“Y-shaped” tectonic features define a boundary that isolates the young, south polar terrains from older terrains on Enceladus,” noted Dr. Paul Helfenstein, an associate of the imaging team also at Cornell University. “The minimal cover of finer material and the preservation of small, faulted, and ridged terrain in this unusual element, parallel ridges and valleys appear to systematically fold and deform around the south polar terrains.”

The apparent absence of sizable impact craters also suggests the south pole is younger than other terrain on Enceladus. These indications of youth are of great interest to scientists who have long suspected Enceladus as one possible source of material for Saturn’s extensive and diffuse E ring, which coincides with the moon’s orbit. Young terrain requires a means to generate the heat needed to modify the surface. Other Cassini instrument teams are working to understand data about temperature, composition, particles and magnetic field. Together with image interpretation, these data can create a more complete picture.

The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. JPL manages the mission for NASA’s Science Mission Directorate. The Cassini orbiter and its two onboard cameras were designed, developed and assembled at JPL. The imaging operations center is based at the Space Science Institute in Boulder, Colo.

**Special Events Calendar**

**Ongoing Support Groups**
- Alcoholics Anonymous—Meets Monday at 6:30 p.m.
- CAREGivers Support Group—Meets the first Thursday of the month at noon in Building 163-111 (the Wellness Place) C2
- Employer Assistance Program—Meets at noon every Wednesday.
- Lambda (Gay, Lesbian and Biexual) Support Group—Meets the second Monday of the month at noon in Building 167-111 (the Wellness Place).

For more information on any of the support groups, call the Employee Assistance Program at ext. 4-3080.

**Saturday, July 30**

**JPL Dodgers Day—The Dodgers host the St. Louis Cardinals at 10:10 p.m.**

**Tickets are $5 and include admission to the Dodgertown summer fun game carnival that starts at 11 a.m.**

**Purchase tickets on Lab at the JPL Stamp Club or online at www.jplcaltechtoastmasters.com.**

**JPL Library Orientation—Stop by Building 111-104 at 3:30 p.m.**

**For more information, call the reference desk, ext. 4-4200.**

**JPL四川省2011年活动（3月-8月）**

- **Ex-JPLer Thomas returns to flight**

When the Space Shuttle Discovery reentered into space Tuesday morning, among its veteran crew was the former JPL engineer Thomas, who began his NASA career right here at JPL.

Thomas is making his fourth shuttle flight, is a native of Australia and is a commercial space career private industry in the late 1970s. He joined JPL in 1980 and, shortly thereafter, was appointed leader of the JPL program for micrometeorite materials processing in space. This NASA-sponsored research included scientific investigations conducted in the laboratory and in low gravity on NASAs KC-135 aircraft, as well as technology studies to support the development of the space shuttle program.

He was selected to join the astronaut corps in March 1992 and reported to the Johnson Space Center in August of that year. Thomas' previous space flight experience includes:

- STS-77, a 16-day mission during which the crew deployed two satellites testing a large inflatable structure in orbit and conducted a variety of scientific experiments in a Spachab laboratory module carried in Endeavour's payload bay. The flight was launched May 19, 1996 and completed 160 orbits of Earth while traveling 4.1 million miles and logging 240 hours and 39 minutes in space.

- STS-62 aboard Endeavour as part of the crew to the dock with the Mir Space Station.

- STS-112—Mission 2, 3-10 July 2003.


- **STS-102 Discovery (March 28-21, 2001).** The shuttle mission to visit the International Space Station. Mission accomplishments included the installation of the Leonardo Multi-Purpose Logistics Module, and the return to Earth of Expedition 1 crew. During the mission, Thomas performed an EVA of 6.5 hours to install components to the outside of the space station. Mission duration was 107 days and 140 hours.

**Wednesday, August 4**

- **Investment Advisor—Fidelity will provide our on-site counseling in 7120-114. For an appointment, call (800) 642-7111.**

- **JPL Gun Club—Meeting at noon in Building 163-111.**

**Thursday, August 4**

- **Understanding the Advantages of Diversification—This Fidelity invest- ment seminar will be held in JPL 381-137, 5 p.m.**

**Thursday, August 11**

- **Ex-JPLer Thomas returns to flight**

- **JPL Stamp Club—Meeting at noon in Building 300-77.**

**Friday, August 12**

- **JPL Library Orientation—Stop by Building 111-104 at 3:30 p.m.**

**Wednesday, August 18**

- **JPL Library Orientation—Stop by Building 111-104 at 3:30 p.m.**

- **JPL Stamp Club—Meeting at noon in Building 300-77.**

**Thursday, August 19**

- **JPL Library Orientation—Stop by Building 111-104 at 3:30 p.m.**

- **JPL Stamp Club—Meeting at noon in Building 300-77.**

**Friday, August 20**

- **JPL Library Orientation—Stop by Building 111-104 at 3:30 p.m.**

- **JPL Stamp Club—Meeting at noon in Building 300-77.**

**Saturday, August 21**

- **JPL Library Orientation—Stop by Building 111-104 at 3:30 p.m.**

- **JPL Stamp Club—Meeting at noon in Building 300-77.**

**Sunday, August 22**

- **JPL Library Orientation—Stop by Building 111-104 at 3:30 p.m.**

- **JPL Stamp Club—Meeting at noon in Building 300-77.**
It’s back to Mars we go

By Mark Whiaku

The orbiter has been at the Cape since the beginning of May. What’s the latest on launch preparations? Are there any areas of concern? What’s left to be done?

The spacecraft has completed its electrical testing and we have loaded the propellant. We are in the process of integrating the spacecraft with the payload fairing and will be moving shortly to Launch Complex 41 for mating with the launch vehicle. While those activities are going on at the Cape, the operations team is conducting critical launch readiness tests. I have no concerns about the flight vehicle at this time.

Last week a review by JPL’s Governing Program Management Council affirmed that MRO is ready for launch. Subsequent to that we provided a mission readiness briefing at NASA Headquarters. The team is ready to go.

What is unique about this mission?

MRO is flying the most ambitious payload suite we have ever sent to another planet. The instruments will cover more of the surface and at higher resolution than ever before and produce a data volume five times all other Mars missions combined. The payload will “follow the water” in the atmosphere with the JPL-provided Mars Climate Sounder: on the surface with various imagers, and even under the surface with a radar that penetrates the subsurface. The telecommunications subsystem enables a data rate of up to 5.6 megabits per second from Mars to Earth. The high data rate is needed to return all of the data generated by the instrument suite.

From the MER rovers we have in-depth knowledge of specific, relatively small regions on the surface. With the instruments on MRO and their ability to cover vast portions of the planet, we can now transfer that MER knowledge to other areas on the surface.

MRO’s science orbit will be lower than previous orbiters’ have been. Does that produce any special challenges?

The lower orbit helps to increase our spatial resolution, but since we are closer to the atmosphere, the drag caused by the atmosphere increases and we will have to conduct more drag-mitigation maneuvers than we would like. The increased drag also impacted our approach to planetary protection. We are not able to stay in orbit long enough to satisfy the traditional criteria for planetary protection. The MRO project pioneered the use of the bio-burden approach to satisfy planetary protection requirements. This technique required that we both clean the hardware as well as estimate the spores that may be left on the spacecraft after cleaning the hardware as well as bio-burden approach to satisfy planetary protection requirements. We are not able to stay in orbit long enough to satisfy the traditional criteria for planetary protection. The MRO project pioneered the use of the bio-burden approach to satisfy planetary protection requirements. 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This technique required that we both clean the hardware as well as estimate the spores that may be left on the spacecraft after cleaning the

MRO will use a type of launch vehicle (Atlas V) never used on an interplanetary mission before. What’s the reason for that?

There are several reasons for the change in launch vehicle. First, the planets are not as well aligned as we would like and the opportunity is the worst in decades in terms of energy requirements. Second, the payload and the large telecom subsystem to return the data are massive. These facts drove us to a new class of launch vehicle. The launch service was competed by Kennedy Space Center, and Atlas won.

How will this mission support future Mars missions?

The data will dramatically increase our basic understanding of the planet. It will also tell us where it is both scientifically interesting and safe to land for missions like Phoenix and Mars Science Laboratory. Lastly, the JPL-produced Electra radio on MRO will provide a critical radio relay between Earth and those landers in much the same way Odyssey and MGS are providing that function for the MER rovers.

What are your personal challenges? In QuikSCAT, you managed an Earth mission whose development seemed to begin and end in a flash. How are you handling the larger scope of MRO?

QuikSCAT was a great mission. It was ready to launch one year after go-ahead and after six years in space it is still producing critical ocean-winds data. We took risk in that mission since it was unique and didn’t have other missions relying on it. We can’t take that same risk posture on MRO since it is a flagship mission with many more missions relying on it. Also, QuikSCAT was simpler—since it had one instrument—while MRO has seven instruments plus three engineering payloads and two more investigations using engineering data.

The instrument, the subsurface radar, was provided by the Italian Space Agency, which led to additional complexity in order to comply with International Traffic in Arms Regulations (ITAR). Let’s just say that my hair has grayed a lot more on MRO than on QuikSCAT.

Describe the team that has gotten you this far, and the one that will carry out the mission once you get to Mars. What work is being done at JPL and what will be done by industry/university partners?

The technical and administrative staff on MRO is terrific. They include some of the finest professionals I have worked with. The JPL team has worked hand in glove with the Lockheed Martin spacecraft development team to develop an orbiter that is the most capable we have ever sent to another planet. We combined the strengths of both organizations in one team. This arrangement will carry over into operations with prime activities both in Pasadena and Denver.

The instruments were developed by private industry, JPL, universities and the Italian Space Agency, and those principal investigators and team leaders will each be processing the science data when it starts flowing back to Earth in November 2006. The Interplanetary Network Directorate will play a critical role in successfully capturing the flood of data that MRO will transmit back to Earth.

How do you expect to feel at launch? Excited, nervous, confident?

The MRO team has done everything possible to make the mission a success; however, we will all breathe a sigh of relief when the first signal comes back from the spacecraft.

The Aug. 10 launch of JPL’s newest sojourn to the Red Planet—Mars Reconnaissance Orbiter—is approaching fast. Universe caught up with Project Manager Jim Graf, who provided an update.
Culminating a right-turn dig through the American southwest, two teams of high school students competing in the Dell-Winston Solar Car Challenge crossed the finish line at JPL on Saturday, July 16.

The solar vehicles, built entirely by the students, started the race July 1 from Round Rock, Texas, and wound their way 1,000 miles through Texas, New Mexico and Arizona to reach their final destination. The last leg of the race ran from citrus country in Groves, Harlingen to JPL.

The Bionox Solar Race Team, driving the Sundancer, reached a top speed of 57 mph and averaged 29 mph to win the Open Division. The team is from Houston Solar Race Team.

The Houston Solar Race Team, driving the Sundancer, reached a top speed of 57 mph and averaged 29 mph in the Open Division. The team is from Houston.

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