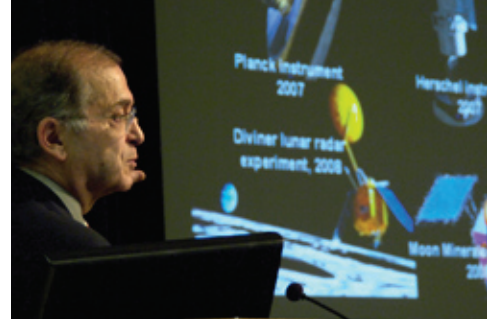


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Photos by Dutch Sliger / JPL PhotoLab

At the all-hands meeting, Dr. Charles Elachi introduced Caltech professor Ares Rosakis, top left, who is working with JPL to establish an aerospace engineering program on campus, and newly appointed JPL Chief Technologist Dr. Paul Dimotakis, below left.

By Mark Whalen

"When we work as a team, we are always successful."

NASA'S FISCAL YEAR 2007 BUDGET REQUEST UNVEILED THIS WEEK

is a tight one for science missions, but in an all-hands meeting Tuesday, JPL Director Dr. Charles Elachi said it should be seen in a positive light, especially relative to the considerable pressures on the federal budget.

The message for the Laboratory was that the impact would be manageable. All of JPL's ongoing projects in development are either fully funded or funded with some delays to their implementation, he said.

As a result, Elachi believes JPL's current workforce of about 4,975 will be stable for the foreseeable future.

Further on the budget, Elachi noted that among NASA's challenges are the retirement of the space shuttle and the development of its replacement, the crew exploration vehicle. In addition, the agency must meet its commitments to the completion of the International Space Station.

The overall NASA budget request totals \$16.8 billion, a 3.2 percent increase over the previous year. In the science area of the budget—where most of JPL's work is funded—the agency requested \$5.3 billion. NASA said the science budget would grow by 1.5 percent in FY 2007 and 1 percent thereafter between 2008 and 2011.

Elachi noted that over the past 13 years the science budget has grown much faster than NASA's total budget. Indeed, in 1992 science represented 24 percent of the total NASA budget. The FY 2007 request calls for 32 percent in science. "There has been very strong support for having a healthy science program," he said.

Phoenix, Mars Science Laboratory, Juno, New Millennium's Space Technology 8 and Kepler are fully funded. The same holds true for Earth science projects, including Jason (a follow-on to Topex/Poseidon), CloudSat, Aquarius and Orbiting Carbon Observatory.

Also included in the budget request is JPL's Flight Projects Building, which is scheduled to break ground in the summer, and the development of a new administration building and education center to replace Building 180 for earthquake safety issues.

JPL-led missions included in the budget request but still awaiting NASA confirmation are Dawn, the first spacecraft ever planned to orbit two different bodies after leaving Earth; the Moon Mineralogy Mapper, one of two instruments that NASA is contributing to India's first mission to the moon; and the Wide-field Infrared Survey Explorer, a telescope that will scan the entire sky in infrared light.

In JPL institutional issues, Elachi noted the Lab's work with NASA's Exploration Systems Mission Directorate. A team led by Mike Sander, Dave Atkinson, Steve Townes and Rich Doyle is assessing how JPL can support other centers with "some of our unique capabilities." Possibilities include some focused JPL contributions to the crew exploration vehicle, Elachi said.

The director also echoed NASA Administrator Mike Griffin's call last week for openness in scientific findings. "Our policy is open scientific and technical inquiry," Elachi said, "and we want to proactively provide our scientific and technical information to the public." He

said that any concerns about public comment should be discussed with the Lab's Office of Communications and Education.

In other institutional issues:

- A reassessment of the Lab's compensation and job-slotting structure is underway and is due to be reviewed by the Executive Council this spring.

- The Engineering and Science Directorate will now add a deputy position for research. "This will provide an additional, significant voice for research," Elachi said. "We do a great job in development, but it's critical to have an equally healthy environment for research because we need both elements to be successful in our mission."

- In an effort to strengthen JPL's engineering relationship with Caltech, Elachi explained an initiative at the campus that will offer a new graduate aerospace engineering program. Master's and doctorate degrees will be offered. JPL researchers and engineers will contribute to the curriculum and will also teach. The program is slated to begin in September.

- A new Diversity and Inclusion Committee has been formed. Replacing the diversity manager position, the body will include representatives of JPL affinity groups, the Advisory Council for Women, Human Resources, the Executive Council and other leadership. The committee will prioritize the Lab's diversity and inclusion activities and leverage resources in support of Lab-wide goals.

- A plan to give employees the option to work 80 hours over nine days (instead of 10) in a two-week period is scheduled to be in place this summer. "You told us this was very important to you in last year's employee survey," Elachi said.

Elachi told staff that JPL needs improvement in "how we develop and operate smaller missions," including those that are competed. "We do pretty well, but I think we can do better," he said. "This is not 'faster, better, cheaper'; it's 'be successful, be successful, be successful,' but with better cost efficiency." Firouz Naderi and Tom Gavin will lead efforts to see how JPL can improve efficiency without compromising in quality.

Elachi also encouraged JPL's "best and brightest," those who think out of the box and are entrepreneurial, to get engaged at the concept phase of future missions. "People who are very good at new concepts and new ideas should get equal recognition to the people who fly missions.

"When we work as a team, we are always successful."

Elachi said the golden age of space and Earth exploration is not something of the past. "It's still here and will still be with us for the next decade. We can expect to be as busy in the next five years as we were for the last five."

He closed by stating, "I don't think there is a more exciting or better place to work than here," adding later, "and with your help I'm confident we will keep it that way."

A copy of the NASA budget is available at www.nasa.gov. To view the all-hands meeting online, visit <http://dailyplanet.jpl.nasa.gov/multimedia.php>.

News Briefs



Roger Gibbs

Gibbs to manage Division 34

ROGER GIBBS has been appointed manager of the Autonomous Systems Division (34).

He had served as project manager for the Mars Telecommunications Orbiter. Prior to that, Gibbs was project manager for the Mars 2001 Odyssey mission.

Gibbs has a bachelor of science degree in electrical engineering from the University of Southern California. He received a NASA Exceptional Service Medal in 1993 for his contribution to the Galileo and Mars Observer spacecraft, and a NASA Exceptional Service medal for his technical contribution and leadership to the Cassini Project.

He has held a number of positions in the Spacecraft Systems Group, including spacecraft chief system engineer for the Cassini mission to Saturn; manager of the Cassini systems engineering team; spacecraft chief system engineer for the Mars Observer mission; and instrument integration engineer for Mars Observer and the Galileo mission to Jupiter.



Dr. Simon Hook

Life environments to be studied

A team led by JPL has been awarded one of only three proposals selected in NASA's new Interdisciplinary Exploration Science Program.

DR. SIMON HOOK of the Solid Earth Group (3242) is the principal investigator for the proposal, titled "Remote Spectral Characterization of Terrestrial Life-Forming Environments for Planetary Exploration."

The proposal calls for studying four Earth environments that are analogous to planetary environments, especially on Mars, and developing approaches to characterize these environments to determine how best to recognize and explore them. This will be achieved by using airborne instruments that provide better spatial and/or spectral resolution than planetary instruments.

"By characterizing these environments on Earth with similar tools to those available for planetary exploration," Hook said, "we can develop appropriate strategies to explore for life on other planets. We can also identify any enhancements to current

planetary exploration tools that would improve future searches for life."

The seven-member science team includes NATHAN BRIDGES of JPL's Geophysics and Planetary Geosciences Group (3223) and researchers from the United States Geological Survey, the University of Arizona and the Desert Research Institute in Nevada. Representatives of Brazil and Australia will also participate.

The three-year study is funded by NASA's Science Mission Directorate.

Spitzer uncovers 'hypergiant' stars

JPL's Spitzer Space Telescope has identified two huge "hypergiant" stars circled by monstrous disks of what might be planet-forming dust. The findings surprised astronomers because stars as big as these were thought to be inhospitable to planets.

"These extremely massive stars are tremendously hot and bright and have very strong winds, making the job of building planets difficult," said JOEL KASTNER of the Rochester Institute of Technology in New York. "Our data suggest that the planet-forming process may be harder than previously believed, occurring around even the most massive stars."

Kastner is first author of a paper describing the research in the Feb. 10 issue of *Astrophysical Journal Letters*.

Dusty disks around stars are thought to be signposts for present or future planetary systems. Our own sun is orbited by a thin disk of planetary debris, called the Kuiper Belt, which includes dust, comets and larger bodies similar to Pluto.

Good news for JPL transit users

The 177 Metro bus line that used to travel from the City of Hope to JPL, arriving about once every 50 minutes, now stops at JPL every half-hour from 6:01 a.m. to 6:53 p.m.

The route has also been shortened. It now goes from the Sierra Madre Villa Transportation Center (Gold Line Station), past Pasadena City College and Caltech, stops at the Memorial Park Metro Gold Line station, onto the 210 freeway to the Oak Grove/Berkshire exit, then to JPL.

The following JPL employees retired in February:

Robert Clauss, 47 years, Section 337F; Paul Cramer, 45 years (333F); Fred Tomey, 45 years (3454); John Duxbury, 41 years (6200); Peter Breckheimer, 39 years (343E); Steve Bednarczyk, 37 years (3764); Dora Montano, 37 years (2100); Richard Norman, 37 years (3862); Veronica Carter, 36 years (3112); Dorothe Horttor, 36 years (252B); Frank Palluconi, 36 years (3242); Jack Barengoltz, 35 years (352); Edward Cohen, 35 years (3247); Thedra McMillian, 33 years (3114); Charles Cruzan, 29 years (3745); Charles Lahmeyer, 29 years (335B); Jeffrey L. Smith, 29 years (312G); Gerald Snyder, 29 years (314C); Rizalina Gordon, 28 years (252B); Gloria Lang, 28 years (373E); Thomas Pastorius, 28 years (3120); Anil Agrawal, 27 years (315G); Charles Beswick, 27 years (3700); Frederic Rosenblatt, 27 years (372B); Vijayaraghavan Alwar,

26 years (343L); Jack Dawson, 26 years (1870); William Wilson, 26 years (385); Henry Harris, 25 years (312A); Shankar Keni, 25 years (2813); Jack Mallory, 25 years (372G); Larry Fowler, 24 years (333B); Patrick O'Brien, 24 years (3752); Michael Frantz, 23 years (3764); Sheryl Owen, 23 years (3210); Scott Fullner, 22 years (343K); James Fu, 21 years (5132); Herbert Siegel, 21 years (3875); Toby Solorzano, 20 years (1123); Suzanne Frederick, 19 years (1080); Robert Nofer, 18 years (2813); Linda Prather, 18 years (2233); Kenneth Schmader, 18 years (2154); Burton Jaffe, 17 years (314D); Ehsanollah Hesar-Amiri, 15 years (372G); Derrick Stockhausen, 15 years (3762); Daniel Harvey, 14 years (2240); Thea Byrd, 11 years (3415); Joseph Charles, 11 years (2030); Darrell Davidson, 11 years (3413); James Wilia, 11 years (3755); Patrick Noone, 10 years (5150).

For the period of September through December 2005, the following JPL recipients celebrated 25 or more years of service and were invited to attend a luncheon and ceremony in their honor on Jan. 18.

45 years: John Arnold, Moustafa Chahine, Paul Cramer Jr.

40 years: Raymond Becker, Robert Berwin, Albert Chang, Susan Finley, James Jordan Jr., Kenneth Kimball, Robert Mitchell, Frank Singleton, John Slonski Jr.

35 years: Hartmut Aumann, Edward Cohen, Joseph Donhauser, Carol Hix, John Rakiewicz, Lutha Shaw Jr., Francis Taylor II, Peter Theisinger.

30 years: Donald Bickler, Jerry Clark, Denis Elliott, Thomas Farr, James Frautnick, Jose Hernandez, William Johnson, Peter Kobele, Ching Leang, Robert Rasmussen.

25 years: Josette Bellan, Ann Bernath, Kurng Chang, Samuel Dolinar Jr., Paul Firnett, Lee-Lueng Fu, Henrik Gronroos, David Hansen, Henry Harris, John Huang, Tooraj Kia, John Klein, David Lehman, Kim Leschly, Pualett Liewer, Long Tuyen Ly, Michael Mangano, Robert Manning, Richard Mattingly, Mark Milman, Jennifer Momjian, Norman Page, Mimi Paller, Hoppy Price, Robert Radocinski, Jose Rodriguez, Maria Sanchez, Wayne Schober, Zdenek Sekanina, Philip Stevens, Albert Taylor, Richard Terrile, Barbara Vaughn, Carmen Vetter.

For information about the programs and services offered by Compensation, Rewards & Recognition, visit <http://hr/esr>.



Service awards

Special Events Calendar

Ongoing Support Groups

Alcoholics Anonymous—Meets Wednesdays at 11:30 a.m.

Caregivers Support Group—Meets the first Thursday of the month at noon in Building 167-111 (the Wellness Place).

Codependents Anonymous—Meets at noon every Wednesday.

Lambda (Gay, Lesbian, Bisexual and Transgender Networking Group)—Meets the first Friday and third Thursday of the month at noon in Building 111-117. For more information, call Randy Herrera, ext. 3-0664.

Parents Group for Children With Special Needs—Meets the second Thursday 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. 4-3680.

Friday, February 10

"The Vagina Monologues"—A diverse cast of students, staff, postdoctoral scholars, faculty and alumnae will give life to Eve Ensler's poignant, funny and very moving monologues at 8 p.m. in Caltech's Beckman Auditorium. Tickets are \$15 for adults; \$5 for students. For more information, call (626) 395-4652 or visit www.events.caltech.edu.

Saturday, February 11

Les Ballets Trockadero de Monte Carlo—This group was founded in 1974 by a group of ballet enthusiasts for the purpose of presenting a playful, entertaining view of traditional, classical ballet in parody form. They will perform at 8 p.m. in Caltech's Beckman Auditorium. Tickets are \$35, \$31 and \$27; \$10 for high school age and younger. For more information, call (626) 395-4652 or visit www.events.caltech.edu.

Sunday, February 12

Chamber Music—The ensemble Trimotif will give a free concert at 3:30 p.m. in Caltech's Beckman Auditorium. For more information, call (626) 395-4652 or visit www.events.caltech.edu.

Monday, February 13

International Polar Year—Chris Rapley, director of the British Antarctic Survey, will present "The International Polar Year and the UK contribution" at noon in conference room 180-101. For more information, contact Dr. Eric Rignot at ext. 4-1640 or eric@pib.jpl.nasa.gov.

Tuesday, February 14

JPL Stamp Club—Meeting at noon in Building 183-328.

Wednesday, February 15

JPL Library 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 the reference desk, ext. 4-4200.

Thursday, February 16

"Caltech Robotics and the Second DARPA Grand Challenge"—Dr. Richard Murray, professor of Control and Dynamical Systems at Caltech, will speak from 4:45 to 6 p.m. in von Kármán Auditorium.

"Murder and Molecules"—This talk by Cal State Los Angeles professor Harold Goldwhite will cover the development of scientific detection in mystery fiction. It will be presented at 8 p.m. in Beckman Auditorium. Free admission. For more information, call (626) 395-4652 or visit www.events.caltech.edu.

Tuesday, February 21

"Interstellar Dust Within the Solar System: The In-situ Detection Point of View"—Join Dr. Nicolas Altobelli

of the Planetary Sciences and Life Detection Section at noon in the 167 conference room. This seminar aims to draw the attention of the astrophysics community to a relatively new method of studying interstellar dust, namely in-situ analysis, using dust detectors onboard spacecraft. In-situ observation of interstellar dust grains is of strong astrophysical interest as it allows retrieval of crucial information that may be not accessible by standard astronomical methods.

Wednesday, February 22

"Beyond Pluto: Discovery of the 10th Planet"—Caltech astronomy professor Michael Brown will speak at 8 p.m. in Caltech's Beckman Auditorium. Free admission. For more information, call (626) 395-4652 or visit www.events.caltech.edu.



JPL Library 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 the reference desk, ext. 4-4200.

JPL Toastmasters Club—Meeting at 5 p.m. in conference room 167. Call Dirk Runge, ext. 3-0465, or visit www.jplcaltehtoastmasters.com.

Thursday, February 23

Caltech Architectural Tour—Hosted by the Caltech Women's Club, from 11 a.m. to 12:30 p.m. Free and open to the public. Meet at the Athenaeum front hall, 551 S. Hill Ave. For reservations, call Susan Lee, (626) 395-6327.

Clogging Class—Meets at noon in Building 300-217. For more information, call Shary DeVore at ext. 4-1024.

JPL Golf Club—Meeting at noon in Building 306-302.

Science 101 Lecture—Max Coleman, director of JPL's Center for Life Detection, will present "Signs of Life, As I Live and Breathe: Detecting Life on Other Planets" at noon in von Kármán Auditorium.

Thu.-Fri., February 23-24

Von Kármán Lecture Series—Join JPL planetary scientist Kevin Baines for "New Views of Hidden Worlds: Revealing the Depths of Venus, Jupiter, Saturn and Titan with 21st-Century Spacecraft" at 7 p.m. Thursday in von Kármán Auditorium and Friday in Pasadena City College's Vosloh Forum, 1570 E. Colorado Blvd. Thursday's lecture will be webcast at www.jpl.nasa.gov/events/lectures/feb06.cfm. For more information, call Public Services at ext. 4-0112.

Friday, February 24

Children of Uganda—This group will perform East African music and dance at 8 p.m. in Caltech's Beckman Auditorium. Tickets are \$25, \$21 and \$17; high school age and younger, \$10. For more information, call (626) 395-4652 or visit www.events.caltech.edu.

Saturday, February 25

MatheMagic!—Bradley Fields will demonstrate math principles with the use of magic tricks at 2 p.m. in Caltech's Beckman Auditorium. Tickets are \$12 for adults, \$7 for high school age and younger. For more information, call (626) 395-4652 or visit www.events.caltech.edu.

Monday, February 27

JPL Softball—Meeting at 11:30 a.m. in the 167 conference room. All team managers and interested individual players not currently affiliated with a team should attend. Information is available at <http://jplreclclubs.caltech.edu/softball> or call Scott Morgan, ext. 4-4972 or Rich Benesh, 4-3748.

stardust

A look back: Stardust brings home its treasure

By Mark Whalen

We've had an excellent response from the public. It's a satisfying feeling to have such support from the public, . . .



Q: In the final days and hours leading up to the landing, what was going through your mind?

I was reasonably confident that we would land successfully. We knew that everything was designed and implemented properly before launch. However, I thought that there was still a small chance that some first-time flight event in the return capsule avionics would not work 100%, giving us a harder landing than planned.

The Genesis experience came into play here, making me feel very good. As we know, the Genesis capsule was not captured in mid-air by a helicopter and hit the ground pretty hard. However, most of their solar samples were recovered and are now at Johnson Space Center being analyzed by the science team. Even their flight avionics board survived this hard impact and worked when powered up in the lab.

I knew that our smaller Stardust capsule and aluminum/aerogel particle collection system were more robust than Genesis and in the event of a hard landing we still had an excellent chance of full mission success. The recovery team trained extensively for this possibility.

Q: So the anomaly that led to Genesis' landing actually gave you more confidence in Stardust's landing?

Yes, it did. It told me that we could land hard and still meet our science goals. However, as we now know, the capsule landed exactly as planned, very slowly under main parachute control. This was a tremendous accomplishment for America.

Q: After Stardust landed, the canister was flown to a Johnson Space Center curation facility. What was the reaction?

A concern was how aerogel would survive the space environment for seven years and if we had captured sufficient cometary particles for mission success. Within minutes of opening the capsule, Don Brownlee, the principal investigator, called me; I don't think his feet were touching the floor. He said the first thing that struck him was that the cometary aerogel, produced by Dr. Steve Jones of JPL, looked better than it did at the Cape prior to launch and had hundreds of dust impacts.

Jones had produced a variable density aerogel. It allows little particles to penetrate and be captured and the bigger particles to meet more and more resistance traveling within the aerogel to be captured as well, rather than going out the other side. It was a superior-quality product that allowed us to be successful.

Peter Tsou, the mission's deputy principal investigator, was part of the original team that wrote the proposal. He provided the aerogel to capture the interstellar particles.

Q: Who were some of the other key players on the team?

All Stardust team members should be proud of their individual accomplishments that led to the project's success. Mission manager Bob Ryan, from JPL, led the mission operations team, which performed near flawlessly. Ed Hirst, the mission systems manager and deputy mission manager, played the lead role in the decision process on releasing the return capsule—that process also was flawless.

Tom Wahl, our systems engineer, led the studies that allowed us to return to Earth with the lowest possible threat to human safety. We had to analyze our trajectory and target point within Utah to minimize the chance of being a threat to people and buildings, especially if we had an anomalous entry to Earth. The entry path and landing point selected gave us near zero probabilities.

Ben Lucas, Systems Safety, helped the project obtain the correct balance between safety and successful recovery. This was not a trivial task. I truly appreciated his support, since safety is the #1 priority at NASA and JPL.

Allan Chevront and Mike McGee, from Lockheed Martin Space Systems, led the successful spacecraft team and recovery team, respectively.

Stardust Project Manager Tom Duxbury led the team that sent the spacecraft on a seven-year mission to comet Wild 2—about 3 billion miles around the solar system—and back to Earth to a safe landing in the Utah desert on Jan. 15. He takes a few moments to reflect back on the journey.

Q: Besides the scientists who will be analyzing the samples, there's an opportunity for the public to get involved as well. How will that work?

About 75,000 people have signed up for the online "Stardust At Home" program. Anybody with a computer can do it. We are taking millions of photos of the aerogel cells and we will need help from the public to sort through this huge archive to identify interesting particles. People will be given instructions on what to look for with their image-browsing tools to help find particles of interest. For those who play a role in the particles that are selected and analyzed, they will be included in the science team and will have authorship of scientific journal articles that describe the results.

We've had an excellent response from the public. It's a satisfying feeling to have such support from the public, who pays for space exploration.

Also, Stardust has a microchip that about 1 million people "signed"—it came back intact in the capsule, and will eventually be on display at the Smithsonian Institution. People will be able to type their name into a computer that will then display their signature on the chip that traveled about 3 billion miles throughout our solar system.

Q: Is your name on the chip?

No [laughs]. I was busy with managing the operations system and supported the Mars Exploration Rovers, and I never got around to sign it. A real opportunity lost.

Q: Besides the sample return, what were the lessons learned from the mission?

Stardust demonstrated the integrity of its thermal protection system to withstand tremendous heat and pressure—more than the early Apollo human flights had to put up with. We also showed that the avionics to release the drogue parachute and main chute all worked perfectly. Those technologies are solid.

Another positive result was the recovery command center that we established at the Utah Test and Training Range (UTTR). I had planned this center before our launch; it was supported as one of the recommendations of the Genesis mishap board. I felt that I was where the most critical Earth-return operations would occur—capsule atmospheric entry, descent, landing and recovery.

I had excellent communications with JPL, Lockheed Martin, U.S. Stratcom, in Cheyenne Mountain, and UTTR range control, the helicopters and recovery team. I was able to follow the capsule from spacecraft separations, landing, the critical recovery operations supported by the helicopters and through the delivery of the capsule to the Stardust clean room at UTTR. All went as planned. And the spacecraft, controlled by the flight teams at JPL and Lockheed Martin, performed its divert maneuver after release and successfully flew by the Earth as planned.

Q: What happens to Stardust now?

On Sunday, Jan. 29, we sent commands to put the spacecraft into a hibernation state. There will be no more Deep Space Network tracking of the spacecraft by the project. A proposal is being written to NASA for a new project, comprised of many of the current team members, to fly the spacecraft on to another comet. If the proposal is approved, the spacecraft will fly by comet Tempel 1 in 2011 and return even better images than the historic Stardust Wild 2 images.

Q: What's next for you? Can you top this?

Working at JPL for 40 years, I've found that there is always something in the near future that will top what we just accomplished. It never ceases to amaze me what unbelievable things we continue to do collectively as an institution.

When I first came to JPL, we had the early Mariner flybys of Mars, Venus and Mercury, and then flew to the outer planets. To be a part of the select group of Americans that saw these planets and their moons and rings for the very first time, in the history of humanity, was very thrilling, very moving. Then these were continually topped by the Mars, Jupiter and Saturn orbiters (Mars Global Surveyor, Mars Odyssey, Galileo, Cassini) and Mars landers (Viking, Pathfinder, MER).

I will be very busy as a participating scientist on Global Surveyor and Odyssey and as an interdisciplinary scientist on the European Space Agency's Mars Express mission. I support the landing-site characterization efforts for Phoenix and Mars Surface Laboratory using both U.S. and European observations of Mars. In a few months, Mars Express will be flying over the Phoenix landing site, so now is a good time to start our long-range planning.

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Study shows quicker Greenland ice loss

By Alan Buis

Image from May 2005 shows the calving front of Helheim Glacier in southeast Greenland. The high calving activity is associated with faster glacial flow.



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, according to a study by researchers from JPL and the University of Kansas.

The study, published Feb. 17 in the journal *Science*, concludes that the changes to Greenland's glaciers in the past decade are widespread, large and sustained over time. They are progressively affecting the entire ice sheet and increasing its contribution to global sea level rise.

Researchers Eric Rignot of JPL and Pannir Kanagaratnam of the University of Kansas' Center for Remote Sensing of Ice Sheets used data from Canadian and European satellites. They conducted a nearly comprehensive survey of Greenland glacial ice discharge rates at different times during the past 10 years.

"The Greenland ice sheet's contribution to sea level is an issue of considerable societal and scientific importance," Rignot said. "These findings call into question predictions of the future of Greenland in a warmer climate from computer models that do not include variations in glacier flow as a component of change. Actual changes will likely be much larger than predicted by these models."

The evolution of Greenland's ice sheet is being driven by several factors. These include accumulation of snow in its interior, which adds mass and lowers sea level; melting of ice along its edges, which decreases mass and raises sea level; and the flow of ice into the sea from outlet glaciers along its edges, which also decreases mass and raises sea level. This study focuses on the least well known component of change, which is glacial ice flow. Its results are combined with estimates of changes in snow accumulation and ice melt from an independent study to determine the total change in mass of the Greenland ice sheet.

Rignot said this study offers a comprehensive assessment of the role of enhanced glacier flow, whereas prior studies of this nature had significant coverage gaps. Estimates of mass loss from areas without coverage relied upon models that assumed no change in ice flow rates over time. The researchers theorized if glacier acceleration is an important factor in the evolution of the Greenland ice sheet, its contribution to sea level rise was being underestimated.

To test this theory, the scientists measured ice velocity with interferometric synthetic-aperture radar data collected by the European Space Agency's Earth Remote Sensing Satellites 1 and 2 in 1996, the Canadian

Space Agency's Radarsat-1 in 2000 and 2005 and the European Space Agency's Envisat Advanced Synthetic Aperture Radar in 2005. They combined the ice velocity data with ice sheet thickness data from airborne measurements made between 1997 and 2005, covering almost all of Greenland's entire coast, to calculate the volumes of ice transported to the ocean by glaciers and how these volumes changed over time. The glaciers surveyed by those satellite and airborne instrument data drain a sector encompassing nearly 1.2 million square kilometers (463,000 square miles), or 75 percent of the Greenland ice sheet's total area.

From 1996 to 2000, widespread glacial acceleration was found at latitudes below 66 degrees north. This acceleration extended to 70 degrees north by 2005. The researchers estimated the ice mass loss resulting from enhanced glacier flow increased from 63 cubic kilometers in 1996 to 162 cubic kilometers in 2005. Combined with the increase in ice melt and in snow accumulation over that same time period, they determined the total ice loss from the ice sheet increased from 96 cubic kilometers in 1996 to 220 cubic kilometers in 2005. To put this into perspective, a cubic kilometer is 1 trillion liters (about 264 billion gallons of water), about a quarter more than Los Angeles uses in one year.

Glacier acceleration has been the dominant mode of mass loss of the ice sheet in the last decade. From 1996 to 2000, the largest acceleration and mass loss came from southeast Greenland. From 2000 to 2005, the trend extended to include central east and west Greenland.

"In the future, as warming around Greenland progresses farther north, we expect additional losses from northwest Greenland glaciers, which will then increase Greenland's contribution to sea level rise," Rignot said.

Orbiter approaches Mars

By Guy Webster



As it nears Mars on March 10, a NASA spacecraft designed to examine the red planet in unprecedented detail from low orbit will point its main thrusters forward and then fire them to slow itself enough for Mars' gravity to grab it into orbit.

Ground controllers for JPL's Mars Reconnaissance Orbiter expect a signal shortly after 1:24 p.m. Pacific Time that this mission-critical engine burn has begun. However, the burn will end during a suspenseful half hour with the spacecraft behind Mars and out of radio contact.

The orbiter carries six instruments for studying every level of Mars from underground layers to the top of the atmosphere. Among them, the most powerful telescopic camera ever sent to a foreign planet will reveal rocks the size of a small desk. An advanced mineral-mapper will be able to identify water-related deposits in areas as small as a baseball infield. Radar will probe for buried ice and water. A weather camera will monitor the entire planet daily. An infrared sounder will monitor atmospheric temperatures and the movement of water vapor.

The instruments will produce torrents of data. The orbiter can pour data to Earth at about 10 times the rate of any previous Mars mission, using a dish antenna 3 meters (10 feet) in diameter and a transmitter powered by 9.5 square meters (102 square feet) of solar cells. "This spacecraft will return more data than all previous Mars missions combined," said Project Manager Jim Graf.

Scientists will analyze the information to gain a better understanding of changes in Mars' atmosphere and the processes that have formed and modified the planet's surface. "We're especially interested

in water, whether it's ice, liquid or vapor," said JPL's Dr. Richard Zurek, the project scientist. "Learning more about where the water is today and where it was in the past will also guide future studies about whether Mars has ever supported life."

A second major job for Mars Reconnaissance Orbiter, in addition to its own investigation of Mars, is to relay information from missions working on the surface of the planet. During its planned five-year prime mission, it will support the Phoenix Mars Scout, which is being built to land on icy soils near the northern polar ice cap in 2008, and the Mars Science Laboratory, an advanced rover under development for launch in 2009.

However, before Mars Reconnaissance Orbiter can begin its main assignments, it will spend half a year adjusting its orbit with aerobraking. The initial capture by Mars' gravity on March 10 will put the spacecraft into a very elongated, 35-hour orbit. The planned orbit for science observations is a low-altitude, nearly circular, two-hour loop. To go directly into an orbit like that when arriving at Mars would have required carrying much more fuel for the main thrusters, requiring a larger and more expensive launch vehicle and leaving less payload weight for science instruments. Aerobraking will use hundreds of carefully calculated dips into the upper atmosphere—deep enough to slow the spacecraft by atmospheric drag, but not deep enough to overheat the orbiter.

"Aerobraking is like a high-wire act in open air," Graf said. "Mars' atmosphere can swell rapidly, so we need to monitor it closely to keep the orbiter at an altitude that is effective but safe." Current orbiters at Mars will provide a daily watch of the lower atmosphere, an important example of the cooperative activities between missions at Mars.

For more information, visit www.nasa.gov/mro.

News Briefs



Dr. Gerard Holzmann

Holzmann earns computing award

DR. GERARD HOLZMANN, who leads JPL's Laboratory for Reliable Software, has been selected by the Association for Computing Machinery as one of this year's six recipients of the Paris Kanellakis Award.

The association said the honor is "for the development of automata-theoretic techniques for reactive-systems verification, and the practical realization of powerful formal-verification tools based on these techniques."

The Paris Kanellakis Theory and Practice Award is granted yearly by the Association for Computing Machinery to honor specific theoretical accomplishments that have had a significant and demonstrable effect on the practice of computing. The award is accompanied by a prize of \$5,000.

Holzmann joined JPL in May 2003 to develop the newly established Laboratory for Reliable Software, which conducts research that targets the application of both new and existing formal verification techniques to mission software.

Last year, he received the prestigious honor of election to the National Academy of Engineering.

Space Foundation honors JPL

JPL has won the Space Foundation's Jack Swigert Award for Space Exploration. The award, which honors the memory of Apollo 13 astronaut and Colorado congressman-elect JACK SWIGERT, will be presented April 3 in Colorado Springs during the 22nd National Space Symposium.

JPL was chosen "for its successful management and operation of a vibrant portfolio of inspiring space exploration programs including the Mars Global Surveyor, the Cassini-Huygens probe to Saturn and its moon Titan, the Stardust spacecraft, the Mars Exploration Rovers Spirit and Opportunity, the Spitzer Space Telescope, the Deep Impact mission, and the Mars Reconnaissance Orbiter," the organization said.

"JPL continues to blaze new trails of exploration and expand the edges of

our known world," said ELLIOT PULHAM, president and chief executive officer of the Space Foundation. "We are pleased to honor JPL for its ongoing work to venture into the unknown and report to the world what it finds."

The Space Foundation was founded in 1983, in part to honor the memory and accomplishments of astronaut Swigert. It is a national nonprofit organization that advances civil, commercial and national security space endeavors and educational excellence. The award was created in 2004 in tribute to his enduring legacy of space exploration. The Mars Exploration Team from JPL was the first recipient of the award. The 2005 recipient was President GEORGE W. BUSH.

Women celebrated March 8

The Director's Advisory Council for Women will hold a Women's History Month luncheon, "Celebrating the Voice of Women: Builders of Communities and Dreams," on Wednesday, March 8, from 11:30 a.m. to 1:30 p.m. at the La Cañada-Flintridge Country Club.

Being honored is DR. SHIRLEY ANN JACKSON, president of Rensselaer Polytechnic Institute. Tickets are \$22. Ticket request forms, which are due March 1, are available at <http://acw>.

Science fair judges needed

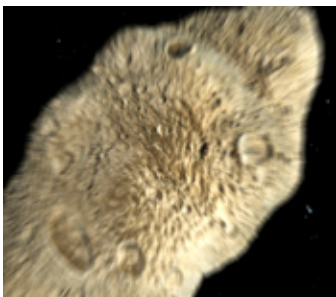
Volunteers are sought to serve as judges for the 56th annual Los Angeles County Science Fair for middle school and high school students, to be held at the Los Angeles Convention Center April 19 to 21. In the past, JPLers have generously responded with their time and expertise to act as judges.

More than 60 judges are still needed in areas such as biology, physiology, behavioral/social sciences, biochemistry, Earth/space sciences, engineering, math, and computer sciences.

If interested, respond before March 9 to TIM WILLIAMSON at Williamson_Tim@lacoec.edu or (562) 922-6682.

For more information, call DAPHNA ENZER, ext. 3-6414, or RICHARD SHOPE, 4-3812.

Challenge: asteroid deflection



Artist's impression of the final moments before impact with asteroid 2001 TW229.

The target: Asteroid 2001 TW229. The problem: How to get there and deliver the most energy to deflect its orbit. This was only a test, since the asteroid poses no danger to the Earth, but the potential need to deflect an Earth-impacting asteroid is certainly not an impossible scenario. So the European Space Agency's Advanced Concepts Team staged the Global Trajectory Optimisation Competition late last year to determine the best way to slam a spacecraft into the celestial object.

Researchers from around the world were invited to bring their time, resources and resourcefulness to bear on this fictional mission design problem. Since this was an elaborate test case for mission design software and algorithms undergoing development at JPL under the In-Space Propulsion Program, a team of JPL mission designers volunteered to participate in the competition in support of the development. The JPL team proved best, beating teams of researchers from across Europe, China, Russia and the U.S. Its corkscrew-like trajectory included four Earth flybys, two flybys of Jupiter and one each for Venus and Saturn.

Earlier this month, at a workshop for the participating teams at the European Space and Technology Research Centre in the Netherlands, a plaque was presented to the winning team from JPL. In all, about 15 JPLers were included in the honor, almost all from the Outer Planets Mission Analysis Group.

The problem, said team leader Anastassios Petropoulos, was one of celestial mechanics and math, rather than of engineering. To impact the asteroid, the goal was to design a theoretical optimal low-thrust trajectory departing from Earth. Petropoulos noted that the team considered a variety of methods to solve the problem. To do it, they required expertise in a variety of areas, including low-thrust trajectory design, celestial mechanics and global optimization.

"The task was representative of what we might actually do to deflect an Earth-bound asteroid," Petropoulos said. "When the spacecraft hits the asteroid, much of the spacecraft's momentum is transferred to the asteroid, thereby changing its orbit. The challenge is to find a trajectory that changes the hypothetical Earth-bound asteroid's orbit enough so that it ends up missing the Earth."

The response to the competition was so good that the Advanced Concepts Team said it hopes the competition will be an annual event, "to further stimulate research in the exciting field of mission analysis."

"The fact that the competition was held shows that there are still significant improvements that can be made on our methods in the astrodynamics community," Petropoulos said. "It's a wonderful idea."

The competition results are available at www.esa.int/gsp/ACT/mission_analysis/goresults.htm.

Many family events offered at Caltech

Events just for families continue this month at Caltech as part of the newly established "Programs for School Groups and Families."

The "Family Nights Out" series will next offer a performance by Children of Uganda on Friday, Feb. 24, at 8 p.m. in Beckman Auditorium. This 20-member contingent, through exuberant dance and song, tells the stories, history, legends and beliefs of East Africa. Tickets for those of high school age and younger are \$10. Adult prices are \$25, \$21 and \$17.

On Saturday, Feb. 25, the "Saturdays at 2:00" series continues with "MatheMagic" presented by Bradley Fields, in Beckman Auditorium.

Fields, a magician and former math teacher, reprises his show at Caltech. It's all about math, incorporating bits of history, language and philosophy. Kids will leave the theater with self-confidence and a renewed sense of wonder.

This show is recommended for ages 6 and up. Youth tickets are \$7; adult tickets are \$12.

Special Events Calendar

Ongoing Support Groups

Alcoholics Anonymous—Meets Wednesdays at 11:30 a.m.

Caregivers Support Group—Meets the first Thursday of the month at noon in Building 167-111 (the Wellness Place).

Codependents Anonymous—Meets at noon every Wednesday.

Lambda (Gay, Lesbian, Bisexual and Transgender Networking Group)—Meets the first Friday and third Thursday of the month at noon in Building 111-117. For more information, call Randy Herrera, ext. 3-0664.

Parents Group for Children With Special Needs—Meets the second Thursday 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. 4-3680.

Friday, February 24

JPL Black History Month Celebration—Alice Fairhurst, former JPL career development coordinator, will present "DNA Testing: How to Trace Your Ancestry" from 11:30 a.m. to 1 p.m. in von Kármán Auditorium.

Von Kármán Lecture Series—Join JPL planetary scientist Kevin Baines for "New Views of Hidden Worlds: Revealing the Depths of Venus, Jupiter, Saturn and Titan with 21st-Century Spacecraft" at 7 p.m. in Pasadena City College's Vosloh Forum, 1570 E. Colorado Blvd. For more information, call Public Services at ext. 4-0112.

Friday-Sunday, Feb. 24-26

"As You Like It"—The Shakespeare play will be presented in Caltech's Ramo Auditorium Friday and Saturday at 8 p.m., Sunday at 2 p.m.

Saturday, February 25

MatheMagic!—Bradley Fields will demonstrate math principles with the use of magic tricks at 2 p.m. in Caltech's Beckman Auditorium. Tickets are \$12 for adults, \$7 for high school age and younger. For more information, call (626) 395-4652 or visit www.events.caltech.edu.

Monday, February 27

JPL Softball —Meeting at 11:30 a.m. in the 167 conference room. All team managers and players not currently affiliated with a team should attend. Information is available at <http://jplpreclubs.caltech.edu/softball> or call Scott Morgan, ext. 4-4972 or Rich Benesh, 4-3748.

Tuesday, February 28

Information Technology Career Panel—Sponsored by JPL's Advisory Council for Women at 11:30 a.m. in von Kármán Auditorium. Scheduled panelists are Melissa English, Trisha Jansma, Izeller Cureton-Snead, Robin Dumas and Joy Bottenfield.

Wednesday, March 1

Associated Retirees of JPL/Caltech—Meeting at 10 a.m. at La Cañada United Methodist Church, 104 Berkshire Place, La Cañada. Call (626) 794-1698 to leave a message for an ARC board member.

JPL Chorus—Meets at noon in Building 233-303. For more information, call Shary DeVore, ext. 4-1024.

JPL Civil Programs—A town hall meeting will be held from 2:30 to 4 p.m. in Building 180-101 to discuss reimbursable opportunities in science, technology and engineering, working with various federal agencies and universities. Lessons learned, processes and resources will be covered.

JPL Library 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 the reference desk, ext. 4-4200.

Thursday, March 2

JPL Gun Club—Meeting at noon in Building 183-328.

Friday-Sunday, March 3-5

"As You Like It"—The Shakespeare play will be presented in Caltech's Ramo Auditorium Friday at 8 p.m. and Saturday at 2 p.m. Sunday's show will be at the Huntington Library in San Marino at 1 p.m.

Tuesday, March 7

JPL Gamers Club—Meeting at noon in Building 301-227.

JPL Genealogy Club—Meeting at noon in Building 301-271.

Wednesday, March 8

JPL Amateur Radio Club—Meeting at noon in Building 238-543.

JPL Chorus—Meets at noon in Building 233-303. For more information, call Shary DeVore, ext. 4-1024.

JPL Library 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 the reference desk, ext. 4-4200.

JPL Toastmasters Club—Meeting at 5 p.m. in conference room 167. Call Dirk Runge, ext. 3-0465, or visit www.jplcaltechtostmasters.com.

Thursday, March 9

"Behind the Veil: Inside the World of Arab Women"—National Geographic photographer Annie Griffiths Belt will lecture at 8 p.m. in Caltech's Beckman Auditorium. Free admission. For more information, call (626) 395-4652 or visit www.events.caltech.edu.

Clogging Class—Meets at noon in Building 300-217. For more information, call Shary DeVore at ext. 4-1024.

Saturday, March 11

Irish Ballads—Singer Karan Casey will perform at 8 p.m. in Caltech's Beckman Auditorium. Tickets are \$25, \$21 and \$17; \$10 for high school age and younger. Call (626) 395-4652 or visit www.events.caltech.edu.

Tuesday, March 14

JPL Stamp Club—Meeting at noon in Building 183-328.

Other shows for children and their families will continue through the spring. The next Family Nights Out event, "Flamenco Vivo Carlota Santana," is set for Friday, March 3, with "Hal Holbrook in Mark Twain Tonight!" scheduled for Saturday, March 18. Both shows start at 8 p.m.

Later next month, the "Science Saturdays at 2:00" series will continue with "Space—Are We Alone?" on Saturday, March 25 at 2 p.m. Laura Baker, of Caltech's Geology Department, will introduce the film and lead a post-screening discussion. Tickets are \$5.

Also part of "Programs for School Groups and Families" is a series of field trips in the performing arts and sciences. These sessions, arranged through schools, provide entertaining and educational experiences to complement science curriculum.

For more information on programs for families and other Caltech Presents events, log on to <http://events.caltech.edu>.

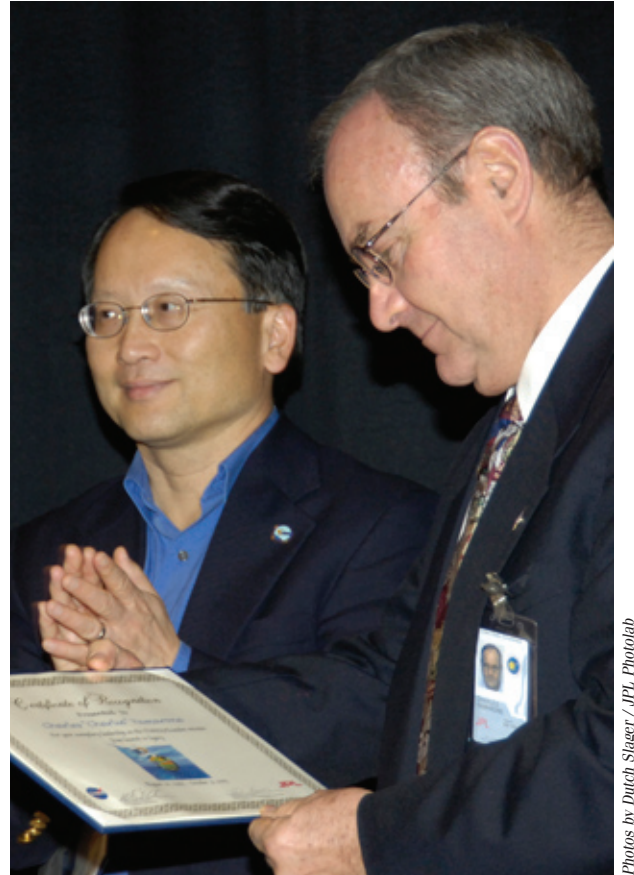
Topex/Poseidon staff recall mission's highlights

MEMBERS OF THE TOPEX/POSEIDON PROJECT CELEBRATED THE END OF THE MISSION EARLIER THIS YEAR WITH A GET-TOGETHER ON FEB. 9.

Topex/Poseidon, which lasted 13 years, was the first to produce data that demonstrated the importance of large-scale ocean phenomena on driving global climate. The mission was launched during a minor El Niño event in 1992 and, when a major El Niño hit five years later, Topex/Poseidon data prompted communities to prepare for the impending storm, helping to save lives.

Speakers discussed Topex/Poseidon overcoming numerous challenges, reminiscing about how the creativity and prowess of the mission operations and engineering teams kept the satellite going long after its three-year primary mission.

Topex/Poseidon was hailed as a pioneer in satellite-based ocean science. Its successor, Jason, will eventually be followed by the Ocean Surface Topography Mission, which will be operated by the National Oceanic and Atmospheric Administration.



From left: Oceanographer Dr. Bill Patzert (top); Earth Science and Technology Director Dr. Diane Evans (bottom); Dudley Chelton, a science team member since Topex/Poseidon's inception; Topex/Poseidon Project Scientist Lee Fu and the mission's first project manager, Charles Yamarone.

Photos by Dutch Slagter / JPL Photolab



Santa Monica takes Science Bowl regional held on Lab

ONE OF TWO TEAMS FROM SANTA MONICA HIGH SCHOOL WON A REGIONAL COMPETITION for the National Science Bowl in a contest held at JPL Feb. 11.

The regional event included approximately 120 high school students from 22 Southern California-area schools. Teams answered tough questions about biology, chemistry, physics, mathematics, astronomy and Earth science.

The event, one of 68 national regionals held from January to March, was hosted by the Public Services Office. In all, more than 40 volunteers from all areas of JPL helped make the event a success.

"Without our JPL volunteers, these types of events would not be possible," noted Public Services Office Manager Kim Lievense.

The Laboratory has hosted a regional Science Bowl competition for Southern California-area teams for 14 years. The U.S. Department of Energy created the National Science Bowl in 1991 to encourage high school students to excel in math and science and to pursue careers in those fields.

The regional champions receive an all-expense-paid trip to compete in the National

Science Bowl finals in Washington, D.C., April 27 thru May 1. In addition to the academic competition, students will be given the opportunity to build and race a model fuel cell car and attend presentations by well-known scientists on current topics in math and the sciences.

Among the many student-based competitions it supports, JPL will next co-host regional competitions for the National Ocean Sciences Bowl on Saturday, March 4, at USC. Coordinated by the Consortium for Oceanographic Research and Education, the event is in many ways similar to the National Science Bowl but focuses specifically on ocean-related topics. Student teams answer questions about biology, chemistry, geology and physics of the oceans, as well as navigation, geography and related history and literature.

The National Ocean Sciences Bowl invites winning teams from regional competitions to go head-to-head at the finals in Pacific Grove, Calif. in May.



Public Services Office Manager Kim Lievense with members of the winning Santa Monica High School team.

From left: Ben Lucas, Dimitry Petrenko, Bennett Rankin, Ingo Gaida and ZeNan Chang.

Below, Santa Monica competes against Arcadia High School (left).

