

universe

Jet Propulsion Laboratory

I n s i d e

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Spitzer eyes icy, organic material

Ultra-deep images also unveiled

By Whitney Clavin

NASA has announced new findings from the JPL-managed Spitzer Space Telescope, including the discovery of significant amounts of icy organic materials sprinkled throughout several "planetary construction zones," or dusty planet-forming discs, which circle infant stars.

These materials, icy dust particles coated with water, methanol and carbon dioxide, may help explain the origin of icy planetoids like comets. Scientists believe these comets may have endowed Earth with some of its water and many of its biogenic, life-enabling materials.

Drs. Dan Watson and William Forrest of the University of Rochester, N.Y., identified the ices. They surveyed five very young stars in the constellation Taurus, 420 light-years from Earth. Previous studies identified similar organic materials in space, but this is the first time they were seen unambiguously in the dust making up planet-forming discs.

In another finding, Spitzer surveyed a group of young stars and found intriguing evidence that one of them may have the youngest planet detected. The observatory found a clearing in the disc around the star CoKu Tau 4. This might indicate an orbiting planet swept away the disc material, like a vacuum leaving a cleared trail on a dirty carpet. The new findings reveal the structure of the gap more clearly than ever before.

◀ Nebula RCW 49 is 13,700 light-years from Earth and houses more than 2,200 stars.



Because CoKu Tau 4 is about 1 million years old, the possible planet would be even younger. As a comparison, Earth is approximately 4.5 billion years old.

"These early results show Spitzer will dramatically expand our understanding of how stars and planets form, which ultimately helps us understand our origins," said Dr. Michael Werner, Spitzer project scientist at JPL.

Spitzer also discovered two of the farthest and faintest planet-forming discs ever observed. These discs surround two of more than 300 newborn stars uncovered for the first time in a stunning new image of the dusty stellar nursery called RCW 49. It is approximately 13,700 light-years from Earth in the constellation Centaurus.

"Preliminary data suggest that all 300 or more stars harbor discs, but so far we've only looked closely at two. Both were found to have discs," said Dr. Ed Churchwell of the University of Wisconsin, principal investigator of the RCW 49 research, with Dr. Barbara Whitney of Space Science Institute, Boulder, Colo.

Planet-forming, or "protoplanetary," discs are a natural phase in a star's life. A star is born inside a dense envelope of gas and dust. Within this envelope, and circling the star, is a flat, dusty disc, where planets are born.

"By seeing what's behind the dust, Spitzer has shown us star and planet formation is a very active process in our galaxy," Churchwell said.

Spitzer's exquisitely sensitive infrared eyes can see planet-forming discs in great detail. "Previously, scientists could study only a small sample of discs, but Spitzer is already on its way toward analyzing thousands of discs," Werner said.

Spitzer's infrared spectrograph instrument, which breaks apart infrared light to see the signatures of various chemicals, was used to observe the organic ices and the clearing within CoKu Tau 4's disc. Spitzer's infrared array camera found the new stars in RCW 49. Papers on the research will appear in the Sept. 1 issue of the journal *Astrophysical Journal Supplements*.

On June 1, astronomers unveiled the deepest images from Spitzer and announced the detection of distant objects—including several

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Lab hosts tribal colleges

By Susan Braunheim-Kalogerakos

Michael Nieto of Section 272, left, greets Dr. Ron His Horse Is Thunder, president of Sitting Bull College in Fort Yates, N.D., at the tribal colleges conference.

Representatives from tribal colleges and universities nationwide convened May 19–21 at a JPL-hosted conference aimed to develop partnerships and encourage science, engineering and technology-related research and education programs.

The Education and Research Opportunities for Tribal Colleges and NASA Conference was designed to encourage invitees to access education, research and professional development opportunities with space and Earth science missions and provide an opportunity to share goals for education and research. The invitation was extended to tribal college presidents, deans, math and science teachers and NASA representatives. Twenty-six of the nation's 34 tribal colleges were represented, as were eight of the 11 NASA centers. The tribal colleges, mostly located on Native American reservations, serve about 30,000 students.

"One of the conference objectives was to provide a forum to allow the tribal college presidents and staff to elaborate specifically on identified needs of the colleges," said Roger McClure, Indigenous Math and Science Institute K–12 Programs director, Salish Kootenai College, Pablo, Montana. "I think the conference went a long way to accomplish this goal."

The conference consisted of several open sessions that covered a wide variety of topics ranging from engineering education initiatives to grant-writing workshops. The event also included a closed roundtable discussion that covered partnership opportunities, challenges these institutions face, their accomplishments and the cultural nuances of each tribe.

The event was sponsored by JPL and funded by NASA Code N's Higher Education Division and participating centers' Education Offices through the American Indian Higher Education Consortium, which advocates and protects Native American history, culture, art and language through higher education.

"Tribal colleges have been around for less than 40 years, and consequently, we sometimes feel overlooked," McClure said. "So, when NASA chooses to hold a conference specifically for tribal college presidents and their math and science personnel it is a big

deal. When JPL agrees to host the conference that is icing on the cake."

The Salish Kootenai College is located on the Flathead Indian Reservation. The college mainly serves the Salish/Pend d'Orielle and Kootenai tribes.

Some of the other tribal colleges represented at the conference include Diné College—which is controlled by the Navajo Nation—with campuses in Arizona and New Mexico, and Sitting Bull College in Fort Yates, North Dakota, started by the Standing Rock Sioux Tribal Council.

JPL will directly benefit from the tribal college partnerships, which will help spread the JPL story to the typically underserved Native American population. The conference provided NASA and JPL with feedback on what current programs tribal colleges feel are valuable and what needs to be changed.

According to Jennifer Cummings-Martin, manager of JPL's Diversity Program Office, "JPL leveraged this conference to share research, educational and mission-related outreach opportunities, while learning of the needs, capabilities and accomplishments of the participating institutions."

The event also offered an opportunity for tribal colleges to share future goals for education and research. "This conference offered tribal colleges and universities the opportunity to potentially collaborate on upcoming missions that in some way would have a positive impact on tribal communities," said Eva Graham, the JPL Minority Education Initiatives manager. "It also enabled an open platform for dialog, building sustainable partnerships and an opportunity to impart rules of engagement in working with tribal colleges and universities."

Through the conference, distinct plans for future collaborations between the tribal colleges and JPL were made. These plans include pre-service and in-service teacher professional development, teacher workshop development, and internships and externships for students and faculty. These types of education and professional development opportunities will enable more Native Americans to enter the science, technology, engineering and math education pipeline.

According to Cummings-Martin, the tribal college representatives came away from the conference feeling like they had a place with NASA. "Many tribal college and university presidents and representatives came into the conference with the preconception that there were no opportunities for them. However, they walked away with the enlightenment that there are definitely roles for them in the NASA vision."



Bob Brown/JPL Photolab

News Briefs

Lab wins hydrogen research project

JPL has been awarded a partnership in a hydrogen storage research project, one of many selected last month by the Department of Energy.

DOE selected more than \$150 million in hydrogen storage research projects to support President Bush's Hydrogen Fuel Initiative. The awards include the formation of three "Centers of Excellence"—at the National Renewable Energy Laboratory, Los Alamos National Laboratory and Sandia National Laboratories—integrating the expertise of the DOE national laboratories in partnership with industry and academia.

JPL will be a member of Sandia's Metal Hydride Virtual Center of Excellence, as a result of a proposal titled "Development and Evaluation of Advanced Hydride Systems for Reversible Hydrogen Storage" and submitted by JPL in September 2003 in response to the DOE's "Grand Challenge" solicitation. DR. ROBERT BOWMAN of Section 354 is the JPL principal investigator.

The three centers of excellence will address the major technical barrier to on-board hydrogen storage—storing enough hydrogen to enable greater than 300-mile driving range without impacting cargo and/or passenger space or significantly increasing the vehicle's weight. Bowman said JPL's contributions will include assisting in the design of improved hydride storage vessels and developing better storage materials with higher weight percentages of hydrogen than current hydride systems' light-mass containers.

"One of the key recommendations of a recent National Academies report, 'The Hydrogen Economy: Opportunities, Costs, Barriers and R&D Needs,' is that DOE should partner with a broader range of academic and industrial organizations to greatly increase the probability of success in bringing the United States to a hydrogen economy," said JPL's DR. DAVID TRALLI, manager of Civil Space Programs. "JPL's successful bid is an example of non-NASA or reimbursable opportunities pursued through the Civil and Commercial Space Program of the National Space and Technology Applications (NSTA) Office at JPL, addressing research and technology areas of national importance where JPL contributes unique capabilities that in turn support the NASA mission."

The Spacecraft Power Technologies Program, organization 661 (managed by DR. RAO SURAMPUDI) will manage the technical work under the award while NSTA continues to develop further opportunities with DOE.

O'Neil receives honorary doctorate

WILLIAM O'NEIL, former Galileo project manager now retired from the Lab, received an honorary Doctor of Engineering degree from Purdue University in ceremonies held last month.

O'Neil joined JPL in 1963. His assignments at JPL included trajectory design and navigation for Surveyor, the first soft-landing lunar spacecraft. He was the navigation chief for Mariner Mars, the first U.S. spacecraft to orbit another planet, and for Viking, the first soft-landing craft on Mars. In addition, he was the science and mission design manager for Project Galileo during its development phase throughout the 1980s, and then became project manager shortly after its launch in 1989.

Following Galileo's primary mission, O'Neil was appointed chief technologist

and then project manager for the Mars Exploration Program at JPL. However, that project was postponed and O'Neil became manager of JPL's Systems Management Office until his retirement in 2001. He continues as chairman of the Space Exploration Committee of the International Astronautical Federation and is a member of the International Academy of Astronautics.

O'Neil received NASA's highest award, the Distinguished Service Medal, for his management of Galileo. In 1997, he received the Purdue Distinguished Engineering Alumni Award and an honorary doctorate from the University of Padova in Italy, Galileo's university.

O'Neil earned his bachelor's degree in aeronautical engineering from Purdue in 1961. Six years later he received his master's in the same field from USC.

Cassini corrects path

The Cassini spacecraft successfully performed a critical six-minute trajectory correction maneuver May 27 to put it on course with its first encounter, Saturn's outermost moon Phoebe, set for June 11. The spacecraft is operating normally and is in excellent health.

"The maneuver is very critical for getting us into Saturn orbit because it is the first checkout of the bipropellant pressurization system after nearly five years of dormancy," said TODD BARBER, propulsion engineer for Cassini at JPL. "It sets the stage for Saturn orbit insertion on June 30."

During the course of its trip, Cassini has traveled 3.4 billion kilometers (2.1 billion miles). "We couldn't have asked for a smoother ride," said ROBERT MITCHELL, program manager for the Cassini-Huygens mission at JPL. "All the instruments are performing well, and for almost seven years we have traveled without any major hitches. The excitement is building as we are getting ready to put Cassini in orbit around the ringed planet." The orbiter has relied on three radioisotope thermoelectric generators to power all the electrical components, including the 12 science instruments. The European-built Huygens probe on board Cassini carries six instruments.

TV, movie workshop available

The American Film Institute is accepting applications from scientists and engineers to participate in a workshop to learn about writing for movies and television. Focusing on the craft and practice of screenwriting, "Catalyst Workshop: Communicating Science and Engineering" will be held July 17 and 18 at the American Film Institute in Los Angeles.

The purpose of the workshop is twofold: to provide a means for scientists and engineers to become more knowledgeable about motion picture projects, and to encourage them to learn how to write and submit scripts. Scientists and engineers are needed as consultants on movie sets, just as lawyers and police officers have been for the past decade.

Applications are due June 9. Twelve applicants will be selected to attend the workshop. For application procedures and requirements, visit <http://www.afic.com/education/catalyst/default.aspx>.

The workshop is funded by the U.S. Air Force Office of Scientific Research. The National Academies supports accurate portrayal of science and engineering on TV and film, and encourages interested scientists and engineers to get involved.

Special Events Calendar

Ongoing Support Groups

Alcoholics Anonymous—Meetings are available. Call the Employee Assistance Program at ext. 4-3680 for time and location.

Caregivers Support Group—Meets the first Thursday of the month at noon in Building 167-111 (the Wellness Place). For more information, call the Employee Assistance Program at ext. 4-3680.

Codependents Anonymous—Meeting at noon every Wednesday. Call Occupational Health Services at ext. 4-3319.

Gay, Lesbian and Bisexual Group—Meets the first Friday and third Thursday of the month at noon in Building 111-117. Call the Employee Assistance Program at ext. 4-3680 or Randy Herrera at 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).

Working Parents Support Group—Meets the third Thursday of the month at noon in Building 167-111. For more information, call the Employee Assistance Program at ext. 4-3680.

Saturday, June 5

Caltech Ballroom Dance Club—The end-of-term party will be held in Winnett Lounge, beginning with a mini-lesson on merengue at 8:30 p.m., followed by general dancing from 9 p.m. No partner or previous dance experience is necessary. Free admission; refreshments provided.

Sunday, June 6

Chamber Music—Calico Winds will perform a free outdoor concert at 2:30 p.m. at Old Mill, 1120 Old Mill Rd., San Marino. This is part of Caltech's chamber concert series and is performed off campus during Dabney Lounge's remodeling. For more information, call (626) 395-4652.

Tuesday, June 8

CSMAD Talk—Jonathan Krueger, systems methodologist at Guidants Cardiac Rhythm Management in St. Paul, Minn., will present "Applying Computer Models

to the Design of Implantable Cardiac Rhythm Management Devices" at 10:30 a.m. in conference room 167. The talk is presented by the Center for Space Mission Architecture and Design.

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

Wednesday, June 9

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

JPL Toastmasters Club—Meeting at 5 p.m. in the 167 conference room. Call Debbi Llata at ext. 4-8374 for information.

Thu.-Fri., June 10-11

Von Kármán Lecture Series—Dr. Charles Beichman, executive director of Caltech's Michelson Science Center, will present "Finding Planets and Searching for Life: Worthy Goals for 21st Century Science," 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/jun04.cfm. For more information, call Public Services at ext. 4-0112.

Saturday, June 19

CEC Wine Tasting Benefit—The JPL/Caltech Child Educational Center will hold its annual fundraiser from 5:30 to 10 p.m. at Caltech's Avery House, 293 S. Holliston Ave. in Pasadena. The event will include fine wines, great food and live music from the Chad Edwards Quartet. Guests may bid on unique auction items and take their chances at the gaming tables. All proceeds from the evening will directly benefit the nonprofit organization, which has been providing high-quality child care and educational outreach services since 1979. General admission tickets are \$35; Connoisseur tickets include 10 tastes of premium wines, and are \$65. Tickets are available at the JPL Store, Caltech Book Store and the CEC, 140 Foothill Blvd. in La Cañada. Tickets may also be purchased at the door the evening of the event for an additional \$10. For more information, call ext. 4-3418.

American Heritage Week, June 15-17

All events will be held on the mall. JPL Director Dr. Charles Elachi will deliver opening remarks on Tuesday, June 15, at 11:50 a.m., followed by an introduction of the American Heritage Week committee and music by JPL's Big Band Theory. Ice cream and sun visors will be given away while supplies last.

Free ice cream will also be offered on Wednesday afternoon, when several performances are planned from 11:45 a.m. to 1:30 p.m. More lunch-hour entertainment will follow on Thursday, which is also the ever-popular International Cuisine Night, to be held from 4:45 to 7:30 p.m. Along with numerous food booths, cultural dance and music will be offered into the evening hours.

Here's the entertainment schedule for Thursday:

Stage 1

4:30-5:00 East Indian Dance, Dheera Sharma
5:00-5:30 Cleary School of Irish Dance
5:30-6:00 Filipino: Troy Philippines
6:00-6:30 Filipino: Kultura Dance Group
6:30-7:00 Thai Boxing and Sword Fight
7:00-7:30 Polynesian (Hawaiian) Dance Group

Stage 2

4:30-5:30 African American Music

Stage 3

5:00-7:30 Big Band Theory

Table Mountain telescope lab dedicated

The Optical Communications Telescope Laboratory is shown at dedication ceremonies.

JPL's Optical Communications Telescope Laboratory was commissioned May 18 at the Lab's Table Mountain facility. OCTL is a research and development facility that houses a 1-meter elevation/azimuth telescope capable of tracking spacecraft from 250-kilometer altitude to deep space.

Designated as the uplink facility for the Mars '09 Lasercomm demonstration, OCTL will support high-power laser beam propagation and communications links. Specially designed baffles and secondary spider support covers enable the telescope to operate as close as within 30 degrees of the sun, and safely point as close as 10 degrees.

Early OCTL projects will include a high-bandwidth unmanned aerial vehicle-to-ground link, experiments to validate multi-beam scintillation mitigation strategies, the development of safe laser beam propagation strategies, and exploration of adaptive optics strategies to reduce the effect of sky background noise on the deep-space downlink at small sun angles.



Tom Wynne / JPL Photolab

Jupiter orbiter

receives mission design requirements

NASA has issued its mission design requirements to three industry teams for a proposed mission to Jupiter and its three icy moons. The requirements are also the first product formulated by NASA's new Office of Exploration Systems.

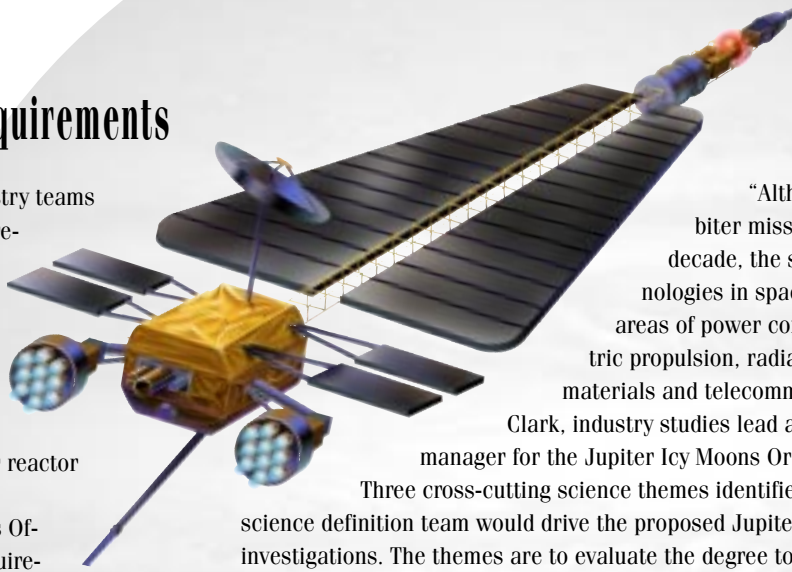
The Jupiter Icy Moons Orbiter is a spacecraft with an ambitious proposed mission that would orbit three planet-sized moons of Jupiter—Callisto, Ganymede and Europa—that may harbor vast oceans beneath their icy surfaces. JPL manages the proposed Jupiter Icy Moons Orbiter mission, which would be powered by a nuclear reactor and launched sometime in the next decade.

Associate Administrator retired Rear Adm. Craig Steidle of NASA's Office of Exploration Systems said, "The Jupiter Icy Moons Orbiter requirements represent our new way of doing business, tracing exploration strategies to the technology maturation programs that will enable this exciting mission and the other missions that make up Project Constellation."

The request for proposal was released last week to the three previously qualified industry teams led by Boeing, Huntington Beach; Lockheed Martin, Denver; and Northrop Grumman, Redondo Beach. These three companies are currently working under study contracts investigating conceptual designs for the mission. The proposals are due July 16, 2004.

The scope of the initial contract is to co-design the spacecraft through the preliminary design with the government team. A contract modification will be issued after preliminary design to implement the design, to integrate and test the spacecraft and to integrate the spacecraft with the reactor module and mission module.

JPL would be responsible for delivering the mission module, which would include instruments procured competitively via a NASA announcement of opportunity. The launch vehicle will be supplied by NASA. The Department of Energy's Office of Naval Reactors would be responsible for the reactor module. To ensure the technologies demonstrated are consistent and coordinated with the Vision for Space Exploration, Project Constellation is managed within the Office of Exploration Systems.



"Although the Jupiter Icy Moons Orbiter mission may not launch until the next decade, the study of revolutionary new technologies in spacecraft design is underway in the areas of power conversion and heat rejection, electric propulsion, radiation-hardened electronics and materials and telecommunications," said JPL's Karla Clark, industry studies lead and deep space avionics project manager for the Jupiter Icy Moons Orbiter mission.

Three cross-cutting science themes identified by the NASA-chartered science definition team would drive the proposed Jupiter Icy Moons Orbiter science investigations. The themes are to evaluate the degree to which subsurface oceans are present on these worlds; to study the chemical composition of the moons, including organic materials, and the surface processes that affect them; and to scrutinize the entire Jupiter system, particularly the interactions between Jupiter and the moons' atmospheres and interiors.

"The scientists have told us what they want," said John Casani, project manager for the Jupiter Icy Moons Orbiter mission at JPL. "When you consider the five- to eight-year trip to Jupiter, going from one moon to the next, not only flying by but orbiting each moon, this will require a unique nuclear power and electric propulsion system. The large amount of power required for electric propulsion could be used in orbit to power a significantly enhanced suite of instruments not even conceivable with previous power systems."

The Jupiter Icy Moons Orbiter mission is part of NASA's Project Prometheus, a program studying a series of initiatives to develop power systems and technologies for space exploration. The Jupiter Icy Moons Orbiter would be the first NASA mission utilizing nuclear electric propulsion, which would enable the spacecraft to orbit each of these icy worlds to perform extensive investigations of their makeup, history and potential for sustaining life.

For more information, visit <http://spacescience.nasa.gov/missions/prometheus.htm> or <http://www.jpl.nasa.gov/jimo/index.cfm>.



From left: JPL Director Dr. Charles Elachi, Sen. Sam Brownback, and Rep. Dana Rohrabacher.

Space vision discussed

Two members of Congress participated in a May 25 town hall meeting with JPL staff, discussing the nation's vision for space exploration.

Sen. Sam Brownback (R-Kan.), chairman of the Science, Technology and Space Subcommittee of the Senate Committee on Commerce, Science and Transportation, was joined by Rep. Dana Rohrabacher (R-Calif), chairman of the Space and Aeronautics Subcommittee of the House Science Committee.

"We're trying to determine what that new direction and what the legislative architecture should be," Brownback told the von Kármán Auditorium audience. "Just as you prepare for your missions years in advance, we have to prepare years in advance legislatively. So what is the right design for us to get to the moon, Mars and beyond? We're having those discussions now."

JPLers, never shy, provided varied and passionate views about the nation's future space policy.

Brownback and Rohrabacher also thanked and congratulated JPLers for the success of the Mars Exploration Rovers missions, not only the engineering and scientific aspects, but the inspirational as well.

Brownback and Rohrabacher and their staffers were joined by former astronaut Buzz Aldrin. The group toured the MER science and mission control areas during their brief visit.

Spitzer

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supermassive black holes—that are nearly invisible in even the deepest images from telescopes operating at other wavelengths.

Dr. Mark Dickinson, of the National Optical Astronomy Observatory, Tucson, Ariz., principal investigator for the new observations, said, "With these ultra-deep Spitzer images, we are easily seeing objects throughout time and space, where the most distant known galaxies lie. Moreover, we see some objects that are completely invisible, but whose existence was hinted at by previous observations from the Chandra and Hubble Observatories."

Seven of the objects detected by Spitzer may be part of the long-sought population of "missing" supermassive black holes that powered the bright cores of the earliest active galaxies. The discovery completes a full accounting of all the X-ray sources seen in one of the deepest surveys of the universe ever taken.

This detective story required the combined power of NASA's three Great Observatories—the Hubble Space Telescope, Chandra X-ray Observatory and Spitzer. Each observatory studies different wavelengths, from high-energy X-rays with Chandra, through visible light with Hubble and into the infrared with Spitzer. Together, these telescopes yield far more information than any single instrument.

All three telescopes looked as far as 13 billion light-years away, toward a small patch of the southern sky containing more than 10,000 galaxies, in a coordinated project called the Great Observatories Origins Deep Survey (GOODS). Chandra images detected more than 200 X-ray sources believed to be supermassive black holes in the centers of young galaxies. Extremely hot interstellar gases falling into the black holes produce the X-rays.

Also announced June 1 was the fact that Spitzer has captured in unprecedented detail massive galaxy Centaurus A's last big meal: a spiral galaxy twisted into a parallelogram-shaped structure of dust.

A stunning image of the galaxy and its bizarre dust structure can be found at <http://www.spitzer.caltech.edu/Media/releases/ssc2004-09/index.shtml>.

While previous observations with other telescopes have revealed this galactic remnant, it appeared as one long and irregular bar of dust. Spitzer's uniquely sensitive infrared eyes allowed the telescope to see clearly this strangely geometric structure for the first time.

"Now we can actually see the shape of this structure, which helps us explain how it arose," said Dr. Jocelyn Keene, principal investigator for the new research and an astronomer at JPL.

Located 10 million light-years away, Centaurus A is a type of galaxy known as "elliptical." It is one of the brightest sources of radio waves in the sky, which suggests the presence of a supermassive black hole at its center. About 200 million years ago, this galaxy is believed to have consumed a smaller spiral galaxy—the contents of which appear to be churning inside Centaurus A's core, triggering new generations of star birth.

Resolving this unusual parallelogram structure has helped astronomers finally put together a picture of its history. The geometric shape can be explained using a model that describes a flat spiral galaxy falling into an elliptical galaxy and becoming twisted and warped in the process. The folds in the warped disc, when viewed nearly edge on, take on the appearance of a parallelogram. The model predicts that the leftover galaxy will ultimately flatten into a plane before being entirely devoured by Centaurus A. Warped discs like this are the "smoking guns" of galactic cannibalism, providing proof that one galaxy once made a meal of another.

For images and information about the research, visit <http://www.spitzer.caltech.edu> and <http://photojournal.jpl.nasa.gov>.



A Spitzer image showing galaxy Centaurus A's last big meal: a spiral galaxy twisted into a parallelogram-shaped structure of dust.

Passings

ROBERT METZGER, 63, manager of the Costing Office (1610), died May 25. Metzger had worked at JPL since 1990. He is survived by his wife, Linda, son Mark and daughter Cheryl Vierregger.

A memorial service was held June 1 at Our Lady of Perpetual Help Church in Santa Clarita. Metzger was buried at Arlington National Cemetery.

Letters

My thanks to my friends and co-workers for the wonderful love and support that you have shown me following the passing of my sister. The cards and beautiful plants were genuinely appreciated and will always be a reminder of what very special people you are.

Carmen Mikulski

On behalf of the Mori family, heartfelt thanks to JPL for the bright red bromeliad. It came via my family's favorite florist, Haru Florist in East L.A. My Nisei grandmother, Umeko Genevieve Mori, passed away at USC University Hospital May 12 at the age of 87. She was the last surviving member (15th generation) of the Minamiki family, (Kumage District, Yamaguchi, Japan).

M.K. Mori

My heartfelt thanks to my co-workers for the words of sympathy on the death of my sister. And thanks to the ERC for the lovely flowers delivered to my home.

Ed B. Massey

Sincere thanks and appreciation to all my JPL friends regarding the passing of my father. Such times are never easy and for many of you who knew my father the loss is a personal one as well. Also thank you to JPL for the beautiful plant.

George Greanias

I would like to thank my friends in Office 513, JPL friends so much for your support, comfort, and kind expression of sympathy and condolence on the recent passing of my mother. The plant from JPL Hospitality, the orchids, and other plants and flowers I have received really lift up my spirit in accepting her passing. Sincerely,

Elizabeth Mangun

Retirees

The following JPL employees retired in May:

Thomas Shain, 42 years, Section 313; Marshall Fong, 33 years, Section 3263; Mary Kunstler, 28 years, Section 501; Richard Santiago, 24 years, Section 512; Peter Young, 24 years, Section 253; Krishna Sinha, 22 years, Section 3193; John Hackney, 14 years, Section 3140; Donna Avila, 10 years, Section 710.

Classifieds

For Sale

BED, girl's twin size canopy, incl. mattress and box spring, \$100. 249-3565, eve.

BEVERAGE PITCHER, glass, 2 1/2 qt., beautiful gold rings & etched-like designs, \$7; VEG-ETABLE DISH, 8", porcelain, covered w/handles, painted fruit patterns, like new, \$25 value, \$9. 626/793-1895, Albert.

BICYCLE, BMX, very rugged construction, specialized model 415 FSX w/4130 chromoly frame, 20" wheels, Alex rims, 3-pc. crank set, gyro for barspins, exc. cond., orig. price, \$430, sacrifice for \$210. 790-4028, Daryl.

BICYCLE, mountain, Diamond-Back, Apex, 1993, 18" frame, Avocet Cross tires, spare pair "knobby" off-road tires, new chain/brake pads, \$100. 848-5282, 5 to 8 pm, Richard.

BOOKS: "Applied Electronics," WWII classic engineer's textbook by MIT staff, publ. 1943, \$12; "Big Band Almanac," 400 pages of text and photos covering popular dance bands, musicians & singers from '30-'60s, published '78, gd. cond., \$10. 626/793-1895, Albert.

CAR SEAT, child's, \$20; child's booster seat with back & headrest, \$25; port-a-crib, \$18; all in gd. cond. 249-3677, eve.

CELL PHONE, Sony-Ericsson T616, GSM, tri-band/int'l capable, integrated camera, brand new, from AT&T but can use any SIM card when unlocked, see <http://cellphones.about.com> for rating, best offer. 406-9312, Keith.

COMPUTER, Apple 520, laptop, w/batteries, external CD drive, modem, disk storage, etc. \$75; BLENDER/juicer/mixer/bread maker, Vita Mix 3600, stainless steel, super powerful w/juice press & extras, \$75; BRICKS, 30, clear glass construction, 11 1/2" W x 12" H x 4" D, \$7/ea., \$200/all, you pick up. 626/836-8561, Jack or Sam.

CONCERT TICKETS, Eric Clapton, sold out Aug. 2 show, M Promenade 2, sec. F1, Row

18, face value, \$154 for 2. 626/301-1538.

COUCH (7) & LOVE SEAT (5), country style, lt. blue w/white tweed, great cond., must see, \$450/pr./obo; TRUNDLE BED, great cond., incl. bedding/comforter, \$250/obo. 805/529-7762, Debby.

DIET TAPES, Jenny Craig, set of 14, \$25; COMPUTER POWER CONTROL CENTER, 5 power switches + 1 master switch, 5 surge-protected outlets + 2 modem/fax/phone jacks, new, \$20; CARD SHUFFLER, Johnson, collectible, all-metal construction w/carved-wood dowel handles, stands ~6" handle-high, and ~9" by 6", \$35. 790-3899.

DODGER TICKETS, selected games from season ticket pkg., loge level (orange), aisle 132, inside 1st base, 2 tickets/gm., face value (Yankees series not avail.), \$30 ea., see www.delunac.net/tickets. 626/296-1253.

DRYER, Roper, electric, 5 yrs. old, extra lg., 4 temps, 3 cycles, gd. cond. 957-2805.

EXERCISE MACHINE, Bowflex Motivator, includes bench press, lat pulldown, bicep curls, leg extension, leg curl, squats & many more exercises, vg. cond., performs as advertised, \$650. 249-8108.

FEATHER BED, queen size, barely used, newly cleaned, \$35. 626/355-4967.

FLOATATION SYSTEM for queen size waterbed, Somma-type tubes w/foundation, \$100. 626/447-6423.

FURNITURE: desk, carved oak, 50" W x 24" D, 2 matching bookcases, 50" H x 25" W x 12" D, \$500; Techline, office, white, 6 pcs., \$350; rug, Spanish, hand-made, 7' x 9', bright pink & orange, \$200; mirror, framed, tall, wood, \$25; server, mission, oak, 38 W x 20 D x 37 H, \$300; 2 lamps, ceramic, dusty rose, \$30. 626/584-0860, day: 626/794-3144, eve., Donna.

FURNITURE, executive table with right-hand turn, \$80; sofa with love seat, light color, like new, \$80; conf. rm. chairs, 4, wooden, \$5 each; folding tables, \$5 each, sell for best offer. 626/841-8887.

FURNITURE: sectional, 2-piece Bassett (1 piece is a sleeper), floral print, photo & dimensions available, in gd. cond., \$350/obo. 626/791-6101.

GOLF CLUBS & stand bag, ladies, MacGregor Master Irons, graphite shafts, 4-SW, 3 and 5 fairway woods, \$200. 626/795-3345.

INFANT CLOTHES, jacket, zip-up, navy blue w/hood, Rotschild, size 3T, exc. cond., \$7/obo; jacket, zip up w/hood, red/navy blue, Old Navy, size 2T, exc. cond., \$5/obo; sweater, sky blue w/navy trim & buttons, size 3T, \$1/obo; shoes, zipper Spongebob motif, size 11M, exc. cond., \$6/obo; photos avail. 626/791-6101.

LAWN MOWER, Murphy gas, 5 HP, 20," 3-in-1 capability to mulch, bag and side discharge, adjustable height, gd. working cond., \$95/obo. 909/576-5788.

MISC: children's bunk beds, wood, can be divided into 2 single beds, \$150; Dirt Devil bagless vacuum cleaner, lg. capacity dirt cup (no bags), \$120; sewing mannequin, small dress form (sz. 6 to 12), completely adjustable, bought \$200, sell \$100; lg. plastic log cabin playhouse, 59 x 51 x 47", bought \$300, sell \$200; large armchair + 1 convertible sofa double bed, vg cond., \$180. 952-5587, benoite.kneib@free.fr.

MISC: pool table, 8', Brunswick, \$500; tablecloths, 2, slate blue oval, 18 matching napkins & rings, \$10; creeper, for car, Huffy, \$5; shovels \$2 ea; hoe, \$5; punch bowl set, 18 piece, \$10; portable basketball system, needs net, \$200; sych, \$10; wig, red, shoulder length, never used, \$20; Foodsaver plus bags, \$20. 626/357-8210.

MOVING SALE: June 11-12, couch, 8'; baby grand piano; bedroom sets, beautiful, king/queen; twin beds; dressers; chairs, antique & classic; sofa/hideabed; china hutch & credenza; file cabinets; bookshelves; dining room set; end tables; books; VCR, DVD player; Mac G3 computer; VHS tapes. 909/981-7492, Darlene, or dfhaug@yahoo.com.

ORGAN, Yamaha 415 electronic console w/13 pedals, 3 keyboards, 144 rhythm patterns, pd. \$7,500, sacrifice for \$2,000; PORT REPLICATOR, for IBM Thinkpad, works with T20, T21, A20, A21, or X, R series, like new, \$85; CONTROLLER CARD, Ultra ATA with cable, fits into 32-bit PCI 2.1 or 2.2 expansion slot on motherboard, brand new, \$20. 790-3899.

PHOTO EQUIPMENT: printing easels, darkroom (set 4), \$35; grain focuser, \$5, matboard holder, custom-made, \$25; hand mat-cutter, Logan, \$15; print trimmer, \$10; print positioner tool, \$5; changing bag Kalt, \$5; reflector, 22", gold/silver, \$10; reflector, 12", \$5; tripod, Slik 1200, \$20; tripod, Vertex, \$25; tripod, Slik 444, \$15; Slik U212 w/point-shoot head \$50; monopod, Bogen, \$10; carrying case, tripod, \$10. 626/355-4967.

PINE TREES, 2, 15' and 8', large, healthy and beautiful, in pots ready to be planted, \$65 and \$45/obo. 249-4561.

RECLINER, vintage '60s era, fully reclining, w/pop-out footrest, burgundy-red, vinyl, vg cond., some slight wear on armrests, antique tack head detail throughout, mechanical for footrest needs repair, \$399. 626/345-0670, Dennis.

REFRIG./FREEZER, Kenmore 17", white, like new, \$300/obo; WASHER, Kenmore and DRYER, Whirlpool, \$280/pair/obo. 805/529-7762, Debby.

SEWING MACHINE, antique, in orig. carved oak cabinet, professionally refinished, orig. black finish has some gold lettering worn off, foot powered, decoration purposes only, don't know if it works, \$125. 626/345-0670, Dennis.

SPEAKERS (2), AR 28b in walnut case, exc. cond., minimal use, \$45/obo. 353-5671, Mildred.

TABLE, dining/library, Mission oak, new dbl. connected pedestals, 10" end drop leaves, 70 x 40, in La Verne, \$85/obo. 909/593-4046, vivdavies@earthlink.net.

TENTS, Sears Hillary, 9 x 9 ft., fiberglass poles, vg. cond., 2/\$80. 626/797-6982.

THEATER TICKETS, 2, for Little Shop of Horrors, Ahmanson Theatre, Aug. 26, 8 p.m., seats in mezzanine, \$140. 790-8523.

YARD SALE, huge, multi-family, Sat., June 5, 7:30 am to 1 pm, ~2030 Oakwood Street, Pasadena, no early birds.

Vehicles / Accessories

'81 BEECHCRAFT B-55 Baron, 1540 TNT, 150 En. & props on Cole mill conversion, ND King silver crown avionics, DC 200 auto pilot, new paint/interior, immaculate aircraft, considered best B-55 in the world today, make offer. 626/289-8799.

'03 BMW F650GS motorcycle, fuel inj., ABS, dark blue, 1,800 mi., \$6,800/obo. 894-8365, Linda or Marvin or Marvf150@aol.com.

'99 CHRYSLER LHS, white, exc. cond., V6, CD player/tape deck (Infinity), chrome wheels, leather interior, full power windows/seats, heated seats, front & back, cruise control, new transmission & a/c, roomy, quiet/smooth ride, only 37K mi., \$9,999. 909/225-2323.

'98 EZ-GO limo golf cart, custom rims & tires, lifted, 48 volt electric motor, custom interior, CD player, \$4,950. 242-8241.

'99 FORD Crown Victoria LX, 85K mi., loaded, leather power seats, a/c w/auto temp., am/fm stereo w/cass., 6-disc CD changer, V8, 4.6L, pwr. tinted windows/door locks, trailer hitch, remote keyless entry, 4-wheel ABS, Michelin tires w/less than 15K mi., alloy wheels, exc. cond., orig. owner, \$7,500. 661/296-1037, eves.

'99 FORD Rexhall Aerbus motorhome, V10, 35", only 7K mi., slideout, Levelors, 6.6 kw gen., Corian counters, hardwood floor, back-up camera, side-by-side fridg., microwave/convection oven, 2 TVs, VCR, CD, auto, roof vents, gelcoat exterior, much more, immac. in/out, finest quality, view at <http://www.rvsearch.com/findrv/index.cfm?a=d&tc=36261&vid=81429>, below Bluebook, \$65,000. 909/944-1064.

'99 FORD Taurus LX sedan, white, very clean, like-new interior, cass. player, power windows/doors/mirrors, well maint., exc. cond., \$4,550. 310/836-0779.

'99 FORD Windstar, 7-pass., V6, low mile 32K, 2nd sliding door, keyless entry/alarm, am/fm cass., 10-disc CD changer, privacy glass, power window/door, air, etc., vg cond., clean, well-maint., pics. avail., \$7,200. 653-8571, Jack.

'98 FORD Windstar GL, 3.0L, 95K mi., red, automatic trans., airbag, a/c, radio + tapes, gd. cond., \$7,500. 952-5587, benoite.kneib@free.fr.

'89 FORD Aerostar EXT, gray, 127K mi., great cond., first owner, \$2,000/obo. 626/823-2646, Sam.

'99 GMC Yukon Denali, 75K, 4WD, loaded, leather, 6 CD changer, exc. cond., \$18,000/obo. 800/937-9200, Levi or Cathy.

'81 GULFSTAR 44 sailboat, center cockpit sloop, radar, Ioran, PS, auto pilot, propane, stereo, 3 staterooms, 3 showers, new canvas, always privately owned, many improvements, near Bristol cond., make offer. 626/289-8799.

'99 HONDA Civic, DX, 39K mi., 4-dr. sedan, green, manual, a/c, am/fm/CD stereo, Wet Okole waterproof seat covers, Yakima dual bicycle rack, waterproof trunk liner, gd. cond., 1 owner, \$8,500. 626/441-5501 or swaimm@earthlink.net.

'94 HONDA Accord LX coupe, gold, 2-dr. manual, 124K mi., 6 CD audio sys., spoiler, great shape, photos avail., \$4,500. 626/840-3987.

'89 HONDA Prelude Si coupe, white, automatic, cruise control, a/c, moon roof, \$1,600/obo. 626-318-3187.

'90 JEEP Cherokee Laredo, 4 wheel drive, all power, new tires, alarm, CD player w/4 speakers, very well maintained, \$2,800. 626/359-7666.

'03 KAWASAKI Ninja, 250R, <1K mi., \$2,750. 726-3343.

'96 MERCEDES C220, white, 4 dr., auto., 102K mi., CD changer, Bose audio system, leather seats, great shape, photos avail., \$8,000. 626/840-3987.

'89 MERCEDES BENZ 260E, 4-door, gold, 147K original miles; garage kept, interior perfect, looks and runs great, new tires, brakes; \$4,500. 626/794-6860.

'92 PLYMOUTH Sundance, 91,500 miles, beige, automatic transmission, airbag, a/c, radio, 4 doors, good runner, \$1,700. 952-5587, benoite.kneib@free.fr.

'02 TOYOTA Camry, 4-dr., white, all power, alarm, CD player, 44K miles, 4 cyl., must sell, make offer, \$13,500. 242-8241.

'00 TOYOTA Tundra Ltd., full power, ABS, 6-CD in dash, tow pkg., snug top, exc. cond., 56K mi., \$16,300. 909/596-9007.

'99 TOYOTA Camry LE, auto, a/c, am/fm/cass/CD, cruise control, all power, 75.5K mi., vg cond., new tires & battery, \$8,500/obo. 831-2923.

'99 TOYOTA Tacoma SR5, extended cab pickup, 4-cyl., 5 spd., a/c, new 17" wheels & tires, exc. cond., orig. owner, garage kept, books & records, low 35K mi., must see, \$10,950 or make offer. 805/584-8673, 805/304-0938.

'97 TOYOTA Avalon XLS, loaded, 3-CD changer, moonroof, power leather seats, wood trim paneling, pearl white color, auto, salvage history, 72,000 miles, exc. cond., \$8,000. 909/599-3230.

'99 VOLKSWAGEN GTI, VR6, 5 speed, vg cond., 86K mi., \$9,500/obo. 952-6181.

Free

KITTENS, adorable, 8 wks. old, to wonderful homes, also looking to place the very young mama cat with one of her babies, photos available. 323/856-9044.

SLIDE TRAYS, Kodak, Carousel 140 & 80 capacities, 10-20 avail. 952-7060, lv. msg.

SQUAT RACK, weightlifter's, 249-6989.

Lost & Found

LOST: medallion, small (dime size), image of Jesus, in solar system display area (190 café) on May 16. 626/796-8275.

LOST: diamond tennis bracelet on 5/25, great sentimental value; reward. Ext. 4-6315, 909/338-0225.

Wanted

CAR, reliable, inexpensive, for teenage daughter, ~\$3,000. 790-6989.

CARPPOOL Riders from Walnut/Diamond Bar/Chino Hills/Covina, meet at Grand and Amar, leaving Walnut at 7 a.m. Ext. 4-9735.

COMPUTER, laptop, need to run older DOS programs, 3.5" drive. 626/799-5349, Marilyn or Larry.

FITNESS STEP AND RISERS for step aerobics, Reebok, approx. 43 x 16". 626/345-0681.

RENTAL, Aug. 1; private apt., guesthouse, cottage, townhouse, condo or long-term sublet; prefer unfurnished, hardwood floors, no pets, major gas appliances + some util. incl.; desired location within 10 mi. of JPL and near public

transportation; \$800 max., month to month or flexible lease. jolanita@yahoo.com or 626/437-9593, voicemail.

ROOM or small 1 bd. in the South Pas., Eagle Rock or S.G. Valley areas for responsible, non-smoking, 63-year-old male, references on request, move in in July. 213/926-4656, Bill.

SPACE INFORMATION/memorabilia from U.S. & other countries, past & present, for personal use. 790-8523, Marc Rayman.

STORAGE, garage or room to rent for craft supplies. 249-4561.

TUTOR for two 4th graders, English and math at private house conveniently located in La Canada, 3-4 days/wk., flexible work hours and good pay. martha_belcher@fanniemaec.com.

VANPOOL RIDERS from Victor Valley/Hesperia. Ext. 4-1424, Scott.

VOLLEYBALL PLAYERS, coed, no beginners possible, Tues. nights 8 to 10 p.m. at Eagle Rock High School, \$4/nt. 956-1744, Barbara.

WEIGHTS for home gym or Universal Gym w/weights. 952-8455.

For Rent

BELMONT SHORE area of Long Beach, Spanish-style house for lease, just blocks from the water. 2 bd., 1 ba., \$1,950. 626/794-3250.

GLENDALE studio apt., private entrance, 15 min. from JPL, stove, microwave, refrigerator incl., furn. or unfurn., gas, water & gardener paid, \$475. 249-3602 or manatt@kbt.net.

LA CANADA, private room in home, private bath, off-street parking, BBQ, pool, full kitchen priv., wash/dry, etc., avail. 6/15, \$550 + util. 790-1280.

LA CRESCENTA house for lease, 3 bd., 1 ba., copper plumbing, new dual-pane vinyl windows, updated kitchen, lg backyard perfect for entertaining, perfect "move-in" cond.; 3643 Montrose Ave., do not disturb occupants; available July; credit check required, 1-year lease, first month + security deposit required; \$2,250, serious inquiries only. 399-1667.

MONROVIA/ARCADIA border, back house, 2 bd., 1 ba., new carpet, fresh paint, stove, refrig., laundry hookups, large fenced yard, covered patio, shared garage, trash, water, gardener paid, avail. soon, \$1,000. + \$1,000 deposit. 626/447-5725, eves.

MONTEREY HILLS condo, 2 bd., 1 ba., 3rd flr./private end unit, open and airy with nice view, fireplace, hrdwood flrs. & carpet, central air/heat, dishwasher, stove, laundry rm. w/washer/dryer hookups, swimming pool, secure ground level parking, close to 110 fwy., 15 min. from JPL; \$1,200, cable, trash, gas and water included. 626/296-9073.

PASADENA condo, short-term lease, 3-12 mos., 1 bd., 1,000 sq. ft., fully furnished, 1 block from Caltech, inc. utilities, garage, laundry, \$1,500. 626/285-0730.

PASADENA condo, spacious 2 bd., 2 ba., 2-car gar., in-unit washer/dry, fireplace, storage, 1/4 mile to Caltech, info: <http://rental.k-von.com>, \$2,295. 626/233-9496, Kevin.

PASADENA, share 2 + 2 + loft apt. with male near Caltech, pool, Jacuzzi, excellent gym, DSL, underground parking, security building, on-site mgmt., furnished except your bed/bath, \$650 + utilities. 626/644-5431.

SAN MARINO home, 3 bd., 1.5 ba., walking distance to Carver Elementary & San Marino High, refrig., range, microwave (brand new), newly painted, centr. a/c & heat, alarm system, covered patio, 2-car attached gar., 1580 Bellwood Rd., \$3,200 incl. gardener, trash + water bills. 714/553-8585, Richard Tan.

Vacation Rentals

ALTADENA "sabbatical house," 3 bd. + study, boundary Angeles Nat'l Forest, 3 mi. from JPL (trails to Lab behind house), view, hardwood floors, fireplace, antiques, completely furn.: furniture, dinnerware, pots/pans, linens, down comforters, fine soaps, necessities incl.; just bring toothbrush & clothes; TV/DVD/VHS/Dish satellite, wireless DSL avail., garden, courtyard, BBQ, parking, garage, private, immaculate, month-month. 626/798-3235.

ARROWHEAD cabin, lake view, 6 max., \$140/wkends., \$350/wk., others available, security/cleaning deposit required. 952-6221, Mon-Thur.: 909/337-1036, Fri-Sun.

BALBOA ISLAND, cute 2 bd., 1 ba., apt. avail. for weekly rental July-September, fully furnished, sleeps 5, covered deck, laundry, steps to bay and canal, \$1,200-\$1,500/wk. 626/429-3677 or bettyrs@earthlink.net.

BIG BEAR LAKEFRONT luxury townhome, 2 decks, tennis, pool/spa, beautiful master bd. suite, slps. 6. 949/786-6548.

CAMBRIA house, ocean front, exceptional white water view, accom. up to 4 people, all amenities provided. 702/256-1359.

FLORIDA condo, New Smyrna Beach, fully furnished, 2 bd., 2 ba., full kitchen, half hour to Cape Canaveral, quiet, relaxing, overlooking beach, BBQ, pool, game rm, great ocean view, easy walk to stores and restaurants, sleeps 6, available weekly or monthly. 909/981-7492, Darlene or dfhaug@yahoo.com.

GREEN VALLEY LAKE cabin, near Big Bear, sleeps 6, furnished, cable TV, 1 bd., 1 ba., lg. living room, fully equipped kitchen, fenced deck, pets OK; fishing, swimming, hiking; \$100/nt. 949/859-2237 or 323/258-4464.

HAWAII, Maui condo, NW coast, ocean front view, 25 ft. fr. surf, 1 bd. w/loft, comp. furn., phone, color TV, VCR, microwave, d/w, pool, priv. lanai, slps. 4, laundry fac., low season rate \$115/nite/2, high season rate \$130/nite/2, \$15/nite/add'l person. 949/348-8047 or jackandrandy@cox.net.

MAMMOTH, Snowcreek, 2 bd., 2 ba., + loft, slps. 6-8, fully equip'd kitch. incl. microwave, D/W, cable TV, VCR, phone, balcony w/mtn. view., Jacz., sauna, streams, fishponds, close to Mammoth Creek, JPL disc'nt. 626/798-9222 or 626/794-0455 or valeriec@caltech.edu.

OCEANSIDE condo, on the sand, charming, 1 bd., panoramic view,

universe

Jet Propulsion Laboratory

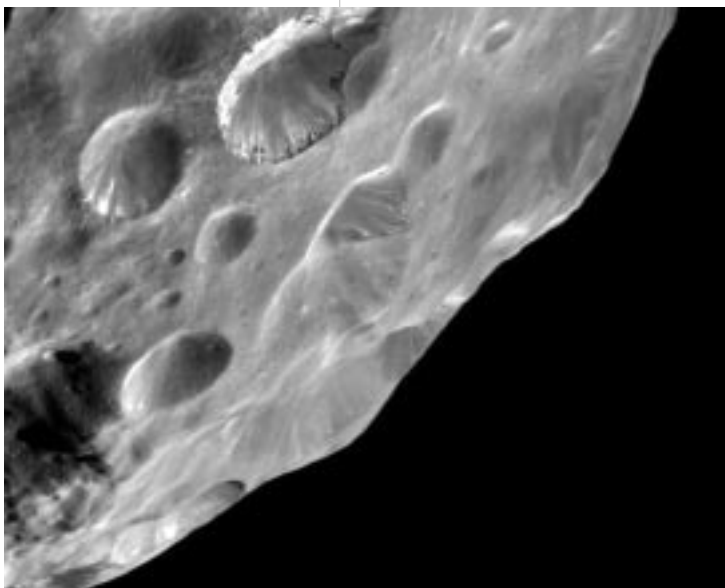
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Cassini passes Phoebe; Saturn next

By Carolina Martinez



This image of Phoebe was obtained on June 11 from a distance of 13,377 kilometers.

Images collected during Cassini's close flyby of Saturn's moon Phoebe have yielded strong evidence that the tiny object may contain ice-rich material, overlain with a thin layer of darker material perhaps 300 to 500 meters (980 to 1,600 feet) thick.

The surface of Phoebe is also heavily pitted with large and small craters. Images reveal bright streaks in the ramparts of the largest craters, bright rays that emanate from smaller craters and uninterrupted grooves across the face of the body.

"The imaging team is in hot debate at the moment on the interpretations of our findings," said Dr. Carolyn Porco, Cassini imaging team leader at the Space Science Institute in Boulder, Colo. "Based on our images, some of us are leaning towards the view that has been promoted recently, that Phoebe is probably ice-rich and may be an object originating in the outer solar system, more related to comets and Kuiper Belt objects than to asteroids."

Cassini came within approximately 2,068 kilometers (about 1,285 miles) of the dark moon on Friday, June 11. The spacecraft was pointing its instruments at the moon during the flyby. Several hours later it turned to point its antenna to Earth. The signal was received through the Deep Space Net-

work antennas in Madrid, Spain, and Goldstone, in California's Mojave Desert, at 7:52 a.m. PDT June 12. Cassini was traveling at a relative speed of 20,900 kilometers per hour (13,000 mph) relative to Saturn.

"One down, 52 to go," said Jeremy Jones, chief navigator for the Cassini-Huygens mission at JPL. During Cassini's planned four-year tour it will orbit Saturn 76 times and execute 52 close encounters with seven of Saturn's 31 known moons.

"Although this is the first flyby in the Saturn tour, it is the only opportunity to see Phoebe," said Dr. Dennis Matson, project scientist for the Cassini-Huygens mission.

"This flyby is key to knowing more about the mysterious oddball, which has been the object of interest of many scientists."

In ascertaining Phoebe's origin, imaging scientists are noting important differences between the surface of Phoebe and that of rocky asteroids that

have been seen at comparable resolution. "Asteroids seen up close, like Ida, Mathilde and Eros, and the small martian satellites, do not have the bright 'speckling' associated with the small craters that are seen on Phoebe," said Dr. Peter Thomas, an imaging team member from Cornell University.

The landforms observed in the highest-resolution images also contain clues to the internal structure of Phoebe. Dr. Alfred McEwen, an imaging team member from the University of Arizona, said, "Phoebe is a world of dramatic landforms, with craters everywhere, landslides and linear structures such as grooves, ridges and chains of pits. These are clues to the internal properties of Phoebe, which we'll be looking at very closely in order to understand Phoebe's origin and evolution."

"I think these images are showing us an ancient remnant of the bodies that formed over 4 billion years ago in the outer reaches of the solar system," said Dr. Torrence Johnson, an imaging team member from JPL. "Battered and beat-up as it is, it is still giving us clues to its origin and history."

Dr. Gerhard Neukum, an imaging team member from Freie University in Berlin, said, "It is very interesting and quite clear that a lot of craters smaller than a kilometer are visible. This means, besides the big ones, lots of projectiles smaller than 100 meters (328 feet) have hit Phoebe. Whether these projectiles came from outside or within the Saturn system is debatable."

Phoebe may be an icy interloper from the distant outer solar system that found itself captured by giant Saturn in its earliest, formative years. Final conclusions on Phoebe's origins await a combination of the results on Phoebe's surface structures, mass and composition gathered from all 11 instruments, which collected data during the flyby.

"This has been an impressive whirlwind flyby and it's only a curtain raiser on the events about to begin," Porco said.

Cassini arrives in orbit around Saturn on the evening of June 30 (July 1 Universal Time).

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

For the latest images and information about the mission, visit <http://saturn.jpl.nasa.gov> and the Cassini imaging team home page, <http://ciclops.org>.

Hills, crater beckon for rovers

By Guy Webster



JPL's Mars rovers are delighting scientists with their extra credit assignments. Both rovers successfully completed their primary three-month missions in April.

The Spirit rover is exploring a range of martian hills that took two months to reach. It is finding curiously eroded rocks that may be new pieces to the puzzle of the region's past.

Spirit's twin, Opportunity, is also negotiating sloped ground. It is examining exposed rock layers inside a crater informally named "Endurance."

"Both rovers have begun exploring brand-new places," said Dr. Mark Adler, mission manager at JPL. "Opportunity has entered Endurance Crater. Spirit has arrived at the Columbia Hills. Both rovers are getting their second wind in bonus time, and we are very excited about the scientific potential we see at their new homes. Of course, the terrain at both locations is challenging, one up and one down. We are making certain that we proceed safely to keep these wonderful machines as healthy as we can for as long as we can."

Spirit began climbing into Columbia Hills late last week, and right away sent pictures of tantalizing rocks. "Some of the rocks appear to be disintegrating. They have an odd kind of rotting appearance, with soft interiors and resistant rinds or hulls," said Dr. Larry Soderblom, a rover science-team member from the U.S. Geological Survey, Flagstaff, Ariz. "The strangest things we've encountered are what we're calling hooded cobras, which are evidently the resistant remnants of some of those rocky rinds. They stand above the surface like small canopies."

Another rock, dubbed "Pot of Gold," appears to have nodules and resistant planes in a softer matrix. Scientists have chosen it as a target for Spirit to examine with the instruments on the rover's robotic arm. Afterwards, controllers plan to send Spirit to an outcrop farther uphill.

"Although it's too early to even speculate as to the processes these rocks have recorded, we are tremendously excited over the new prospects," Soderblom said.

The Columbia Hills rise approximately 90 meters (about 300 feet) above a plain Spirit crossed to reach them. Scientists anticipate a complex blend of rocks in the hills, perhaps holding evidence about a broader range of environmental conditions than has been seen in the volcanic rubble surfacing the plain. The entire area Spirit is exploring is within Gusev Crater. Orbital images suggest water may have once flowed into this Connecticut-sized basin.

Halfway around Mars, Opportunity has driven about 5 meters (16 feet) into stadium-sized Endurance Crater. "As we look back up toward the rim, we can see the progress we've made," said Scott McLennan, science-team member from the State University of New York, Stony Brook.

Opportunity's first target inside the crater is a flat-lying stone about 36 by 15 centimeters (14 by 6 inches) dubbed "Tennessee" for its shape. Opportunity will inspect it for analysis with the spectrometers and microscopic imager on the rover's robotic arm. It is in a layer geologists believe corresponds to sulfate-rich rocks. The rocks are similar to those in which Opportunity previously found evidence for a body of water covering the ground long ago.

"The next step will be to move farther down from this layer to our first close-up look at a different sedimentary sequence," McLennan said. "Color differences suggest at least three lower, older layers are exposed below Opportunity's location."

"The interpretation of those lower units is in a state of flux," he said. "At first, we thought we would encounter poorly consolidated, sandy material. But as we get closer, we're seeing more-consolidated, harder rock deeper into the crater. If we can get to the lower units, this will be the first detailed stratigraphic section ever done on another planet. We're doing exactly what a field geologist would be doing."

Spirit is showing what may be the first sign of age and wear. "The right front wheel is drawing about two to three times as much current as the other wheels, and that may be a symptom of degradation," Adler said. "There may be steps we can take to improve it. We'll be studying that possibility during the next few weeks."

News Briefs



Jim Erickson

Erickson named MER manager

JAMES ERICKSON has been named project manager for the Mars Exploration Rover Project as his predecessor, RICHARD COOK, switches to the development of an even more capable Mars rover for launch in 2009.

Cook becomes deputy project manager for NASA's Mars Science Laboratory, the future rover mission whose project manager, PETER THEISINGER, managed the Mars Exploration Rover Project from its inception in mid-2000 until February 2004, when Cook succeeded him.

Both rovers remain healthy, though the harsh martian environment could end their operations at any point. "We are adapting to a pace of sustained exploration of the two landing sites," Erickson said. "The fun part of the job is working with the highest caliber engineers and scientists. The challenge is to lead without getting in their way."

Erickson was project manager for JPL's Galileo mission to Jupiter for three years prior to joining the rover project as mission manager in 2001. During 30 years at JPL, he has also worked on the Viking missions to Mars, the Voyager missions to the outer planets and the Mars Observer mission.

Cook was flight operations manager for the Mars Pathfinder project, which put a lander and small rover on Mars in 1997. He joined JPL in 1989 and worked on the Magellan mission to Venus prior to Pathfinder.

Naderi earns Italian honor

DR. FIROUZ NADERI, director of Solar System Exploration Programs and Mars Exploration Program manager, has been awarded the Liberal Prize by a leading Italian policy group.

Fondazione Liberal honored Naderi as "a personality whose work has contributed to profound changes in ideas in modern times." Naderi was recognized for his leadership role in the Mars Exploration Rover mission.

The award will be presented at an international conference on philosophical thought in Palermo, Sicily, in October. The prize consists of a plaque dedicated to Naderi's achievements and a \$3,000 honorarium.

"We believe that achievements such as the Mars missions are important positive symbols, reflecting a new, optimistic perspective that is more open to a hopeful future," the organization noted.

Pioneer 10 team receives honors

The Pioneer 10 Spacecraft Management Team at JPL recently received the Institute of Electrical and Electronics Engineers' Management Innovation Award for 2003.

The award was given on May 12 to DR. JOHN ANDERSON, WILLIAM KIRHOFER, DR. ARVYDAS KLIORRE and ROBERT RYAN. It was presented by IEEE's JOEL SNYDER and PAUL A. WILLIS "for innovative engineering management in coordinating diverse teams at multiple locations for complex astrophysical experiments in deep space."

CEC summer camp ready to open

Spaces are still available for the JPL/Caltech Child Educational Center's summer camp program. The camp for children completing kindergarten through 6th grade is held from June 21 to Aug. 27.

The camp will be held at the Oak Grove site in La Cañada, next to La Cañada High School; La Cañada Elementary School; and the CEC site in Pasadena, near Caltech. At the Oak Grove site, a pre-K summer program is offered for children entering kindergarten in the fall.

Scheduled field trips include the Southern California Conservatory of Music, Discovery Science Center, Adventure Playground, IMAX Theater, Peterson Automotive Museum, ice skating, forest ranger guided hikes and more. Also featured are arts and crafts, drama, music, creative writing, swimming, outdoor sports and games, gardening, water play and science exploration.

Families may apply for the full summer or for weekly sessions; however, enrollment is limited at each location. For information, to obtain a brochure or to arrange a site visit, call the CEC at ext. 4-3418.

Radio clubs to have Field Day

The JPL and Caltech Amateur Radio clubs will hold their annual Field Day test of emergency communications skills over the weekend of June 26.

From the clubs' location atop Mount Gleason, they will use Morse code, voice and digital modes to contact as many stations as possible around the country. This yearly event tests amateur radio operator readiness to provide emergency support during earthquakes, floods or other emergencies.

Field Day operations begin at 11 a.m. on June 26. Visitors are invited to the site, a 45-minute drive from JPL via the Angeles Crest Highway. Non-radio amateurs can participate in making contacts or in such activities as using telescopes in the excellent viewing conditions of the hilltop location.

For more information, call JAY HOLLADAY at ext. 4-7758 or JIM LUX at 4-2075.



From left: Robert Ryan, Joel Snyder, Dr. Arvydas Kliore, Larry Simmons, William Kirbofer, Paul A. Willis. Not pictured: Dr. John Anderson.

Special Events Calendar

Ongoing Support Groups

Alcoholics Anonymous—Meetings are available. Call the Employee Assistance Program at ext. 4-3680 for time and location.

Caregivers Support Group—Meets the first Thursday of the month at noon in Building 167-111 (the Wellness Place). For more information, call the Employee Assistance Program at ext. 4-3680.

Codependents Anonymous—Meeting at noon every Wednesday. Call Occupational Health Services at ext. 4-3319.

Gay, Lesbian and Bisexual Group—Meets the first Friday and third Thursday of the month at noon in Building 111-117. Call the Employee Assistance Program at ext. 4-3680 or Randy Herrera at 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).

Working Parents Support Group—Meets the third Thursday of the month at noon in Building 167-111. For more information, call the Employee Assistance Program at ext. 4-3680.

Saturday, June 19

CEC Wine Tasting Benefit—The JPL/Caltech Child Educational Center will hold its annual fundraiser from 5:30 to 10 p.m. at Caltech's Avery House, 293 S. Holliston Ave. in Pasadena. The event will include fine wines, great food and live music from the Chad Edwards Quartet. Guests may bid on unique auction items and take their chances at the gaming tables. All proceeds will directly benefit the nonprofit organization, which has been providing high-quality child care and educational outreach services since 1979. General admission tickets are \$35; Connoisseur tickets include 10 tastes of premium wines, and are \$65. Tickets are available at the JPL Store, Caltech Book Store and the CEC, 140 Foothill Blvd. in La Cañada. Tickets may also be purchased at the door the evening of the event for an additional \$10. For more information, call ext. 4-3418.

Tuesday June 22

JPL Hiking Club—Photojournalist James Michael Dorsey will share his experiences with wildlife in 27 countries in a noon slide show in Building 238-543.

"Purchasing at JPL"—This two-day interactive course will be held in von Kármán Auditorium from 8:30 a.m. to 12:30 p.m. today and Wednesday. The end-to-end acquisition process will be covered, including key steps, what is not included in the acquisition process, key contact personnel for each step, time factors involved, required documentation and use of forms, rationale underlying requirements and ways to avoid potential challenges. Anyone who

purchases commodities or services using the services of the Acquisition Division should plan on attending. Register at <http://jplregistrar.jpl.nasa.gov/stc/persreg>. If you have questions, call Dana Edler (4-5825) or Aileen Batin (4-4281).

Wednesday, June 23

JPL Library Orientation—Come to Building 111-104 from 11:30 a.m. to noon 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 Library reference desk, ext. 4-4200.

JPL Toastmasters Club—Meeting at 5 p.m. in the 167 conference room. Call Debbi Llata at ext. 4-8374 for information.

Thursday, June 24

Caltech Architectural Tour—The Caltech Women's Club offers this free service, which is open to the public. Meet at the Athenaeum front hall, 551 S. Hill Ave., Pasadena. Tour begins at 11 a.m. and lasts 1 1/2 hours. For reservations, call Susan Lee at (626) 395-6327.

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

JPL Stories—Dr. Matt Golombek, planetary geologist in the Earth and Space Sciences Division, will present "Landing (and Roving) on the Red Planet," at 4 p.m. in the Library, Building 111-104.

Golombek, project scientist for the Pathfinder mission, will discuss the challenges, responsibilities and joys of selecting landing sites on Mars. If you have questions about the JPL Story series or wish to participate, call Teresa Bailey at ext. 4-9233.



Wednesday, June 30

JPL Library Orientation—Come to Building 111-104 from 11:30 a.m. to noon 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 Library reference desk, ext. 4-4200.

Volunteer Professionals for Medical Advancement—Meeting at 10:30 a.m. at the Caltech Credit Union, 528 Foothill Blvd., La Cañada.

Thursday, July 1

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

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

Software process management approach is assessed

The Software Quality Improvement (SQI) Project at JPL recently participated in a formal assessment of the Lab's process management approach for software against the Capability Maturity Model Integration (CMMI). The CMMI was developed by the Software Engineering Institute as a model and guideline to help organizations improve the way they do business.

The CMMI model includes specific practices for four major categories: Process Management, Project Management, Engineering and Support. It is used to evaluate organizations against the specific goals and practices of each process area, as well as additional generic practices. A formal assessment using the CMMI model is called a SCAMPI, which stands for Standard CMMI Appraisal Method for Process Improvement. There are six capability levels in the Continuous Representation of the CMMI model: 0 – Incomplete, 1 – Performed, 2 – Managed, 3 – Defined, 4 – Quantitatively Managed, 5 – Optimizing.

According to Trisha Jansma, project element manager, SQI Deployment Element, JPL chose to be evaluated against three process areas that are part of the Process Management category, namely Organizational Process Focus, Organizational Process Definition and Organizational Training.

The purpose of the Organizational Process Focus process area is to ensure that an organization plans and implements its process improvement based on a thorough understanding of the current strengths and weaknesses of the organization's processes and process assets. The Organizational Process Definition process area's purpose is to ensure that an organization establishes and maintains a usable set of organizational process assets, usually called a Process Asset Library. Typical items in a PAL include standard processes, life-

cycle model descriptions, tailoring criteria and guidelines, measurement repository, checklists, templates, handbooks and the like. The purpose of the Organizational Training process area is to ensure that an organization develops the skills and knowledge of its people so they can perform their roles effectively and efficiently.

Jansma said these three process areas set the stage for process improvement activities since they help to document and share best practices, develop and organize various assets to support improvement, and share learning across the organization.

On March 26, when the SCAMPI briefing was held, JPL senior managers and the SQI Project were pleased to find that JPL had attained Capability Level 3 (Defined) for all three process areas that were part of the evaluation. "We have demonstrated that we have a solid foundation for moving forward with our software quality improvement activities," said David Nichols, JPL's software process owner and the manager of the Information Technologies and Software Systems Division (36). Ray Kile, lead appraiser from Center for Systems Management, said he was impressed with "the level of infrastructure that has been put in place to facilitate process improvement across the Lab, the quality of the JPL Software Training Plan, and the variety of courses on software management, software engineering and process improvement."

"While everyone was very happy with this achievement, all agreed that there is still much more work to be done in order to address the other process areas in the Project Management and Engineering categories," Jansma noted.

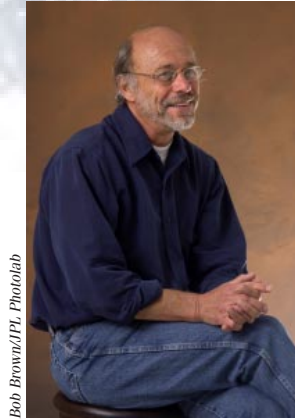
For more information about the SQI Project and this recent CMMI appraisal, visit the JPL Software website at <http://software.jpl.nasa.gov>.

AURA

P R E P A R E S F O R L A U N C H

By Rosemary Sullivant

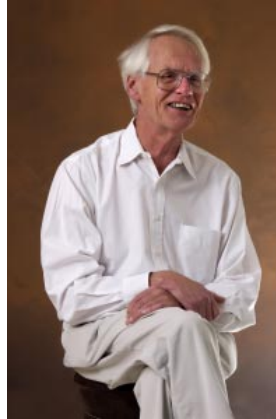
Aura, NASA's latest Earth-observing satellite, is poised and scheduled to take flight from Vandenberg Air Force Base in July. The mission is designed to give us the best, most complete picture ever of the health of our atmosphere. Two of Aura's four instruments—the Microwave Limb Sounder (MLS) and the Tropospheric Emission Spectrometer (TES)—were designed, built and tested at JPL, and they will also be operated by the Lab.



Bob Brown/JPL, Photolab



Taking a few moments in these last few days before launch, MLS principal investigator Joe Waters (above) and TES principal investigator Reinhard Beer (right) talk about the mission.



What are your instruments going to do and how do they fit into the Aura package?

Waters: The instruments on Aura are extremely complementary. Each has a job to do, but they work together to understand what is happening in the atmosphere. All four measure ozone, and three measure temperature, for example.

Each instrument also has unique measurements. MLS will uniquely measure bromine monoxide and chlorine monoxide, which destroy stratospheric ozone; hydrochloric acid, a safer form of chlorine; and hydroxyl radicals that are important to atmospheric chemistry but have never been adequately measured on a global scale before.

Major goals of MLS are to track the recovery of the stratospheric ozone layer and understand aspects of how atmospheric composition affects climate and vice versa.

Beer: One of Aura's major themes is to determine the processes controlling air quality, especially tropospheric ozone. TES is directly focused on tropospheric ozone.

One of the most important things TES will do is help us understand the intercontinental transport of pollutants. Every other day, we'll produce a global map of pollutants, such as tropospheric ozone, showing where they are and their altitude. Altitude matters because most transport takes place between two and eight kilometers above the surface. That's how pollution from Asia ends up in the United States, and Europe ends up with pollution from the United States.

Besides ozone, we'll be mapping carbon monoxide, methane and a couple of nitrogen oxides, which are an important part of the equation that creates tropospheric ozone.

What's the history of MLS and TES and how many people have been involved in building and operating them?

Waters: The concept for MLS was developed here at JPL starting in 1974, and I've been involved with it since then. First we flew an instrument on an aircraft. Then we had balloon experiments. Our first satellite MLS was on the Upper Atmosphere Research Satellite (UARS) launched in 1991.

We submitted the proposal for this new instrument—the one on Aura—in July 1988. The program had its ups and downs. At its peak, the equivalent of more than 100 full-time people were working on MLS.

There are 10 JPL members on the NASA "official" MLS science team, and three more from the University of Edinburgh in Scotland. During the MLS operations phase, there will be about 25 JPLers working on MLS operations, data and science. Production data processing for MLS and TES will be done by teams at Raytheon ITSS in Pasadena.

Beer: We'd been thinking about this for a while and submitted our proposal in July 1988. It was accepted in February 1989.

The program kept getting cut and re-scoped. Tom Glavich, our JPL project manager, deserves a special acknowledgement

for seeing this project through from the very beginning.

During the early years we put together the science team, and it now has about 20 people. About five years ago we started building the hardware. At our busiest, we had well over 100 people working on TES.

Most recently, we've been planning our ground data system. We have about 35 people here at JPL in the science computing facility, in Building 169. All the algorithm development and coding have been done here at JPL. Routine operations for TES will be done by Raytheon in Pasadena.

How is the new MLS on Aura different from its predecessor on UARS?

Waters: The new instrument is substantially advanced from the UARS instrument. This advance was made possible primarily with new technology developed by the JPL Submillimeter Wave Advanced Technology Group headed by Peter Siegel and new devices from our Microdevices Lab.

The new technology enables MLS on Aura to make measurements that were simply impossible with the previous MLS. These include hydroxyl, bromine monoxide, hydrochloric acid and others—all of which are important for tracking recovery of the ozone layer.

What special challenges did TES present?

Beer: The biggest challenge was to keep the program alive.

On a technical level, one of the biggest challenges involved one of the instrument's critical components, which is made from potassium bromide. Potassium bromide has some nasty properties. Leave it on your desk and when you come back you'll find a pool of water. It has to live in a vacuum. The spacecraft is in a tent flooded with dry nitrogen to make sure no water gets near it. The stuff is so soft that if you poke it with your finger it leaves a dent, yet we had to design a mount that can survive a launch environment.

Another challenge was that TES is a prolific data generator. When we first put it together five years ago, the state of computing was such that we were facing the possibility of being able to process only a fraction of the data. Now, with a cluster of top-of-the-line desktop computer chips, we now have enough computing power not only for our day-to-day operations but we can go back and reprocess everything whenever necessary.

What have you been doing these past few weeks before launch?

Waters: The last few months have been very busy, but very satisfying, as we approach launch for which we have waited more than a decade.

Our group has been making sure the software is in place for processing the data when they come in and making final pre-launch adjustments to the software.

Beer: Making sure launch software is in place—that we have everything ready for the first 90 days of the mission.

We've been conducting mission rehearsals, pretending we're getting real data and running it end-to-end through our system. Of course, the first time we did it, it didn't work exactly the way we wanted.

Are you nervous about launch?

Waters: Overall, I feel much more comfortable now than at launch of the previous MLS, which proved our technique works well in orbit. We've done a lot of testing and preparing with the instrument and the data processing and are prepared for launch. Both the instrument and software teams deserve tremendous credit.

Beer: Yes, of course, but I'm also excited.

Letters

My family and I were very touched and remain in appreciation for the many expressions of kindness and support in the recent passing of my father. He was a big fan of JPL and liked to brag to his friends about what we do here. He loved his yard and the things that grow there. So I know that he enjoyed your gift of flowers, which are now the newest lilies of his field.

David T. Spencer

On behalf of my family and myself, I would like to thank all my friends and co-workers at JPL for their kindness and thoughtfulness after the passing of my mother. Thank you as well for the beautiful plant and cards.

Cliff Fredericks

I would like to thank my friends and co-workers at JPL for their expressions of sympathy and support on the recent death of my grandmother. I would especially like to thank the IND and DSMS communities for their support during this emotional time. Your words of comfort, cards and prayers made this difficult time more bearable. I would also like to thank the Employee Services & Recognition Office for the lovely plant they sent to my home.

Wayne Sible

My heartfelt thanks to my co-workers for the beautiful flowers and words of encouragement regarding the passing of my father, Glenn Turpin. Also, thank you to JPL for the beautiful plant. Many of you knew my father and developed close relationships, after 21 years at JPL. He passed away on June 2 and had his ceremony with military honors on June 5.

Carl Turpin

Retirees

The following JPL employees retired in June:

Steven Cole, 25 years, Section 3512; Radheshya Das, 21 years, Section 346; William Taylor, 19 years, Section 366h; Joyce Pulliam, 16 years, Section 900; Frank Hartley, 14 years, Section 351; Edward Hagerott, 13 years, Section 387.

Classifieds

For Sale

BED, antique, brass and iron, exc. cond., made by Indiana Iron Foundry around 1885, recently repainted and brass repolished, headboard 58" H x 54"W, footboard 40"H, 73" long, would make a terrific child's bed, \$850, 352-4033, after 5.

BED, futon, queen size w/nice cover, used once, space problem forces sale, \$150/obo, 626/254-1550.

BICYCLE, Specialized Expedition "Comfort," 19," ridden less than 3 hours, pd. \$289, sell, \$150; HELMET, large, \$17; SHIPPING CASE for golf club, used once, \$50, 790-0697.

CLOTHES, infant: jacket, navy blue, zip-up w/hood, by Roitschild, size 3T, exc. cond., \$7/obo; jacket, red/navy blue, zip-up w/hood, by Old Navy, size 2T, exc. cond., \$5/obo; sweater, sky blue w/navy trim, buttons, size 3T, \$1/obo; zipper shoes, Spongebob motif, size 11M, exc. cond., \$6/obo, photos of each item available, 626/791-6101.

COMPUTER DESK, on wheels, cherry veneer, made by O'Sullivan, model 61925, exc. cond., like new; best offer, 626/449-0997.

COMPUTER TABLE, like new, compact size, white, exc. cond., \$90/obo, 353-5872.

DIET TAPES, Jenny Craig, set of 14, \$25; COMPUTER POWER CONTROL CENTER, 5 power switches + 1 master switch, 5 surge-protected outlets + 2 modem/fax/phone jacks, new, \$20; CARD SHUFFLER, Johnson, collectible item, all-metal construction with carved-wood dowel handles, stands ~6" handle-high, and ~9" by 6", \$35, 790-3899.

DINETTE, glass top, 4 chair set, \$80; SECTIONAL SOFA, leather, beige color, \$400, 626/355-7086.

DODGER TICKETS, selected games from season ticket package, loge level (orange), aisle 132, inside first base, 2 tickets/game, face value (Yankees series not avail.), \$30 ea., see www.delunac.net/tickets, 626/296-1253.

DOORS, interior flush, gd. cond., shiny honey stained oak: four are: 79.5" H x 29" W, one is 79.5" x 24", all for \$40, 626/345-0681.

DVD PLAYER, Panasonic, single disc, black, refurbished, purchased new in 8/01 with transferable Best Buy 4-year service plan (expires 8/05), \$30, 626/222-1034, Jason.

FURNITURE: executive table, right-hand turn, \$80; sofa w/loveseat, light color, like new, \$80; conf. rm. chairs, 4, wooden, \$5/ea; folding tables \$5 each, sell for best offer, 626/841-8887.

FURNITURE, china hutch & 7-pc. din. room table/chairs, w/protective cover, \$1,000/obo; oriental rugs, India, handmade, Bisnar design, wine background w/multi-color,

pictures in ERC, 4' x 6', \$250, 6' x 9', \$450/obo, 957-4746.

FURNITURE: 2-pc. Bassett sectional (1 pc. is a sleeper), floral print, photo & dimensions available, cushions need new covers, rest in gd. cond., \$350/obo, 626/791-6101.

GARDEN WAGON, used once, 48" L x 24 W, 12" fold-down side panels & pneumatic tires, >1,000 lb. capacity, \$40, 626/584-6518.

HITCH, Equal-i-ler sway control, complete system, the best sway control hitch available, exc. cond., \$160, 626/359-7666.

ICEBOX, antique, oak, exc. cond., made around 1915, 44" H x 32" W x 8" D, \$600, 352-4033, after 5.

JUICE FOUNTAIN, Breville, powerful stainless steel motor, great for daily juicing, bought 10/03, used 2-3 times only, orig. package, \$110/obo, 626/840-0955.

LAWN MOWER, Black & Decker, model MM850, 19", electric, 4hp, rear bag, 7 height positions, blades just sharpened, \$209 new at Home Depot, super lightweight, no fumes to breathe, hassle-free starting, needs no gas or oil, gd. cond., w/manual, \$110, 332-0481.

LAWN MOWER, Eager, rear bag, \$50, 249-6629.

MISC: 8' pool table, \$500; table cloths, 2 slate blue oval, 18 matching napkins and rings, \$10; punch bowl set, 18 piece, \$10; mailbox, oversized, green, \$20; wig, red, shoulder length, never used, \$20, foodsaver with bags \$20; electric frying pan, \$10; answering machine, \$5; large oil painting, landscape, gold tones, paid \$175 in 1970s, sell \$75; fishing pole (saltwater), \$25, 626/357-8210.

MISC: dinosaur topiary forms (2), 4' tall, Hammacher Schlemmer, orig. price \$220/ea., sell for \$60/ea. or \$100/pair; theater tickets, 2, Little Shop of Horrors, Ahmanson Theatre, Aug. 26, 8 p.m., seats in mezzanine, orig. \$140 for pair, sell \$100, 790-8523.

MISC: diamond chip ring, ladies, 10K yellow gold, \$90; Wristop sports computer, Suunto S6, \$275; wireless intercom, Radio Shack, 3-station, \$40; water purification system, \$50, 897-1203.

MOVING SALE: couch, 8'; piano, baby grand; bedroom set, dressers, antique and classic chairs, beautiful; sofa/hideabed; china hutch & credenza; dining room set; end tables; double-wide refrigerator; antique stove; entertainment center; executive desk; file cabinets; computer desk; bookshelves; books; VCR; DVD player; Mac G3 computer; VHS tapes, 909/981-7492, Darlene or dhauge@yahoo.com.

MOVING SALE: sofa bed, \$50; loveseat, \$15; dining room set, antique, \$500; bed and frame, \$40; dresser, \$50; coffee table, \$30; side table, \$15; skis & boots, size 10M, \$75; chairs; small desk; coffee maker; ironing board; lamps; kitchen appliances; phones, 626/683-9224.

MOVING SALE: sofa bed, only 1 yr. old; coffee table; queen bed frame; dining table + chairs; floor lamp; bar stools; floor upright; 28" Panasonic TV; microwave; coffee maker; + more, 626/795-3345 or backlund@sbcglobal.net.

ORGAN, Yamaha 415 electronic console w/13 pedals, 3 keyboards, 144 rhythm patterns, pd. \$7,500, sacrifice \$2,000; PORT REPLICATOR, for IBM Thinkpad, works with T20, T21, A20, A21, or X, R series, like new, \$85; ULTRA ATA CONTROLLER CARD with cable, fits into 32-bit PCI 2.1 or 2.2 expansion slot on motherboard, brand new, \$20, 790-3899.

PRINTER, all-in-one, Epson Stylus, RX500, print/scan/fax/copy, under full 3-yr. warranty at Fry's w/owner on request, just bought new, great photo quality; must sell to make room for new laser printer won in raffle, \$225/obo, 323/578-8995, be@begrific.com.

SAXOPHONE, alto, Yamaha YAS-23 with soft case, gd. cond., \$450, 626/355-4447, John.

SCUBA GEAR: fins, snorkels, masks, computers, dry suits, wet suits, etc, 626/447-4734.

SURFBOARD, Spyder Jarvis, size 6 1/2", 1 yr. old, exc. cond., owner moving to Colorado for college, \$495/obo, 790-3109.

TILES, beautiful pre-seated saltillo, terracotta clay, 300 square feet available, can be used indoor/outdoor, \$1.50 per tile/obo, 848-2214, David or Karen.

TREES (2), pine, large, healthy, and beautiful, 15' and 8', \$65 and \$45, or both for \$100, 249-4561.

VACATION COUNTRY CLUB MEMBERSHIP, based in So. Calif. w/exchange rights to 3,000 resorts nationally + internationally; your choice of 1 to 4 weeks/year of enjoying resort lifestyle at your choice of a huge variety of fantastic locations (great golfing incl. free); 2 bd., 2 ba. condo for up to 6 people; Club is selling memberships for \$19,900 but due to my spouse's recent death, anxious to sell, will accept \$4,000/obo, 805/967-7725

VIDEO GAME, Sony Playstation, w/memory card & 1 controller, \$30, 249-4561.

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control, fog lights, tan leather interior, power locks/seats/steering/windows, prem. sound, rear defroster/wiper, remote keyless entry, sunroof/moonroof, tinted glass, tow pkg., low mileage, \$15,300, 661/269-1362.

'01 HONDA 929RR, 4K mi., bought new in '03, \$6,600/obo, 661/251-1590.

'99 HONDA Civic LX, 4-dr., 5 speed, gray, 51K mi. orig. owner, am/fm/CD, pwr. window/doors/locks, a/c, alarm, driver/passenger side airbag, cloth interior, childproof rear window/locks, adj. steering wheel, cruise control; garaged, well maintained, exc. cond.: \$8,500, 909/466-8712, Charmaine or seamayes@netzero.com.

'93 HONDA Accord LX, 4-dr., 5 speed manual, 90K mi., one owner, great shape, \$4,000, 790-6989.

'91 JAYCO designer Cardinal 6 pop-up trailer, 3-burner stove, refrig., shower/toilet, overhead cabinets, stand-up closet, travel length 18' 10", campsite length 24' 2", sleeps approx. 5, \$4,000/obo, 909/590-1276.

KAYAKS (2), sea, used, "Sealution" by Wilderness Systems, with rudders, fore and aft hatches, bulkheads, 17' XL and 16' XS, rotomolded plastic, each includes like-new paddle & fitted sprayskirt, \$400/ea, 626/584-6518.

'01 MAZDA 626 LX, 46K mi., auto, silver, cruise control, dual front airbags, a/c, alloy wheels, CD, exc. cond., \$8,800/obo, 626/795-3345 or backlund@sbcglobal.net.

'96 PONTIAC Grand Am SE, V6, 3.1L engine, auto, power steering, air cond., cruise, elec. windows, ABS, stereo, runs very well, selling due to move, \$2,150, 626/683-9224.

PONTOON BOAT & pump, Bucks Bags Alpine, 6' inflatable, perfect for fishing small lakes, http://www.bucksbags.com, \$135, 626/794-4592.

TIRES (4), P285 60R16, \$100, 897-1203.

'94 TOYOTA Tercel, white, 4-dr., gd. cond., perfect for your new driver, teenager or high school grad, \$2,700, 957-8614 after 5 p.m.

'94 SATURN SC2, white, leather, a/c, automatic, ABS, alarm, 144K mi., cruise control, sat. radio, power locks/windows, gd. cond., \$2,200 or fair offer, 626/799-3276.

'99 VW Golf GL (new body style), 2 dr., 5-spd manual, red ext., dark cloth int., 58,300 mi., perfect cond. in/out, new tires/roof rack, see http://spider.jpac.caltech.edu/staff/rafael/golf, \$8,550, 323/644-5607.

'99 VOLKSWAGEN Passat, power everything, sunroof, heated leather seats, 2nd owner, www.begrific.com/4sale, \$13K/obo, 323/578-8995, be@begrific.com.

'02 VOLVO V4 wagon, only 12,300 mi., 4-cyl., 1.9L turbo, silver color, a/c, stereo/cassette/CD, dash cover, exc. cond., garage parked, all service records, price reduced, \$17,190, 626/355-5631.

'99 VOLVO V70 GLT, 2.4L turbo, very clean, white, loaded, family wagon, leather, heated seats, am/fm/CD/cass audio, moonroof, rear spoiler, roof rack, 3rd row seat, front/side airbags, full tinted glass, dual climate system, 17" white R-wheels, hot/cold box, new tires, recent fluids change, 90K mi., \$13,500/obo, 310/472-9283, Steve.

'83 VOLVO wagon, red, runs great, had much work done recently: new suspension, new electrical harness, transmission rebuilt; 175K mi., \$1,750, 626/345-9693.

Free

FILL DIRT, clean, 12 cu. yards avail., haul as little or as much as you like, near Los Robles/Jackson, Pasadena, 626/791-3103, dtrask6@its.caltech.edu.

Wanted

BOOKS, paperback or hardback, romance, science-fiction, mystery, etc. 248-0178, engineerbob4449@yahoo.com.

FITNESS STEP & RISERS for step aerobics, Reebok, approx. 43 x 16", 626/345-0681.

ROOM TO RENT, Pasadena or surrounding area, mature professional man just relocated from Maryland needs short-term (3-6 mo.) rental while locating permanent housing, willing to do minor home improvement projects as part of rent, 626/305-6338, day or 626/796-9291, rm. 316, Peter VanSickler.

SKYDIVERS, if you have jumped before or are interested, join the Caltech/JPL Skydiving club. Ext. 3-2655, thielman@yahoo.com.

SPACE INFORMATION/memorabilia from U.S. & other countries, past & present, for personal use, 790-8523, Marc Rayman.

VANPOOL RIDERS, from Victor Valley/Hesperia, Ext. 4-1424, Scott.

For Rent

ALTADENA, house to share in historic Janes Cottage Village, 1 mi. to JPL, 3 bd., 2 ba., completely remodeled, quiet, great neighborhood, large lot w/fruit trees, gardens, etc., dogs in backyard, private rm. + bath, female preferred, \$1,000, util. incl. 626/794-8884.

ARCADIA apt., 2 bd. + den, 1 ba., garage, remodeled, refrigerator/washer/dryer in unit, a/c, dishwasher; spacious, walking dist. to shops, exc. neighborhood, no pets, water/gardener/trash incl., \$1,300, 626/576-7333.

ARCADIA room to share, 5001 Ethan Ave., 1 bd., 1 ba., quiet, secluded residential area in cul-de-sac, home newly remodeled, \$650 + utilities, 626/221-9024.

BURBANK room in 2-bd. apt., walk to mall/shops, balcony, private bath, laundry in building, no pets, no smoking, \$595 + share util., 841-2830.

EAGLE ROCK historic Craftsman house, 2-story, furn. w/3 bd., 2 ba., fireplace, 2,100 sq. ft., large, tree-filled yard w/90-yr.-old Live Oak tree, rear brick patio, river rock front porch, 1-yr. lease starting 9/1, ideal commute to Pasadena/Glendale/SF Valley; approx. \$2,200, incl. water & gardener, negotiable if care for 2 cats, 323/344-7238.

LA CANADA, private room, single, non-smoker, female preferred, walking distance to JPL, available in Sept. 790-7920.

LA CANADA, private room in home, private bath, off-street parking, BBQ, pool, full kitchen priv., wash/dry, etc., avail. 6/15, \$550 + utilities, 790-1280.

MONTEREY HILLS condo, 2 bd., 1 ba., 3rd fl./private end unit, open and airy with nice

view, fireplace, hrdwood flrs. & carpet, central air/heat, dishwasher, stove, refrigerator, laundry rm. w/washer/dryer hookups, pool, secure ground-level parking, close to 110 fwy., 15 min. from JPL, \$1,200, cable, trash, gas and water included, 626/296-9073.

MONROSE apt., 2 bd., 1 ba., a/c, garden, off-street parking, laundry, charming, view, trash/ water/gardener paid, 10 min./JPL, walking distance to Montrose Mall, \$1,250, 248-4637.

PASADENA condo, 2 bd., 2 ba., 1,300 sq. ft., wood floors, subterranean parking, on corner of Cordova and Mentor, avail. July 1, \$1,650, includes water, 626/827-5472.

PASADENA condo to share, quiet person, male preferred, near Caltech on Calif. Blvd., very clean, lg. rm. & bath, privacy, green trees, \$550 + \$35 util. 626/796-9221.

PASADENA, beautiful home in Hastings Ranch, 3 bd., den, 2 ba., central a/c, 2 fireplaces, refrigerator, stove, microwave, washer/dryer, large yard w/pool & spa, on golf course, lease required, avail. Aug. 1, \$3,300 + utilities & \$4,300 security deposit, 626/429-3677 or bettyrs@earthlink.net.

SAN MARINO house, 3 bd., 2 ba., 2-car garage w/automatic opener, newly painted, remodeled kitchen, dishwasher, a/c, laundry hookups, fireplace, spacious family rm. overlooking yard, no pets, exc. neighborhood and school district, \$3,200, 626/576-7333.

SIERRA MADRE, bachelor pad located on a quiet cul-de-sac, full bath and kitchenette (stove and fridge), use of pool, \$1,000 + security deposit, 626/796-6983.

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