

Polar Lander heads to red planet

By DIANE AINSWORTH

After a stellar launch at 3:21 p.m. Eastern Standard Time on Sunday, Jan. 3, NASA's Mars Polar Lander is now on its way to the south pole of Mars to search for water ice beneath the edge of layered terrain in this uncharted region of the planet.

The spacecraft was launched atop a Delta II-class launch vehicle identical to the expendable rocket used to loft Mars Climate Orbiter into space on Dec. 11, 1998. Hitchhiking aboard the diminutive spacecraft are two grapefruit-sized microprobes designed to crash into Mars' surface and carry out up to seven days of soil and water experiments as far as 1 meter (3 feet) below the Martian surface. The probes will ride silently to Mars, mounted on the Polar Lander's cruise ring, before they are turned on and deployed 10 minutes before the mothership touches down.

"The launch was incredible, just amazing, because the vehicle is just sitting there one minute and then it's gone," said Kari Lewis, chief mission engineer on the New Millennium Deep Space 2 microprobe mission. "There was a low cloud cover, though, so we didn't see it for very long."

Sixty-six seconds after liftoff on a cloudy, blustery day at Cape Canaveral Air Station, and the morning after a storm packing 38-mile-per-hour winds had swept through Cocoa Beach, the Delta's four solid-rocket strap-on boosters were jettisoned.

At 4:03 p.m. EST, Mars Polar Lander separated from the third stage. A set of solar panels located on the spacecraft's outer cruise stage were deployed shortly thereafter and pointed at the Sun. The lander's signal was acquired at 4:19 p.m. EST over Canberra, Australia, by a 34-meter-diameter (112-foot) Deep Space Network antenna.

The spacecraft is in excellent health, the flight team reports, and continues to show normal power and temperature levels and the proper attitude control for telecommunications with Earth using its medium-gain horn antenna.

Earlier in the week, the flight team was continuing to analyze data from Mars Polar Lander's star camera, which had not yet been able to lock on to the proper set of stars to establish its reference in space. The situation became evident shortly after launch, as the lander was beginning to try to locate stars to establish its proper orientation in space. Proper operation of the star camera was initiated on Wednesday morning.

Mars Polar Lander's interplanetary cruise will take it more than 180 degrees around the Sun in a Type 2 trajectory, allowing the spacecraft to target a landing zone close to Mars'

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A Delta II lights up a stormy sky Jan. 3, with 483,000 pounds of thrust, hurtling Mars Polar Lander skyward.



KENNEDY SPACE CENTER PHOTO

MGS zooms in on Mars

By DIANE AINSWORTH

Mars Global Surveyor began the second phase of aerobraking this fall, after spending the spring and summer in an elliptical, 11.6-hour orbit to allow Mars to move into the proper position for the start of the mapping mission in March 1999.

Over five months, the spacecraft reaped the benefits of an orbit that took it much closer to the planet's surface than will be possible once mapping starts. Surveyor collected an additional bounty of data at a closest approach of about 170 kilo-

meters (106 miles) above the surface, allowing scientists to make highly detailed measurements of the Martian atmosphere and surface and magnetic measurements of near-surface fields without interference from currents generated by the interaction of the solar wind with the planet.

The results were spectacular. Close-up views of Elysium Basin revealed the first evidence of giant plates of solidified lava, rather than lakebed sediments, that appeared to have been broken up and transported across the Martian surface millions of years ago as they floated on top of

molten lava. Scientists postulated that the area in the northern lowlands was once the site of giant ponds of lava flows hundreds of kilometers across.

MGS's closest passage over the planet also took it right over the north polar dune fields four times a day, revealing new evidence that sand dunes in the region had hopped or rolled across the surface in recent months.

Some of the dunes appeared to be coated with thin, bright frost that was left over from the northern winter season that ended in mid-July. The frost was covered with dark streaks emanating from small dark spots that dotted the bases of many

of the dunes. Dr. Michael Malin, principal investigator of the Mars Orbiter Camera, suggested that the dunes were probably altered by gusts of wind that had blown the dark sand out across the frost-covered dunes and created a streak of deposited sand over the frost.

To top off a summer of bonus science, new images and temperature readings of Phobos showed that the small moon had been pummeled by eons of meteoroid impacts, pounding surface materials into a fine powder that had started some landslides along the steep slopes of giant craters.

Temperature measurements—
See MGS, page 6

New HR policies kick off 1999

By MARK WHALEN

With the new year comes a number of changes in JPL human resources policies.

Changes affecting extended work week, overtime and jury duty pay, sick leave and other issues have been in the works throughout 1998, said Human Resources Director Sue Henry. "With the implementation of our new Oracle-based business systems for 1999, now is a great time to implement the new personnel policies," she said.

Policy changes are as follows:

Extended Work Week (EWW): The maximum salary eligibility for EWW will be raised from \$1,400 to \$1,600 per week. Eligible

exempt employees will receive their straight time hourly rate for hours worked in excess of 40, provided the EWW request meets policy guidelines.

"This policy change came about as a result of supervisor requests," Henry said, noting that the \$1,400 weekly limit had been in effect for many years. "We've also simplified the formula for paying EWW and increased the number of eligible employees."

Computing overtime premiums for non-exempt employees: Non-exempt employees will be paid overtime for hours worked in excess of 40 hours in any work week. Employees will no longer be paid overtime for hours worked in excess of eight hours per day, unless the time worked exceeds 12 hours in a day. For hours in excess of 12, double time will be paid. "We've been looking forward to making this change since it became state law early last year," Henry said. "It provides

a lot more flexibility for non-exempt employees and their supervisors to get work done."

Jury duty pay: This policy has been changed to provide five paid days per year, replacing the current policy of 15 paid days in a three-year period that has been difficult to communicate and track. Employees who report for jury duty should clearly state the five-day limit to the judge when asked.

In May, Los Angeles County will implement a one-day or one-trial system in which jurors will be required to be excused from duty if not selected on their first day of service, Henry said.

Flexible workday: Current policy includes a choice of two standard work days, 8 a.m. to 4:45 p.m. or 7:30 a.m. to 4:15 p.m. Supervisors, at their discretion, may authorize an alternative work schedule, as long as it includes eight hours of work time (which includes two 15-minute paid

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Special Events Calendar

Ongoing

Alcoholics Anonymous—Meets at 11:30 a.m. Mondays, Tuesdays, Thursdays (women only) and Fridays. Call Occupational Health Services at ext. 4-3319.

Codependents Anonymous—Meets at noon Wednesdays. Call Occupational Health Services at ext. 4-3319.

Gay, Lesbian and Bisexual Support Group—Meets the first and third Fridays of the month at noon in Building 111-117. Call employee assistance counselor Cynthia Cooper at ext. 4-3680 or Randy Herrera at ext. 3-0664.

Parent Support Group—Meets the fourth Tuesday of the month at noon. Call Jayne Dutra at ext. 4-6400.

Senior Caregivers Support Group—Meets the second and fourth Wednesdays of the month at 6:30 p.m. at the Senior Care Network, 837 S. Fair Oaks Ave., Pasadena, conference room #1. Call (626) 397-3110.

Friday, January 8

Associated Retirees of JPL/Caltech Board—Meeting at 10 a.m. at the JPL Woodbury complex, room 601-224, 500 W. Woodbury Rd., Altadena.

JPL Dance Club—Meeting at noon in Building 300-217.

Sunday, January 10

Chamber Music—The DeBussy

Trio will perform harp, flute and viola at this free concert, to be held at 3:30 p.m. in Caltech's Dabney Lounge. Call (626) 395-4652.

Tuesday, January 12

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

"From Caltech to Low Earth Orbit"—The Caltech Management Association and the JPL Space Flight Awareness Program present astronaut Dr. John Grunsfeld, the only Caltech faculty member to have flown in space, at 11:30 a.m. in von Kármán Auditorium. Grunsfeld is currently assigned to STS-104, the third Hubble Space Telescope servicing mission, to launch in early 2000. For information, call Michael Eastwood at ext. 4-9273.

Wednesday, January 13

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

JPL Drama Club—Meeting at noon in Building 301-127.

JPL Toastmasters Club—Meeting at 5:30 p.m. in the Building 167 conference room. Guests welcome. For more information, contact Mary Sue O'Brien at ext. 4-5090.

Russian Language Workshop—Meets from 7 to 9 p.m. on the Caltech campus. Some knowledge or previous study of the language is essential.

Call Joyce Wolf at ext. 4-7361.

Thursday, January 14

Associated Retirees of JPL/Caltech—The group's installation and awards luncheon will be held at Burger Continental in Pasadena. Cost: \$14 per person. For information, call Lila Moore at (818) 790-5893.

Friday, January 15

JPL Astronomy Club—Meeting at noon in Building 198-102.

JPL Dance Club—Meeting at noon in Building 300-217.

Saturday, January 16

Joe Williams—The legendary jazz and blues singer will perform at 8 p.m. in Caltech's Beckman Auditorium. Tickets are \$35, \$31 and \$27. Call (626) 395-4652.

Sunday, January 17

Chamber Music—The Schubert Ensemble of London will perform at 3:30 p.m. in Caltech's Beckman Auditorium. Tickets are \$25, \$21, \$17 and \$13. Call (626) 395-4652.

Wednesday, January 20

JPL Drama Club—Meeting at noon in Building 301-127.

JPL Hiking Club—Meeting at

noon in Building 238-543.

"The Monitor Is The Message: Writing Web Site Content That Works"—Sunjay Moorthy of Section 644 will discuss online documentation, helping users navigate your site and scan online information, and testing sites for usability. At noon in von Kármán Auditorium. Information from this talk will be available on the web in the "ICIS Noontime Talks" area of the "News & Events" section of the ICIS home page at <http://icis.jpl.nasa.gov>.

Thursday, January 21

Von Kármán Lecture Series—Origins Program Manager Dr. Firouz Naderi will speak at 7 p.m. in von Kármán Auditorium. Open to the public.

Friday, January 22

Award for Excellence Nominations—Due today from JPL personnel in business operations organizations (1X, 19X, 2X, and 6X) to the Reward & Recognition Administrator. For more information, visit the R&R home page at <http://eis/sec614/reward/excel.htm> or call ext. 4-3825.

Von Kármán Lecture Series—Origins Program Manager Dr. Firouz Naderi will speak at 7 p.m. in The Forum at Pasadena City College, 1570 E. Colorado Blvd. Open to the public.

DS1 kicks off New Millennium

By JOHN G. WATSON

With one mission launched in 1998, another having launched on Jan. 3 and four others in the hopper, the New Millennium Program has been busy indeed over the last 12 months.

The program's goal is to identify and test advanced technologies that will provide future spacecraft with capabilities needed to achieve important science goals. Through a series of deep space and Earth-orbiting flights, the New Millennium Program will "validate" these technologies in space—that is, either prove that they work or determine what problems may crop up. The testing of advanced technologies is the basic requirement for New Millennium Program missions; as a bonus, missions can also collect science data as new instrument technologies are put through their paces.

The first New Millennium mission to launch was Deep Space 1, whose picture-perfect liftoff on Oct. 24 culminated many months of test and assembly. Unlike the typical mission that enters a cruise phase after launch, this mission began testing its new technologies immediately. In fact, two of them—large solar arrays and a new radio transmitter/receiver—were functionally validated within just two hours of launch.

A much-watched technology on Deep Space 1 is its ion propulsion system, which combines the gas xenon with some of the technologies that make television picture tubes work. Despite an almost imperceptible level of thrust, over the long haul Deep Space 1's ion engine can deliver up to 10 times more thrust than a conventional liquid or solid fuel rocket for a given amount of fuel. It has since been turned on and off repeatedly, perform-

See Millennium, page 7

Galileo provides many discoveries in '98

By JANE PLATT

1998 was a tough year for those trying to keep up with all the discoveries from the Galileo Europa Mission, which has wrapped up the first half of its two-year extended mission. Following on the heels of the primary mission, Galileo Europa has sent numerous batches of pictures and data back to Earth, helping scientists unlock the mysteries of Jupiter and its moons.

A series of additional Europa flybys in 1998 has provided information bolstering the premise of a liquid ocean beneath the icy moon's surface. The science community, the media and the public were enthralled this past March when pictures were unveiled from Galileo's closest Europa flyby in December 1997. The images, taken from only 200 kilometers (124 miles) above Europa, revealed rough, broadly scalloped icy cliffs on Europa as high as Mt. Rushmore, and a large, icy

fracture large enough to be spanned by the Brooklyn Bridge. Also shown were impact crater Pwyll and the Conamara Chaos region, where icy plates on the surface have broken apart and moved around.

It appears Europa may not be the only Jovian moon with a possible ocean. Data from Galileo's magnetometer instrument revealed evidence supporting the premise of a liquid ocean under Callisto's surface. This data indicated that electrical currents flowing in a shell near Callisto's surface are causing changes observed in Jupiter's magnetic field during Galileo's flybys. A salty liquid layer has been suggested as a likely candidate for creating the electrically conducting shell.

Scientists are re-thinking their ideas about Callisto's interior structure, based on new data from Galileo. While previous data indicated that Callisto's interior was totally undiffer-

Earth missions look forward to launches, new beginnings

By MARY HARDIN

The Quick Scatterometer (QuikScat) satellite will be stored at Ball Aerospace in Boulder, Colo. while waiting for launch in April from Vandenberg Air Force Base in California. The launch was delayed from November 1998 due to problems with the Titan II launch vehicle.

"The Air Force and its Titan contractor, Lockheed Martin, are implementing a return to a flight test program which will enable a spring launch of the QuikScat satellite with the SeaWinds instrument onboard," said Jim Graf, JPL's QuikScat project manager. "The instrument was modified and the satellite was procured and developed in record time—one year and six days from formal go-ahead to launch readiness."

QuikScat will measure the speed and direction of winds over the oceans and will restart the valuable data stream that was lost with the NSCAT instrument when Japan's Advanced Earth Observing Satellite (ADEOS) mission ceased functioning in June 1997.

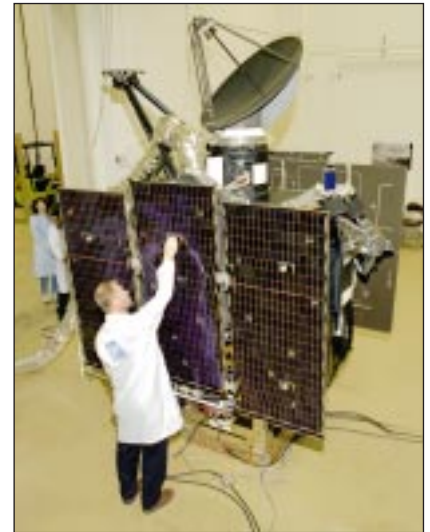
The TOPEX/Poseidon team capped off 1998 by receiving the prestigious William T. Pecora Award at the American

Geophysical Union fall meeting in San Francisco. In December, the satellite conducted the first-ever NASA autonomous navigational maneuver in Earth orbit, giving mission controllers confidence that satellites can operate autonomously within an acceptable level of risk and with lower costs. The TOPEX/Poseidon Autonomous Maneuver Experiment (TAME) is the first step in demonstrating a complete autonomous navigation system for Earth-orbiting satellites.

The TOPEX/Poseidon science team continued to make valuable contributions to our understanding of the ocean by tracking the end of El Niño and the developing La Niña situation in the Pacific. At the same time, science team members reported that the 1997-98 El Niño event may have been a major contributor in the average global sea level rising about 2 centimeters (eight-tenths of an inch) before it

returned to normal levels.

In 1999, work will begin on the TOPEX/Poseidon follow-on mission, Jason-1. Satellite assembly, test and integration will begin in February at satellite contractor Alcatel Space Industries in Cannes, France. Jason-1 will be launched from



BALL AEROSPACE PHOTO

A Ball Aerospace worker inspects the QuikScat spacecraft's solar panels.

Vandenberg in late 2000.

September 1999 will see the launch of Space Shuttle Atlantis with the Shuttle Radar Topography Mission (SRTM) onboard. SRTM uses the Spaceborne Imaging Radar C (SIR-C) antenna that flew twice in 1994 and adds a second antenna at the end of a 60-meter (200-foot) mast extending from the shuttle. The two antennas allow SRTM to conduct radar interferometry, a technique that compares two radar images taken at slightly different locations to obtain elevation or surface-change information. The SRTM antennas will leave JPL in early February for the Cape, where they will be installed in the shuttle payload bay.

The first radar test flights of the Geographic Synthetic Aperture Radar (GeoSAR) are expected to begin early this year with final delivery of the system by the end of 1999. GeoSAR is a new airborne interferometric mapping radar being designed and built by JPL for future commercial operation by Calgis Inc. under sponsorship of the Defense Advanced Research Projects Agency (DARPA) and the California Department of Conservation. The system will

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TAP success noted at JPL and beyond

By JOHN G. WATSON

1998 marked the first calendar year that the Technology and Applications (TAP) Directorate was under the helm of director Mike Sander, who assumed the post after more than 25 years with JPL and NASA Headquarters in various capacities. While engineering a customer-oriented reorganization of the directorate, in 1998 he oversaw milestones in a wide range of diverse technology development units.

Following development and ground testing through 1997, the NASA Solar Electric Propulsion Technology Application Readiness (NSTAR) project delivered the xenon ion engine used on Deep Space 1. NSTAR is a JPL/NASA Lewis venture. The ion propulsion equipment used on Deep Space 1 was provided by Hughes Electron Dynamics Division, Moog Inc., Spectrum Astro and Physical Science.

The first mission of the New

Millennium Program, designed to flight-validate new technologies so that they can be confidently used on future science missions, Deep Space 1 marks the first-ever use of an ion propulsion system for primary propulsion in deep space. From Nov. 24 to Dec. 8, the engine thrusted continuously for 335 hours, far beyond the 200-hour minimum required to declare mission success.

The NSTAR team also used the Deep Space 1 flight spare ion thruster to demonstrate 50 percent extended lifetime to support Deep Space 4/Champion and future Discovery missions.

In the past year, improvements continued with such technologies as the Quantum Well Infrared Photodetector, one of the world's most highly sensitive infrared cameras at long wavelengths, and the Active Pixel Sensor, which enables video cameras to be reduced to the size of a chip coupled with optics while using only 1/100 the power of standard CCD

cameras.

JPL was awarded nine projects in 1998 in the inaugural year of NASA's Incubator Instrument Program, five of which were heavily dependent on TAP-sponsored technologies. These included "Global Positioning System on a chip" technology, Millimeter Integrated Circuit low-noise amplifiers and a submillimeter sensor to measure ice.

TAP-developed technologies contributing to far infrared missions include submillimeter heterodyne sensors (mixers, receivers and associated electronic components for detection needs in the microwave and submillimeter wave spectral regions) and cryobolometers (designed to absorb light for broadband astronomy in spaceborne astrophysics missions). They will enable such missions as the First Infrared and Submillimeter Space Telescope (FIRST), the Microwave Instrument for the Rosetta Orbiter (MIRO) and FIRST/Planck, which

will determine how structure in the universe emerged from the Big Bang.

TAP is also developing Lithographie Galvanofornung Abformung (LIGA) grids for NASA's High Energy Solar Spectroscopic Imager (HESSI) mission. The grids will help reduce the size of this spaceborne telescope. LIGA is a microfabrication technique created in Germany in the 1980s, with specific applications developed in collaboration with several national lab, university and industrial partners.

New collaborations and strategic alliances with industry continued through JPL's Commercial Technology and Regional Development Program, as more than 200 new JPL-developed technologies were reported, about one-third of which were converted to patent applications, higher than in any previous year. 1998 milestones included a licensing agreement with Ford Motor Company for neural network chip technology for diagnostics under the hoods of

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Cassini performance excellent heading into '99

By MARY BETH MURRILL

The Cassini/Huygens mission to Saturn and Titan celebrated a year of problem-free flight as the spacecraft travels through the inner solar system. "The overall performance of the Cassini spacecraft and the operations team has been excellent," said Cassini Program Manager Bob Mitchell. Mitchell was named to his post in mid-1998 when former program manager Richard Sphehalski retired.

One highlight of the spacecraft's flight over the year was trajectory correction maneuver number 2,

which was performed using Cassini's reaction control system on Feb. 25, 1998. The performance was excellent, and as a result, two other scheduled trajectory correction maneuvers were cancelled as they became unnecessary.

The first of two Venus flybys occurred flawlessly on April 26, 1998 at 284 kilometers (175 miles) altitude. The radio plasma wave spectrometer was operated in an attempt to detect lightning in Venus' atmosphere, but none was detected. The program conducted a review of requirements in preparation for the

second Venus flyby and an Earth swingby in June and August this year.

A large propulsive maneuver (called the Deep Space Maneuver) was performed on Dec. 3, 1998, in order to establish the necessary gravity-assist conditions at the upcoming Venus encounter. A total of 771 kilograms (1,700 pounds) of propellant was used to change the spacecraft's speed by 450 meters per second (1,000 mph). All systems performed properly.

Engineering checkouts of the Huygens probe were conducted twice last year, and periodic instru-

ment and engineering maintenance activities on Cassini have shown the spacecraft to be running smoothly. The first in-flight use of Cassini's high-gain antenna began Dec. 28, 1998 for the start of a 25-day instrument checkout activity.

Sphehalski received the American Astronomical Society W. Randolph Lovelace II Award in recognition of "his outstanding contributions to space science technology." In October, NASA Honor Awards were given to Cassini and Huygens team members and contractors in recognition of their contributions to the program's successful development and launch. □

Stardust readies for Feb. launch

By MARY BETH MURRILL

The Stardust Project is now buttoning up its spacecraft for a Feb. 6 launch on a Delta II rocket from Cape Canaveral, Fla. "Stardusters," as the project personnel call themselves, spent the last year assembling and testing spacecraft components and materials at JPL, at Lockheed Martin Astronautics in Denver, where the spacecraft was built, and at the Kennedy Space Center in Florida. The project maintained its schedule and budget throughout the year.

Stardust's target is Comet Wild-2 (pronounced "VILT-2")—a "fresh"

comet which just 24 years ago was deflected by Jupiter's gravity from its previous home in an orbit lying much farther out in the solar system. Having spent most of the solar system's history in the coldest, most distant reaches of the solar system, Wild-2 represents a well-preserved example of the fundamental building blocks out of which formed our solar system and everything in it.

To collect comet samples, Stardust will use a high-tech sieve made of a special silicon-based material called aerogel, an exotic, lightweight transparent silica gel that looks like solid smoke and holds the

title of being the lowest density solid material in the world. Embedded in the aerogel, the particles will be preserved inside the cone-shaped return capsule that the Stardust spacecraft will later target and release for reentry into Earth's atmosphere.

One major highlight of the past year was the successful drop test of the Stardust sample return capsule at the the U.S. Army's Dugway Proving Grounds at the Utah Test and Training Range near Salt Lake City. The capsule swung gently beneath its parachute after being dropped from a balloon floating at about 3,960 meters (13,000 feet) altitude. Project engineers said the soft landing demonstrated that the return

capsule can successfully deliver comet and interstellar dust samples at the mission's end in 2006.

An educators conference was hosted by the project as a key element of its outreach emphasis. "Our participation in the JPL community open house, involvement with the release of the Paramount picture 'Deep Impact' and interaction through the project's education partners at Omniplex, the Jason Foundation, and the Challenger Centers got millions of students involved with Stardust," said Project Manager Dr. Kenneth Atkins.

More than 1.5 million names were collected and etched onto

See Stardust, page 7

Origins to look beyond solar system

WIRE launch set for Feb. 26

By JANE PLATT

A galaxy of developments this past year pertained to the Origins Program and related astrophysics missions. Public interest was heightened by the discovery of additional extra-solar planets, including a Hubble Space Telescope image of what appeared to be a planet ejected into deep space by its parent stars. The image of the object, called TMR-1C, may turn out to be the first direct look at a possible planet outside our solar system.

Excitement was generated also by the discovery of the clearest evidence yet of a budding solar system around a nearby star. An image taken with the new Keck II telescope in Hawaii, equipped with the sensitive, JPL-developed infrared MIRLIN camera, revealed probable planet formation site around the star HR 4796.

Wide-Field Infrared Explorer (WIRE), a spaceborne telescope designed to explore the evolution of starburst galaxies and search for protogalaxies, is scheduled for launch Feb. 26 from Vandenberg Air Force Base. Fabrication, assembly and test of the instrument were completed in 1998 and the instrument was shipped to Goddard Space Flight Center for spacecraft-instrument integration. It will be shipped from Goddard to Vandenberg in mid-January.

WIRE is NASA's fifth Small Explorer mission. The Small Explorer Program, managed for NASA by Goddard, provides frequent flight opportunities for highly focused, relatively inexpensive science missions.

The Space Infrared Telescope Facility (SIRTF) entered its formal development phase last spring. The highly advanced orbiting space observatory formally passed its critical design review in September and NASA's independent annual review in October.

The SIRTF Science Center was formally established in April, with Caltech Professor B. Thomas Soifer named as director. The center will be responsible for all the observatory's sci-

ence operations, including interaction with the science user community.

A decision was made to use a prototype 85-centimeter (33-inch) diameter beryllium mirror as the flight primary mirror. Procurement and fabrication are under way for five types of detectors for the three science instruments.

Development activities in 1999 include the fabrication of the spacecraft bus and focal plane assembly for each of the science instruments; telescope and cryostat fabrication and assembly will also be done. SIRTF, scheduled for launch in December 2001, will give astronomers unprecedented views of phenomena in the universe that are invisible to other types of telescopes.

In 1998, JPL selected Lockheed Martin Missiles and Space of Sunnyvale and TRW Inc., Space and Electronics Group of Redondo Beach for negotiations as industry team members for the Space Interferometry Mission (SIM).

The total value of these two contracts, including mission formulation and implementation phases, is estimated to be above \$200 million. The initial contracts will cover the formulation phase, with an option for the implementation phase. During the formulation phase, initial mission design and planning for full-scale implementation will be completed.

In 1999, SIM will focus its efforts on a set of technology experiments and analyses to enable an instrument architecture decision later in the year. In parallel, the SIM team will develop the initial draft of its project implementation plan. SIM will launch in 2005 on a journey to measure precisely the location of stars and to search for planets orbiting nearby stars.

Terrestrial Planet Finder project members in 1998 studied a number of mission configurations, developed a technology roadmap, and developed plans to support the upcoming National Academy of Science decade review process. This year, a detailed technology plan will be developed for a starlight demonstration, and ongoing industrial studies will be completed.

The Keck Interferometer project completed

its Critical Design Review last August and selected EOST of Tucson, Ariz., as contractor for the outrigger telescopes. The Keck project also received a permit from the Hawaii Department of Land Management for the test siderostats, which will be installed in 1999 after site construction is completed. During the coming year, the Keck project will also apply for a permit for the outrigger telescopes, and the two-way beam combiner will begin lab integration and testing at JPL.

In 1998, the configuration of the FIRST/Planck project (Far Infrared/Submillimeter Telescope) was selected for technology demonstration by the European Space Agency's Space Program Council, the scientific body that makes recommendations to the director. Composite Optics Inc. of San Diego was selected as telescope contractor.

ESA is scheduled to confirm the FIRST/Planck mission in February, as long as conflicts are resolved between instrument funding profiles and delivery schedules. Fabrication of the 2-meter telescope technology is also scheduled for 1999.

FIRST/Planck will determine how structure in the universe emerged from the Big Bang by studying the evolution of galaxies and stars, the origin and evolution of the elements, and star and planet formation.

Laser Interferometer Space Antenna (LISA) Mission Definition Team members met twice in 1998. This year, a New Millennium DS-5 opportunity for flight demonstration will be sought for LISA technology, with the goal of demonstrating inertial sensors. LISA will partner with European space agencies to the extent possible.

Eighteen scientists from all over the world collaborated in 1998 to define science goals for Advanced Radio Interferometry between Space and Earth (ARISE), which will use an innovative spacecraft with a 25-meter inflatable antenna. An innovative combined structural and thermal antenna model was developed using new Develop New Products software.

ARISE goals for 1999 include the issuance of draft guidelines of cooperation between National Science Foundation and NASA. Feasibility, trade and implementation studies will be performed for the antenna, ground seg-

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Outer Planets/Solar Probe: new name; launch dates set

By JANE PLATT

A project encompassing three diverse missions gained a new name and a set of launch dates in 1998. Europa Orbiter, Pluto-Kuiper Express and Solar Probe, which had been grouped as the Ice and Fire Preprojects, were converted to Outer Planets/Solar Probe Project. Europa Orbiter was assigned a planned launch date of November 2003, with a December 2004 launch planned for Pluto-Kuiper Express, and February 2007 for Solar Probe.

Dr. John McNamee was appointed Outer Planets/Solar Probe project manager, with Robert Staehle serving as deputy project manager. Prime science objectives were selected for all three missions, and X2000 began developing

the hardware and software for the planned journeys to the Sun, Europa, Pluto and beyond.

The new year will bring additional progress for the missions, with the anticipated selection by NASA of the first science payload for Europa Orbiter. A propulsion module contract will be awarded, and an industry collaborator selected for all three missions.

Europa Orbiter has reaped the rewards of inter-

MUSES CN progresses

By MARY BETH MURRILL

NASA and Japan's space science organization ISAS signed an interim agreement formally establishing the collaboration on the MUSES C sample return and rover mission to an asteroid. Last year, the announcement of opportunity for the MUSES CN science team was released and proposals were received.

In the area of nanorover and spacecraft

est stirred up by recent findings from the Galileo Europa Mission. New pictures and data bolster the premise of a liquid ocean beneath Europa's surface. Pluto will make history on Feb. 11, 1999, when its orbit crosses over Neptune's, reclaiming Pluto's title as "most distant planet" in our solar system. And our celestial life source, the Sun, will be scrutinized by Solar Probe, which is to fly 20 times closer to the Sun than any previous spacecraft. □

engineering, the project tested the ISAS-developed heat shield materials at NASA's Ames Research Center. The engineering models of the motors for the MUSES CN nanorover were delivered to JPL. The rover is about halfway finished with its detailed design, said Project Manager Ross Jones. In addition, he said, the electronic boards for the software development model rover were completed.

JPL and The Planetary Society signed a memorandum of understanding establishing the society as an outreach partner with MUSES CN. □

MGS

Continued from page 1

taken from distances of 1,045 to 1,435 kilometers (648 to 890 miles), or far enough away to capture global views of the Martian moon in a single spectrum—showed that the surface must be composed largely of fine ground powder at least 1 meter (3 feet) thick, and that day-and-night-side temperatures varied from extremes of -4 degrees Celsius (25 degrees Fahrenheit) during the day to lows of -112 Celsius (-170 degrees Fahrenheit) at night.

Dr. Philip Christensen of Arizona State University, principal investigator of the thermal emission spectrometer, explained that the

temperature drops are the result of the absence of an atmosphere around the moon and a thick carpet of fine, powdery granules that have a low heat capacity and lose heat quickly once the Sun sets.

Extensive laser altimeter measurements were made of the north polar region, including scans that crossed very near to the geographic pole. These measurements allow scientists to make an accurate determination of the volume of the ice cap. In addition, data from the magnetic investigation revealed peculiar magnetic anomalies as the precession of the low point of the orbit, or the periapsis, moved across new latitudes.

Mars Global Surveyor will continue aerobraking operations until

early February 1999. The spacecraft recorded its 1,000th orbit around Mars on Jan. 5 and will descend to a three-hour orbital period by Jan. 15. After reaching a two-hour orbit, the "walk-out" phase of aerobraking, which will begin to raise the spacecraft's periapsis in preparation for the start of the mapping mission, will be initiated on Feb. 4, followed by termination of aerobraking on Feb. 9.

The flight operations team will deploy Surveyor's high-gain antenna on March 30, 1999, approximately three weeks after the start of mapping on March 8. The antenna deployment is being delayed to ensure that a minimum set of science data is acquired and the minimum mission success criteria are

met in case there is any problem resulting from the antenna deployment. There has been some concern about the performance of a damper device in the antenna's deployment mechanism. A problem with a similar damper on Global Surveyor's solar panel caused damage to the panel's supporting structure just after the spacecraft was launched.

Surveyor's science mapping mission, which will last one full Martian year or the equivalent of two Earth years, will be complemented by additional imaging and atmospheric measurements in 2000, when Mars Climate Orbiter begins its scientific mission to study the Martian weather, atmosphere and climatic history. □

Policies

Continued from page 2

rest periods for non-exempt employees), and an unpaid 45-minute lunch break.

"Why not empower employees to get their work done the best way possible?" Henry asked. "As long as people work eight hours a day and take their required breaks, we think employees and supervisors can be trusted to do a good job with flexible schedules."

If questions or disagreements on schedules arise, Henry suggested that new schedules be put in writing "to avoid misunderstandings."

Sick leave/illness in the immediate family: Employees may continue to use up to 10 sick days per year to attend to illnesses in the family. If the employee has accrued sick leave and is attending to the serious health con-

dition of an immediate family member, up to an additional 10 days per year may be approved. Written certification from a health care provider, in accordance with the Family and Medical Leave Act, is required.

"Fortunately, there is not a large number of employees who will need to take advantage of this change," Henry said. "But it is very nice for those who need it."

Advancing sick leave: A section manager may request a one-time sick leave advance of five days provided the employee has a serious or long-term illness or disability and he or she has completed a minimum of 60 days of continuous employment.

Once the advance is authorized by the Benefits Office, the policy requires that the subsequent monthly sick leave accruals be used to "pay off" the negative balance.

"There are not many in this situa-

tion, but it is very sad when it does happen," Henry noted. "We think it's a nice gesture to help those in need when they come back to work."

Leaves of absence: Laboratory policy requires supervisors to submit leave of absence paperwork to the Benefits Office on the 10th day of an employee's absence and use the first day the employee did not report to work as the effective date of the leave.

When an employee is placed on a FMLA (Family and Medical Leave Act) leave for his or her own serious health condition, supervisors are required to debit all sick leave accrual first and then debit vacation accrual.

Payroll will debit the employee's sick leave balance each pay period by the amount of State Disability Insurance (SDI) income (converted to hours) paid directly to the employee by the state of California. This process will begin the eighth calen-

dar day of a non-work related illness. Payroll will supplement SDI income with vacation accrual only after all sick leave accrual has been used.

Employees who want to continue medical coverage while on FMLA or disability leave for their own serious health condition pay only the employee portion of the medical premium for a period of up to six months.

"This change is really a coordination of benefits," Henry said, "and will allow employees to maximize their sick leave as well as take advantage of disability payments."

Changing to a non-benefit-based status: The revised policy requires the payoff of all vacation accrual and personal holiday at the time the status change is effective.

Employees are encouraged to discuss questions on the new policies with their supervisor or call the Employee Relations Office at ext. 4-7506. □

TAP

Continued from page 2

Ford cars and a memorandum of understanding (MOU) with Jacobs Engineering to commercialize specific JPL technologies.

Seventy-eight new tasks were written with Technology Affiliate members, of whom nearly 75 percent were repeat member companies. Partners included: the Anchorage-based Alyeska Pipeline Service Company, studying oil spill detection technologies for the trans-Alaska pipeline; the National Geographic Society, for whom JPL used its digital imaging expertise to help create a geographical map of the world that the society gave away to every U.S. school; Babylonian Productions, producers of "Babylon 5," working with JPL scientists on the accuracy of episodes of its new "Crusade;" and

Dubbs & Severino, working with JPL's digital imaging experts through the Technology Affiliates Program and a Small Business Technology Transfer and Research agreement to create digital terrain mapping software for pilots of small planes.

One of TAP's 1998 objectives was to begin partnering relationships with reimbursable (non-NASA) sponsors. Toward this end, TAP signed MOUs with the National Reconnaissance Office and the Air Force Research Laboratory.

To further JPL's assistance to site sponsors, TAP used the Inter-Agency Personnel Act Program to place individuals at the Defense Information System Agency, is in the process of exchanging personnel with the Air Force Research Laboratory and has started discus-

sions with the National Reconnaissance Office.

To make its programs of benefit both to NASA and reimbursable sponsors, TAP is now seeking tasks that both NASA and reimbursable technology funders are willing to invest in. As a result, TAP is actively seeking joint funding for a variety of programs, often with NASA and the Department of Defense.

JPL's Space Inflatable Technology Program moved toward center stage as a resource for future missions. Successful testing was completed on a half-scale model of the inflatable sunshield for the Next Generation Space Telescope and the construction of 14-meter-long (42-foot) inflatable composite booms for future applications on solar sails.

See TAP, page 7

Earth

Continued from page 3

map above and below vegetation canopies.

The long-awaited launch of NASA's Earth Observing System satellite AM-1, now named Terra, is slated for late 1999 with two JPL-related instruments onboard. The Multi-Angle Imaging Spectro Radiometer (MISR) was built by JPL and the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) is provided by Japan's Ministry of International Trade and Industry, with scientific support provided by JPL. Terra will launch from Vandenberg.

The Active Cavity Radiometer Irradiance Monitor (ACRIM) satellite (ACRIMSAT), which will study the Sun and its impact on the Earth's climate, is scheduled for launch in October 1999. □

Millennium

Continued from page 3

ing beyond expectations throughout.

Deep Space 1's other new technologies, many of which have already been validated, include autonomous optical navigation, several microelectronics experiments, and software to plan and execute many onboard activities with only general direction from the ground. Two science instruments—one combining a camera, ultraviolet imaging spectrometer and infrared imaging spectrometer, the second combining several instruments that study space plasma—will be further tested during a planned flyby of asteroid 1992 KD this July. By Dec. 1, Deep Space 1 had accomplished enough testing to satisfy the technology validation aspects of the minimum mission success criteria and is now well on its way toward meeting maximum criteria as well.

Following its Jan. 3 launch, Deep Space 2's two small probes will reach Mars this December and will crash into the Martian soil to test new technologies and conduct science experiments. Each probe, approximately the size of a large grapefruit inside a basketball-sized aeroshell, contains a suite of miniature electrical and mechanical systems that must withstand extreme environments, including crashing into the planet's surface at speeds of up to 500 mph and surviving extremely low temperatures. Upon impact, they will begin collecting data to verify the survival of the penetrator system, which contains 10 new technologies.

Within the first six hours, they will also attempt to detect the presence of water ice. If successful, this mission will pave the way for future science projects involving scores of microinstruments sent to all regions of a solar system planet or moon.

The probes' three parts—a forebody that pierces up to nine-tenths of a meter (three feet) into the ground, an aftbody that remains above the ground (tethered to the forebody for telecommunications) and the aeroshell in which they are traveling to Mars—were delivered to the Kennedy Space Center this fall and attached to the Mars Polar Lander cruise ring, on which they are piggybacking to the red planet. Launch was the crowning touch to an intensive year of test and assembly for the mission team.

Deep Space 3, a proposed optical interferometry mission involving spacecraft orbiting the Sun in formation, made significant progress in

1998, as the mission was reconfigured from three spacecraft to two. Engineering design experiments determined that separated spacecraft interferometry could be accomplished using two spacecraft separated by up to one full kilometer. This change has yielded both cost and mass savings. An industry partner is scheduled to be selected and on contract by this March. Deep Space 3, which is scheduled to launch in December 2001, will undergo system requirements and architecture review in August.

Deep Space 4/Champion, a proposed mission that will send a lander to the nucleus of comet Tempel 1 in 2005 following a scheduled launch in 2003, achieved many milestones in 1998. The team continued working on the detailed design of the lander and mother ship, including the construction of a striking, full-scale mockup of the diminutive lander. An observational program on Tempel 1 has revealed the size of the nucleus to be 3.9 by 2.8 kilometers; the team is now trying to determine additional information on the nucleus' shape and its rotation period. A NASA review is scheduled for April.

Earth Orbiter 1, New Millennium's first Earth orbiter flight, will validate technologies for future land-imaging missions. Over the course of this mission, launching in December 1999, three new land-

Galileo

Continued from page 3

at about 810 kilometers (more than 500 miles).

Jupiter's fiery moon Io turned out to be even hotter than scientists had known. Galileo's camera captured images of dozens of volcanic vents on Io, where lava is hotter than any known surface temperatures on any planetary body in the solar system. At one of these volcanic vents, called Pillan Patera, the lava temperature may be 2,000 Kelvin (3,140 degrees Fahrenheit). Such high temperatures are not known to have occurred on Earth for billions of years. Galileo Project Scientist Dr. Torrence Johnson said this data indicates high-temperature eruptions are a basic, common part of Io's volcanic processes.

Recent images of Ganymede, the largest moon of any planet in the solar system, revealed impact craters with unusual pedestals, dark ejecta haloes, evidence of tectonic activity and possible signs of icy volcanic flows. A crater chain appeared to have been caused by impacts from a broken-up comet, similar to the 1994 Shoemaker-

imaging instruments will collect multispectral and hyperspectral scenes in coordination with the Enhanced Thematic Mapper (ETM+) on Landsat-7. Managed by NASA's Goddard Space Flight Center, EO-1 will demonstrate breakthrough technologies in lightweight materials, high-performance integrated detector arrays and precision spectrometers. Detailed comparisons of the EO-1 and ETM+ images will be carried out to validate these instruments for future missions.

In 1998, EO-1's advanced land imager completed environmental testing and is now in final calibration. Its Hyperion instrument was added in May and is now being fabricated; this unique instrument's capabilities provide resolution of surface properties into hundreds of spectral bands, versus the 10 multispectral bands flown on traditional Landsat imaging missions. Other instruments delivered for integration and test included EO-1's pulsed plasma thruster, carbon-carbon radiator, X-band phased array antenna, lightweight flexible solar array and enhanced formation flying software.

With Earth Orbiter 2, New Millennium will fly an infrared laser in the cargo bay of the space shuttle to see if a space-based sensor can accurately measure global winds within Earth's atmosphere from just above

Levy impact on Jupiter.

Scientists now know much more about the origin of Jupiter's rings, thanks to recent Galileo images. The huge planet's swirling ring system is formed by dust kicked up as interplanetary meteoroids smash into Jupiter's four small inner moons. And the outermost ring, previously believed to be a single feature, was found to be two rings, one embedded within the other.

New information gathered by Galileo, the Hubble Space Telescope and ground-based observations revealed that two of Jupiter's giant, swirling "white oval" storms merged early in 1998 to form a larger white oval as big as Earth. A colorful image of aurora on Io was also released.

Galileo continues under the leadership of Project Manager Jim Erickson, who assumed the post after the previous project manager, Bob Mitchell, became Cassini program manager last June. In 1999, Galileo will wrap up its series of Europa flybys on Jan. 31, then it will fly by Callisto four times before lowering its orbit for two Io flybys, as long as the spacecraft remains healthy. □

the surface to a height of about 16 kilometers (10 miles). Successful measurements in this key region of the atmosphere could lead to improved weather forecasting and better understanding of such climate-related events as El Niño.

Based on technology tested aboard research aircraft, the Space-Readiness Coherent Lidar Experiment (Sparcle) will detect the frequency shift of an eye-safe laser pulse as it reflects off dust and aerosol particles as they move with the winds. The resulting measurements should give researchers precise information about the speed, direction and vertical profile of tropospheric winds. Due to launch in 2001, Sparcle is managed by NASA's Marshall Space Flight Center. This year's milestones included a preliminary system design review in October, to be followed by a critical design review this April. □

TAP

Continued from page 6

Two experiments were selected when the program issued a solicitation for inflatable space experiments to fly with an inflatable sunshield, including an inflatable solar array test in 2000 for potential use on Deep Space 4/Champion.

As part of its current proof-of-concept phase, the Viewing Imager Gimbaled Instrumentation Lab & Analog Neural Three-dimensional processing Experiment (Vigilante) testbed infrastructure was completed in 1998. Vigilante is a machine vision instrument that combines several sensors to recognize specific targets in real time without the aid of the human eye. The key is a new, JPL-developed, sugar cube-sized processor built on neural networking principles. □

Stardust

Continued from page 4

silicon chips mounted and flown on Stardust.

A milestone was reached as the mission's environmental assessment process was successfully completed.

The cometary and interstellar dust analyzer instrument, provided by Germany, was delivered on time, and the flight system completed fabrication and test in Denver and was shipped on time to Kennedy Space Center. All stages of Boeing's Delta II launch vehicle arrived and began integration at KSC, said Atkins, and pre-launch operations have proceeded smoothly. □

FOR SALE

BICYCLE, hand-made recumbent, P-38 Lightning, very lightweight, very fast, very comfortable, cost \$2,300, sell \$1,200. 626/836-8561. CD PLAYER, Denon DCD 1300, single play, remote cont., perfect working order, \$200. 626/281-2179, Mike.

COFFEE and END TABLES, oak, 54 x 24 x 15 and 26 x 23 x 19, \$100/both/obo. 626/285-7284.

COFFEE TABLE, oak, vg cond., 29" x 55", \$50; MTN. BIKE, women's Nishiki, 21-sp., nds. new tires, exc. cond., \$40. 249-2669.

COMPUTER, new Gateway 333 G6 Pentium 2 w/64M RAM, DVD, sound card, speakers w/subwoofer, 3-yr. gold warr., must sell, make offer. 626/398-4101.

COMPUTER CASE, tower, 5 drive bay, \$20; MX mid-tower case, \$35; Anadex dot matrix printer, 9501. 249-8524.

COUCH, beautiful, decorator qual., 7' long, floral design on soft beige backgrnd., \$450/obo. 626/449-8709.

COUCH, beautiful, exc. cond., aqua blue/green w/ white trim, 7 ft., camel back, \$300. 626/798-9090.

DIET TAPES, Jenny Craig, set of 14, \$50. 790-3899.

EXERCISE BIKE, Tunturi Ergometer, \$60; ROWING MACHINE, Precor, \$50; BBQ, Weber 22 1/2" kettle, \$25; BIKE, Motobecane 10-sp., \$35; TV STAND, Sony blk. 25" w/storage underneath, \$15; SLANT BOARD, padded abdominal, \$10. 626/577-7027.

FIREWOOD, pine, ready to burn. 248-0853.

FOOTBALL CARDS, box of Excalibur '97, 24 unopened packs, major stars/rookies, \$40; BASEBALL CARDS, '98 Leaf set, Beckett value \$200, major stars/rookies, \$60; 200 var. baseball stars/rookies, \$20; 200 var. football stars/rookies, \$20. 626/914-6083.

ORGAN, Yamaha 415 electronic console w/13 pedals, 3 keyb'ds, 144 rhythm patterns, pd. \$7,500, sacr. for \$3,000. 790-3899.

PERSONAL INFO. MGR., Seiko "Phone-Pal", \$25. 790-3899.

PIANO, Wurilizer upright, w/bench, \$500. 952-8455.

PICTURE FRAMES, three made of brass, 22" x 28", \$10/each, \$21 for all three/obo. 626/568-8296.

POWER CENTER for computer, \$20. 790-3899.

REFRIGERATOR, lg. 25.4 cu. ft. Whirlpool, side-by-side drs., water/ice dispenser, clean, gd. cond., \$140. 626/796-5684.

SKIS, new, size 18", \$220/obo. 213/313-0136.

SNAKE, ball python, very gentle, with cage, heat lamp & bath dish, \$100 firm. 626/799-0109.

SNOWBOARD, \$100/obo. 310/886-2621, pager.

SOFA SET, sofa, loveseat, coffee table and end table, good condition, all for \$150/obo. 790-9772.

SOFTWARE, for Mac, all \$25 and under. 790-3899.

SPRINKLER VALVE actuators, Lawn Genie model 756LG3/4, new, \$10 each. 790-3899.

SWEATER, Coogi, from Australia, new, \$325 in Nordstrom, \$100. 790-3899.

TABLE, din. rm., round, mahogany, sits 8 with/2 extensions, almost new, comes w/6 matching chairs, \$700/obo; matching China buffet, \$1,000/obo; all for \$1,500/obo. 909/592-0780, Ana.

TELEVISION, Sharp 13", \$20. 626/795-8340, Paul.

TREADMILL, like new, exc. cond., \$225. 626/798-9090.

WINE RACK, black wrought iron, lockable, holds 60+ bottles in 18" x 18" footprint, \$200. 626/281-2179.

VEHICLES / ACCESSORIES

'87 ACURA Legend, 4-dr. sedan, blue, exc. cond., low mi., \$6,500. 248-9561.

'77 CADILLAC, vg cond., runs well, 125,000 mi., \$1,400/obo. 626/334-8871.

'90 CHEVY Lumina APV 7-pass. minivan, loaded, only 54,700 mi., newer breaks and tires, new battery; auto, ps, pw, pdl, a/c, cruise con-

Universe

Editor: Mark Whalen

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trill, cass., tilt; anti-theft device, exc. cond., \$6,999. 909/594-3935.

'84 DODGE D-50 pickup truck, vg cond., auto, 2.6 eng, tilt wheel, bedliner, shell, new batt., very clean, well maint., 139K mi., orig owner, \$2,600. 626/332-2682.

'96 FORD Contour, loaded, 38,000 mi., ext. warr. avail., black ext., gray int., 5-sp., \$10,500. 362-3358.

'95 FORD Aerostar van, 7 pnsgr., white, blue interior, ps, pb, a/c, folding seats, exc. cond., 93,000 fwy. mi. 949/248-2711, eves.

FORD LTD Brougham, loaded, a/c, auto, power, 74,000 mi., blue, \$1,750/obo. 626/794-4592, Dan.

'91 HONDA Accord LX, tan, 4-dr, auto, 24,700 mi., pwr. locks/windows, tilt whl., a/c, cruise, am/fm/stereo cass., gd. cond., \$9,800/obo. 626/395-6142, Terry.

'93 JEEP Wrangler sport utility 2D 4WD, exc. cond., 5-sp. manual trans., 4.0L inline 6 cyl., soft-top, blue 2-tone paint, running boards, power steering & brakes, tilt wheel, AM/FM cass. stereo, premium sound package, 55k miles, \$9,500. 626/398-6356.

'85 MITSUBISHI Colt, very low miles, auto, a/c, \$1,495. 790-3802.

'89 NISSAN Maxima SE, 4-dr. sedan, a/c, ABS, all pwr. options, all sched. maint. complete (have receipts), exc. cond., new tires, rebilt. trans., silver/black, \$5,900/obo. 790-8069, after 5 p.m.

'97 PLYMOUTH Voyager van, loaded, 44K mi., transf. 100K-mi. bumper-to-bumper warr.; exc. cond., \$18,500. 626/574-8782.

'89 PONTIAC GrandAm SE, quad 4 eng., auto, a/c, pwr. windows/locks, am/fm/cass., orig. owner, \$4,200/obo. 323/255-1106.

SPARE TIRE for Jeep Cherokee, brand new Michelin P215/70R15, mounted on Laredo whl. w/tan cover, \$150. 626/281-2179.

WANTED

BUNK BED, Ethan Allan. 626/939-3853.

CARPOOLER, Granada Hills/Mission Hills area to main Lab. Ext. 4-0307, Marilyn.

HOUSEMATE to share 3-bd., 2-ba. house in San Gab., all amen.; avail. 1/15, \$500. 626/281-2179, Mike.

RACQUETBALL PLAYER, out-of-shape club-b level player. 845-8449, Ray.

RIDE to/from JPL and Monterey Park or Alhambra a few days of the week for full-time work; will compensate. 626/573-2564, Mary.

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

VANPOOL RIDERS, #3, from Fontana Rancho Cucamonga, Upland, Claremont, La Verne area to JPL main facility. Ext. 4-8343, Mike Taylor or Ext. 4-5831, Rhea Clearwater.

VOLLEYBALL PLAYERS, coed, all levels of play, Tuesday nights 8-10 at Eagle Rock High Sch., \$4/nt. 956-1744, Barbara.

WASHING MACHINE, Westinghouse front-loader, for parts, will disconnect and haul. 246-3777, 8-10 p.m. weekdays.

WINDOWS, old hinged, open or out. 909/398-1854.

FREE

CLEAN FILL DIRT [mostly gravel like], you haul, several cu yds., as much as you like, 3 blks. ESE of NY/Hill, Altadena. 791-3103.

WOOD LOG for fireplace, pick up yourself, Santa Anita/Live oak, Temple City. 626/844-0620 ext. 229.

LOST & FOUND

Lost: PENDANT, silver Lapis, lost last month somewhere on Lab or in parking annex. Ext. 4-7828 or 249-1523.

Found: GLASSES, prescription, purple flower/paisley frame, found 12/17 E. side of Bldg. 233 (outside). Randy, ext. 4-4365.

FOR RENT

PASADENA, roommate wanted to share w/2 others in 3-bd. apt., parking, pool, \$460 + dep. 626/564-1078.

SAN GABRIEL/LAS TUNAS area house, 2 bd., 2-car gar., liv. rm., din. rm., fenced yd., clean, nr. bus, school, 15 min./JPL. 626/451-0453.

REAL ESTATE

BIG BEAR, new cabin 2 blocks from lake, 2 bd., 2 ba., mud/laundry room, \$129,000. 909/585-9026.

LA CANADA, vintage Tudor, prime loc., exc. schools, 4 bd., 2.5 ba., den, formal din. rm., dramatic living rm. w/vaulted ceiling, bay window frpl., remod. kitch., lots of wd. cabinets, sunny brfstarea, detached gar, hardwood flrs., skylights, apprx. 2,100 sq. ft., lg. yd., brand new roof & paint, great cond., by owner, \$569,000/obo. 790-0375.

LAKE ARROWHEAD cabin, beautiful, 3 bd., 2 ba., x-country ski into nat'l forest 400 yds. away, lake rights, \$124,900. 626/794-2077.

PALM DESERT, exquis., 2 bd., 2 ba. villa, vac. or long-term, newly remod., w/skylight, patio & 2-car gar.; across/Living Desert, great priv., secure resort, tennis cts., multiple pools & spas and clubhouse facili.; great locality, nr. 2 top resorts. 909/620-1364.

SAN GABRIEL/LAS TUNAS area house, 2 bd., 2-car gar., living rm., din. rm., fenced yd., clean, nr bus, school, 15 min./JPL. 626/451-0453.

VACATION RENTALS

BIG BEAR, 7 mi. from slopes; full kitchen, f/p, 2 bd., 1 ba., sleeps 6; reasonable rates; 2-night minimum; no smokers, no pets; exc. hiking, biking, fishing nearby. 909/585-9026, Pat & Mary Ann Carroll.

BIG BEAR cabin, quiet area nr. village, 2 bd., slps. 8, compl. furn., F/P, TV/VCR, \$75/night. 249-8515.

BIG BEAR CITY, 4 mi./slopes, 2-bd., 1-ba. cabin, nicely furn., slps. 8; frplc., TV, full kitch., microwave; \$100 refundable cleaning dep.; \$75/nte weekdays, \$250/weekend (2 nites). 909/982-2986.

BIG BEAR LAKEFRONT lux. townhome, in/outdoor spa, nr. skiing, beaut. stone frplc., slps. 6. 949/786-6548.

CAMBRIA, ocean front house, exc. view, sleeps up to 4, \$125/night for 2, \$175/night for 4. 248-8853.

Lander Continued from page 1

south pole at 73 degrees to 76 degrees south latitude. The precise landing zone will be pinpointed in June or July, with the help of new images taken by Mars Global Surveyor.

The spacecraft is scheduled to fire its thrusters in a trajectory correction maneuver Jan. 18. That maneuver, designed to remove a targeting bias intended to prevent the third stage of the Delta II rocket from following in the lander's flight path and colliding with Mars, as well as any small launch injection errors, is expected to take approximately five minutes to execute. □

Origins Continued from page 5

ment and telecommunication options. An antenna model will be designed, fabricated and tested.

The Galaxy Evolution Explorer (GALEX), which falls under the Structure and Evolution of the Universe theme, completed its preliminary design review in November 1998, with a Critical Design Review planned for July 1999. By year-end, nearly all components of the science instrument will be here at JPL, and the project will be in its integration and test phase. French team member Laboratories d'Astonomie Spatiale will deliver a new technology ultraviolet grism, along with other optical components, in September. The telescope will arrive from Lightworks Optics in November, and the far- and near-ultraviolet detectors will arrive from UC Berkeley in November 1999 and January 2000, respectively.

GALEX, a Space Ultraviolet Small Explorer mission, will launch in September 2001 on a mission to explore the origins of stars and elements. GALEX will map the history of star formation, looking back in time 80 percent of the way to the Big Bang, to the time when galaxies were evolving and star formation was very active. □

CORNWALL, ENGLAND, Aug. '99 total solar eclipse; prime loc. campsite; incl. lectures by Caltech, JPL and UK astronomers; <http://www.ctg-windows.co.uk/eclipse.html>. 626/356-2998.

HAWAII, Kona, on 166 ft. of ocean front on Keauhou Bay, priv. house/guest house comfortably slp. 6; 3 bd., 2 ba., swim, snorkel, fish; spectac. vws., nr. restaur., golf, other attrac. 626/584-9632.

HAWAII, Maui condo, NW coast, on beach w/ocean vw., 25 ft. fr. surf, 1 bd. w/loft, compl. furn., phone, color TV, VCR, microw., dishwasher, pool, priv. lanai, slps. 4, 4/15-12/14 rate: \$95/ntite/2, 12/15-4/14 rate: \$110/ntite/2, \$10/ntite/add'l person. 949/348-8047.

MAMMOTH condo, 2 bd. + loft, 3 ba., slps. 8, spa, full kitch., TV/VCR, covrd prkng; walk to Cyn Lodge, JPL disc. 249-8088.

MAMMOTH condo in Chamonix at lifts 7, 8, 16, 17; walk to Warming Hut, 2 bd., 2 full ba., slps. 6, fully eqpd. elec. kitch., microw. & extras, frplc/wood, color TV, VCR, FM stereo, o/d Jacz., sauna; gm., rec. & Indry. rms., walk to shops, lifts; spec. midwk rates. 249-8524.

MAMMOTH condo, studio + loft, 2 ba., frplc./wood, Jacz., sauna, gm. rm., cbl. TV/VCR, full kitch./microw., terrace, view, amen. 714/ 870-1872.

MAMMOTH, Snowcreek, 2 bd., 2 ba., + loft; sleeps 6-8; fully equipped kitchen incl. microwave, D/W; cable TV, VCR, phone, balcony w/view to mtns., Jacuzzi, sauna, streams, fishponds; close to Mammoth Creek; JPL discount. 626/798-9222 or 626/794-0455.

OCEANSIDE, on the sand, charming 1 bd. condo, panoramic view, walk to pier/harbor, pool, spa, game rm., slps 4. 949/786-6548.

PACIFIC GROVE house, 3 bd., 2 ba., fp, cable tv/vcr, stereo/CD, well-eqpd. kitchen w/microw, beaut. furn, close to golf, beaches, 17 Mile Dr., Aquarium, Cannery Row, JPL discnt. 626/441-3265.

PALM DESERT, exquis., 2 bd., 2 ba. villa, for vac. or long term, newly remodeled, w/skylight, patio & 2-car gar.; located across Living Desert, great priv., secure resort; tennis cts., multiple pools, spas and clubhouse facili.; great locale, around 2 top resorts. 909/620-1364.

ROSARITO BEACH condo, 2 bd., 2 ba., ocean view, pool, tennis, short walk to beach on priv. rd., 18-hole golf course 6 mi. away, priv. secure parking. 626/794-3906.

S. LAKE TAHOE Keys waterfront home, 4 bd., 3 ba., slps. 12+, 2-lev. frplacs, decks overlk. priv. dock/ski lifts, gourm. kitch., bikes, boats, color TVs, VCR, stier. w/tape/disk, pools, hot tub & bch.; tennis, 10 mi./skiing, casinos/golf, 1 hr./wine cntry; \$995/wk. hi seas. [15 June to 15 Sept; 22 Nov. to 1 March]; + \$90 clean fee; 3-day min. 626/578-1503, Jim Douglas.