

## Dawn probes intriguing Vesta

Team analyzes a treasure trove of images as spacecraft lowers orbit

By Mark Whalen

In July, when JPL's Dawn spacecraft reached and entered orbit around remnant protoplanet Vesta in the asteroid belt between Jupiter and Mars, the science team wasn't completely sure what to expect. But the things that are now coming into focus on this new world have heightened the team's excitement.

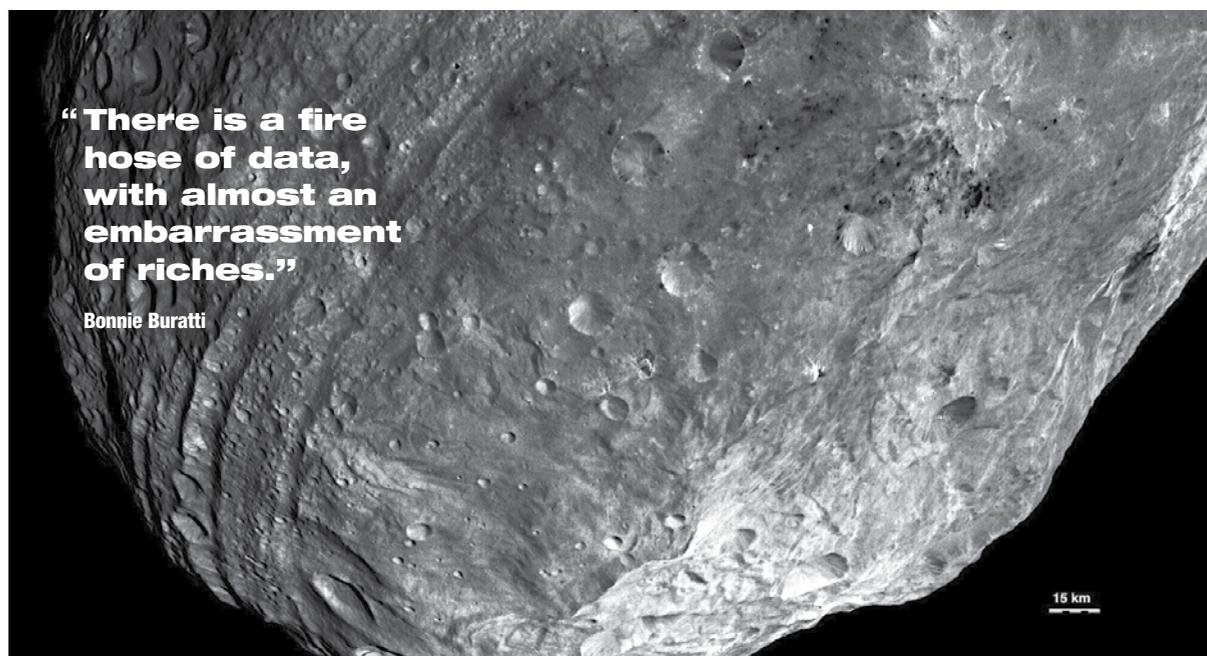
During Dawn's ion propulsion-powered flight, when low-resolution images from the Hubble Space Telescope revealed a huge impact basin in Vesta's south polar region, the team targeted it as a key area for analysis. And when the spacecraft arrived to begin its first orbit, so did scientists' astonishment.

"When we got the first clear pictures of this region—so we could study the asteroid as a geologic world—it was more remarkable than we could have ever imagined," said participating scientist Bonnie Buratti. "There are so many things we didn't expect to see.

"There is a fire hose of data, with almost an embarrassment of riches," she added. "There is just a sense of being overwhelmed at all the discoveries that are currently hiding in the data, waiting to be revealed."

For many reasons, Vesta so far has proven unique among closely observed solar-system bodies, with the puzzling south pole crater chief among them, said Carol Raymond, Dawn's deputy principal investigator. "We've made comparisons to other bodies, such as both icy and rocky moons, but it's difficult to find an analog for that structure," she said. "So we're very interested in working out whether the uniqueness has to do with the size of the impact relative to the body, or whether it's related to a combination of geologic processes that could include both impacts and volcanism, or something else we haven't thought of."

Distinct topographic features such as the troughs and grooves ringing the equatorial region—some with a set of parallel lineations running at an angle to them—are also garnering a lot of attention. Also, Raymond said, although hundreds of impact craters have been seen on Vesta thus far, using them to determine the relative age



In this image, obtained July 24 by Dawn's framing camera, a peak at Vesta's south pole is seen at the lower right. The grooves in the equatorial region are about six miles wide (10 kilometers).

of units on the surface—rather than their sheer number—is most important.

For instance, in the south of Vesta there appear to be fewer craters, which is likely because there was a lot more ejecta that covered the surface and possibly erased some of the other craters, she noted. This process, known as resurfacing, can also be done by lava flowing on the surface.

So as tantalizing as the initial images appeared, the team waited with anticipation as Dawn transferred to a high-resolution mapping orbit, which was achieved on Sept. 29. The initial survey orbit of about 2,700 kilometers altitude, with resolution of 260 meters per pixel, changed to 950 kilometers altitude to achieve 60-meter resolution. The difference promises to be dramatic.

"This is where we expect to get a very high-resolution topographic model of the surface, as well as seeing the details of color variations, the very bright and dark areas, and getting to the bottom of what materials are responsible for some of the very distinct geologic features," Raymond said. "All of these things that are just starting to come into focus will be seen in a very detailed view."

To complete the Vesta story, visible and infrared mapping spectrometer data will be combined with the complete mapping from the framing camera. Data from the gamma ray neutron spectrometer, to be obtained in the lowest orbit later this year, will give the team more information to understand the distribution of rocks and elements on the surface to make the connection between Vesta's geology and the HED meteorites, pieces of Vesta that have fallen to Earth. In the low-altitude orbit, a high-resolution gravity model will be obtained to probe the interior structure, including confirming Vesta's iron core.

"We'll be diving in deeper, because we still have so many questions to answer," said Raymond. "That's where we need to be patient, because it's tempting to try to draw a lot of conclusions from what we're seeing now, but it's also really important to understand the details and make sure that they're all consistent with all of our conclusions."

Buratti is looking forward to an understanding of the big picture. "Are all the unusual features—grooves, dark material, big craters, etc.—related to one event,

*Continued on page 2*



# Weiler retires from NASA

Ed Weiler, who worked almost 33 years as a leader in NASA's science exploration programs, retired from the agency Sept. 30.

Weiler most recently served as the associate administrator of NASA's Science Mission Directorate at agency headquarters in Washington, directing a variety of research and science programs in Earth science, heliophysics, planetary science and astrophysics. Chuck Gay, the directorate's deputy associate administrator, will become the acting associate administrator until a permanent replacement is announced.

"Ed leaves an enduring legacy of pride and success that forever will remain a part of NASA's science history," NASA Administrator Charles Bolden said. "His leadership helped inspire the public with each new scientific discovery, and enabled NASA to move forward with new capabilities to continue to explore our solar system and beyond."

Weiler's career at NASA included stints as chief scientist for the Hubble Space Telescope from 1979 to 1998; associate administrator for the agency's Space Science Enterprise from 1998 to 2004; and director of NASA's Goddard Space Flight

Center in Greenbelt, Md., from 2004 to 2008. He had led the Science Mission Directorate since May 2008.

The successes under Weiler's leadership include NASA's great observatory missions, unprecedented advances in Earth science and extensive exploration of Mars and other planets in our solar system. These advances have rewritten science textbooks and earned enormous support for NASA's science programs from the general public.

For Weiler's complete biography, visit <http://www.nasa.gov/about/highlights/weilerbiography.html>.

## Exhibit showcases Juno mission technology

Pasadena Museum of California Art's 'Beneath the Surface' is underway through January



"Beneath the Surface," an interactive art installation created by JPL visual strategist Dan Goods that shares the spirit of the Laboratory's Juno mission to Jupiter, continues through Jan. 8 at the Pasadena Museum of California Art.

Inspired by the technology used in the mission, the museum's Project Room will be covered in a vast layer of fog, beneath which infrared light—invisible to the naked eye—will create forms that can be seen with the aid of cameras common to most mobile phones. Just as the Juno spacecraft—which launched Aug. 5—will peer beneath Jupiter's clouds to understand its true nature, museum visitors will be able to "see" hidden light beneath the surface.

The Pasadena Museum of California Art is located at 490 E. Union St. For

more information, visit <http://www.pmcaonline.org> or call 626-568-3665 x18. Cost for the ongoing exhibition is \$7 general, \$5 students and seniors, \$2 off for JPL and Caltech personnel with ID, children under 12 free.

This project is a featured component of Pasadena's Fire and Water/Arts x Science Festival. For more information, visit <http://axsfestival.org>.

Goods' work at the Pasadena Museum of California Art will be part of Pasadena Art Night on Friday, Oct. 14 from 6 to 10 p.m. The event is held twice yearly, offering a free night at Pasadena arts institutions. Visit <http://artnightpasadena.org>.

Also, a Juno day will be held Sunday, Oct. 16 from noon to 5 p.m. at the museum's Day Of Discovery, when there will be speakers from JPL, afternoon programs

for families, an evening talk and a panel discussion. Admission will be free.

Goods' other art work for JPL includes drilling a hole into a grain of sand to describe where planets have been found in our galaxy, an interactive light exhibit about planet finding and projecting onto aerogel. He has also been instrumental in the design of the following JPL facilities: the Earth Science Center, Mechanical Design Center, Left Field, Team X and the Hub. Outside of JPL, Goods works on public and private art pieces around the world. The eCLOUD, a 108-foot, data-driven sculpture based upon weather from around the world, is at the San Jose International Airport and recently won a Silver International Design Excellence Award.

The eCLOUD and more of Goods' art can be seen at <http://directedplay.com>.



Participating scientist Bonnie Buratti



Deputy principal investigator Carol Raymond

**DAWN** Continued from page 1

such as a catastrophic collision, or are they all due to different things?

"I'd like to understand the connection between Vesta and the terrestrial meteorites," she added. "One goal is to understand how asteroids get propelled into the Earth's vicinity and present a hazard to life here."

**"We'll be diving in deeper, because we still have so many questions to answer."**

Carol Raymond

Overall, Dawn employs about 50 JPLers on the flight operations team at JPL. The project also has about 50 co-investigators and participating scientists around the country and internationally, and about 25 more associates working with the scientists.

Dawn's stay at Vesta is scheduled to conclude in July 2012, when it departs for a 2½-year journey to the protoplanet Ceres.

"There's a handful of interesting objects in the asteroid belt that we'd really like to look at; we're just very fortunate that Dawn is able to visit two of them," said Raymond.

For more information on the Dawn mission, visit <http://dawn.jpl.nasa.gov/>.

# ‘Beginnings of the Space Age:’ 75 years of rocketry

‘The American Rocketeer,’ which recounts JPL’s founding, kicks off three-part series Oct. 25 at Caltech



The 75th anniversary of JPL’s first rocket experiments will be celebrated with a three-part documentary miniseries, *Beginnings of the Space Age*.

The first episode, *The American Rocketeer*, will be shown at Caltech’s Beckman Auditorium Tuesday, Oct. 25 at 8 p.m. Also, KCET Los Angeles will broadcast the episodes Nov. 3, 10 and 17 at 9 p.m.

The films were written, produced and directed by Blaine Baggett, JPL’s director for communications and education. Prior to joining JPL, Baggett produced documentaries for KCET.

The 90-minute *American Rocketeer* tells the little-known and controversial story of Frank Malina, who was a Caltech graduate student studying aviation engineering in the 1930s when two young men wanting to build rockets approached him. He agreed to team up, having no idea of what that decision would mean to his life, to Caltech and to the nation.

On Halloween Day 1936 Malina led a ragtag group of Caltech students and amateur rocket enthusiasts to the Arroyo Seco, at JPL’s current eastern end, where they conducted their first stand-up rocket engine test that set in motion the Lab’s founding.

Malina’s personal letters, drawings and paintings reveal an extraordinary story of how JPL came to be. “Though there are many fascinating characters in *The American Rocketeer*, at its core it is personal story of one man’s dreams, and how his ideas and idealism put him on a collision course with the world,” said Baggett.

The second episode, *Explorer 1*, is a 60-minute documentary that relives the beginning of the space age with the launch of Sputnik and America’s successful response with JPL’s *Explorer 1* satellite.

*Destination Moon*, now being finalized, is a 60-minute documentary that tells of JPL’s first attempts to reach the moon and our nearest planetary neighbor, Venus.

The three films are part of an ongoing project to tell the story of JPL’s historic exploration of the solar system. The next project in the series will focus on the first missions to Mars.

“We are always looking for JPL retirees who have stories to tell about the lab’s missions,” said Baggett. “By conducting oral history interviews, we can capture their experiences for others to enjoy and learn from.”

October

## The American Rocketeer

Tuesday, Oct. 25      8 p.m.      Beckman Auditorium, Caltech

November

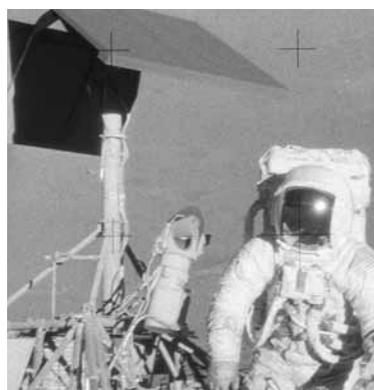
## Explorer One

Thursday, Nov. 3      9 p.m.      KCET

Thursday, Nov. 10      9 p.m.      KCET

## Destination Moon

Thursday, Nov. 17      9 p.m.      KCET



Top: Frank Malina with the fifth WAC Corporal at White Sands, N.M., circa 1946. Left: Celebrating *Explorer 1*’s launch, 1958.

Right: Pete Conrad approaches JPL’s *Surveyor 3* moon probe during the *Apollo 12* mission in 1969.

# News Briefs

## Earth science proposals advance

Four proposals led by JPL private investigators and three others with significant JPL co-investigator participation were selected in September for funding through NASA's 2010 Earth Science Advanced Component Technology Program.

NASA selected 15 of the 96 proposals evaluated, based on their potential for making significant contributions to the technology readiness of the Earth science measurements recommended by the National Research Council decadal survey. About \$16 million (over three years) was awarded for the winning proposals.

JPL's proposals and their principal investigators:

"Precision Deployable Mast for the SWOT Ka-band Radar Interferometer Instrument," Gregory Agnes. A prototype boom for a 10-meter deployable reflect array antenna for use on the Surface Water and Ocean Topography mission.

"Advanced Amplifier-Based Receiver Front Ends for Submillimeter-Wave Sounders," Goutam Chattopadhyay. Implemented on NASA's Global Atmospheric Composition Mission, these ultra-sensitive receivers will provide the high sensitivity required to complete measurements essential for making informed policy decisions affecting ozone chemistry, climate and air quality.

"Advanced W-Band Gallium Nitride Monolithic Microwave Integrated Circuits for Cloud Doppler Radar Supporting ACE," King Fung. Advanced electronic components for the Aerosol-Cloud-Ecosystem mission that will enable improved resolution, reduced ground interference, faster observations, reduced instrument mass and volume, and reduce risk.

"High Efficiency, Digitally Calibrated Transmit/Receive Modules Enabling Lightweight SweepSAR Architectures for DESDynI-Class Radar Instruments," James Hoffman. A technology that proposes to reduce the development time, risk and cost of precision-calibrated modules by accurately tracking characteristics through closed-loop digital calibration.

Winning proposals with JPL co-investigators:

"High Power Mid-Infrared Laser Development 2.8 to 3.5 Microns," Siamak

Forouhar. A proposal to advance two key Earth Science mission concepts, the Global Atmospheric Composition Mission and the Active Sensing of CO<sub>2</sub> Emissions over Nights, Days and Seasons mission. Harvard University is lead institution.

"Development of Immersion Gratings to Enable A Compact Architecture for High Spectral and Spatial Resolution Imaging," Andreas Kuhnert. Will build and test silicon gratings for Earth observation systems, with a long-term goal to enable the second-generation airborne digital beamforming synthetic aperture radar. The University of Texas is lead institution.

"A 2-Micron Pulsed Laser Transmitter for Direct Detection Column CO<sub>2</sub> Measurement from Space," Robert Menzies. Will support the Active Sensing of CO<sub>2</sub> Emissions over Nights, Days and Seasons mission. NASA's Langley Research Center will lead.

## Astrobiology proposals funded

Six proposals led by JPL principal investigators were recently selected for funding through NASA's Astrobiology Science and Technology for Instrument Development Program.

Here are the winning JPL proposals, with principal investigator:

"Green and UV Raman Imager with Laser-induced Autofluorescence: Next Generation Instrument for Mineral-Organic Mapping," Rohit Bhartia. Addresses the need for a micromapping organic and mineral detection system for in-situ and sample return missions to Mars and future in-situ missions to moons, asteroids and comets.

"AstroBioNibbler: Integrated Macroscopic Sample Acquisition and Extraction for Microfluidic Biomarker Detection," Frank Grunthaner. An instrument that utilizes a JPL-developed miniature ultrasonic drill for sample acquisition coupled with a dual laminar flow extraction technique adapted from microfluidic analytical chemistry.

"Fiber Optic Probe for Chemical Characterization of Titan's Lakes," Robert Hodyss. A proof-of-concept probe for absorption and fluorescence spectroscopy of solutes in liquid methane/ethane mixtures.

"Enceladus Amino Acid Sampler: Selective, Solid Phase Amino Acid Pre-

# Victory for JPL team in asteroid chase



From left: Ilya Grigoriev (Moscow State University), Dan Grebow (JPL team member), Anastassios Petropoulos (JPL team lead), Dario Izzo (founder of the competition series), Maxim Zapletin (Moscow State University).

By Susan Braunheim

The question: With more than 7,075 near-Earth asteroids to choose from, how many of them can a spacecraft visit in 15 years? The answer: 18.

In September, a JPL team made up primarily of people from the Mission Design and Navigation Section (343) won the Fifth Annual Global Trajectory Optimisation Competition. The goal of the contest was to devise a trajectory to visit as many asteroids as possible with a single spacecraft, first dropping off an instrument package then returning to release an impactor, within a given amount of time. JPL's winning trajectory flew by 18 asteroids in just under 15 years.

Researchers from around the world participated in this fictional mission design challenge, which consisted of 19 teams with the runners-up, teams from Italy and China, scoring 17 asteroids. Each team had only a month to prepare.

concentration with Optical Detection," James Kirby. An astrobiology instrument component concept to enable addressing high-level Enceladus science objectives to understand icy world satellite evolution, to determine the plume composition and evolution, and to infer the moon's subsurface composition and habitability.

"TextureCam: Onboard Image Analysis for Autonomous Astrobiology Survey," David Thompson. A new class of

Anastassios Petropoulos, who led JPL's 12-member team, and team member Dan Grebow traveled to Moscow State University, the hosts of the competition, to present their results, meet the leads of the other top teams and to collect their trophy.

"It was very satisfying to see all of our hard work culminate in our reclaiming the trophy. Many of the world's best mission designers participated in the competition, making it a wonderful way to compare different techniques for solving particular mission design problems," Petropoulos said.

With JPL winning the original competition in 2005, this is the first time any team has had a repeat victory. It's the responsibility of the winning organization to host the next year's competition, so JPL will soon be posing a new problem and evaluating worldwide entries for 2012.

instrument with texture channels that differentiate and map habitat-relevant surfaces, the project will develop reliable automatic recognition of basic geological elements under varying conditions.

"Miniature Hyperspectral Laser Spectrometer Probe for Astrobiology Applications," Nan Yu. A new type of optical probe that can be used for in-situ gas sample analysis or planetary atmospheric characterization.



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# Universe

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## Passings

**Leo Espinoza**, 78, a retired technician from the Facilities Division, died Aug. 1.

Espinoza worked at the Lab from 1971 to 1998. He is survived by his wife, Lupe, and children Frances, Caesar and Mayda. Funeral services were held in Porterville, Calif.

**John Hewitt**, 77, a retired photographer and manager, died Aug. 27.

After graduating from Art Center in Los Angeles with a degree in photography, Hewitt joined JPL's Photography Department in 1959. He ended his career in 1994 as manager of Photographic, Printing and Duplicating Services. During these 35 years, he was directly involved with the processing of images returned from JPL missions.



John Hewitt

Hewitt is survived by his wife, Nancy; children Suzanne Dunton, Paul and Katie Cox; grandchildren Riley, Rheanna and Rickey; sister Joyce Cook and several nieces and nephews.

Burial was at Los Osos Cemetery, Los Osos, Calif.

**Melissa English**, 51, manager of the Application Development and Flight Project Support Division, died Aug. 30.

English had been with JPL since 1988. Her career and responsibilities increased rapidly, from computer aide to group manager, deputy section manager and section manager prior to her division manager appointment. She was awarded numerous accolades and honors for distinguished leadership and service at JPL.



Melissa English

English is survived by her husband, Keith; son Doug, daughter Marcea Croxton, mother Jane McGregor, sister

Liz Pounds and grandchildren Cadence and Aiden Croxton.

Services were held at Bethany Church in Sierra Madre.

## Letters

I would like to thank all my friends and colleagues for their kind words and condolences after the passing of my father. Thanks also to the ERC for the plant; it will always be a reminder of him and his great legacy.

Pim Vosse

## Retirees

The following JPL employees retired in September:

**Harry Woo**, 37 years, Section 3120;  
**Laurel Flinn**, 33 years, Section 274.