

Dawn approaches a whole new world

By Mark Whalen

Spacecraft will enter orbit around main-belt asteroid Vesta July 16 to begin a year of observations

When JPL's Dawn spacecraft reaches asteroid Vesta July 16, it will begin a mission to characterize the solar system's early history by investigating two of the largest protoplanets remaining intact since their formations.

Dawn will orbit Vesta for a year before moving on to study protoplanet Ceres, which like Vesta resides in the main asteroid belt between Mars and Jupiter.

In many ways, the mission is like none other ever attempted before, said Marc Rayman, Dawn's mission manager and project system engineer.



Dawn obtained this image on June 20 from about 117,000 miles away from Vesta.

Rayman noted that Dawn is the first spacecraft to be sent to orbit a large body that has not been previously visited by a spacecraft. Earth's moon, Mercury, Venus, Mars, Jupiter and Saturn were all seen in flyby missions before being orbited.

Also different will be the orbit-insertion method. Rather than execute a breakneck maneuver, Rayman said, the mission team will sculpt Dawn's spiral path to gently place it into its first science orbit, which will occur in mid-August and continue until July 2012. Dawn has been thrusting for almost 1,000 days under the power of its ion propulsion system.

"On previous missions we knew more about the environments and physical characteristics of those bodies than we do with Dawn going to Vesta and Ceres," said Rayman. "For example, we have no real knowledge of Vesta's gravity field." Also, the team is unsure if Vesta has any moons, a factor that must be taken into consideration; Dawn will get as low as 180 kilometers (about 110 miles) above Vesta's surface.

But the unknown is a big reason the team is anxious about the possibilities.

"To me, that's part of what's so exciting

about this," Rayman said. "Collectively, we're going to explore an uncharted world."

Images from the Hubble Space Telescope had provided small, rough and fuzzy views of Vesta, but now, Rayman said, approach images from Dawn's camera are better than Hubble's.

What's been seen has been tantalizing. Team members are hoping to examine what might be a huge crater known to exist at Vesta's south pole.

"The crater is believed to have a peak about 8 miles high, so this is going to be an extraordinary site," said Rayman. "And the event that created this crater may have excavated about 1 percent of Vesta's volume and sprayed it out into the solar system. That's believed to be the source of meteorites we have on Earth that come from Vesta. We have far more meteorites from Vesta than we have from the moon and Mars, the only other solar system bodies to which we have linked specific meteorites."

From a geophysical standpoint, Vesta is much more like a terrestrial planet than most asteroids, with a crust, mantle and core comprising its layered structure. "That's why it's going to be so interesting to study — it's going to tell

us more about other rocky worlds in the solar system, one of which is right beneath our feet," said Rayman.

Dawn's year at Vesta also includes mapping the asteroid's elemental composition, topography and mineralogy, and obtaining color photographs. In the first science orbit, instruments will acquire data for about 34 hours on Vesta's day side and relay them to Earth for the same period of time from the night side. "We will occupy four different science orbits, the first of which will start in August," said Rayman. "We will make seven revolutions in survey orbit, each revolution lasting just under three days. After that, we go to lower altitudes where the orbit period is shorter."

Rayman said the project would release one approach picture per week until Vesta begins science observations. "Vesta is not just another little asteroid, not just another chip of rock or a jagged boulder in space," he said. "When we start to see images that reveal its true nature, I think that will give people an appreciation for how amazing it is that there's still this unexplored world in the inner solar system."

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If it's summer, it's time for students on Lab

By Susan Braunheim

With a sea of summer students on Lab, many of these talented young people may go unnoticed by the majority of the JPL population. However, two of them possess something very unique that sets them apart. They are twins.

Ryan and Michael Goetz are part of the Education Office's summer student program and although they are fraternal twins, it is difficult to miss the resemblance.

The 22-year-olds are going into their senior year at Cal Poly Pomona. Ryan is studying computer science while Michael is majoring in aerospace engineering with a minor in astrophysics.

The two could not be happier about being able to share their JPL experience.

"It is always great to see a familiar face around the Lab and share the wonderful experiences JPL has to offer," Michael said. "I never imagined that after 22 years I would be interning with my brother at the same facility, let alone JPL. It is nice that after all these years we can still be a part of each other's lives."

Ryan wouldn't want it any other way. "To me, it is normal. We are twins so we are always together. It has been that way ever since I can remember. It is also nice knowing there is someone close by," he said.

That doesn't mean there isn't a little bit of sibling rivalry. "We are always competing for who is best," Ryan said. "We are constantly trying to outdo one another here at work."

The brothers have been making the most of their JPL internships and are truly enjoying themselves. "It's an extraordinary experience because JPL takes dreams and fantasies and transforms them into reality. They have always pushed the boundaries and, in a sense, inspired the imagination of what we can do," Michael said. "I am very fortunate and honored to be a part of this process and to work with such talented JPL scientists and engineers."

For Ryan, his work at JPL has been just as rewarding. "It means a lot to me that I am here. I always had a fascination with space and the universe and to know

Cal Poly Pomona students Michael (left) and Ryan Goetz.



that I am working someplace that actually studies and sends missions to space is thrilling," he said. "I feel that I have learned so much more here than could ever be taught in a classroom. Where a classroom teaches theory, at work I can put that theory to the test and get a hands-on approach."

Both brothers would like to continue their work at JPL after graduation. Ryan would like to focus on robotics, artificial intelligence and software development. Michael wants to work on guidance, navigation and control in

"We are always competing for who is best," Ryan said. "We are constantly trying to outdo one another here at work."

tracking and orbital determination with applications to astrophysics and space sciences.

Just as the blooming jacarandas bring more deer to the mall, the beginning of summer welcomes many young, new faces to the Lab.

Approximately 350 new students are here to participate in several summer research and affiliated programs through JPL's Education Office.

These students are from all over the country, large and small colleges and universities, community colleges, high schools and even foreign universities. Participating students hail from schools as far away as the University of Oxford in England and Universita' La Sapienza in Rome and as close as Glendale Community College and everywhere in between.

The majority of the students are working in research or activities related to research and development in the Engineering and Science Directorate.

The program period lasts about 10 weeks. The summer cohort represents about two-thirds of all students hosted by the Education Office. The rest participate in year-round programs at JPL.

A series of summer professional development activities is planned in conjunction with Human Resources and the Education Office for the students. They include technical seminars, career development and tours. Most students will give final presentations at the conclusion of the summer, where they will present their research or activities to their JPL hosts and others.

Rich Alvidrez is the program coordinator for the JPL Visiting Student Researchers Program, one of almost a dozen programs that bring students to the Lab.

"It is very impressive to see the extent of collaboration that is taking place between scientists and engineers at JPL and the visiting students," Alvidrez said. "JPL is pleased to assist visiting students and there is great benefit to both the students and the JPL hosts."

Each student has at least one mentor during the summer. An indicator of the popularity of these programs is that students tend to continue with the same mentor or host during the next session or the following year. The continuity of student participation enables a deeper experience for the students and a productive experience for the mentors.

For information about JPL's Education Office, visit the Education Gateway at <http://education.jpl.nasa.gov>. For questions about specific programs, contact the Education Office at ext. 4-8252. For other student programs, visit <https://careerlaunch.jpl.nasa.gov>. ■

DAWN *Continued from page 1*

"This tiny world will give us a window into the early solar system and the terrestrial planets," added JPL's Carol Raymond, the mission's deputy principal investigator. "We're literally on the edge of our seats."

In late July 2012, Dawn will set out to achieve another "first" when it gradually spirals out to leave Vesta's orbit and move on to Ceres, making it the first-ever spacecraft to orbit two bodies in the solar system. Then

Dawn will take 2½ years reshaping its orbit so that it matches Ceres' orbit around the sun.

Dawn operations are housed on the 8th floor of Building 264. "We have a team of excellent JPLers who are responsible for flying the spacecraft and, along with UCLA and the instrument teams, getting the science data that then are going to be used by our science team, which includes people from four countries and many institutions," noted Rayman. Christopher Russell of UCLA is the

mission's principal investigator, with UCLA also operating a Dawn science center.

"This is true exploration," said Rayman. "I think it's exciting not just for the people working on Dawn, but for everybody. To me, we're all going. Like other ambitious JPL projects, this is a mission for humankind."

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

Modern-day rocket man relives key moment in JPL history

By Mark Whalen

As a JPL geophysicist, much of Greg Lyzenga's work is focused on or under Earth's surface, as he probes earthquake faults and tectonics to see how the landscape is moving.

But when he gets the opportunity, he'll turn his eyes skyward in pursuit of his passion, amateur rocketry. And in early June he fulfilled a longtime goal of reenacting one of the key events in JPL's history.

As part of an event hosted by the Rocketry Organization of California at Lucerne Dry Lake Bed in the Mojave Desert, Lyzenga successfully launched a full-scale replica of the WAC Corporal, a rocket developed and launched in JPL's infancy. The WAC Corporal, one in a series of rockets produced at the new JPL in response to Germany's V-2 rockets during World War II, was developed by a team led by Frank Malina, the future JPL director.

Malina's launch of the furfuryl alcohol-powered WAC Corporal from White Sands Proving Ground, N.M. on Oct. 11, 1945 carried about 400 lbs. of combustibles. Its journey of about 7.5 minutes reached an altitude of more than 43.5 miles.

Lyzenga's rocket had less lofty goals. His WAC Corporal used about 10 pounds of propellant, an ammonium per-

chlorate composite, which he said is basically the same as in the solid rocket boosters of the space shuttle.

Lyzenga's rocket peaked at about 4,700 feet, only about 200 feet more than Lyzenga's prediction. However, after about three minutes in the air, the rocket plunged downward under its parachute, drifting in the wind. About 10 seconds before touchdown, the rocket floated over Highway 247 and some vehicle traffic. But the landing occurred without incident, a few hundred feet from the road. The rocket lived to fly another day.

"As an homage to Frank Malina and to JPL," Lyzenga said, "my son Andrew and I cooked up this slightly crazy project."

Lyzenga was 10 years old when he ordered his first rocket catalog. "I can still see the Sky and Telescope magazine ad that said 'fly your own rockets.' I got really excited about it and saved up my pennies," he said. And it so happens that the first rocket he built and flew was a model of the WAC Corporal, about 12 inches tall.

His involvement grew and then after flying competitively during his teen years, Lyzenga put the hobby aside when he went off to college, launching only occasionally with friends.

"My real renaissance in rocketry came when my son was about 12 and began to appreciate it," he said.

"That's when we discovered Lucerne Dry Lake and the Rocketry Organization of California." The location is considered "hallowed ground" for many in amateur or professional rocketry who cut their teeth there, he said.

"When we came out here for our first launch, we were blown away, seeing these enormous rockets go off. Our eyes met and we decided we've got to get into this."

They started off making rockets 2 or 3 inches in diameter, with successive efforts growing in size. "Pretty soon it was clear the WAC was going to happen," Lyzenga said.

About seven years ago the pair began the "audacious" task. After many "ups and downs" (no pun), Lyzenga said an unsuccessful test flight required about a year of redesigning and repairing. Their efforts produced the full-scale WAC Corporal that was painted and modeled to be a replica of Round 5, the first fully fueled WAC Corporal that went into space. The space vehicle was made famous through pictures of Malina holding the rocket.

About the only thing Malina's and Lyzenga's rockets had in common was their size, each about 16 feet long.

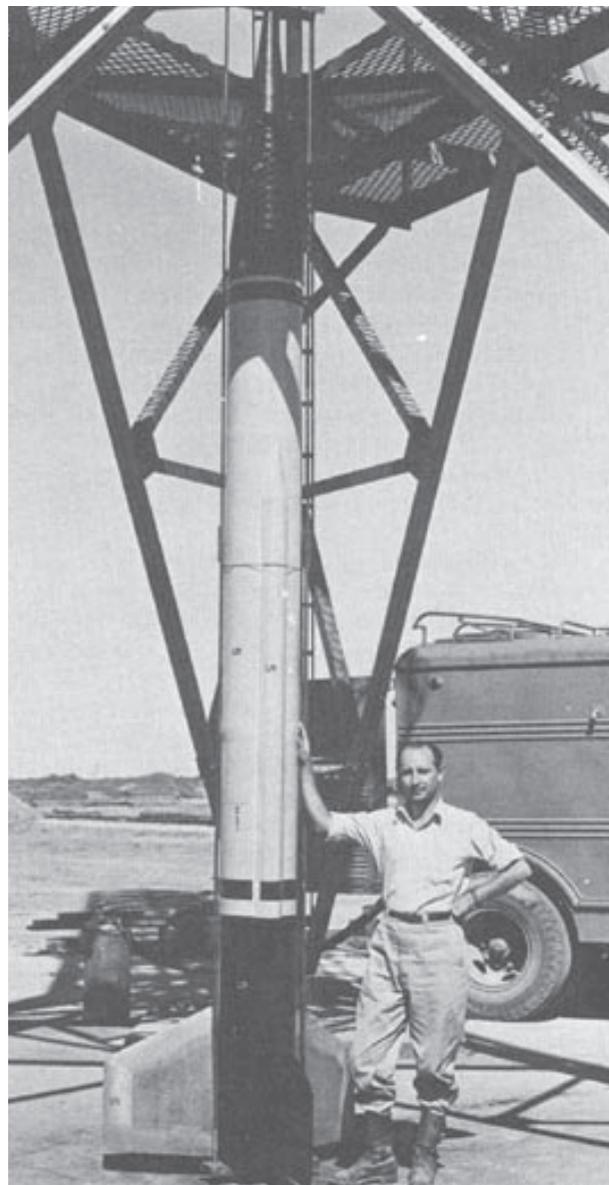
Having moved to Japan recently, Andrew, now 27, couldn't make the launch at Lucerne, so on the big day his dad, aided by his volunteer ground crew, set up the rocket on its launch pad as the gathering of several hundred looked on.

When he pushed the button, "It took off with a very satisfying flame and roar. The crowd loved it," Lyzenga said, laughing.

Lyzenga said rocketry has been powerful throughout his career. "The myriad ways of figuring out how to solve a problem, how to build something and fix it when it's broken, has affected all parts of my education, as I went off to college, then on to my career at JPL and as a faculty member." Lyzenga has been at JPL for 30 years and is also a physics professor at Harvey Mudd College, his alma mater. His graduate and doctorate studies took place at Caltech.

With his launch, Lyzenga certainly succeeded in putting on a good show, but he also achieved another important goal. "It's really exciting to see kids with the same sparkle in their eye that I had back in the '60s, when my first little rockets were taking off then landing in trees or getting lost in swamps. Kids should learn how to be involved hands-on with a technological activity like this; the fact that you can design, build and fly something with your own hands and mind is really empowering."

View the launch of Lyzenga's rocket by going to [youtube.com](https://www.youtube.com) and searching for "WAC Corporal at NSL 2011." ■



Far left: Frank Malina with the fifth WAC Corporal at White Sands, N.M., circa 1946.

At left is Lyzenga's model.

News Briefs

JPLers receive Explorer, Ed Stone Awards

Twenty JPL employees were recognized with an Explorer Award or Edward Stone Award for their exceptional accomplishment or outstanding performance in 2010 in a June 2 ceremony.

The Explorer Awards are the highest individual awards granted by JPL to its employees.

The event also included the Edward Stone Award for Outstanding Research Publication, a program administered by the Office of the Chief Scientist.

Here are the Explorer Award honorees: Strategic Leadership: Chester Borden, George Chen.

Scientific and Technical Excellence: Shyamkumar Bhaskaran, John Gallon, Thomas Gautier, Alejandro Jimenez, Kenneth Klaasen, James Lambert, Rhonda Morgan, Tommaso Rivellini.

Effective Business Management: Bartel Drake, Thomas Lynch, Sandra Moncada, Beth Wilson.

Effective Partnerships and Relationships: Tooraj Kia, Yunling Lou, Joseph Provenzano, Ronald Reeve.

The 2010 Ed Stone Award honorees are Jordana Blacksberg and Xiaoping Wu.

For the honorees' complete citations and more information, visit <http://hr/compensation/reward/bonus.cfm>.

Rotary honors Spitzer team

JPL's Spitzer Space Telescope team has been bestowed a Stellar Award from the Space Center Rotary Club of Houston.

The annual awards recognize outstanding achievements in space and create greater public awareness of the benefits of space exploration. The Spitzer team, one of seven honored out of 36 final candidates, was cited for "outstanding innovation, dedication and technical excellence enabling both engineering and scientific firsts from which the next generation of astrophysics missions will benefit."



Spitzer Manager Suzanne Dodd accepts the Rotary Club award.

Spitzer Project Manager Suzanne Dodd accepted the award on behalf of the team at a May 6 ceremony. For more information, visit <http://www.rnasa.org/stellar/stellarwinners2011.html>.



Faramaz Davarian

Davarian is guest editor for engineering publication

Faramaz Davarian, manager of JPL's Deep Space Network Advanced Engineering Program, served as a guest editor of the May 2011 publication of the Proceedings of the Institute of Electrical and Electronics Engineers, a special issue on solar system radar and radio science.

Davarian, who has been with JPL for more than 20 years, co-edited the publication with Chung-Chi Lin of the European Space Agency. The articles in the special issue discuss several of the latest developments in radar and radio science for solar system scientific investigations, with an emphasis on tools, methodology, algorithms and system design. Some of the articles address JPL projects as well as the role of the JPL-managed Deep Space Network.

For more information, visit <http://ieeexplore.ieee.org/xpl/tocresult.jsp?isnumber=5753253>.

Lab hosts international software conference

About 120 people from 16 countries attended the recent NASA Formal Methods Symposium at the Hilton Hotel in Pasadena, which was hosted by the JPL Laboratory for Reliable Software.

Formal Methods is a class of design techniques—especially for software design, development and verification—that aims to be more rigorous than traditional methods. Several NASA centers have groups that focus on the advancement of more formal design methods for missions.

The event attracted 140 submissions of technical and scientific papers discussing advances in the field, 38 of which were selected for the final program.

The proceedings of the symposium were published by Springer Verlag's series Lecture Notes in Computer Science (<http://www.springer.com/computer/swe/book/978-3-642-20397-8>).

The symposium organizers were Gerard Holzmann, Klaus Havelund, Rajeev Joshi, Michaela Bobaru, Shakti Wadia and Michelle Medina.

For more information about the symposium and about the Laboratory for Reliable Software, visit at <http://lars-lab.jpl.nasa.gov/>.

Passings



Fred Vote

Former JPL manager **Fred Vote**, 77, died March 22.

Vote joined JPL 1966 in the Combustion Devices Group and helped develop the beryllium rocket motors used on Mariner 7 and the Viking orbiters. He was awarded NASA's Exceptional Service Medal for development of the Viking '75 propulsion orbiter. Vote worked on JPL's energy programs and finally as manager of Defense Programs in the Technology and Applications Program until his retirement in 1992.

He is survived by his wife, Judi; son Kurt (Shelly); and grandsons Steven and Kevin. He was predeceased by daughter Erika, also a JPL employee.

A celebration of Vote's life was held in San Clemente. His family requests consideration of donations to the Coalition for Pulmonary Fibrosis, 10866 W. Washington Blvd. #343, Culver City, CA 90232.

Conway Snyder, 93, a retired space scientist, died April 14.

Snyder joined the Lab in 1955 after earning a Ph.D. in nuclear physics from Caltech in 1948 and working for the Atomic Energy Commission on nuclear propulsion. At JPL he was involved in missions that included the first U.S. satellite, Explorer; the moon probes Rangers 1 and 2; several Mariner missions

to Venus and Mars; Pioneer Venus 2; Vikings 1 and 2, which explored Mars; the Orbiting Geophysical Observatory and the international Infra-Red Astronomical Survey. A solar wind spectrometer that Snyder conceived and designed was deployed on the surface of the moon by astronauts of both Apollo 12 and 15. NASA honored him with three Exceptional Scientific Achievement Awards.



Conway Snyder

Snyder is survived by children Don Snyder, Sheryl Savina and Sylvia Woods; four grandchildren and three great-granddaughters. The University of Redlands has established a Conway Snyder Scholarship to benefit a worthy science student; donations in his name may be sent to the University of Redlands Student Scholarship Fund.

Ben Sanders, 70, a retired machine shop group supervisor, died April 27.

Sanders worked at JPL from 1986 to 1997. He managed the Building 170 and 18 satellite machine shops, during which computer numerical control machining and the paperless manufacturing process was implemented and refined. Sanders oversaw the manufacture of all machined flight hardware developed at JPL during his tenure.

Sanders is survived by his wife, Sharon; children Al, Mike and Georgia; and grandchildren Jasmine and Lucia.

Joan Swan, 80, a retired JPL librarian, died May 9.

Swan joined the Lab in 1953 and worked here for 38 years. Besides her library duties, she was an officer of the Employees Recreation Club and was a noted contributor to JPL events such as the children's holiday party and art fair.



Joan Swan

She is survived by nieces Kathleen and Pat, nephew Richard, and grand nephews and nieces Taylor, Blaine, Kelsey and Riley. Services were held May 19 at La Crescenta Presbyterian Church. In lieu of flowers, the family has asked that donations be considered to the Center for Children, 2902 Montrose Ave., La Crescenta, CA 91214.

cards and sincere words of encouragement and sympathy gave both of us strength through this difficult time.

Gaylon McSmith

Retirees

The following JPL employees retired in June: **John Arnold**, 50 years, Section 5127; **Parthasarathy Shakkottai**, 42 years, Section 3547; **Milton Lavin**, 36 years, Section 342; **Ming-Tuan Leu**, 35 years, Section 3286; **Curtis Tucker**, 34 years, Section 350; **Robert Miyake**, 33 years, Section 3542; **Tetsuo Miyahira**, 31 years, Section 5144; **Ed Baroth**, 30 years, Section 342; **Wayne Schober**, 30 years, Section 810; **Charlene Hazelton**, 28 years, Section 2501; **Richard Pomphrey**, 28 years, Section 312C; **Jeane Stipanuk**, 28 years, Section 318A; **Norberto Munoz**, 23 years, Section 2133; Lawrence **Lawrence Ansley**, 21 years, Section 333C; **Claire Perigaud**, 21 years, Section 3248; **Philip Smith**, 21 years, Section 334A; **Arturo Esteban**, 20 years, Section 2142; **Betty Ruff**, 19 years, Section 5137; **Lewis Redding**, 15 years, Section 100; **Scott Pick**, 12 years, Section 314B; **Bobby Naron**, 10 years, Section 314D; **Katherine Wilde**, 10 years, Section 5114.

Correction

An article in the June issue of Universe about the Aquarius mission contained inaccurate numbers for the temperature change in the ocean associated with hurricanes. It should have stated that temperature decreases 2 or 3 degrees C (about 3.6 to 5.4 degrees F) after a hurricane passes.

Letters

My family and I would like to sincerely thank all of our friends for their support and kind words during the recent illness and passing of my wife, Judy. Thank all of you for the cards, notes, donations to the American Diabetes Association, and lovely plants. Your sympathy has been very comforting and your support during this very difficult time helped us get through.

Lloyd Keith

My wife, Pamela, and I wish to thank all of our friends, colleagues and "family" of JPL for their condolences for the recent loss of my father. The plant,

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