

# PLANETARY SCIENCE INSTITUTE

## NEWSLETTER



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## The Art and Science of Iapetus

One of the many reasons that PSI Postdoctoral Research Scientist Eric Palmer became interested in planetary science has to do with the amazing beauty of the universe. And, while spacecraft missions to planets, asteroids, and comets have returned breathtaking images, they are limited in where they can go and what they can photograph. Artists can provide “views” of the solar system that no robotic camera or human will ever see. PSI Scientist William K. Hartmann is one of these visionary science painters.



*This painting by PSI scientist William K. Hartmann depicts the surface of Saturn's moon, Iapetus. The view from near the pole shows Saturn's rings and its many moons. Titan is the orange moon to the right of Saturn. Also shown in this painting is some of what makes Iapetus unique: the dark area in the center is not a shadow, but dark brown material that was swept up onto the leading side of Iapetus as it orbited Saturn.*

A few years ago, at a space art show at the Lunar and Planetary Laboratory, University of Arizona (UA), Eric Palmer met Bill Hartmann. Prophetically during the encounter, Eric, who was doing research at UA, mentioned that one day he

as bright as snow. And stranger still, the demarcation line between the dark and the white halves is quite distinct; there is no mixing of the materials. Scientists are still debating the cause of this unique feature.

hoped to have his own Hartmann painting, related to his study of Iapetus. Well, a year later, he commissioned Hartmann to do just that.

Iapetus is one of the strangest objects in the solar system. It orbits around Saturn once every 79 Earth days, and it rotates at the same rate, so that one side always faces the direction of travel (leading side), and one side always faces away from the direction of travel (trailing side).

The most unusual and interesting fact about Iapetus is that the leading side is as dark as coal, while the trailing side, being mostly water ice, is

### PSI Partners in Earth Camp

(Story on page 4)



Photo by David A. Crown

*A camera attached to a balloon took aerial photographs at the Earth Camp for Educators, in May.*

*Learn about other areas of Eric Palmer's research and his interesting background on the next page.*

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## Palmer's High-Flying Path to PSI

Eric Palmer joined PSI in Nov. 2010, as a Postdoctoral Research Scientist, and is working on two projects for Director Mark Sykes: NASA's Dawn Discovery mission and the Mercator project.

The Dawn spacecraft was launched in 2007, and is on track to visit the two largest asteroids, Ceres and Vesta, in its effort to understand the origin or "dawn" of the solar system. It will finally arrive at its first destination, Vesta, this summer. Eric will assist in analyzing the data collected by the spacecraft.

Vesta is a fascinating asteroid for several reasons: it appears to be fully differentiated, meaning that it has a lava crust, a rocky mantle and an iron/nickel core; it has basaltic volcanism on its surface; and it has undergone numerous impacts, one of which created a huge crater at its south pole. It is believed this large impact sent samples of Vesta to Earth in a suite of meteorites known as the Howardites, Eucrites, and Diogenites (or HEDs).

The Mercator project's goal is to provide navigation to future NASA missions to the Moon and Mars. While GPS satellites have made navigation on Earth easy, the difficulties with identifying positions on other solar system objects remain. Mercator is a partnership between PSI and Raytheon to develop independent position identification and navigation. It will use images taken from orbit to create an elevation model, then a computer algorithm on a future rover will compare what it sees to the elevation model. By using horizon matching, the rover can determine its position on the surface without extensive communication with mission control, allowing for autonomous rover navigation.

Eric's path to space science has not been typical. After graduating in 1990 with a bachelor's degree in computer science and then earning a master's degree in political science in 1991, he entered the U.S. Air Force and was trained as an analyst.

Over the next two years, he deployed to Saudi Arabia in support of Operations DESERT CALM and SOUTHERN WATCH. In 1994, he went to flight school and trained as an Air Force pilot for T-37 *Tweet* and T-44 *King Air* aircraft. Upon graduation, he went to Pope Air Force Base, NC, and flew C-130 *Hercules* for the next 4 years, deploying to Germany during the crisis in Bosnia, and then Saudi Arabia. After flying C-130s, he was sent to Nellis AFB, NV, and trained to "fly" the unmanned reconnaissance aircraft, RQ-1B *Predator*. During this time, he was sent to Bosnia to support the Kosovo crisis, and back to Saudi Arabia for military operations there.

Eric's final assignment was to Germany for three years, where he flew C-21 Lear jets, training younger pilots. Throughout his years in the military, Eric never lost his interest in space and astronomy, and, as he was able, took classes to prepare himself for the graduate program at the University of Arizona (UA).

In January 2005, Eric entered the Ph.D. program at the Lunar and



*Eric Palmer is surrounded by his three wonderful children, l-r: Thomas (7), Anna (3), and Jenna (10).*

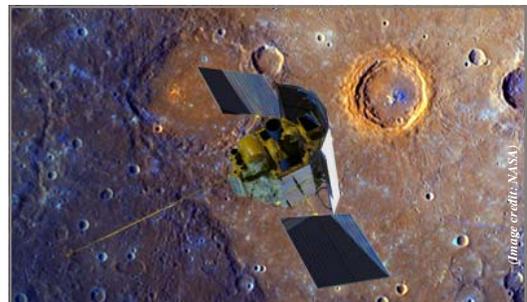
Planetary Laboratory, UA. He worked with Dr. Robert Brown on data from Cassini's Visual and Infrared Mapping Spectrometer (VIMS), a multispectral mapping camera orbiting Saturn. Specifically, Eric looked at why there is a large quantity of carbon dioxide on the surface of Saturn's moon, Iapetus. Carbon dioxide is too volatile to remain on the surface of Iapetus for more than a few hundred years, which suggests that it is being actively produced. Eric's research included analysis of the Cassini data, computer modeling of the ability of polar cold traps to retain CO<sub>2</sub>, and cryogenic (extremely low temperature) laboratory production of CO<sub>2</sub> from water ice and solid carbon dust.

Eric also did cosmochemical work with Dr. Dante Lauretta, analyzing how minerals of a type of meteorite, known as CM carbonaceous chondrite, react to water. He used an electron microprobe, which uses electronic beams to determine an object's chemical composition, and Raman (laser) spectroscopy in his research to better understand where and when water interacted with the meteorite in the early solar system. He specifically tried to unravel the alteration mechanism and formation of a mineral called "tochilinite", a very rare mineral recently discovered in 1974 and found in only two places on Earth. He continued working with Dr. Lauretta on meteorites and the Phase A study of OSIRIS-REX, a recently-funded mission awarded to UA for a sample return from the C-type asteroid, RQ-36.

Eric is a busy father of three children, Jenna, Thomas, and Anna, and when he can, he enjoys hiking, photography, and staring at the night sky.

We feel very lucky that Eric's path led him to PSI!

### Upcoming: The Mercury MESSENGER Mission



*In the next issue: The MESSENGER spacecraft's first findings upon entering Mercury's orbit March 18, 2011. Six PSI scientists are on the MESSENGER team. Stay tuned!*



#### PLANETARY SCIENCE INSTITUTE NEWSLETTER

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Alan Fischer, Contributing Science Writer/Photographer

Amy Hartmann-Gordon, Friends of PSI Update

With special thanks to Carol Neese and Elaine Owens

#### PSI NEWSLETTER

## Elisabetta Pierazzo, 1963-2011 by Mark V. Sykes

Elisabetta Pierazzo, Senior Scientist at PSI, died at home in Tucson, Arizona, on May 15. She was 47.

Betty was an expert on impact modeling throughout the solar system, and the astrobiological and environmental effects of impacts on Earth and Mars. Her work ranged from providing detailed insights into the Chicxulub impact that caused the extinction of dinosaurs, to putting constraints on the thickness of the ice shell of Jupiter's moon, Europa. She was interested in the rise of life and explored the delivery of organics to planets and Europa by comets, and the creation of subsurface hydrothermal systems by impacts that may have been favorable sites for life on Mars.



She was an authority on Meteor Crater in Arizona and made several appearances on national and international programs, including National Geographic specials, explaining the formation of this well-known structure. Betty was innovative, rigorous, and systematic in her science. She recognized the need for benchmarking and validating the different complex numerical codes to model impact and explosion cratering, organizing and leading a community effort to accomplish this major task.

Betty also passionately promoted science education and public outreach. She taught undergraduates at the University of Arizona (UA), developed interactive websites and impact rock and mete-

orite kits for classroom use, and created professional development workshops for elementary and middle school science teachers.

In 1989 Betty arrived in the United States from Italy, and the following year attended graduate school at the Department of Planetary Sciences, UA. She handled the difficulties of living in a foreign country by opening her house and her kitchen to others. She received her Ph.D. in 1997. The quality of her graduate work was recognized by the University of Arizona with the Gerard P. Kuiper Memorial Award. She continued there as a Research Associate until 2002 when she joined the Planetary Science Institute as a Research Scientist. She was promoted to Senior Scientist in 2007.

Betty was an active member of the planetary community. She served on numerous NASA review panels, was an associate editor of *Meteoritics and Planetary Sciences*, reviewed papers for numerous scientific journals, was the organizer of workshops and meetings around the world on impact cratering, and was an organizer of the 2007 Meteoritical Society meeting held in Tucson.

Betty was noted for the intensity with which she approached both life and work. Whether it was in the office, the classroom, on the volleyball court, the soccer field, or dance floor, her enthusiasm and joy in the activity was irresistible. She was cherished by many for her staunch friendship and support. She inspired countless people as a colleague, teacher, mentor, and friend. Her life was brightened even more with her marriage to Keith Powell in 2007.

Over the past six months, Betty valiantly battled a rare form of cancer, never letting it overwhelm her. She was ultimately and suddenly struck down by a pulmonary embolism.

The loss of Betty is profound to all those who knew her and worked with her, to our profession, and to our Institute. She left us too soon; we shall always miss her. □

## Decadal Survey Outlines Plans for Space Science Efforts Through 2022 by Alan Fischer

On March 30, scientists from around the southwest — some concerned about the future of their research — gathered in Tucson for a town hall meeting hosted by PSI to learn about NASA's ten-year plan for space exploration.

"Science comes first," said Steve Mackwell, who presented *Vision and Voyages for Planetary Science in the Decade 2013-2022* at the Westward Look Resort. "We must address the most compelling science that can be accomplished with the funding levels we have in place. In the president's budget there are some serious concerns going forward," he said. "With the budget we were given, this looks like a viable plan."

Mackwell, Vice-Chair of the Planetary Science Decadal Survey's Inner Planets panel and Director of the Lunar and Planetary Institute in Houston, discussed the document and answered questions.

Three major themes — building new worlds, planetary habitats, and the workings of solar systems — guided the development of the report. Mission prioritization studies, which looked at factors including science return on the dollar, programmatic balance, technological readiness, and availability of appropriate trajectories to targets, saw 25 mission candidates chosen for detailed review.

"The human program is going through some significant changes," Mackwell said, "with President Obama calling for sending hu-

mans to near-Earth asteroids by 2025." He discussed the future of Flagship (per mission cost greater than \$1 billion), New Frontiers (per mission cost cap of \$1 billion, excluding launch vehicle) and Discovery (per mission cost cap of \$500 million, excluding launch vehicle) missions, and said plans call for a strong focus on research and development and technological advances.

A number of scientists brought up their concerns about aspects of solar system exploration that they felt were shortchanged in the report. Mackwell said that good new Mars Discovery missions are still possible, but Flagship or New Frontier missions to Mars are unlikely unless they involve returning samples to Earth.

Sarah Horst, a planetary science graduate student at the UA's Lunar and Planetary Laboratory, said she found the decadal survey depressing for young scientists. Yet even though the study calls for financial constraints for planetary science, Mackwell said, young scientists have an advantage in helping determine where future missions will be going because Congress is interested in the vision of young people. □

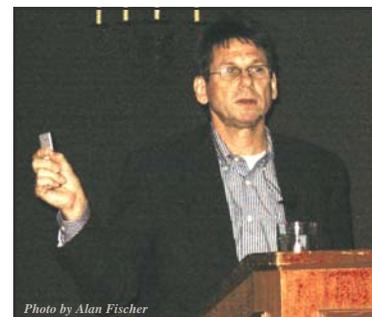


Photo by Alan Fischer

At the PSI-hosted meeting, Steve Mackwell discussed the future of NASA missions.

## Youngsters Make Comets at Yuri's Night

by Alan Fischer



*A youngster at Yuri's Night crushes together dry ice, water, ammonia, carbon, and organic material to form a softball-sized comet model.*

The event was one of 200 others across 30 nations commemorating Russian cosmonaut Yuri Gagarin's flight on April 12, 1961, that made him the first man in space.

The Planetary Science Institute participated in an event on April 9<sup>th</sup> celebrating the 50-year anniversary of manned space flight. PSI's Thea Cañizo, Gavin Nelson, and Eric Palmer created a PSI display where school-age children learned about and made models of comets at Yuri's Night, held at the Pima Air & Space Museum in Tucson. The

children gave their own names to the model comets they constructed out of dry ice, water, and other materials that are found in real comets that zoom through space. □

"Tucson's children participated in a worldwide event to celebrate Yuri's great step forward," said Cañizo, PSI Education Support Specialist. The educational, hands-on experience of making model comets could spark an interest, potentially professional, in the youngsters, she said. "They got a chance to engage in and learn about science, something that could be a big part of their future."

The children gave their own names to the model comets they constructed out of dry ice, water, and other materials that are found in real comets that zoom through space. □



*One child looks skeptical as she helps Thea Cañizo mix ingredients to make a model of a comet. Photos by Cora Varas-Nelson.*

## PSI Partners in Earth Camp

by Alan Fischer and Chris Holmberg

On May 7th, a team of PSI scientists and educators met with 16 teachers from Arizona, at the University of Arizona's Environmental Research Lab



*PSI Scientist Alice Baldrige (center) conducts an Earth Camp for Educators class on remote sensing, focusing on water resources in the desert southwest.*

for the first *Earth Camp for Educators*. Modeled on successful teen Earth camps, *Earth Camp for Educators* gives middle and high school teachers the tools to inspire and empower their students to think about the health of our whole planet and take steps to protect it in their communities.

This workshop employed NASA satellite images of Earth to focus on the "power of perspective" in educating the teachers about water and the use of remote sensing in studying Earth. The PSI team explained remote sensing to the class: In brief, *remote sensing* is acquiring and analyzing data about an object without touching it, by using a camera or other sensor that could be on a spacecraft or airplane.



*Using images of Earth from NASA satellites, educators observed changes on Earth's surface.*

PSI scientists demonstrated how remote sensing is used to study changes in landscapes due to human or natural causes. For an-

other perspective, a camera attached to a balloon (photo on front page) took aerial photographs of the workshop location so the class could compare the area from above, in that broad context, to their detailed, up-close observations on the ground.

A three-year, \$800,938 grant from NASA funds Earth Camp. *The Laurel Clark Earth Camp Experience* is named for Laurel Clark, an astronaut who lost her life in the Columbia space shuttle tragedy. Earth Camp is a partnership between the Arizona-Sonora Desert Museum (the lead organization), the Planetary Science Institute, and Arizona Project WET (at UA's Water Resources Research Center).

PSI's Thea Cañizo, David Crown, Alice Baldrige, and Sanlyn Buxner worked with Desert Museum staff to develop the education and public outreach grant proposal for the program, and are now involved in implementing the program.



*Teachers at Earth Camp used spectroscopes to observe emission lines corresponding to the composition of various light sources, including the Sun. Photos by David A. Crown.*

"The PSI scientist/educator team supports the Earth Camp project through design of and instruction in training activities for educators, and by providing expertise on the availability, manipulation, and visualization of NASA data for Earth," David Crown said. Programs and interactive exhibits will examine water resources from the small scale of water molecules, to water in desert ecosystems, up to the global scale of climate change and potential effects on the water cycle.

"Using snapshots of the global view enjoyed by Laurel Clark, teens and teachers will learn and teach others about the connections between their lives and the changing Earth System," said Debra Colodner, Project Director and Desert Museum Education Director and Earth Scientist. □

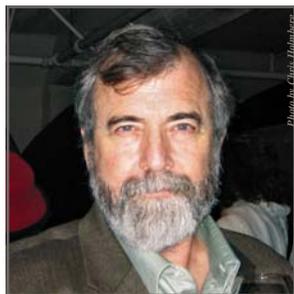
## Director's Note: *Our PSI Family*

One of the great pleasures of working at PSI is the people who make up this institution. We are a community and in many ways we are like a family. We give of our time and knowledge to help each other be more competitive and succeed in our proposals, we collaborate in areas of overlapping interests, we celebrate awards and joyous events such as weddings and births, and we mourn together when one of our own is taken from us.

It is difficult not to be somber in the wake of Betty Pierazzo's unexpected death. However, I will always remember the last time I saw her two weeks earlier. She was complaining about losing hair and the other indignities of her situation, and she was also talking about writing recommendations for an award panel on which she was serving, a paper on which she was working with her dear friend and colleague Natasha Artemieva, a proposal that was in the works, and more. Chemo was slowing her down, but she had many things to do and was relentlessly forward looking. Not without fear or trepidation, but not allowing that to rule her.

The day before she died, she was working on a progress report for a NASA grant and was communicating about it with our Sponsored Projects Manager, Kelly Yoder. It was Saturday. Betty's was a life well-lived and an end well-met. We benefit from her example.

Life moves forward. We love the arrival of new babies, to which readers of our Newsletter will attest, and enjoyed the recent visit of our newest member, Louis Tricarico. We congratulate our newlyweds, Bruce Barnett and Tammi Palmer! We have much to be grateful for as we look to the future, and Betty's memory will always be a part of that.



Mark V. Sykes  
June 2011



After 13 years together, Tammi Palmer and PSI CFO Bruce Barnett tied the knot on April 1<sup>st</sup> — no foolin'! Best wishes, Tammi and Bruce!



On April 10, PSI IT Tech Kathi Gardner walked five kilometers for breast cancer research in the Susan B. Komen Race for the Cure®. She raised \$500.00 for the cause that day. Attagirl, Kathi!

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***Thank you!***



Happy first-time parents, PSI Research Scientist Pasquale Tricarico and his wife Caroline Cordier with their newborn son, Louis Vincenzo Luc. He was born late on May 8<sup>th</sup>, just in time for Mother's Day! Louis's equally proud aunt, Pasquale's sister, Giovanna, is in the background. Welcome, gorgeous Louis!



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