PLANETARY SCIENCE INSTITUTE

NEWSLETTER

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David Crown explains images of Mars to the Congresswoman, while Steve Kortenkamp and Mark Sykes look on.

Arizona Congresswoman Gabrielle Giffords speaking to PSI members.

Looking at 3-D HiRISE images of a crater on Mars, from left, David Crown, Dan Berman, Bill Hartmann, Congresswoman Giffords, Alexis Rodriguez, and Congressional District Director Ron Barber.

Betty Pierazzo shows the Congresswoman meteorites from education kits used by PSI scientists in teaching K-12 and college students, and in teacher training.

Giffords examines samples of meteors and impact craters.

Congresswoman Giffords listening to the Director's presentation.

Congresswoman Giffords Tours PSI

by Ed Stiles

Congresswoman Gabrielle Giffords toured Planetary Science Institute's headquarters in Tucson on June 1 to learn more about the institute's research and outreach activities.

Giffords, who chairs the Subcommittee on Space and Aeronautics of the House Committee on Science and Technology, emphasized the importance of adequate funding for space research and praised PSI for providing high-tech jobs in her Arizona Congressional District. She also said America's space program is vital to the country because access to space near Earth has important national security implications.

(Continued next page)

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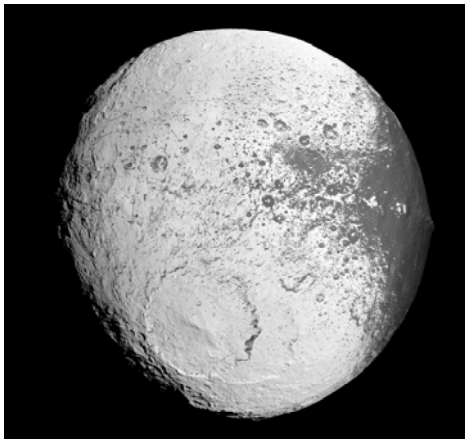
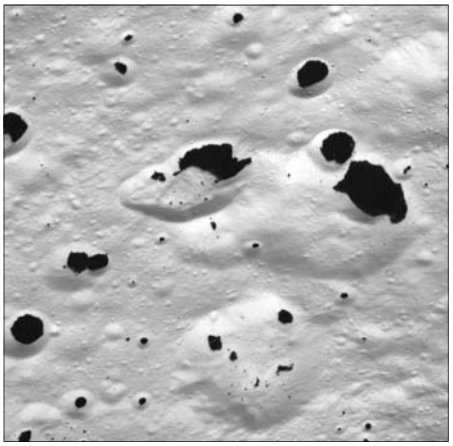
Tucson AZ Chandler AZ Flagstaff, AZ Phoenix AZ Althambra CA Angwin CA Cupertino CA Pasadena CA Washington DC Honolulu HI Columbia MD Pasadena MD Ft Kent ME Durham NH Albuquerque NM Los Alamos NM Reno NV Houston TX San Antonio TX Arlington VA Chester VT Medina WA Seattle WA Appleton WI Evansville WI Sobieski WI Waunakee WI Wheeling WV



Full disk image from Cassini Orbiter shows the ice-rich trailing side of Iapetus at left, and a part of the black leading side at right. Sunlight is from the right. The contrast is so great that the black material is underexposed and shows little detail. The boundaries of the black material are intricately convoluted with the cratered topography. *(Cassini image, Sep. 2007; NASA/JPL/Space Science Institute)*



Close-up of part of the boundary zone between the black and white material on Iapetus. The image shows craters in the icy surface, but with patches of the black material (not shadows!) on some crater walls. Sun is from the bottom; there is some tendency for the black patches to lie on sunlit walls. *(Cassini image, Sep. 2007; NASA/JPL/Space Science Institute)*

Iapetus, A Study in Black and White

by William K. Hartmann

Around 1671, the French observer G. D. Cassini discovered that one side of Saturn's moon Iapetus is very bright and the other side so dark that he could not see it when that side faced Earth. He also discovered that Iapetus keeps one side toward Saturn (as the moon does with Earth), and that the dark hemisphere is the one that leads during orbital motion, like the front windshield of a car, while the bright hemisphere trails. The bottom line of Cassini's work was that Iapetus is a moon with one hemisphere black and the other white. Ever since, there has been a mystery as to why this situation, unique in the solar system, exists.

Twentieth century observers discovered that the dark material, with reflectivity about 5%, is reddish-black or brownish-black carbonaceous soil, and the bright material, with reflectivity about 50%, is frozen water. A theory arose that the black material actually came from the next-outer satellite, Phoebe, which is a captured, black, carbonaceous moon moving in the retrograde direction around Saturn, opposite to Iapetus's motion. The idea was that if black powder was blasted off Phoebe by meteorite impacts, the powder grains would spiral in toward Saturn and hit the leading side of Iapetus in head-on, high-speed collisions. Thus, the leading side of Iapetus would have black material "plastered on" as if by a spray gun aimed at that side.

The only problem with this nice theory is that Phoebe's material is neutral black, while Iapetus's has a reddish spectral tone indicative of organics. Are they the same material?

A more recent theory, by Tilmann Denk (Frei University, Berlin) and John Spencer (Southwest Research Institute, Boulder), suggests at least two steps: First, the black material from Phoebe is plastered on, but then the new ice-soil mixture, being dark, absorbs sunlight and heats up. Second, this causes sublimation of ice in the surrounding icy material. The loss of ice makes the dark material purer and even darker, causing a feedback effect. The darker it gets, the more it heats up, and the faster the ice sublimes. This effect is very sensitive to topography and to the total exposure of various crater-wall slopes to sunlight. Possibly, according to various studies, interaction of the ice and carbonaceous material with sunlight creates reddish-toned organic materials in the dark soil. This model may account for the patchy distribution and color of the dark material.

Although PSI has not had major projects aimed at Iapetus, this unique moon presents many problems in our areas of expertise, including dynamics of motion of the black ejecta from Phoebe, impact phenomena, and geologic morphology of the cratered Iapetus surface. Perhaps there is an Iapetus project in our future. □

Congresswoman Giffords Tours PSI

(continued from front page)

During a presentation given for Giffords, PSI Director Mark Sykes explained that understanding other planets helps us better understand Earth and has already led to a deeper understanding of the effect humans have on Earth's atmospheric processes. He also said that the long-term dominance of the United States in space will depend on whether it is the first to address the possibility of expanding human activity in space.

Director Sykes describes PSI's participation in numerous space missions.

Sykes noted that PSI participates on the science and instrument teams of a number of missions sponsored by NASA and other agencies. These include: Mercury MESSENGER, Dawn, Cassini, Mars Odyssey, Mars Reconnaissance Orbiter, Mars Exploration Rovers, Mars Express (European Space Agency), Hayabusa (Japanese Aerospace Exploration Agency), NEO Surveillance and Tracking (Canadian Space Agency) and Chandrayaan-1 (Indian Space Research Organization). □

Rare Encounters, Precious Data

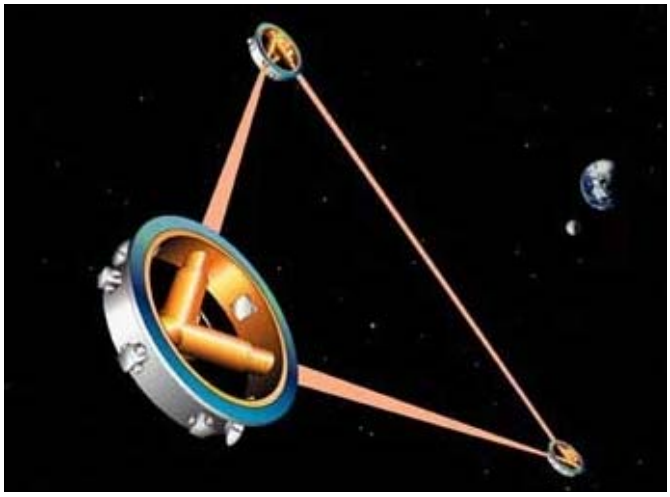
by Pasquale Tricarico

For a spacecraft moving into the empty space of the solar system, an encounter with an asteroid is an extremely rare event. If the asteroid is not previously known, the event will likely go completely unnoticed as the gravitational attraction of the asteroid does not cause significant perturbations to the spacecraft trajectory, and the instruments on board are not sensitive enough to detect its passage.

But for the joint NASA-ESA mission LISA (Laser Interferometer Space Antenna), due to operate in the period 2018-2025, the passage of asteroids will generate a characteristic "noise" in the onboard instruments, permitting their detection. The LISA mission is composed of three spacecraft maintaining a triangular configuration, each satellite five million kilometers apart from the other two.

The spacecraft are connected by laser beams, and are designed to detect the passage of gravitational waves, a phenomenon predicted by Einstein's General Theory of Relativity that still lacks a direct confirmation after decades of active search.

In my recent study, I found that an average of two asteroid passages per year will be close enough to one of the three LISA spacecraft to be detected. This relatively high rate is due to the exceptionally high sensitivity of the LISA instruments. When the detection happens, it is very likely that the orbit of the asteroid will be known before the passage, thus permitting its prediction.



The Laser Interferometer Space Antenna (LISA) mission's primary objective is to search for gravitational waves, but the mission will also help astrobiologists study near-Earth asteroids (NEAs). Image Credit: NASA

From the strength of the noise in the data, it will be also possible to estimate the mass of the passing asteroid. When the mass is correlated with what we already know about the size, shape, and spectral type of an asteroid, we can obtain important information on its bulk density and macro-porosity.

The study was published in *Classical and Quantum Gravity*, Volume 26, Number 8, 21 April 2009. □

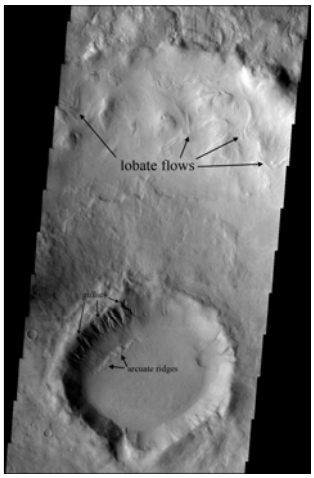
PSI Scientists at the 2009 Lunar and Planetary Science Conference, in Houston

In March, PSI on-site and off-site scientists met for their annual LPSC conference dinner. This year's site was The Grotto Restaurant, in Houston. Pictured, from left, Gary Hansen, Patrick Russell, James Head, Aileen Yingst, Karl Hibbitts, Keith Holsapple, Jon Clark (visitor), Chuck Wood, Andrew Wheeler (visitor), Ann Clark (visitor, seated) Cathy Weitz, Kevin Housen (visitor), Eldar Noe Dobrea, Mary Bourke (seated) Dan Berman, Paul Abell, Joe Michalski, Asmin Pathare (seated), Rebecca Williams, Frank Chuang, Melissa Lane, Steve Metzger (seated), Bill Feldman, Scott Mest, and Kim Kuhlman. (Karly Pitman, Cyrena Goodrich, and Andrea Philippoff attended but are not pictured.)

PSI Martian Research Published in *Icarus*

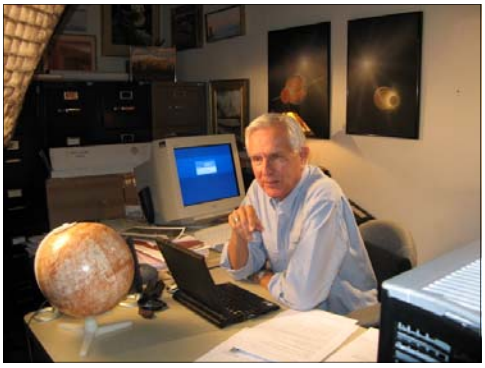
PSI scientists have found further evidence for the large role that water has likely played in shaping the Martian landscape. Their results, published in April in the journal *Icarus*, provide strong evidence that multiple wet and/or icy climate cycles have shaped the topography of the planet's large craters. Associate Research Scientist Daniel Berman who is the lead author on the paper says that studying crater degradation in potentially ice-rich environments is vital to understanding the geology of craters and their surroundings, as well as for determining whether the ice comes from the atmosphere or from below the ground.

Berman, along with PSI Senior Scientist David Crown and PSI Research Scientist Leslie Bleamaster III, surveyed the geologic features in two sets of mid-latitude craters, one in the northern hemisphere and one in the southern hemisphere. Each set included about 100 craters. They looked specifically for these erosional or depositional features on the walls and floors of the craters: lobate flows, channels, crater-wall valleys, gullies and alcoves, arcuate ridges, and debris aprons, the number and sizes of those features, and how the features are oriented (whether they face the equator or the planet's pole in their hemisphere). All of these features suggest a landscape shaped by liquid water and/or ice. Berman found that the orientation of these features was often dependent on their latitude. The features' pole-facing or equator-facing orientations could result from uneven heating of the crater walls. Ice on walls that get more sunlight would melt faster, causing more water to flow and form the gullies and other features. □



THEMIS image showing a 16-km diameter crater with gullies and arcuate ridges on its north, pole-facing interior wall in the center of a larger, 60-km diameter crater with lobate flows on its north, interior wall. Image width is 17.4 km. ***THEMIS VIS image V07798008, centered at -40.32° N, 132.5° E.***

Hartmann to be on History Channel



Bill Hartmann under television lights in his office for the History Channel interview.

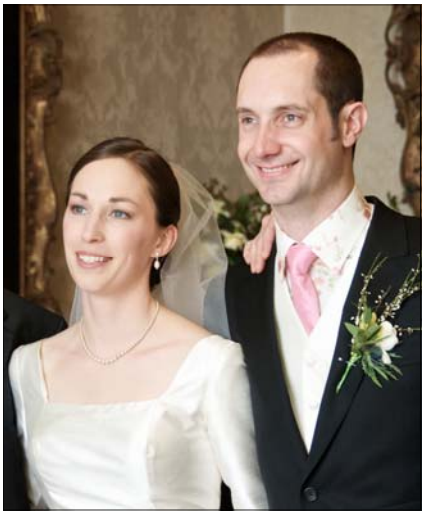
In early June, the History Channel sent a crew from Flight 33 Productions, in Los Angeles, to PSI to interview Bill Hartmann for a new television show that will be airing later this year. It's part of a series on the universe.

The subject of this episode is Earth and the moon. The interviewer had questions about the moon origin theory that PSI founders Bill Hartmann and Don Davis postulated in 1974. He also asked Bill some hypothetical questions, such as "What would Earth be like without a moon?" Bill noted that there might not be gross differences, but "What we learned on Mars is that without a moon the tilt of the polar axis changes, and that can cause enormous climate variations over periods of millions of years."

Production crew member attaching microphone to Bill's shirt for television taping.

Should be interesting. Stay tuned!

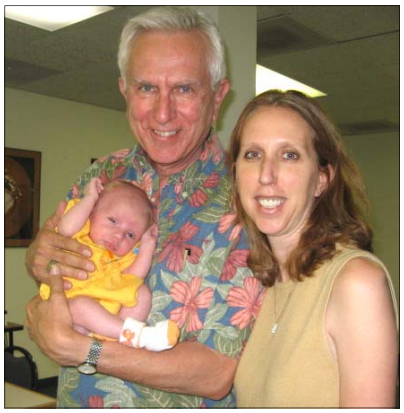
Marriage for Balme



PSI Research Scientist Matthew Balme married Anne Jay on March 28, in a stylish ceremony at the bride's home in Herefordshire, England. Best wishes, Matt and Anne!

Two Beautiful Grandchildren, Two Days Apart

Chief Financial Officer Bruce Barnett became a first-time grandfather April 24, 2009, when new grandson Tristen Owen Lucas was born. Bruce is holding Tristen, Tristen's mother, Jackie, is on the right and her twin sister, Carrie, is on the left.



Not to be outdone, Senior Scientist Bill Hartmann also became a first-time grandfather on April 26, 2009, when his daughter Amy gave birth to Grace. (Seasoned PSI grandpa Don Davis, with 3 grandchildren, will offer counsel.)

Catching up with Alexis Rodriguez

Alexis Rodriguez joined PSI as an Associate Research Scientist in January, 2008, and is now a Research Scientist working at PSI headquarters in Tucson. He arrived here via a rather circuitous route.

Jose Alexis Palmero Rodriguez was born in the Canary Islands, Spain, and lived there until he was seventeen years old. At that time, he left home and embarked on what would become a three-year, solo, world-traveling adventure that ranged from Europe to Asia. He worked odd jobs along the way to support his travels.

After years of traveling Alexis settled in the U.K. and entered the University of London, where he earned a Bachelor's degree in geology in 1996. His aim in studying geology was to better understand the processes that shape diverse terrestrial landscapes. Until he went to the U.K. he did not speak English, but, of course, he does now.

He had planned to go to India next but never made it past Japan, where he spent the next eight years. And once again, Alexis did not speak the language when he arrived in Japan but is now a fluent Japanese speaker. He dabbled in the import/export business between Japan and China before he secured a scholarship to attend University of Tokyo.

At university, he earned his Master's Degree in Earth and Planetary Science in 2001, and his PhD in Mars Geology in 2004. His interest in planetary science stemmed from wanting to learn how similar, or different, other planetary bodies are to Earth when observed at comparable scales.

His professor and later his post-doctoral advisor in Japan was Sho Sasaki under whose tutelage he wrote many papers about the chaotic terrains of Mars. As a post-doctoral research student at the National Astronomical Observatory in Tokyo, he continued writing papers about Mars all the while enjoying the food, culture, and beauty of Japan.

His connection to PSI came through PSI Affiliate Scientist Hirdy Miyamoto who lives in Japan and put him in contact with PSI Assistant Director David Crown. Here in Tucson, Alexis is working on many projects, primarily: Mars outflow channels, wind streaks on Mars and Earth, and the evolution of polar layered deposits on Mars. His two NASA-funded grants are "Formational History of the Polar Troughs in the North Polar Plateau on Mars" and "Martian volatile storage, hydrology, and geologic activity controlled by the thermal conductivity of surficial materials."

Later this summer, he will be traveling back to Asia where he will be working on data collected by the Chinese unmanned lunar-orbiting spacecraft, Chang'e 1, at Wuhan University, Wuhan, China.

Although he misses certain aspects of life in Japan, Alexis has embraced the Arizona heat, enjoys hiking in our beautiful desert and mountains, and is learning about Native American cultures.

We are very glad to have Alexis at PSI!

Director's Note: *A Visit from Congress*

We were honored to have Congresswoman Giffords take the time to visit PSI headquarters, on June 1. The Subcommittee for Space and Aerospace, which she chairs, oversees NASA, our principal source of funding. She has a serious appreciation for the work that we do and how that fits into the national interest. We are very fortunate to be in her district.

It was also a pleasure to show off the Institute, its people, and the incredible range of science we undertake. We are on the science teams of 11 missions, running instruments on 4 of them, and have 123 ongoing contracts with NASA, primarily for research. We continue to grow at more than 20% per year, and with 57 PhDs we are becoming one of the larger centers of planetary science in the country.

It was also nice to show off our growing efforts in Education and Public Outreach by showing her the impact-rock and meteorite kits that are loaned out to schools around the country, and pictures of public lectures, events, and the teacher training workshops conducted on-site at PSI. This last is of even greater importance now in the Tucson area, because state budget shortfalls to K-12 programs will most likely result in zeroing out teacher professional development within many school districts. We look forward to continuing to develop and deepen PSI's relationship with Congresswoman Giffords and her staff.

This is a time of potentially great change. The new administration is reviewing the focus of our human space efforts, decadal surveys are underway to give direction to the future of our space science investments, and there is increased attention being paid by the National Academy and other advisory groups to the essential role of planetary research programs in NASA's solar system exploration program. We need to continually engage the system and participate in these various processes, as well as reach out and be a resource for our legislators and the public.

Mark V. Sykes
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Planetary Science Institute

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