



Scrutinizing the moon's far side

GRAIL mission to track the lunar surface and interior begins science phase

By Mark Whalen

Despite the popularity of Pink Floyd's 1973 album, the moon doesn't really have ... a dark side. Of course, both sides of the moon receive equal amounts of sunlight; it's just that we only see the "near" side because the moon spins around its pole at the same rate it orbits the Earth, showing us only one side, what scientists call a synchronous lock situation.

It is the far side of Earth's natural satellite that is expected to provide the most tantalizing discoveries for JPL's Gravity Recovery and Interior Laboratory (GRAIL) mission, now operating in its science phase.

"It's not dark in the sense of sunlight," said Sami Asmar, GRAIL deputy project scientist. "It's dark in the sense of knowledge. The crux of the mission is to reveal the side we never see from Earth. From Lunar Prospector and other missions, we got a very good

idea of what the near side looks like gravitationally—but virtually nothing for the far side."

The twin GRAIL satellites, Ebb and Flow, will create the most accurate gravitational field of the moon to date. In examining the structure of the lunar interior from crust to core, the mission will enhance understanding of the moon's thermal evolution, which is essential to understanding its origin and development.

In their precision formation-flying orbit since early March, Ebb and Flow owe their payload heritage to a JPL mission now celebrating its 10th year in Earth orbit, the Gravity Recovery and Climate Experiment, or GRACE, a joint mission of the United States and Germany.

"We can't see them over the far side, but Ebb and Flow track each other, and that's really what opens up

the far side for us. That capability was the big breakthrough for GRAIL, similar to GRACE around Earth," said Michael Watkins, the project scientist for both missions.

GRACE's pair of satellites track minute changes in Earth's gravity field by measuring micron-scale variations in the separation between the two spacecraft. This has resulted in a hundred-fold improvement over existing maps of Earth's gravity. GRAIL is using the same techniques at the moon.

"Our knowledge of the moon's near-side gravity field is not too bad, but the far side is very poorly known, and GRAIL will make it uniform on both sides," said Watkins.

GRAIL's 82-day science phase continues through late May. But the team is already anticipating a newly approved, three-month extended mission that will allow Ebb and Flow to fly at even lower altitudes than the prime mission to acquire enhanced data sets. The result is expected to produce a better gravity field for the moon than for any of the terrestrial planets.

"In terms of the space-observed field, it's amazing what GRAIL will get us, which is very definitive, tens-of-kilometer resolution," said Watkins. "It's going to be fantastic, especially when combined with the extended mission."

"The interplay between the topography—the shape of features on the moon—and the gravity that those temporary features are causing, is really the key to the mission," he added.

GRAIL's instrument was built by the same JPL group that built the GRACE instrument. Many of the data analysis and mission operations staff have worked on both missions.

Asmar noted another significant correlation between the two. "The success of GRACE made GRAIL lower cost," he said. "Since the technology was demonstrated and the payload was developed, we knew what to expect, so it became affordable to do GRAIL as a Discovery-class mission."

Watkins termed GRAIL's mission operations team's pinpoint maneuvering of Ebb and Flow into their science orbit "one of the most amazing mission operations challenges in the history of JPL." From launch to the beginning of the science phase, the team conducted 27 maneuvers, "which is a lot of great work in a short period of time to get us in precision formation-flying configuration," added Asmar.

GRAIL has released the first images from Moon Knowledge Acquired by Middle School Students, or MoonKAM, an education and public outreach program that allows participating students to select features on the moon that cameras on Ebb and Flow will photograph. The effort is led by Sally Ride Science in San Diego.

For more information on the mission, visit <http://solar-system.nasa.gov/grail/home.cfm>. ■



Journey from community college to Ph.D. all worth it

By Susan Braunheim

Not every Ph.D. student chooses the same route to achieve their objectives. Ask Dr. Farisa Morales. As a research scientist for the Spitzer Space Telescope, Morales currently studies stars with circumstellar debris discs,

the dusty ring-like structures that circle some stars and may hint at planet-formation processes. At times, completing her Ph.D. might have seemed as far away as the stars she now studies. However, she continued to persevere on the path, ultimately leading her to her goal.

Morales started her education as a math major at Los Angeles Mission Community College in 1997, where a physics professor pointed her toward the JPL Undergraduate Scholars program for community college students. She signed up immediately.

Being at JPL inspired her to complement her math courses with astronomy classes. Subsequently, she was hired as an academic part-timer in 2000 and switched from the engineering work she had started with to join the Spitzer science team.

“While I was attending Mission College, Spitzer was on its way to being launched and I was invited to participate in meetings where astronomers would discuss objectives like identifying brown dwarfs, distant galaxies, peeking through gas and dust to find baby stars and planetary systems forming,” Morales said. “That got me really excited because I realized that the telescope would soon unveil a universe that had not been seen before at infrared wavelengths. I became very motivated and decided to change my major from math to astrophysics.”

By 2001, she had transferred and was already a senior at UCLA, making the switch a huge undertaking.

“That was the turning point,” Morales said. “I wanted to know more of the physical universe that would be revealed and get involved if given the opportunity. Both happened. Getting the Ph.D. and working on Spitzer makes me feel like I’m helping decipher tiny pieces of a huge cosmic puzzle.”

Morales graduated from UCLA in 2003 and went on to get a master’s in physics from Cal State Northridge in 2005 and ultimately a Ph.D. from USC, also in physics, in 2011.

While working and going to school Morales had a family with two young children.

“I took it one day at a time,” she said. “After dinner, my children and I would all sit down to do homework at the same time. That was fun. Many times my children were more interested in my homework than theirs.”

Morales experienced many challenges along the way. “The Ph.D. examination process is very demanding and really tests your abilities and desire for the degree. Not many people understand what I do and I didn’t grow up in a science-oriented family. This has made me a little bit of an alien to my extended family,” she said.

“It was worth every weekend immersed in study, every time I had to cut my sleep short to get more stuff done during a day, every tear when times got tough,” she added. “Now my daughter is in college at UC Riverside, my son is doing great in high school, my husband is very proud and I get to continue doing what I love.”

Morales’ boss and advisor, Spitzer project scientist and Astronomy and Physics Directorate chief scientist Michael Werner, said she was able to fulfill her dreams while also serving as a mentor and role model for other students. “Farisa is a wonderful beneficiary of the California educational system,” he said. “It is sobering to imagine that the current state budget woes may make it much more difficult for future students to follow in her footsteps. Seeing her work through the educational process has been very gratifying. She started as an intern and is now writing her own successful proposals.”

Werner added that Morales is also the first person in recent years to earn a Ph.D. from USC for work in astronomy while working at JPL. “This has led to strengthened ties between USC and JPL,” Werner said. “To our team she brought technical competence, willingness and ability to learn, reliability and a friendly face and demeanor, which has made for a more civil working environment.”

“My education and work on Lab have been a personal journey in search of truth and the laws that govern our physical universe,” Morales said. “I wouldn’t trade it for anything.” ■

Women’s achievements highlighted



Top, from left: Powell-Meeks, Chodas, Short.
Above, from left: Raymond, Harrison, Alexander, Lopes and Mainzer.

In recognition of Women’s History Month, JPL hosted an event in March to highlight the achievements of women in the Laboratory’s success.

Los Angeles-area female college students studying science, technology, engineering and math (STEM) subjects looked on in the 321 auditorium as journalist Patt Morrison moderated a panel of women who lead a NASA mission as principal investigator. Fiona Harrison of Caltech, principal investigator for NuSTAR; Amy Mainzer of JPL (NeoWise); Carol Raymond of JPL (Dawn); and Maria Zuber of MIT (GRAIL) described their missions as well as their career experiences.

Human Resources Director Cozette Hart moderated a panel of JPL women engineering and science leaders. Claudia Alexander, Jan Chodas, Elizabeth Kay-Im, Rosaly Lopes, Mag Powell-Meeks and Kendra Short offered their personal career stories and advice.

A third panel targeting upcoming scientists and engineers was called, “What I Was Like in 5th Grade and How I Became Interested in STEM Careers.”

The Women’s History Month events are available for viewing at <https://jpltube.jpl.nasa.gov>. For the event agenda, visit <http://www.jpl.nasa.gov/whm/event.php>. ■



Rinaldi: Protection of IT assets is critical

Chief information officer discusses cyberattacks, security

By Mark Whalen

A recent NASA cybersecurity report outlined the agency's most serious challenges in protecting its information technology assets. The Lab's chief information officer, Jim Rinaldi, addresses the threats and the importance of IT security.

Q: What are the motivations of these hackers?

A: It's hard to say. NASA and JPL are far from alone in being the targets of hacking attempts. These types of attacks are happening more and more around the country with both private firms and government facilities. In some cases, they may be looking for technical data or intellectual property. In other cases, people may just be looking to advance their technology skills. In the past, some attackers have tried to deface websites for fame, and some of those have been caught and prosecuted.

Q: Is it possible to stop all hacking attempts?

A: Well, there's no doubt we're going to be attacked. We block thousands of attacks every day. The thing that we're focusing on is how to minimize the impact and focus on the more advanced, persistent threats.

One thing I'm heartened by is that we have very talented people in IT security at JPL. Often it goes unrecognized, but I have a new sense of appreciation just watching them at work.

Q: What steps are being taken to better protect JPL's IT assets?

A: While most of what we do is adequate to stave off day-to-day virus attacks, there are things we need to improve. We can't be quite as trusting as we were in the past. Attackers have a different level of sophistication, so that means we have to change.

For example, in today's world, we tend to try to protect the device. Since we have so many devices now,

that's almost impossible to do, so we've also got to find better ways of protecting the data. One way of doing that is by encrypting data stored on laptops.

We've also taken many steps to help prevent malware, spam and viruses from attacking JPL. We have much-improved detection tools that provide many layers of defense. For example, on any given day we block 55,000 e-mails from getting inside the Lab—so that's millions of attacks we've blocked from trying to get inside the firewall.

“On any given day we block 55,000 e-mails from getting inside the Lab ... that's millions of attacks we've blocked from trying to get inside the firewall.”

One other step that has to occur is that all computers that touch a JPL network need to be subscribed through the Office of CIO. This way, software patches can be rolled out that prevent new threats. These patches usually contain fixes to known vulnerabilities as well as to resolve problems. We have found this true for Macs, Linux and Unix as well as Windows computers.

Q: Have actions such as frequent changing of passwords proved to be valuable? What more is being done?

A: We could change passwords every day and we'd still be vulnerable. That's why we believe that multifactor authentications are a key to tighter security. For example, for some websites you might visit as a consumer, you have to answer a known question—such as

your mother's maiden name—before even the password works. There are tools available that allow you to enter a user ID, password and a personal identification number, and that PIN changes every time you sign in, so it makes you unique.

It's very easy to go to a website that you thought was safe and unknowingly download a virus or malware. That's why those on Lab who have elevated or higher administrative privileges on their computers and servers are going to require multifactor authentication right away, which will help mitigate malware damage to computers as well as to our networks.

We have also fully implemented a system that blocks access to known “bad” websites and has helped prevent viruses, malware and intrusions. In addition, all JPL public-facing websites are being reviewed for any vulnerabilities, access, data and architecture. The goal is to reduce the amount of critical data exposed and to modernize how we work with external resources.

In OCIO it's our job to minimize the impact of attacks. But it's up to everybody at JPL to protect their data, protect their equipment and guard their credentials. Safeguard them like you would your bank account.

Q: What trends do you see coming that affect how IT works at the Lab?

A: One we're watching closely that has a big influence on how we work is the consumerization of IT. Today, people can bring their own devices and connect to the guest network, and we're looking at how we can improve that, including creating a separate network that would provide those devices with limited access, so that we can track who owns each one, and disable it if there's a problem indicated.

Our policy is that only work computers can access the JPL networks. But a lot of new thoughts and ideas are coming out. We offer a wide range of technology in our catalog that mitigates the need to bring your own device, but we understand that this trend is continuing, and many people don't want to have multiple devices if they don't have to. ■

News Briefs



Fred Hadaegh

Hadaegh takes technology post

JPL Fellow and senior research scientist Fred Hadaegh has been named the Laboratory's associate chief technologist.

Hadaegh, who also manages the Laboratory's Distributed Spacecraft Technology Program, came to JPL in 1984 as a member of technical staff in the Autonomous Systems Group. Prior to his recent appointment, he served as supervisor of the Guidance and Control Analysis Group.

Previously, he led the design and development of autonomous rendezvous and docking, formation flying concepts, architectures and flight software for NASA missions and Department of Defense programs. Hadaegh has received NASA's Exceptional Service and Exceptional Achievement medals and JPL's Award of Excellence for flight validation of autonomous rendezvous in Earth orbit.

Two receive engineering honors

Two JPL engineers have been awarded top honors from the National Society of Black Engineers.

At the organization's Aerospace Systems Conference in February, Art Rankin (3476) and Ashitey Trebi-Ollennu (3475) each received the 21st Century Trailblazers in Aerospace award. Rankin's honor was in the Avionics and Software category, while Trebi-Ollennu



Art Rankin

was honored in the Systems Engineering category.

The pair was cited for exemplifying the society's mission "to increase the number of culturally responsible black engineers who excel academically, succeed professionally and positively impact the community."

The society said the bi-annual conference, first held in February 2010, is America's only technical conference focused specifically on the scientific and engineering contributions of African American aerospace professionals.

Museum honors Cassini

JPL's Cassini mission to Saturn has received the Smithsonian's National Air and Space Museum's Trophy for Current Achievement, the organization's top group honor.

The trophies for current and lifetime achievement are the National Air and Space Museum's most prestigious awards. They recognize outstanding achievements in the fields of aerospace



Ashitey Trebi-Ollennu

science, technology and their history.

Representatives for Cassini received the trophy on March 21 at a black-tie dinner in Washington, D.C.

The mission, a cooperative project of NASA, the European Space Agency and the Italian Space Agency, launched in 1997 and entered orbit around Saturn in 2004. In December of that year, the spacecraft successfully released ESA's Huygens probe to pass down through the atmosphere of Saturn's largest moon Titan.

For more information about the Cassini-Huygens mission, visit <http://saturn.jpl.nasa.gov>.

JPL spinoffs highlighted

Several JPL developments are featured in the latest issue of NASA Spinoff magazine, which highlights the ways in which the agency's research is commercialized for societal benefit.

• A Santa Barbara company received funding from JPL and two other NASA

centers to develop and refine 3-D flash lidar technologies for space applications. Today, the NASA-derived technology is sold to assist with collision avoidance, navigation and object tracking.

• JPL computer scientists developed a unique software framework to help NASA manage its massive amounts of science data. The technology is now in use by cancer researchers and pediatric hospitals.

• A technology developed at JPL uses a technique to improve weather forecasts, monitor climate change and enhance space-weather research. The Arizona-based company that produced the receivers licensed the technology and then commercialized it for Earth science use by NASA and international organizations.

• JPL awarded Small Business Innovation Research funding to a New York firm to demonstrate the feasibility of using a tool to automatically check software for compliance. Today, the software tool has hundreds of users worldwide, including Fortune 500 companies, educational institutions, and government agencies working on satellites, avionics, medical devices and consumer electronics.

The publication is available at http://www.sti.nasa.gov/tto/Spinoff2011/hm_1.html.

Passings

Bjorn Lenck, 92, a retired senior financial analyst for the Galileo project, died Dec. 18.

Lenck joined JPL in 1964 and retired in 1984, then consulted for JPL for an additional eight years. He is survived by his wife, Margaret; daughter Nancy Bloodworth and her husband, Mark; son Brian and his wife, Tracy; and granddaughters Chelsea and Jessica.

Lenck was cremated and his ashes scattered over Monterey Bay.



Lila Moore

Lila Moore, 98, a retired secretary, died Dec. 28.

Moore worked at JPL from 1957 to 1980. She was one of the founders of the Associated Retirees of Caltech/JPL and remained active in the group for more than 20 years after her retirement.

Fred Rosenblatt, a retired software engineer and systems analyst, died Jan. 10.

Rosenblatt joined JPL in 1978 and retired in 2005. He is survived by his wife, Veronica; children Matthew, Sarah, Aaron and Deena, as well as several grandchildren.

Ken Beutler, 75, a retired Deep Space Network engineer, died Feb. 6.

Beutler became a JPL employee in 1975 after working for several years as a Bendix contractor at the Goldstone tracking station. He later served as a lead engineer and cognizant operations engineer for Deep Space Network operations, retiring in 1998.

Beutler, predeceased by his son Greg, is survived by his wife, Dixie; children Karen and Glenn; granddaughter, Zoë; brothers Dean, Jimmy and George; and sister Benna. A memorial service was held Feb. 25 at the United Methodist Church of La Verne.



Ken Beutler



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Letters

My sincere and heartfelt thanks to all my JPL family of friends and colleagues for the tremendous outpouring of love and support you have given me and my children. I thank all of you who generously donated to the Sue Savona Memorial Funds at both the JPL Credit Union and Bank of America. These funds will be a great help as I continue to care for and educate my nine children for many years to come. Sue was a wonderful wife and mother, and the children and I miss her every day. She will always be a part of our lives as we continue to keep her memory alive. Thank you again for being there for all of us during this very difficult time.

Gary, Kali, John, Sam, Jenna, Emma, Sara, Josh, Ava and Chloe Savona

Thank you to my JPL family and friends for your thoughts, prayers and

kind words during my mother's passing. Knowing how many of you had gone through similar experiences helped me realize I could/would get through this. The plant from JPL and flowers I received from 103 were beautiful. Not having a large immediate family made my JPL family and friends invaluable. I would like to thank my friends and co-workers for your words of comfort and support. My words can't express how thankful I am to work with such caring people. From the bottom of my heart, "Thank you!"

Maria Silva

My sister and I would like to thank my colleagues at JPL for your kind words and for the beautiful plant you sent in remembrance of our father. My dad was an engineer and was always proud of what we do at JPL.

Sanford Krasner

Thank you so very much to everyone in Section 324, Division 32 and all the

other friends and colleagues in the other divisions that I have had the pleasure to work with during my 35 years at JPL. My retirement party was a great ending to a fulfilling career and the lasting friendships will always be with me. The cards, gifts, food and flowers were very thoughtful and greatly appreciated. Again, thank you for a great sendoff.

Sharon Chapman

To my JPL friends and colleagues, thank you for your thoughts, prayers, flowers and plants at the recent passing of my beloved husband. Your kindness and caring has been inspirational and I am deeply touched. It is heartwarming to know such good people rallied around me during this difficult time.

Linda Clifton

Thank you to the many colleagues who have offered expressions of sympathy on the recent passing of my mother. I am touched by your kindness. My mom was

interested in the U.S. space program, and proud of the work we do here at JPL. I also thank JPL at large for the lovely memorial plant.

David Berry

Thank you to my JPL friends and co-workers for your kind and caring words following the death of my son Robert. They were comforting and meant a great deal to my family and me. The plant from JPL and the flowers were beautiful and much appreciated. I'm very fortunate to work with so many caring and considerate individuals.

Larry Latimer

Retirees

The following employees retired in March: **Louis D'Amario**, 34 years, Section 343; **Karen Matthews**, 12 years, Section 2113; **Edwin Bennett**, 10 years, Section 172A.