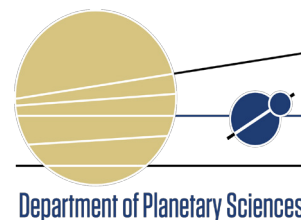




UA SCIENCE

LUNAR & PLANETARY LABORATORY



LUNAR AND PLANETARY LABORATORY NEWSLETTER

FALL 2016

Bound for Bennu! OSIRIS-REx Launch Was 'Perfect'

by Doug Carroll, University Relations



Photo: Vishnu Reddy

An Atlas V rocket, a candle burning brightly in the evening sky trailed by a thick plume of white smoke, successfully launched the latest chapter in the University of Arizona's rich history of planetary science September 8 from Cape Canaveral Air Force Station.

After 12 long years that included two failed proposals with NASA and the untimely death of the project's principal investigator, the spacecraft for the UA-led OSIRIS-REx asteroid sample return mission has left the planet, much to the relief of the scientist who has been involved every step of the way.

"You all will be glad to know that we got everything exactly perfect," said a jubilant Dante Lauretta, the UA professor who succeeded the late Michael Drake

as the mission's chief, in a news conference at the Kennedy Space Center two hours after liftoff.

"We kicked that field goal right down the center of the goalposts," Lauretta said.

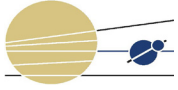
The sports analogy seemed appropriate for a launch that in many ways resembled a stadium event. An estimated 8,000 spectators — including some clad in the red and blue of the UA — packed two grandstands at the Banana Creek Viewing Area to watch the 7:05 p.m. EDT liftoff, which took place at Space Launch Complex 41, about two miles in the distance. Cheers of "U of A! U of A!" could be heard intermittently, and the commentary of NASA announcer Mike Curie added to the drama.

Tim Swindle, who succeeded Drake as director of the UA's distinguished Lunar and Planetary Laboratory, seemed grateful that OSIRIS-REx finally was bound for Bennu, the carbon-rich asteroid that the spacecraft's arm will gently tag for a sampling of surface material in about four years. If all goes according to plan, 2-plus ounces of Bennu's dirt will come back to Earth in September 2023 as the largest sample returned from space since the Apollo moon landings.

"We've been battling to get this mission confirmed and to get it built," Swindle said of the various twists and turns, "and now we have a flying spacecraft. Now the fun begins."

The spacecraft, about the size of a sport utility vehicle, separated from the rocket at 8:04 p.m. The solar arrays deployed and are now powering the spacecraft, which is "working absolutely as we designed and tested it," said Rich Kuhns, OSIRIS-REx program manager for Lockheed Martin Space Systems in Denver.

"Let's go get the science," Kuhns said.



Welcome from the Director

It has been a tumultuous few months since our last newsletter, filled with both success and sadness.

The most spectacular success, by far, was the launch of the OSIRIS-REx spacecraft. OSIRIS-REx, with LPL's [Dante Lauretta](#) as PI, was NASA's first interplanetary launch in nearly three years, and the launch itself went flawlessly, departing Cape Canaveral for asteroid Bennu at the very start of the launch window on the first day it was attempted. The event generated worldwide press coverage (we've got links to lots of articles) and there were lots of celebrations in Tucson and in Florida.

At the other end of the scale, LPL lost two beloved figures. [Pam Streett](#), the graduate coordinator for a generation of students, passed away suddenly, and then [Ewen Whitaker](#), the last (not counting students) of the original group that moved from the University of Chicago to the University of Arizona in 1960 to found LPL, passed away at age 94.

Meanwhile, life around the lab has been changing as well. For the folks working on [OSIRIS-REx](#), the transition has been from proposing, planning and building a spacecraft to working on operations. For the folks in the Kuiper Building, there have been transitions to the physical plant, with the outside stairway (the "gantry") finally getting a much-needed coat of paint, and the basement getting a long-overdue facelift in preparation for the installation of more nanocharacterization instruments. We've got two new faculty who have come on board and look forward to [Dr. Jeffrey Andrews-Hanna](#) joining the LPL faculty in January 2017. Seven graduate students were admitted, while three students have finished their PhDs.

But some things don't change. Mostly, we've got lots of people doing lots of exciting planetary science, which is, after all, why this place exists. Read on to find out what's been going on within LPL and the LPL family. And as always, if you've been up to something interesting, please let us know.



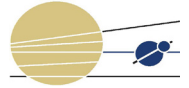
Timothy D. Swindle, Ph.D.
Department Head and Laboratory Director

Thanks to LPL Donors

We gratefully acknowledge donations to LPL. Donations were for The Art of Planetary Sciences, for student travel and scholarships, support for a reception for alumni and students at the OSIRIS-REx launch, corporate discounts and donations on products, and gifts of meteorites, as well as general gifts. The following individuals and corporations were partners in 2015 and 2016.

Individual Donors: David Acklam, Patricio Becerra, Gail Burd, Dan Cavanagh, David Choi, Eric Christensen, Michael Dixon, Kristan Husaker-Wood, Guy Jette, Mike Kaisermann, Keane family, Kelly Kolb, Norm Komar, Phil Lacovara, Carolyn Leigh, Robert Logan, Chester Maleszewski, Anson Martin, Alfred McEwen, Gloria McMillan, Bob McMillan, Kelsey Miller, Patricia Morgan, Sarah Morrison, Dan Petrocelli, Jani Radebaugh, Tim Reckart, Justin Rennilson, Elizabeth Roemer, Holly Schineller, Jessie Shinn, Simon family, Norman Soloway, Kjell Stakkestad, Timothy Swindle, Alvin Tarlov, Ewen Whitaker, Robert Wilson

Corporate Partners: B&H Photo Video, Backcountry, BAE Systems, Borderlands Brewing, Google, Pix4D, Rite in the Rain, Trimble



Department

Carter and Reddy join LPL Faculty

At the beginning of October, [Dr. Lynn Carter](#) joined LPL as an Associate Professor, as part of the Earth Dynamics Observatory cluster hire. Lynn is a planetary scientist whose research interests include volcanism and impact cratering on the terrestrial planets, regolith development on the Moon and asteroids, outer Solar System moons, planetary analog field studies, climate change, and the development of radar remote sensing techniques. Lynn was previously a Civil Service research scientist at NASA Goddard Space Flight Center for six years, where she began working with engineers on the development of a beamforming polarimetric radar system for orbital spacecraft. She is co-I on three spacecraft radar instruments: SHARAD on Mars Reconnaissance Orbiter, RIMFAX on the Mars2020 rover, and REASON on the Europa Flagship mission. She also recently became the Deputy PI of the Mini-RF radar on Lunar Reconnaissance Orbiter. In addition to multiple current planetary geology projects, she has become interested in Earth science research and is part of a project to study permafrost loss in Alaska using a combination of ground penetrating radar, in-situ carbon and methane monitoring, and orbital atmospheric constituent retrievals. At LPL she plans to continue to pursue interdisciplinary projects using geophysical remote sensing techniques.

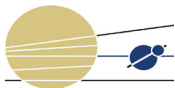


[Dr. Vishnu Reddy](#) joined LPL this fall as an Assistant Professor as part of space situational awareness cluster. Vishnu is a planetary spectroscopist with an interest in understanding the behavior of natural and artificial space objects using a range of remote sensing techniques and sensors. Prior to LPL, he worked as a research scientist at Planetary Science Institute, and as research faculty at the University of North Dakota working on ground-based physical characterization of near-Earth objects. He also worked as a scientist on NASA Dawn mission as a member of the Framing Camera team at the Max-Planck Institute for Solar System Research, Germany. At LPL, he will develop a new spectroscopy lab focused on characterizing space material in space-like conditions for both civilian and military uses, as well as exploring new ways to do low-cost planetary missions.

Farewell, Ed Beshore!



The LPL family extends best wishes and congratulations to [Ed Beshore](#), who retired from his career at LPL on October 4. His many contributions and accomplishments were celebrated at a farewell luncheon held in the Michael J. Drake Building on October 3. Ed has a long history with LPL and the University of Arizona. After being away for many years and building a successful engineering career, he joined the [Catalina Sky Survey \(CSS\)](#) team in 2002, becoming CSS Principal Investigator in 2007. He has served as Deputy Principal Investigator for the OSIRIS-REx mission for the last 4 1/2 years. More information about Ed and his “rocket ride into the sunset” is available from UA News; uanews.arizona.edu.



Department

Ewen Whitaker, 1922-2016



Ewen A. Whitaker came to Tucson in 1960 with Gerard P. Kuiper to conduct a lunar mapping project. Whitaker soon found that his work was just what NASA needed, and played a pivotal role in the first lunar missions: Ranger, Surveyor, and Lunar Orbiter. The mapping project produced the first compositional maps of lava flows on the moon—maps made possible by Whitaker's pioneering use of groundbased differential UV/Infrared lunar photography. These maps were instrumental in the selection of landing sites for the Surveyor and Apollo missions. Along the way, Whitaker worked with Kuiper to build and grow the Lunar and Planetary Laboratory (LPL) into a leader in the field of planetary science. Ewen retired from LPL in 1987, but never gave up his research in lunar selenography and nomenclature (the subject of Whitaker's Mapping and Naming the Moon is the history of lunar maps and nomenclature).

Following his retirement, Ewen was a regular visitor to LPL, taking time away from hobbies like clock repair to participate in outreach events and help to answer questions about the moon or LPL history, fulfill requests for information, and archive lunar maps and glass observing plates. Scientists, reporters, amateur astronomers, and historians sought him out for his expertise. In 2011, he was awarded an honorary doctorate degree by the University of Arizona's College of Science, which recognized his "contributions to the UA, mankind and science." In 2014, he was interviewed extensively in the documentary Desert Moon.

Pam Streett, 1962-2016

Planetary Sciences graduate coordinator Pam Streett passed away suddenly on September 30 after a brief illness. Pam had been with LPL since 1989; her first position was as a part-time secretary working for Professor William Boynton. In 1993, she transferred to the Academic Office as a full-time Administrative Assistant, before transitioning to her most recent role as graduate academic advisor (Program Coordinator) in 2005.

Pam was dedicated to her family and to the success of her LPL family—the many graduate students she helped to guide toward degree completion. She was a close colleague to her peers across the UA campus and a fan of UA Wildcat basketball. Outside of the office, Pam enjoyed craft projects and scrapbooking. She was active with the local Girl Scouts program and fostered animals through local rescue groups. Pam touched many lives with her kind heart, bright smile, and big laugh. Several generations of LPL faculty, staff, and students mourn her passing; we will miss her always.

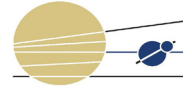


Get to Know a Post-doc: Vivien Parmentier



Vivien Parmentier joined LPL in December 2015 as a NASA Sagan Postdoctoral Fellow with Professor Adam Showman. Vivien is a theorist who works on cloud formation in hot Jupiter atmospheres, planets that are highly irradiated by their stars. He incorporates simple cloud schemes inside the global circulation model SPARC/MITgcm. By comparing the distribution of clouds from the models and observations from Kepler and HST, Vivien determines cloud properties such as chemical composition and particle sizes. His planned work at LPL is to use the knowledge gained on clouds to obtain better measurements of the water abundance in hot Jupiter atmospheres.

Vivien is from Paris, France. He studied at the École Normale Supérieure and obtained his M.S. from the Observatoire de Paris. He did his Ph.D. on analytical models of radiative transfer in planetary atmospheres at the Observatoire de la Côte d'Azur, with an office overhanging the beautiful Mediterranean Sea. One day, Vivien would like to resume biking around the world, but for now he enjoys his family life, which includes two daughters, Acté and Daphné, who are both under three years old.



Department

LPL Field Trip Fall 2016

by Christopher Hamilton

This fall, the LPL graduate students had the opportunity to travel to Florida and participate in the launch of OSIRIS-REx from Cape Canaveral as part of their “Planetary Geology Field Studies” course (PTYS 594A). In total, twenty-one students, led by [Dr. Christopher Hamilton](#) and [Dr. Joe Spitale](#), toured the Kennedy Space Center on September 8 and watched the flawless launch of the spacecraft onboard an Atlas V rocket. It was an extraordinary experience that will stay with everyone for a lifetime.

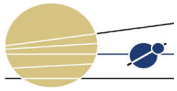
After the launch, the group focused on exploring the local geology by examining coastal processes along the Cape Canaveral National Seashore and at the Sebastian Inlet. In addition to studying shorelines and dunes, the group examined a series of freshwater springs located along the Chassahowitzka River. These sites are not accessible on foot and so the students explored the river by kayak. On the final day of the field trip, the group visited the Paynes Prairie Preserve State Park, which included grasslands, dense forests, baby alligators and their protective mother. Overall, Florida’s geologic history records the evolution of a passive continental margin and its sedimentary sequences have been strongly influenced by relative sea level changes. As such, Florida provides a stark contrast to the tectonically modified geology of the Southwest, and the field trip helped LPL graduate students to broaden their exposure to a wide range of planetary surface processes and experience a historic moment with the successful launch of OSIRIS-REx.



LPL graduate students kayaking on the Chassahowitzka River as part of their 2016 field trip to Florida



LPL graduate students at Kennedy Space Center



Outreach

LPL Outreach Update

by Dolores Hill, Sarah Morrison, and Maria Schuchardt

LPL's outreach efforts continue to flourish. In the past year, we have interacted with over 6,000 people at various events. The monthly Space Drafts lecture series at Borderlands Brewing continues to be very popular, with an attendance of about 100 people at each event. Space Drafts is a public talk series organized by LPL graduate student [Sarah Morrison](#), Steward Observatory, and NOAO.

OSIRIS-REx outreach has been extremely busy also. One of the big events this season was the USA Science and Engineering Festival in Washington, D.C., hosted by spacecraft partner Lockheed Martin. Over several days, more than 350,000 enthusiastic visitors and VIPs learned about the OSIRIS-REx mission at the large NASA and Lockheed Martin pavilions. [Erin Morton](#), [Christine Hoekenga](#), [Heather Roper](#), and [Dolores Hill](#) comprised two LPL teams that displayed OCAMS hardware, TAGSAM simulators and meteorites alongside the original TAGSAM and Sample Return Capsule prototypes.

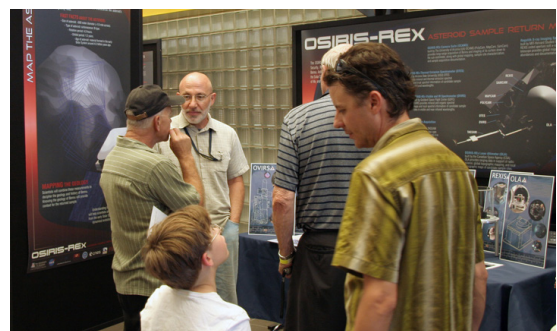
The Fallen Sky: An Intimate History of Shooting Stars. The event also featured a performance by UA Theatre Students, Summer Solon, Socorro Cordova, and Brandon Joule titled Journey Through History. The event included exhibits about OSIRIS-REx and many interactive children's activities. It was a very full and successful day of outreach to 700 visitors.

We have participated in many community STEM activities and in presentations to classrooms of students. Many children who attended University of Arizona summer camps stopped by LPL for tours and talks on Mars and the HiRISE mission. The beautiful globes of the terrestrial planets, moons, and even Pluto have been a great way to attract people for discussion of the research that we do at LPL. We talk to children, and also many adults, answering the questions they have about space: "Science, it's not just for kids."

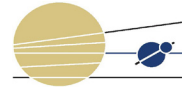


Dolores Hill at the USA Science & Engineering Festival

Countdown to Lift-off, the annual LPL Summer Science Saturday open house held on August 27, highlighted the OSIRIS-REx mission. There was a panel discussion with OSIRIS-REx scientists [Bashar Rizk](#), [Carl Hergenrother](#), and [Mike Nolan](#). [Ed Beshore](#) presented a lecture titled, Benu Here We Come. The event also included an arts component. Assistant Professor of English [Scott Selisker](#) presented a lecture on Imagining Asteroids in Science Fiction and the History of Astronomy and [Christopher Cokinos](#) (Associate Professor of English) gave a reading from his book,



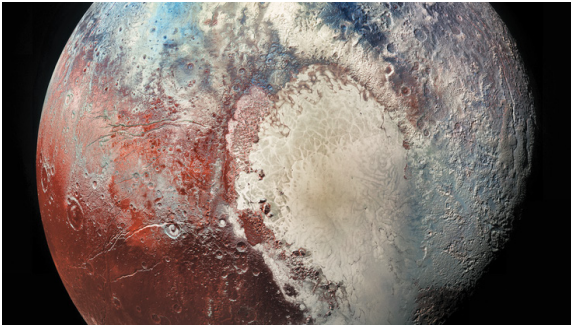
Summer Science Saturday attendees learn about OSIRIS-REx



Department

Cracked, Frozen and Tipped Over: New Clues From Pluto's Past

by Daniel Stolte - UA News



Research by LPL doctoral student James Keane and his advisor, Assistant Professor Isamu Matsuyama, indicate that Pluto's Sputnik Planitia could be in its present location because accumulation of ice caused the dwarf planet to roll over, creating cracks and tensions in the crust that point toward the presence of a subsurface ocean. They propose evidence of frozen nitrogen pileup throwing the entire planet off kilter, like a spinning top with a wad of gum stuck to it, in a process called true polar wander.

The two researchers used observations made during New Horizons' flyby and combined them with computer models that allowed them to take a surface feature such as Sputnik Planitia, shift it around on the planet's surface and

see what that does to the planet's spin axis. As theorized, the geographic location of Sputnik Planitia ended up suspiciously close to where one would expect it to be.

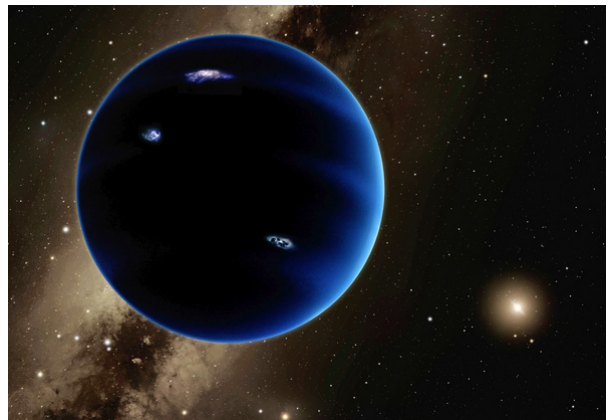
The simulations and calculations also predicted that the accumulation of frozen volatiles in Pluto's heart would cause cracks and faults in the planet's surface in the exact same locations where New Horizons saw them. The presence of tectonic faults on Pluto hint at the existence of a subsurface ocean at some point in Pluto's history, Keane explained. "Before New Horizons, people usually only thought of volatiles in terms of a thin frost veneer, a surface effect that might change the color, or affect local or regional geology," Keane said. "That the movement of volatiles and shifting ice around a planet could have a dramatic, planet-moving effect is not something anyone would have predicted."

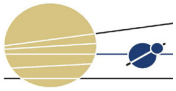
More Evidence for Ninth Planet on Solar System's Fringes

by Daniel Stolte - UA News

A team led by LPL Regents' Professor Renu Malhotra has found that the 4 Kuiper Belt Objects (KBOs) with the longest known orbital periods revolve around the sun in patterns most readily explained by the presence of a hypothetical "Planet Nine," approximately 10 times the mass of Earth. Such a hypothetical planet would complete one orbit around the sun about every 17,000 years and, at its farthest point from the Sun, it would swing out more than 660 astronomical units (1 AU = average distance between the Earth and the sun.)

KBOs are influenced by the gravity of the giant planets. However, there are a few known KBOs that are unlikely to be significantly perturbed by the known giant planets in their current orbits. These "extreme KBOs," (eKBOs) have extremely large orbital eccentricities — they get very close to the sun but swing far out into space once they pass the sun, on long elliptical orbits that take these strange mini-worlds hundreds of AUs away from the sun. Malhotra et al. point out peculiarities of the orbits of the extreme KBOs that went unnoticed until now, e.g., orbital period ratios are close to ratios of small whole numbers. An example of this would be one KBO traveling around the sun once while another takes twice as long, or 3x as long, or 4x as long, etc. — but not, say, 2.7x as long. Such ratios could arise most naturally if the extreme KBOs' orbital periods are in small whole-number ratios with a massive planet, which would help to stabilize the highly elliptical orbits of eKBOs. Calculations also suggest two likely orbital planes for the planet: one moderately close to the mean plane of the solar system and near the mean plane of the four eKBOs at about 18 deg, and one steeper plane, inclined at about 48 deg. While the results provide additional support for the idea of a potential "Planet Nine" and lay out possible scenarios, the authors stress that future observations and studies into the dynamical lifetimes of non-resonant planet-crossing orbits in the far regions of the outer solar system could help to further test the case for the existence and whereabouts of a ninth planet.





Graduate

Recent PTYS/LPL Graduates

Congratulations to Patricio Becerra, Kelly Miller, and Michelle Thompson, LPL's most recent graduates!



Patricio Becerra



Kelly Miller



Michelle Thompson

Patricio Becerra defended his Ph.D. dissertation, *The Poles of Mars, Past and Present: A High-Resolution Observational Study of the Martian Polar Regions and their Connection to Climate*, on July 5. Associate Professor Shane Byrne served as Patricio's advisor. Patricio is currently working as a Research Specialist at LPL, but will begin work in February 2017 as a postdoctoral research associate at the University of Bern.

Kelly Miller defended her Ph.D. dissertation, *The R Chondrite Record of Volatile-Rich Environments in the Early Solar System*, on July 15. Her research advisor was Professor Dante Lauretta. Kelly is working as a postdoctoral researcher at the Southwest Research Institute in San Antonio.

Michelle Thompson defended her Ph.D. dissertation, *Understanding Space Weathering of Asteroids and the Lunar Surface: Analysis of Experimental Analogs and Samples from the Hayabusa and Apollo Missions*, on May 27. Her research advisor was Associate Professor Tom Zega. Michelle has begun a NASA Postdoctoral Program appointment at NASA Johnson Space Center.

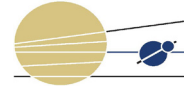
2016/2017 Incoming Graduate Students



From left to right:
Léa Bonnefoy (Paris Observatory), Planetary Surfaces
Laci Brock (Northern Arizona University), Exoplanets/atmospheres
Jessie Brown (University of New Brunswick), Exoplanets/atmospheres



From left to right:
Saverio Cambioni (La Sapienza, University of Rome), Outer Solar System Bodies
Cassandra Lejoly (Northern Arizona University), Small Bodies
Kyle Pearson (Northern Arizona University), Exoplanets/atmospheres
Amanda Stadermann (Washington University), Planetary surfaces



Graduate



Berkner Internship for Peacock

Fourth-year graduate student [Sarah Peacock](#) was awarded a Lloyd V. Berkner Space Policy Internship with the National Academies Space Studies Board. The internship will afford her the opportunity to spend 10 weeks in Washington, D.C., during the Fall 2016 semester. In addition to the Berkner internship, Sarah is the recipient of a NASA Earth and Space Science Fellowship. Sarah's advisor is Associate Professor Travis Barman.

Spring 2016 GTA Award to Chet Maleszewski

[Chet Maleszewski](#) is the recipient of the PTYS Outstanding Graduate Teaching Assistant Award for Spring 2016. Chet worked with Dr. Vishnu Reddy in the PTYS/ASTR 170B2 General Education course (Natural Sciences Tier I). This was Dr. Reddy's first large-classroom teaching experience and first general education class; Chet's previous experience as a General Education GTA was especially useful. Chet was nominated for his efforts in involving the undergraduate students with the course material and helping them to succeed. For example, Chet organized and proctored several class review sessions and hosted extended office hours; he worked closely with students who were enrolled with the Disabilities Resource Center. Chet also posted study guides for each lecture and posted them to the course D2L site. Recipients of the Outstanding GTA Award receive funds of up to \$1,000 to support travel to a professional meeting of their choice.



2016 Carson Fellowship to Léa Bonnefoy

[Léa Bonnefoy](#) is the recipient of the 2016 Carson Fellowship Award, which provides one academic year of support, including salary, tuition and a supply stipend. Léa is beginning her first year of graduate studies at LPL. Léa is French, but moved every four years during her childhood for her father's job, living in Morocco, Burkina Faso, Belgium, and Mexico. She then decided to discover yet another country for her undergraduate studies, and went to Cornell University, where she majored in Physics with an Astronomy concentration. She then completed an Astrophysics Master's at the Paris Observatory, and is now in her first semester as a graduate student in the Department of Planetary Sciences.



2016 NESSF Awards

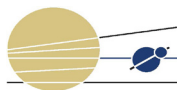
Kudos to LPL graduate students with new or continuing NESSF (NASA Earth and Space Science Fellowship) Awards!

New Awards:

- [Ali Bramson](#), "Investigations of Excess Ground Ice on Mars" (advisor: Shane Byrne)
- [Jess Vriesema](#), "Anisotropic Magnetohydrodynamics and Resistive Heating in Saturn's Ionosphere" (advisor: Roger Yelle)

Renewed for 2016:

- [Hamish Hay](#), "Tidal Dissipation in the Subsurface Oceans of the Icy Satellites" (advisor: Isamu Matsuyama)
- [Tad Komacek](#), "Magnetic Effects in Hot Jupiters" (advisor: Adam Showman)
- [Cecilia Leung](#), "Mesoscale Meteorological Modeling of the Martian Hydrological Cycle" (advisor: Alfred McEwen)
- [Xianyu Tan](#), "Atmospheric Circulation of Brown Dwarfs" (advisor: Adam Showman)
- [Sarah Peacock](#), "Understanding the Early Evolution of M Dwarf Extreme Ultraviolet Radiation" (advisor: Travis Barman)



Invest in LPL

LPL Alumni Gather for Launch

by Jani Radebaugh

At first, the impossibly bright glow of the ignited rocket filled our vision, even 4+ miles distant. But then, as the rising craft reached several rocket heights above the surface, the deep, low rumble of the engine sounding across the water grew to a loud roar that penetrated right to our very cores. No clouds interrupted our view of the rising streak, and as the craft rolled over and continued upward, up toward space with its precious cargo, we were all of us breathtaken.

The launch of the OSIRIS-REx spacecraft was such a special event to all of us in the family of LPL that dozens of alumni gathered together to watch. This was the brain child of Mike Drake, someone who had influenced the lives of all of us, who, along with the other faculty, staff and researchers at LPL, helped us get to where we are today. Now the mission belongs to Dante Lauretta, of the next generation of LPL faculty, and one who so capably embodies the hopes of LPL, the U of A, Arizona and the field as he guides the mission forward. The spacecraft is fully the child of LPL, as were we alumni, so in many ways we wanted to see how our sibling would grow up. We wanted to help it leave the nest, to spread its wings and fly, as we watch and help each other do the same.

There was a reception and banquet for all alumni the night before the launch, sponsored by the College of Science Development Office and the LPL Board of External Advisors, with dinner, drinks and the opportunity to see each other and catch up. LPL alumni receptions have been regularly held during conferences with success, and we saw the launch of OSIRIS-REx as an opportunity to really involve alumni in the excitement and pride surrounding the event, to reconnect them with each other, and to show how much they are valued by LPL. This was fully a reunion for us, with many of us having not seen each other for years, some even over a decade. And yet, just like with blood family, the ties are strong and we had much to talk about and share. We picked up right where we left off. We got to know the soon-to-be-alumni (students), told field trip stories (I even heard some for the first time!), discussed the quote board past and present, and filled each other in on the friends who were not able to come. We rejoiced in each other's successes in work and life and felt inspired at the divergent paths we had each taken. We partied, took pictures, and started planning in earnest for the next reunion.

That one won't take us ten years.

2016 Cavanagh Travel Funds

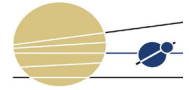
Ethan Schaefer, sixth-year PTYS graduate student, had the opportunity to conduct field work in Hawaii with generous funding assistance from Mr. Dan Cavanagh. The goal of this research was to answer the question, "If all we can see in coarse, remotely-sensed data is the outline of a lava flow, what can we meaningfully infer, if anything, about that flow?" This question has direct application to bodies such as Io and Venus.

From September 5-11, Ethan and field assistant Sky Beard were able to visit all of the priority field sites and most of the secondary sites. Ethan will present results of his field work at the December meeting of the American Geophysical Union.



*Current students and alumni at the LPL Board's alumni reception
(Photo: Barbara Cohen)*





Invest in LPL

Curson Travel Reports

The Curson Travel Scholarship helped support travel for two LPL graduate students this summer.



Margaret Landis in Iceland

Fourth-year student Margaret Landis used funding from the Curson Education Plus endowment for travel to Reykjavik, Iceland, to attend the 6th International Conference on Mars Polar Science and Exploration (Sept. 5-9), a conference typically held once every five years. The conference was small and included discussion sessions built into the flow of the conference. The poster sessions and additional moderated discussion times provided many opportunities for Margaret to interact with scientists from different institutions as well as representatives from the Mars Program Office: “In further discussing issues and ideas about my current project, I was able to not only present my work to the broader community at a key time in my graduate career, but also to get and give feedback on topics related to the polar layered deposits.”

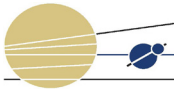
While in Iceland Margaret also participated in conference field trips to western Iceland, which has been shaped largely by the volcanic and glacial pasts of the island. The interaction between glaciers eroding volcanic landscapes as well as the current glacial retreat at Snaefellsjokull and examples of volcanic modification by water and ice were some of the topics discussed in the field. According to Margaret, “These types of modification features are difficult to find in the Tucson area, and attending the field trip portion of the conference expanded my understanding of glacial geologic features. Attending [the meeting] as a Ph.D. candidate provided me a chance to further develop my understanding of Mars polar science as whole, engage with the Mars polar science community, and attend field trips to analog sites that further developed my understanding of post-glacial landforms on Earth and Mars.”

Second-year student Sarah Sutton also applied her Curson award toward travel to Iceland. She attended the 2016 Terrestrial Analogs for Planetary Surfaces field campaign (July 11-August 8), led by LPL Assistant Professor Christopher Hamilton. Sarah’s graduate research topics include a comparative study of channelized lava flows on Earth and Mars using field and remote sensing data. She studies the morphology of channels in the Tharsis region on Mars using remote sensing data such as Digital Terrain Models (DTMs) and high resolution image data. The channels and flows in Tharsis are in some of the youngest volcanic terrain on Mars. The goal of this study is to understand the characteristics of the material that formed the channels, whether volcanic or fluvial. The significance of this work is to understand the tectonic-volcanic-hydrologic systems in Mars’ recent history. To inform the processes related to volcanic channels, Sarah conducted field work during the summers of 2015 and 2016 in Iceland at two recent lava flows. The Laki lava flow (also called the Skaftá Fires) dates from 1783-1784. The Holuhraun flow occurred in 2014-2015.



Sarah Sutton in Iceland

The field work from the 2016 summer campaign included extensive geomorphologic investigations of the main channel in the Laki lava flow. Sarah took observations of ponded lava high stands and fresh rock falls to understand the final stages of the channel formation, as well as the continuing rates of degradation of the channel. At Holuhraun, she assisted in acquiring a survey of the main vent and proximal channel using a Riegl VX-400 LiDAR (provided by NASA’s Goddard Space Flight Center). Post-processing of these data will result in a dense point cloud that Sarah will compare to the 2015 LiDAR survey data, which Sarah also helped collect, to measure channel degradation. At both sites, Sarah also assisted in the acquisition of GPS data, and photogrammetric images acquired from unmanned aerial vehicles (Phantom 3 and a UX5-HP fixed wing aircraft). With data from these systems, Sarah will analyze high resolution (down to cm scale!) topography and map features on the flows not visible from the ground.



LPL in the News

Links to the news stories below and others are available at: <http://www.lpl.arizona.edu/news/2016/fall>

OSIRIS-REx Launches - From weather reports to comic strips, OSIRIS-REx was in the news in the weeks leading up to launch.

Ewen Whitaker's Death - Ewen Whitaker was beloved at LPL and mourned around the world (*New York Times*, *The Times of London*).

Pluto's 'Icy Heart' May Have Tilted the Dwarf Planet Over - The work by James Keane and Isamu Matsuyama generated more than 30 news stories.

New Clues in Search for Planet Nine - Research by an LPL team provides additional support for the possible existence of a hypothetical, unseen planet far beyond Neptune's orbit, and narrows the range of its parameters and location.

New OSIRIS-REx Official Breaks Traditions, Glass Ceilings - Heather Enos, the new deputy principal investigator for the OSIRIS-REx mission, has succeeded in planetary sciences even without the traditional degrees.

OSIRIS-REx Spacecraft Takes a Selfie - Two weeks after launch, with the spacecraft 3.9 million miles away from Earth, the spacecraft's instruments were turned on.

UA Engineering Students, Alumni Critical to OSIRIS-REx Mission - When OSIRIS-REx lifted off from Florida, dozens of engineering students and alumni were on hand to witness their handiwork, while others were at ground control monitoring and steering the spacecraft.

What's the Real Risk of Asteroids? - On "Asteroid Day" (June 30), three LPL scientists discussed how risky asteroids really are in a Slack Chat.

Moving Towards Europa and Search for Extra Terrestrial Life - Prof. Emeritus Rick Greenberg was an early proponent of the idea that there is an ocean (and perhaps life?) on Europa.

Imaging the Details of Crash Site of Europe's Martian Lander - When ESA's Schiaparelli lander was lost, HiRISE produced images of the site of the crash, which will be used in diagnosing what went wrong.

Psyche: Unexpected Discoveries on a Metal World - A large asteroid thought to be the metallic core of a destroyed proto-planet appears to have molecules on its surface that shouldn't be there (unless they were delivered by other asteroids).

One Man's Mission to Mars, 30 Years in the Making - Bill Boynton reflects on successes and failures in Mars exploration that he has been a part of since the 1980s.

After Long, Risky Journey, Juno Spacecraft Makes History, Enters Jupiter's Orbit - For decades, LPL's Bill Hubbard has worked on getting a spacecraft to Jupiter, closer than any have gone before. On the 4th of July, it happened.