UCLA

Earth, Planetary, and Space Sciences

Fall 2016 Newsletter

Greetings from the Chair

Leading UCLA's Department of Earth, Planetary, and Space Sciences is both a humbling and exciting task. I am frequently amazed by the dedication and talent of our students, postdocs, researchers, faculty, and staff. The science results are Earth-shattering (e.g., pages 3 and 16), the quality of instruction is superb (page 6), and outreach to the community is first-rate (page 8). I am excited to share with you our progress and accomplishments in this newsletter. In these stories, you will detect three recurring characteristics that consistently define EPSS:

- Our context: UCLA is a public research university with an extraordinary national and international reputation. We are proud to be an engine of mobility that serves a diverse population across ethnic, economic, and other boundaries.
- Our team: EPSS is an impressive collection of individuals who, along with alumni and friends, share a commitment to push the boundaries of knowledge, educate the next generation of scientists, and share the excitement of science with the community.
- Our engaging mission: we seek to *understand and protect our home in the universe*. This beautiful planet makes it possible for us to experience life. Team EPSS, in return, is committed to improving the world.

If you are among the many alumni or friends of EPSS who contribute to our mission, I would like to express my sincere gratitude for your support. I ask that you remain engaged and committed to our shared goals. You can raise the profile of EPSS by networking with our talented students (page 20) and ensuring a successful launch of their careers. You will earn not only their gratitude but also ours. You can stay connected and let us know about your news and accomplishments. Of course, you can also help by contributing financially to our mission. Your gifts enable important initiatives that are not funded by state and tuition support. Such initiatives make an enormous difference by giving EPSS a competitive advantage. With your help, we can take EPSS to new heights.

If you have not been affiliated with EPSS so far, please consider joining our team. You can help us accomplish our goals, and perhaps we can help you accomplish some of yours. I look forward to hearing from you. Please reach out to me at chair@epss.ucla.edu or 310.825.1475, or find EPSS on Twitter and Facebook.

Warm regards,

Jean-Luc Margot

In this issue

Chair
Jean-Luc Margot
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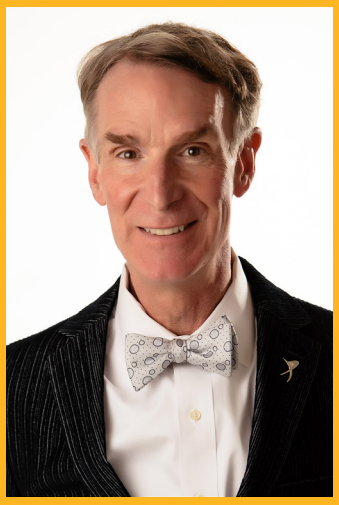
Editing/Layout
Lena Correia and JLM

Front Cover
Visitors at Exploring Your Universe 2016 (page 8) disrupt vortices in a planetary fluid motion demo.
Photo credit: Rebecca DeShetler

Center Spread
A sample of EPSS research
Credit: Adapted by JLM from a UCLA College of Letters and Science illustration published in the Winter 2015 College Report

Back Cover
Summer Field 2016

Bill Nye Joins EPSS Board of Advisors

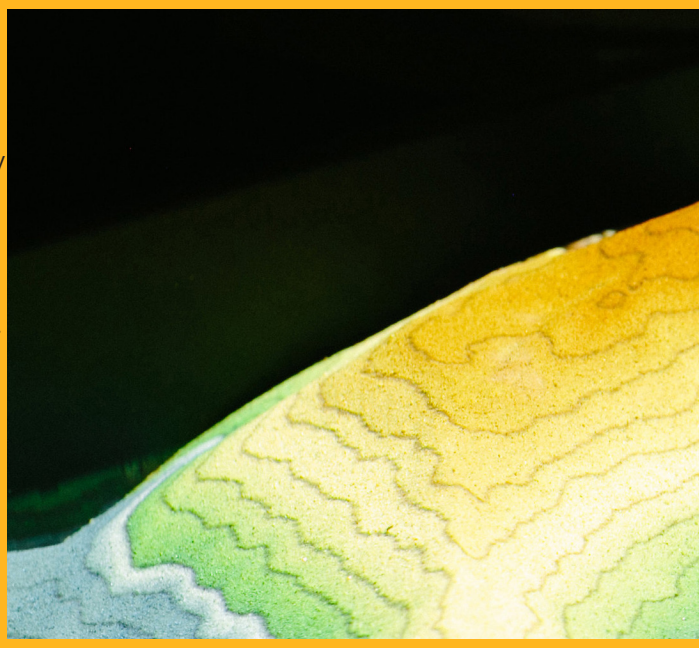


It is our distinct pleasure to welcome Bill Nye to the EPSS Board of Advisors. Bill Nye is a science educator extraordinaire and the CEO of the Planetary Society. He is perhaps best know for his television show "Bill Nye the Science Guy," which won 18 Emmy Awards. He is also an acclaimed author and inventor. When he guest lectured in Prof. Margot's Solar System classes, Mr. Nye conveyed complex science concepts in an engaging and entertaining manner. His guest lectures were the only times when more students attended the lecture than were enrolled in the class. Mr. Nye is a tireless advocate of critical thinking, science, and reason. He is a terrific asset to the EPSS Board of Advisors, which advises the Chair on the Department's operations, development, and strategic initiatives. We very much look forward to welcoming Mr. Nye on campus and gaining his insights on how we can best accomplish our mission. Other advisors to the EPSS Chair currently include William Ballhaus, Jr., Charles Elachi, Janet Marott, and Tatiana Vinogradova.

The longstanding view that the Moon experienced a period of intense bombardment at 3.9 billion years is likely due to a data interpretation artifact implying that the largest observable craters on the Moon are much older than previously thought. Image credit: Tim Wetherell, Australian National University.

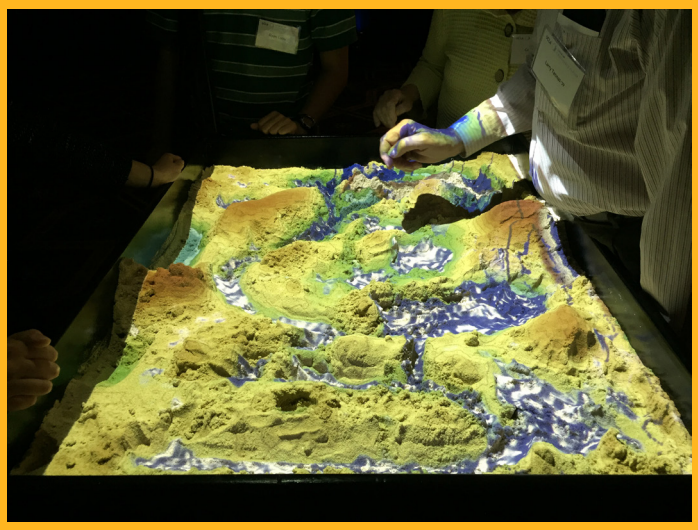
The concept of a Late Heavy Bombardment — an episode of intense impacts into the Earth-Moon system 3.9 billion years ago — has been a bedrock assumption in planetary science for over 40 years. Emerging from the Apollo era, the hypothesis found support in histograms of potassium-argon dates of lunar rocks. More recently these age histograms have been used as the basis of (1) a series of dynamical simulations of the solar system (the "Nice" models) in which giant planet migrations unleash massive amounts of asteroidal material into the inner solar system, and (2) the widely held notion that this episode would have sterilized the planet. However, the rocks returned from the Apollo missions sample less than 4% of the Moon's surface while lunar meteorites (which sample both the nearside and farside of the Moon) don't show any such age spike. It occurred to us that since the lunar crust formed in a relatively brief interval (between about 4.3 to 4.5 billion years ago), subsequent impacts onto that surface would systematically reduce potassium-argon ages potentially yielding an apparent spike. In a September 2016 article in the *Proceedings of the National Academy of Sciences*, we describe a numerical model that accounts for the diffusive loss of the daughter product argon (a noble gas that is weakly held in minerals) in response to impact heating, and we found that apparent age peaks are a robust feature of our simulations in which the intensity of impacts decreases exponentially over time. Restated, the nature of the evidence used to define the Late Heavy Bombardment has an intrinsic tendency to create apparent but illusory age spikes that possess an irresistible lure to be interpreted in terms of bombardment history. Of the many implications of our result, the one most relevant to the antiquity of your ancestry is that life may have emerged during the first five hundred million years of Earth's history and may have been continuously extant since then.

How Augmented Reality Can Transform Our Cl



Visualization in 3D is a powerful and newly accessible technology that can captivate audiences with an immersive, hands-on experience. The Augmented Reality Sandbox repurposes Microsoft Kinect's 3D camera, projector, and open-source software to accurately model terrain elevation and fluid physics, transforming a plain kids' sandbox into a dynamic and surreal landscape that is responsive to touch and hand gestures. Vibrantly colored mountains, canyons, islands, flowing rivers, lakes, and ocean waves appear nearly instantly at your fingertips, and you can summon rain or drought locally or even over the entire sandbox with the push of a button. More importantly, it realistically simulates natural disasters such as coastal sea level rise, flooding from levees or dam breakage, or even volcanoes and lava flows. I first experienced this inspiring device at the Fall 2014 American Geophysical Union meeting in San Francisco, the largest international conference for Earth and space scientists, and knew we must have one at UCLA! Thanks to a mini-grant from the UCLA Office for Instructional Development, our sandbox was completed in Spring 2015 by Gary Glesener and his team of three undergraduate students in EPSS. The technology for our sandbox was based on technology developed by UC Davis researchers, with funding from the National Science Foundation for informal science education. Though it was intended as a teaching tool to augment classroom lectures on topographic mapping and basic geological or hydrological concepts, the Augmented Reality Sandbox has immense appeal for science outreach to general audiences young and old; thousands of people have seen it in person at UCLA and many more on YouTube and social media. It's amazing to see kids jump right in and learn how to interpret the land and water features intuitively without even realizing it. Even with visually impaired and blind audiences, when we explain how the colors and water react as they sculpt the sand, their faces light up and their imaginations take off! Engaging with the sandbox is really a transformative experience for both the audience and for us as presenters, and gives people the power to sculpt and interact with their own worlds. Since we study planetary science, our eventual goal is to expand the software to model exotic environments to transport people to distant moons and planets with vastly different gravity and surface features. Just imagine sculpting methane lakes on Saturn's moon Titan or even ice volcanoes on Pluto!

Photo credit: Jennifer Young Studio



The Augmented Reality Sandbox captivated guests at the opening of the Meyer and Renee Luskin Conference Center on campus on Oct. 7, 2016.

assrooms by Emmanuel V. Masongsong

Photo credit: Jennifer Young Studio

Distinguished Alumni and Faculty Lectures

The 2016 EPSS Faculty Lecture was presented by Prof. Paul Davis on May 10, 2016. Alumni and friends of the Department enjoyed a one-hour reception followed by the lecture on "Recent Developments in Seismology" at the UCLA Faculty Center. Prof. Davis discussed developments in earthquake models that incorporate the fractal nature of earthquake source regions, earthquake clusters, and the catastrophic damage that results from the release of seismic energy. He also described taking students to the field every year for a one-week long immersive experience as part of his course Field Geophysics (EPSS 136C). Prior to the lecture, we were honored to meet the family of the late J. Douglas Traxler and to celebrate a generous gift to EPSS from his estate (EPSS 2015 Newsletter). Some remarkable notebooks from Traxler's college years at UCLA were on display for everyone to enjoy. Also present at the event was Frances Cohen who credits her career in software development in part to Prof. Robert McPherron's influence. She thought that the short reunion was well worth braving Los Angeles traffic.

The 2016 Distinguished EPSS Alumni Lecture was presented by Brad Hacker (Ph.D. 1988, UCLA) on October 27, 2016 at the Fowler Museum. Hacker is now a professor of Earth Science at the University of California, Santa Barbara. His lecture on "Crustal Flow and Melting of the Tibetan Plateau" generated a spirited debate that crossed the disciplines of geochemistry, geology, and geophysics. The one-hour reception in the Fowler interior courtyard prior to the lecture provided a great opportunity to reconnect with friends.

The 2016 EPSS Faculty Lecture was given by Prof. Paul Davis (left). EPSS alumna Frances Cohen (center) enjoyed her reunion with Prof. Robert McPherron (right).

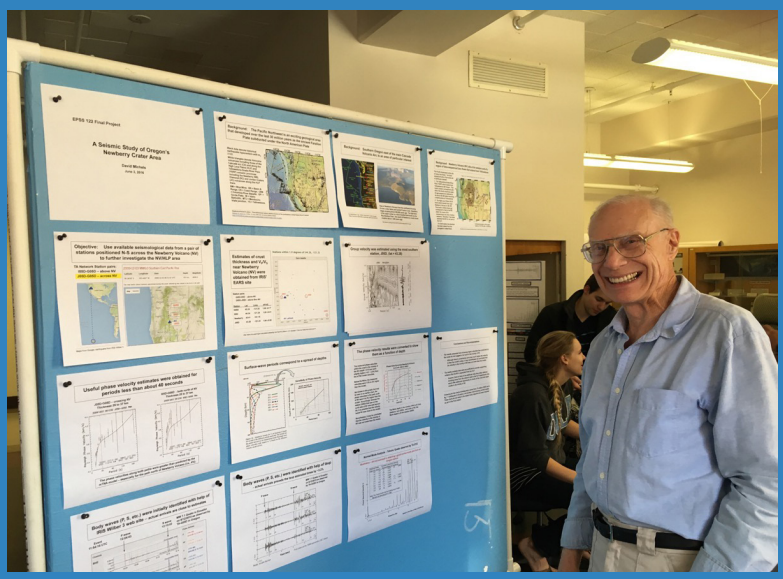
The family of EPSS alumnus J. Douglas Traxler enjoyed a glass of wine with Prof. Joseph Rudnick, former Dean of Physical Sciences, prior to the 2016 EPSS Faculty Lecture.

New Faculty: Hilke Schlichting

Dr. Hilke Schlichting, a planetary scientist and astrophysicist, joined EPSS as an associate professor at UCLA in July 2016. She studied theoretical physics for the B.S. and M.S. degrees at the University of Cambridge and focused on the formation of planets for her Ph.D research in the Caltech astronomy department. Prof. Schlichting came to UCLA for the first time as a Hubble postdoctoral fellow in 2010 after spending one year as a postdoctoral fellow at the Canadian Institute for Theoretical Astrophysics. In 2013, she joined MIT as an assistant professor before coming back to UCLA this year. Prof. Schlichting was born in Germany and grew up in Germany, Japan, and England. Living abroad with her family made her realize at an early age that she wanted to work in an international environment because of the diversity it has to offer. She has always loved math and physics and has been fascinated by the night sky ever since she was a young child; so pursuing a career in astrophysics was an obvious choice. She considers herself very fortunate to have a job she truly loves and that consists of learning new things every day and that takes her on travel around the world. Prof. Schlichting's work is driven by the desire to understand the formation of planets both at home in the solar system and abroad in exoplanet systems. She studies planet formation from various angles using analytic theory, orbital dynamics, and observations of the Solar System and exoplanets. Ultimately, she would like to answer where we come from and why life evolved where it did. When Prof. Schlichting is not working, she spends her time either painting, scuba diving, traveling the world, or walking her feisty Alaskan Malamute, Makalu.

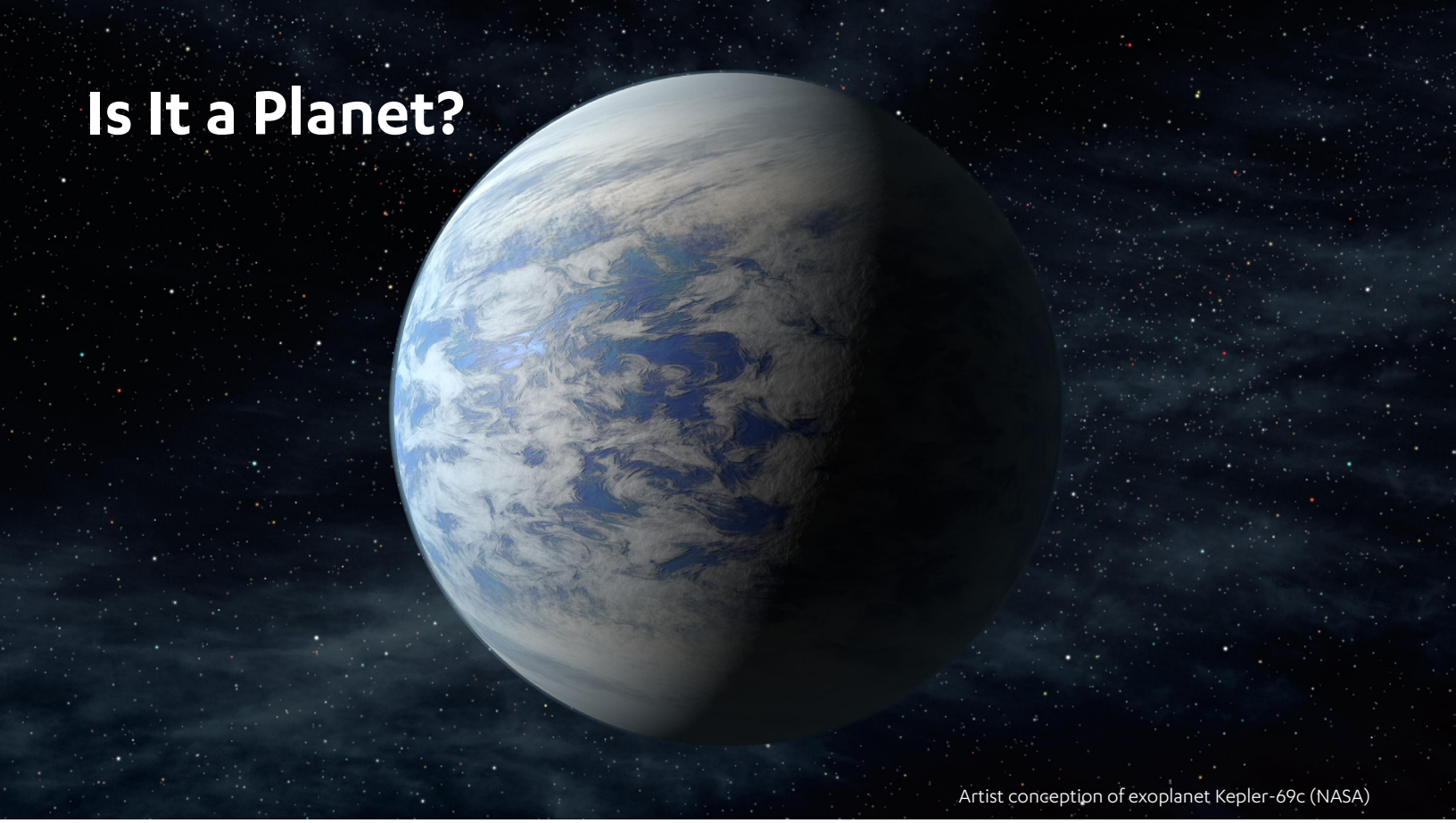
Senior Scholar Raves About EPSS Courses

The UCLA Senior Scholars program makes it possible for people over 50 to audit regularly scheduled undergraduate classes. UCLA alumnus Dr. David Michels likely set a record by taking five EPSS classes recently. He took Introduction to Earth Science (EPSS 1), Solar System (EPSS 9), Dinosaurs (EPSS 17), Plate Tectonics (EPSS 119), and Seismology (EPSS 122). Dr. Michels was so impressed by the quality of instruction that he made a generous gift to the Department. EPSS instructors enjoyed his participation in their classes. "He was so enthusiastic in my class and really pushed himself. It was a pleasure to have him," said Prof. Caroline Beghein. "David and his wife Suzanne were great additions to my EPSS 17 class. They really enjoyed the projects and prepared good questions for discussion," said John Mering. "It was a pleasure to have him in my class as well. He participated a lot and really enjoyed it. He was an asset to have in class," said Dr. Alan Rubin. Dr. Michels is now taking Physics of Earth (EPSS 152).



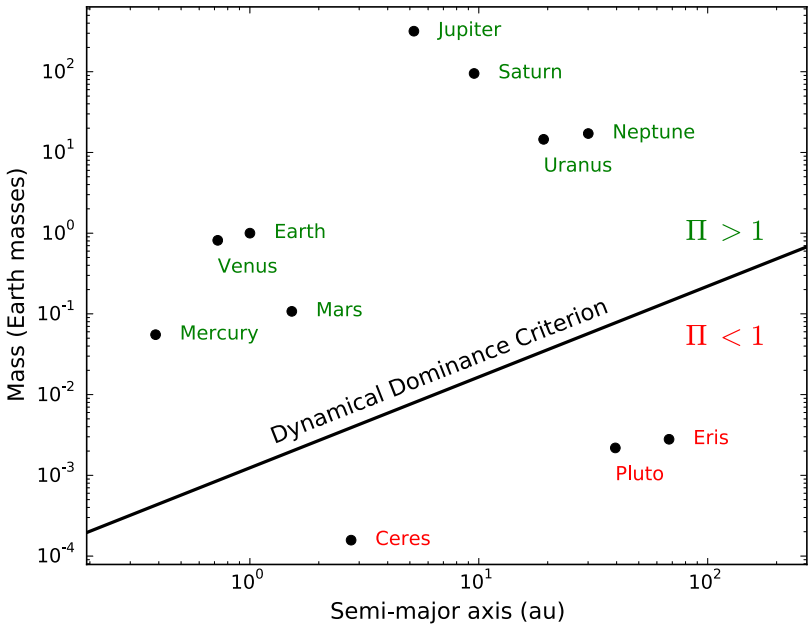
Dr. David Michels presented a seismic study of Oregon's Newberry Crater area as part of Prof. Caroline Beghein's seismology course (EPSS 122).

Is It a Planet?



Artist conception of exoplanet Kepler-69c (NASA)

EPSS was well represented at the American Astronomical Society's annual meeting of the Division for Planetary Sciences in November 2015. Among the presenters was EPSS Prof. Jean-Luc Margot, who described a quantitative criterion for defining planets. An improved definition of "planet" is needed because the current official definition (described below) applies only to bodies in our solar system. The new "planet test" can be applied to bodies orbiting the Sun as well as other stars. In 2006, the International Astronomical Union (IAU) defined what it takes to be a planet but left the classification of exoplanets for future consideration. The recent flood of exoplanet discoveries — now numbering close to 5000 — requires an extension of the current limited definition. The IAU's current definition of a planet is based primarily on the ability of a planet to "clear its orbit" — to evacuate, accumulate, or dominate small bodies in its orbital neighborhood. Prof. Margot derived a simple test that can be used to determine whether a body can clear a specific region around its orbit within a specific time scale, such as the lifetime of its host star. The test is easy to implement and allows immediate classification of 99 percent of all known exoplanets. According to this new test, all eight solar system planets and all classifiable exoplanets are confirmed as planets. Prof. Margot's planet definition proposal is published in the Astronomical Journal. The IAU has an opportunity to refine and extend its current definition, but it remains to be seen whether it will consider the new classification tool. IAU resolutions are typically crafted and reviewed by committees before possible adoption during a general assembly. The next general assembly will be in Vienna in 2018.



The application of a new planet classification tool to bodies in the solar system reveals two distinct groups. This tool can be used to classify bodies orbiting any star.

EPSS Reaches Thousands

EPSS faculty, researchers, students, and staff took advantage of multiple opportunities in Fall 2016 to share their enthusiasm about science and advertise the Department's mission. On October 7, EPSS had a few booths at the grand opening of the UCLA Meyer and Renee Luskin Conference Center, where the attendance numbered about 700. One of the booths was the Augmented Reality Sandbox (page 4). The next day, Prof. Abby Kavner spoke at the Santa Ana Discovery Cube for the launch of the movie *Ice Age: Collision Course*. That same evening, about 300 people admired the Moon during the International Observe the Moon Night on the roof of the Math Sciences building. EPSS volunteers exhibited the Augmented Reality Sandbox again on October 13 at a FuturizeX event on the future of virtual reality. FuturizeX is a collaboration between UCLA and the Xprize Foundation. The event drew an audience of about 400. On October 27, we hosted our annual Distinguished Alumni Lecture (page 5). Finally, EPSS had first-class involvement in UCLA's annual Exploring Your Universe event that drew thousands to campus on November 6. EPSS was responsible for mobilizing dozens of enthusiastic science communicators who took charge of interactive demonstrations, hands-on exhibits, and engaging lectures. The Meteorite Gallery alone recorded almost 900 visitors that afternoon. EPSS showcased its impressive involvement in NASA missions (pages 12-13), including the ELFIN CubeSat that is being designed, built, and operated primarily by UCLA students. The level of interest in EPSS outreach is so high that a Department committee has been tasked with assessing how to best engage the community in ways that are sustainable and compatible with our finite human and financial resources. Education and public outreach are important components of our mission that clearly resonate with Department members and the community.

with Outreach Activities

Education and public outreach are important components of our mission that resonate with EPSS and our community.

EPSS had first-class involvement in the annual Exploring Your Universe event that drew thousands to campus.

Exploring Your Universe 2016 photo captions: (Far left) About 900 people visited the meteorite gallery. Here EPSS graduate student Alexandra Schneider describes the 162 kg (357 pound) Clark iron, which is a sample of the famous Canyon Diablo meteorite. (Left) An EPSS undergraduate volunteer describes fossils. (Above) EPSS graduate students Heather Kirpatrick (left) and Jessica Lin (right) use the augmented reality sandbox to describe topographic measurements and erosional processes. (Top) Kids experiment with a plasma globe. Photo credit: Mojhgan Haghnegahdar.

Summer Field Program by Drew Levy

The EPSS Summer Field Program took place from June 15 to July 15, 2016. We camped at the Cedar Flats group campground off of California State Route 168 at Westgard Pass in the White Mountains. There were 15 UCLA students, nine visitors, two graduate students, and one instructor. Our weekly schedule consisted of mapping, field trips, and a day off in town. We mapped on Monday, Tuesday, Thursday, Friday, and a half day Saturday. Wednesday was our field trip day, and Sunday was our day off. On Sunday evenings, groups of approximately six students would give a presentation on a topic related to the geology of the White Mountains. These presentations were aimed at giving us a background in the regional geological history to write our final report tying our mapping and field trip experiences together. For our mapping exercise, we mapped the Poleta Folds area on the southwestern edge of Deep Springs Valley. Here a sequence of early Paleozoic carbonates have been complexly folded and faulted by numerous events spanning the Paleozoic to the Cenozoic. Students worked in teams of two or three to map the ~2 x 3 km area. Field trips to various locations throughout the White-Inyo Mountains area were geared towards developing our understanding of the broader geological picture of eastern California and the North American Cordillera. A trip through the White Mountains allowed us to see the full sequence of Neoproterozoic and Paleozoic stratigraphy, as well as the structural characteristics of this range. Prof. Art Sylvester from UC Santa Barbara visited us at field camp, and led us on a classic field trip to Papoose Flats in the Inyo Mountains. Prof. Sylvester did his Ph.D. work (at UCLA with Prof. Clem Nelson) on pluton emplacement at Papoose Flats, which is an excellent location to learn about the factors that govern pluton emplacements, such as host rock hydration. A trip to Death Valley introduced us to the geomorphologic features associated with active tectonics. Death Valley is a great location to learn about tectonics of the Eastern California Shear Zone. Finally, a trip to Long Lake in the Sierra Nevada gave us a look at the Bishop roof pendant, which represents remnants of the crust into which the Sierra Nevada batholith were emplaced.

EPSS graduate student Peter Haproff (right) teaches orienteering and mapping to Wei Yao (center) and Chen XingQiang (left) in the Poleta Fold Area.

"Mapping is not easy. The dry heat and blaring sun leave you exhausted at the end of each day. Yet, when you get back to camp after a much needed dip in the Owens River, a sense of accomplishment washes over you as you review that day's work."

"Summer field is a truly unique experience. While it may be difficult and at times testing, field camp is filled with memories of all the fun times."

"That month spent in the White Mountains shapes each of us into capable field geologists, and leaves us with valuable skills that we will carry with us for the rest of our lives."

EPSS Fiat Lux Takes Students to JPL by David Jewitt

About 20 undergraduate students in a Fiat Lux Freshman Seminar (EPSS 19) had the rare opportunity to go behind the scenes at NASA's Jet Propulsion Laboratory on April 22, 2016. The Fiat Lux class series facilitates close interaction with a research professor in a seminar setting with a very small class size. Prof. David Jewitt taught this course on planetary science, which includes topics about the Earth, moons, asteroids and comets, and planets within our solar system and beyond. This course had the added bonus of visiting a real NASA facility, meeting the main project scientist on the Mars Curiosity rover mission (an EPSS alumnus) and talking with the architects of the upcoming Europa orbiter mission to Jupiter's frozen moon. Students learned about the critical elements in planning, funding, and building a planetary science mission, and even got to sit in the actual mission control room where hundreds of active NASA satellites are operated, including Voyager 1 & 2, Cassini and the Mars rovers. JPL has strong ties to UCLA and offers extensive internships where students can work directly with engineers and mission scientists, giving them valuable experience and possibly even a job right out of college.

Dr. Ashwin Vasavada (B.S. Geophysics and Space Physics 1992) describes the excitement and terror of landing the Curiosity rover by sky crane, the daily routine of running a rover and planning its experiments, and even reveals some of the near-fatal technical problems his team has overcome from over 250 million miles away.

UCLA Earth, Planetary, and Space Scie

Understanding and protecting our home in the universe

MERCURY

David Paige provided evidence of water ice deposits near Mercury's poles.
Jean-Luc Margot showed that Mercury has a molten core.

MOON

Edward Young showed that the Moon and Earth are made of the same material, suggesting that the Moon was formed by a giant impact.

EARTH'S SURFACE

An Yin explained the evolution of the Himalayan-Tibetan region.

EARTH'S INTERIOR

Abby Kavner studies material properties to improve estimates of heat transfer in Earth's mantle and core.
Jon Aurnou uses numerical simulations to understand Earth's geodynamo.
Edwin Schauble studies the chemical properties of atoms that make up Earth's core, mantle, and crust.

IMPACT HAZARD

EPSS scientists measure the trajectories and properties of near-Earth asteroids to protect Earth and assets in space.

SEISMIC HAZARD

Lingsen Meng contributes to an earthquake early warning system that mitigates seismic and tsunami hazards.
Paul Davis leads seismic investigations based on a dense network of sensors.

LANDSLIDES

Seulgi Moon built a model to predict fracturing in the bedrock, identifying areas that are prone to landslides or earthquakes.

CLIMATE CHANGE

Aradhna Tripati produced a record of thousands of years of temperature variations, yielding important insights into climate change.

SPACE WEATHER

Vassilis Angelopoulos leads NASA's THEMIS and ARTEMIS missions, and advises the student-run ELFIN project, UCLA's first fully built satellite. He discovered mechanisms responsible for space weather near Earth.

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EXOPLANETS
There are billions of habitable worlds in the Milky Way Galaxy. EPSS scientists study how these worlds form and evolve.

HABITABILITY
Craig Manning refined our understanding of Earth's deep carbon cycle, with implications for life, energy, and climate.

LIMITS OF LIFE
Tina Treude explores the limits of microbial life in sediments deep beneath the seafloor.

HISTORY OF LIFE
Mark Harrison showed that life on Earth arose much earlier than previously thought, as early as 4.1 billion years ago.
William Schopf uses microscopic fossils to trace the evolution of ancient life.

SETI
Jean-Luc Margot uses the largest telescopes on Earth to search for signs of extraterrestrial intelligence.

EUROPA AND GANYMEDE
Margaret Kivelson discovered a magnetic field at Jupiter's largest moon, Ganymede, and provided evidence of an ocean on its sister moon Europa.

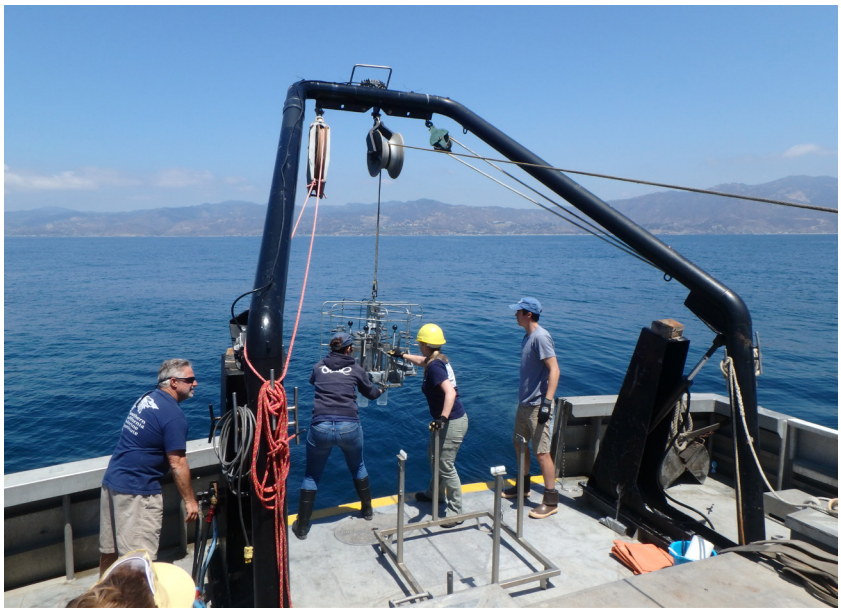
CERES AND VESTA
Christopher Russell is the principal investigator of NASA's Dawn mission to Ceres and Vesta.

KUIPER BELT
David Jewitt discovered the Kuiper Belt, a region of the solar system beyond Neptune.

SOLAR WIND
Kevin McKeegan leads the MegaSims lab, which analyzes samples of captured solar wind from the GENESIS mission to better understand the composition of the Sun.
Marco Velli is the observatory scientist of the Solar Probe Plus mission to study the origins of the solar wind.

MARS
David Paige will operate the radar imager on NASA's Mars 2020 rover mission.
Christopher Russell will build the magnetometer for the InSight lander.

Oceanic Field Trips to Study the Oxygen Minimum in the Santa Monica Basin by Tina Treude

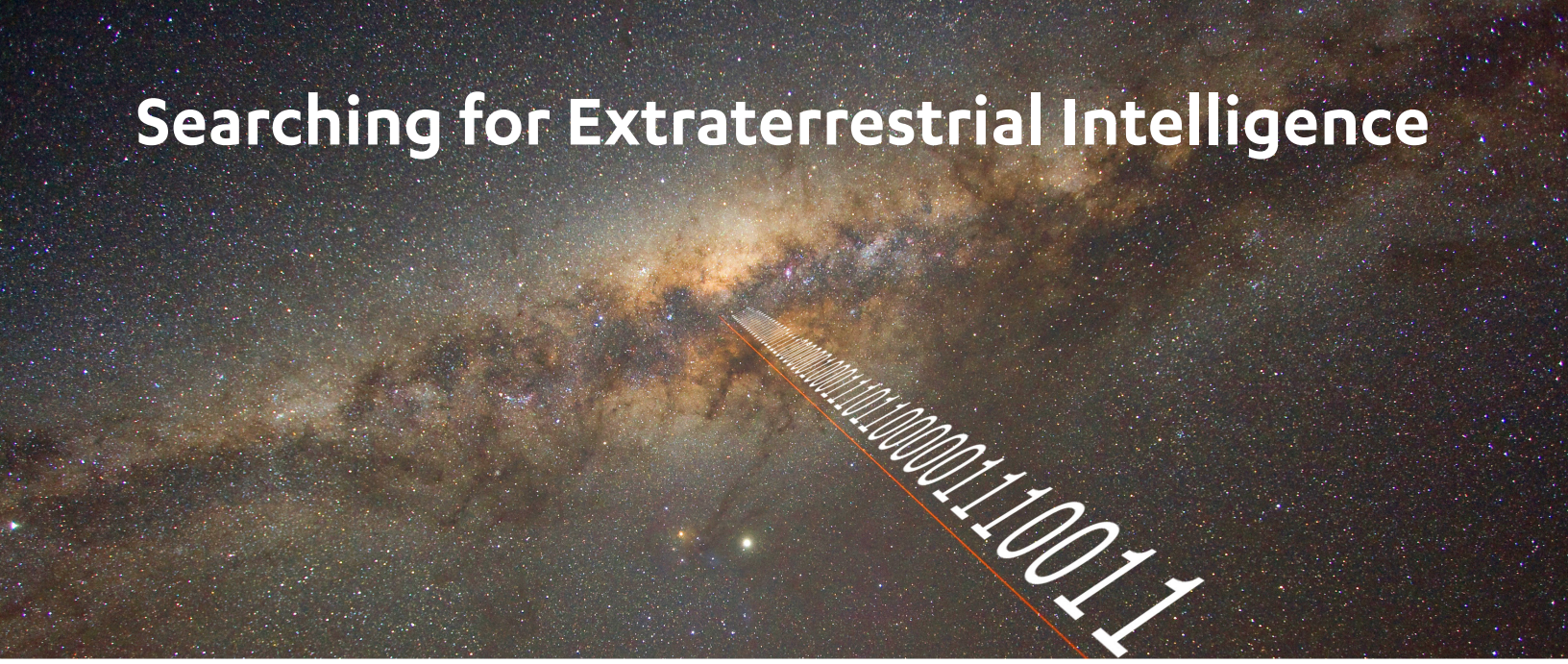


Deployment of the sediment-coring instrument (multicorer) in the Santa Monica basin offshore Malibu.

UCLA Fiat Lux students receive an introduction to oceanic instruments including a water sampler (pictured above) by the SCMI crew during a field trip aboard the R/V YELLOWFIN.

In the spring and summer quarters of 2016, EPSS/AOS Prof. Tina Treude and her group members went to the Santa Monica Bay to study the spreading of the oxygen minimum zone in the water column. The basin of the Santa Monica Bay is partially separated from the open ocean by shallow sills that restrict water circulation. The microbial degradation of organic matter that sediments from the surface waters, in combination with high primary productivity in this nutrient-rich upwelling region, is leading to a significant decline in the quantity of dissolved oxygen in the deeper basin. At the deepest regions (approximately 900 meters), the level of oxygen approaches zero. Large, mobile animals such as fish are unable to survive in such conditions, which is why these environments are sometimes referred to as "Dead Zones." Previous investigations revealed that the oxygen minimum intensified over the last century, but because the last study on this subject was done almost 40 years ago, Prof. Treude and her colleague Prof. William Berelson from USC teamed up to revisit the basin and test whether the spreading had continued since then. Causes for the oxygen minimum spreading are still unknown but could be related to anthropogenic influences such as eutrophication and global warming. The researchers used water column sensors and a sediment-coring instrument to collect data and samples along the continental margin (70-900 m water depth) of Santa Monica Bay on board the R/V YELLOWFIN, a 23 m long research vessel operated by the Southern California Marine Institute (SCMI) in San Pedro. The research was funded through a USC Sea Grant project. Undergraduate students from a UCLA Fiat Lux course and from Mt. San Antonio College accompanied some of the field trips. While on board, the students experienced first hand the work of oceanographers and received an introduction to oceanic instruments. Needless to say, the sighting of dolphins and even a blue whale added further excitement to the trips.

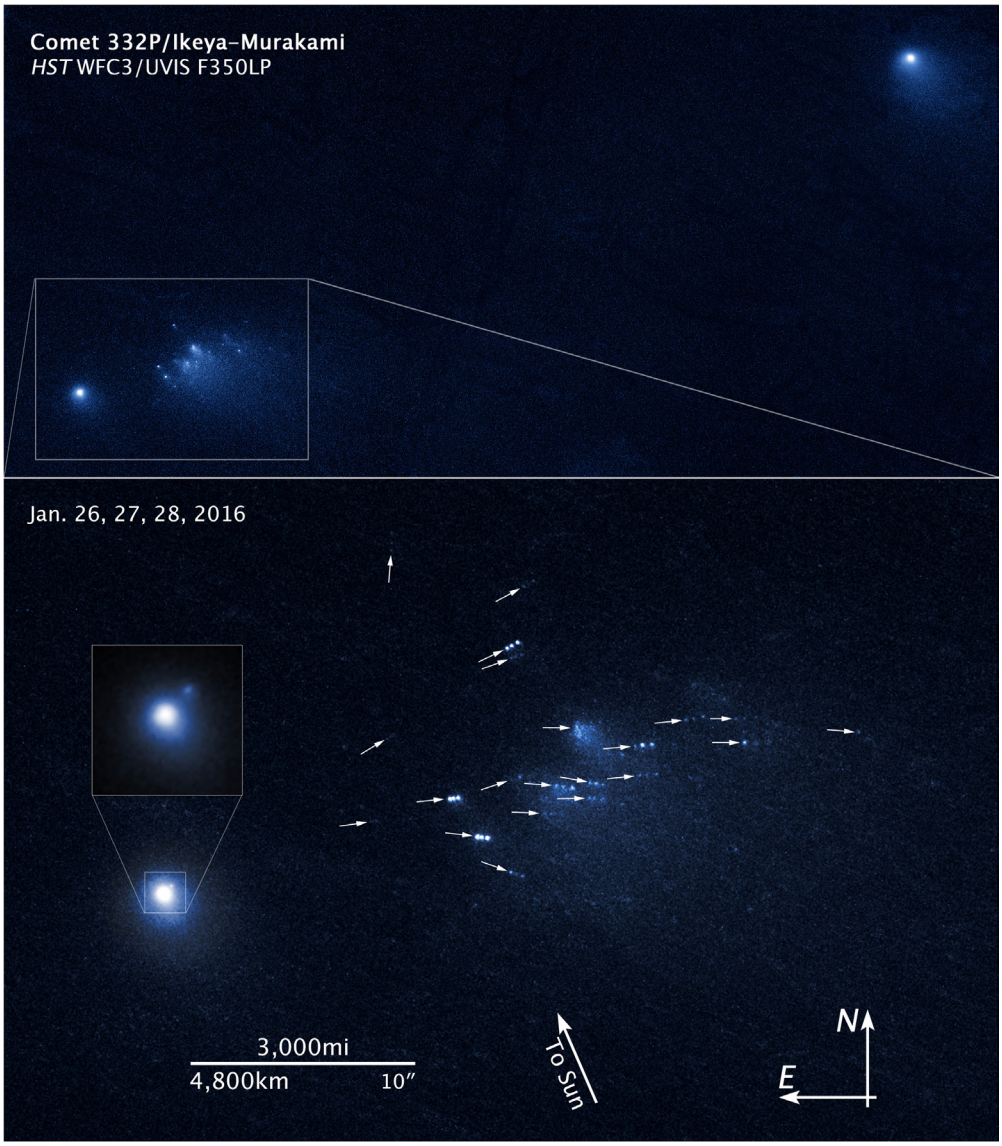
Searching for Extraterrestrial Intelligence



In Spring 2016, nine undergraduate students and five graduate students took a course titled: Search for Extraterrestrial Intelligence: Theory and Applications (EPSS 179/279). The Search for Extraterrestrial Intelligence (SETI) has become a mainstream endeavor because observations with the NASA Kepler telescope have shown that there are *billions* of habitable worlds in our galaxy. The profusion of planets, coupled with the abundance of life's building blocks in the universe, suggests that life in the universe may be common. SETI addresses one of the most important questions of all time: are there other civilizations out there? Radio telescopes can detect signals emitted thousands of light years away, enabling contact from a large fraction of the Milky Way Galaxy. Thanks to generous gifts from UCLA alumna Janet Marott and SETI education proponent Larry Lesyna, we were able to purchase computer equipment and telescope time on the largest radio telescopes on Earth: the 100 m Green Bank Telescope in West Virginia and the 305 m telescope in Arecibo, Puerto Rico. Students designed an observing sequence for the Arecibo and Green Bank telescopes, observed known planetary systems remotely, wrote a sophisticated and modular data processing pipeline, analyzed the data, and presented the results. In the process, they learned radio astronomy fundamentals, software development, signal processing, and statistics. Students were eager to learn because of the engrossing nature of SETI. The students rated the course highly, in part because of the observing experience and the teamwork approach. The next offering of the course will be in Spring 2017, and we would like to purchase additional telescope time and computer equipment. If you wish to contribute to our efforts or participate in the search, please get in touch with Prof. Jean-Luc Margot (jlm@epss.ucla.edu) or visit the web site at http://seti.ucla.edu.

The Spring 2016 SETI class with guest lecturer and donor Larry Lesyna

Hair Today, Gone Tomorrow by David Jewitt

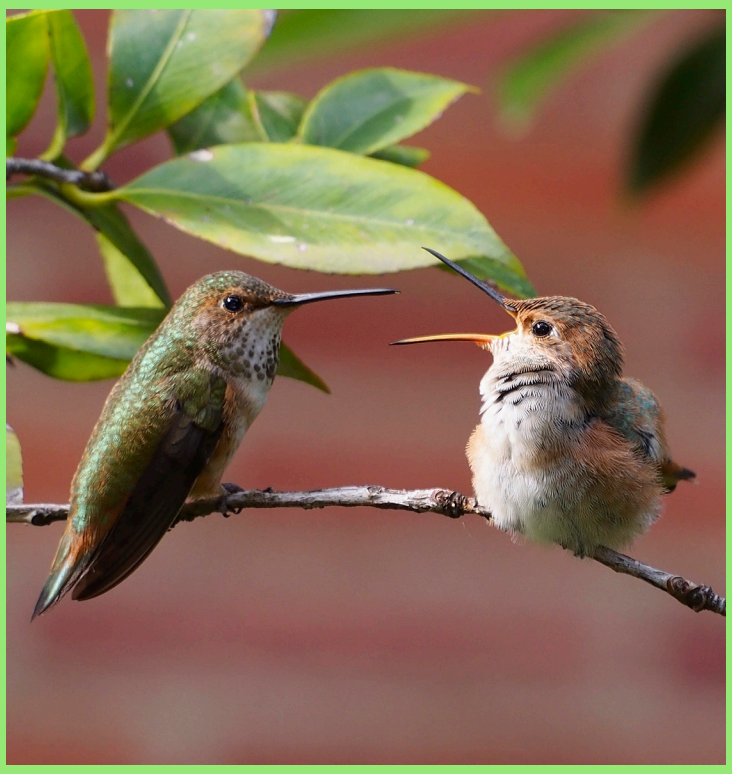


"Comet" means "hairy star", signifying the fuzzy appearance of these mass-losing objects in the night sky. Historically, comets were regarded as omens of doom, capable of wreaking Earthly havoc by bringing plagues and pestilence and leading to the fall of emperors and kings. Now we know better. Billions of comets live, unobserved, in two icy reservoirs in the outer solar system known as the Kuiper belt (beyond Neptune) and the Oort cloud (a quarter of the way to the nearest stars). With temperatures near absolute zero, ices embedded in the cometary nuclei have been preserved, unchanged for the last 4.5 billion years. Only when scattered towards the Sun can temperatures rise to the point where sublimation begins and the ices fizzle away. Eventually, all that's left is a dead hulk or a cloud of dust where an active comet used to be. At least, that's the standard picture, but new measurements of a comet arriving from the Kuiper belt (with the unfortunate name 332P/Ikeya-Murakami) reveal a different fate. Comet 332P was not discovered until 2010. In early 2016, ground-based observers reported that it had split, triggering our observations with the Hubble Space Telescope (HST). Immediately, the fantastic resolution of HST revealed that 332P was fragmenting, not just into two pieces, but into multiple building-sized mini-comets. From measurements over several days, we were able to determine the motions of the fragments, finding that they were released from the parent nucleus in the fall of 2015. We also estimated their mass, about 4% of the parent nucleus, and we found tell-tale signs of the rapid rotation that is likely causing 332P's disruption. Non-uniform sublimation from a comet exerts both a net force and a net torque on the nucleus. The torque is large enough to spin the small nucleus of 332P to rotational instability (where centripetal forces and gravity are equal) in just a few decades. Once ejected from the main nucleus, the fragments are even more susceptible to rotational spin-up, leading to a fragmentation cascade. The process is so rapid that we suspect fragmentation to be the dominant mechanism by which comets die, rather than the steady loss of cometary ices by sublimation. For example, 332P has enough mass to sustain another 25 events. If they occur once per orbit (the orbit period is about 6 years), it will survive only 150 years. This is the blink of an eye relative to the age of the solar system. So, science shows that the historical view is exactly backwards; the comets themselves are doomed by their approach to the Sun. They present no danger to us.

Squeak by Mélanie Barboni

On my very first day at UCLA, I installed one hummingbird feeder by my office window and waited, hoping that a hummer would stop for a drink. I did not have to wait long. Right away, a tiny female Allen's hummingbird approached my window, hovered there for a while, and sat down to take a long drink. I was thrilled beyond belief; it was love at first sight. She seemed content with my nectar and started visiting daily every 10 minutes from dawn to dusk. I had just met my first friend at UCLA. I named her Squeak.

She soon started to feed in my hand, either hovering above my hand or perching on my finger. She is so light that all you feel is weightless warmth and the softness of her feathers. One night, I stayed in my office with the lights off and waited. To my amazement, I saw little Squeak fly in and perch on my computer screen, sleeping soundly away from any dangers. That is where she spends her nights when it is cold or windy outside. On a December day, close to Christmas, Squeak was spotted sitting in a tiny nest she had built in the camellia tree in front of my window. In the perfect little cup, two tiny eggs, each the size of a Tic-Tac, were waiting to hatch. Squeak attacked anybody that approached her nest but me. But she was comfortable with me getting close and taking day-to-day pictures and videos of her babies, Stardust, Zircon, and (later) Milky Way. They soon became a first-rate attraction in the Department as people learned about the nest and visited the little family. The little sanctuary I created at UCLA has attracted more than 200 hummingbirds to this day. A swarm of hummingbirds is now buzzing at my windows. If you happen to walk in between the Geology building and Franz Hall, come and enjoy watching them as they dart, squeak, fight, and hover.



Squeak and her babies (Stardust, Zircon, and Milky Way).

Commencement 2016

Degrees

Bachelor of Arts

Minh Thu Pham

Mark Cave Yu Huang

Bachelor of Science

Solishia Lourdes-Diana Andico
Jodutt Marwan Basrawi
Michael Jeffrey Berina
Sean Tyler Burford
Raul Carrillo, Jr.
Andrew Travis Churchill
David Richard Fandel
Christopher Michael Garrett
Mathew Louis Gruca
Guoqiang Li
Matthew Benjamin Li
Jessica Chen Lin
Alvin Ly
Matthew Kevin Marin
Kevin Tyler McFarland
Dillon Joseph Murphy
Brenda Pack
Eleanor Catherine G. Robertson
Seth Sean Rosner
Kathryn Ann Shurtleff
Roger McLachlan Thompson, Jr.
Louise Wan Yi Tsang
Lucero Villanueva
Tyler Denson Vollmer
Samantha Renee Walker
Abigail Joanna Wesley

Master of Science

Matthew Oliver Bowman
Kevin Thomas Coffey
JT Mayo Daniels
John Arthur Mering
Nathaniel Nels Monson
Katherine Margaret Ramer
Michaela Nicole Villarreal
Ailin Zhang
Cong Zhao

Doctor of Philosophy

Jonathan Shuo Cheng
Xiangning Chu
Carolyn Alicia Crow
Sarah Eileen Maloney Palaich
Jodie Barker Ream
Deborah Anne Weiser
Andrew Vincent Zuza

Students and Student Awards

EPSS welcomed 17 new graduate students in Fall 2016 from a pool of over 100 applicants. Over the past year, EPSS awarded nine M.S. degrees and seven Ph.D. degrees (page 19). Our students continue to do very well in their professional endeavors. We maintain a list of professional outcomes at http://epss.ucla.edu/people/alumni/ and welcome any updates you may have. If you are looking to hire, please consider EPSS graduates. We are proud of the training they receive and of their overall performance and preparadness for the workplace. Undergraduate and graduate student awards are listed below. In addition to these awards, the **Straus Family Fund for Undergraduate Opportunity** allowed us to award a research and travel allowance to Axel Wang, who will attend the meeting of the American Geophysical Union (AGU) in December 2016. The **Donald Carlisle Undergraduate Research Fund** allowed us to award a travel allowance to Drew Levy, who will also attend the AGU meeting.

Undergraduate Awards

John & Frances Handin Scholarship

Presented to undergraduates for scholastic excellence, endowed by alumnus John W. Handin & his wife, Frances

Andrew Travis Churchill
Tyler Denson Vollmer

Eugene B. Waggoner Scholarship

Presented to undergraduates for scholastic excellence, in honor of alumnus Eugene B. Waggoner

Drew Alexander Levy

Clem Nelson Summer Field Award

Presented to summer field students, in honor of Prof. Clem Nelson

Nicholas Joseph Inserra
Julien Y-Son Kuhn de Chizelle
Michael Christopher Say

Clarence A. Hall, Jr. Summer Field Award

Presented to summer field students, in honor of Prof. Emeritus Clarence A. Hall, Jr.

Gregory Stuart Jesmok
Drew Alexander Levy
Dillon Joseph Murphy

Deane Oberste-Lehn Field Award

Presented to summer field students, in honor of alumna Deane Oberste-Lehn

Mary Elizabeth Rouse Braza
Brittney Emmons
Samantha Hangsan
Allison Wai-Ting Hui
Sarah Ayed Kanee
Ashley Christine Miller
Deepshikha Upadhyay
Lucero Villanueva
Abigail Joanna Wesley

Donald Carlisle Undergraduate Research Award

Presented to outstanding undergraduates for research in Geology, in honor of Prof. Emeritus Donald Carlisle

Solishia Lourdes-Diana Andico
Emil Chang
Charles Joseph Salcido, III
Shiqi (Axel) Wang

Clarence A. Hall, Jr. Scholarship

Presented to an undergraduate for academic excellence, in honor Prof. Emeritus Clarence A. Hall, Jr.

Abigail Joanna Wesley

Clem Nelson Scholarship

Presented to an undergraduate for academic excellence, in honor of the late Prof. Clem Nelson

Samantha Renee Walker

Graduate Awards

W. Gary Ernst Fellowship

Provides a quarter of support to a graduate student, endowed by alumnus W. Gary Ernst

Nathan Brown

Paul M. Furukawa Scholarship

Provides stipend support to a graduate student, in honor of Paul M. Furukawa

Erin Leonard

Eugene B. Waggoner Scholarship

Presented to a graduate student on the basis of merit, endowed by alumnus Eugene B. Waggoner

Zixu Liu

Harold and Mayla Sullwold Scholarship

Presented to graduate students on the basis of merit, endowed by Harold and Mayla Sullwold

Jeanine Ash
Nathan Brown
Peter Haproff
Wentao Xu (Man-To Hui)

Outstanding Teaching Assistant

Presented to graduate students to recognize outstanding performance in teaching

Nathan Brown
Zagid Abatchev
Ellen Alexander
Michael Lawson
Erin Leonard
Raquel Nuno
Napoleon Pempena
Liutauras Rusaitis

Students and Student Awards

Nathan Brown is a fifth-year graduate student and the recipient of the W. Gary Ernst Fellowship. He works with Profs. Mark Harrison and Ed Rhodes (University of Sheffield) on the application of luminescence dating to geomorphic and climatic problems.

Erin Leonard is a third-year graduate student and the recipient of the Paul M. Furukawa Memorial Scholarship. She works with Prof. An Yin on the formation and evolution of surface structures on icy satellites such as Europa.

Shiqi (Axel) Wang is a senior undergraduate student and the recipient of a research and travel award enabled by the Straus Family Fund for Undergraduate Opportunity. Axel is developing a drone-based magnetic field survey instrument that will be used in the field for research and teaching purposes. Magnetic field measurements can be used to detect faults and mineral deposits.

Comings and Goings

The Department welcomed two new staff members this year.

- Michelle Pang joined EPSS in August as a purchasing assistant. In this role, she says tongue-in-cheek, she gets to buy things all day. She is a UC alumna (UCSD B.S. Management Science 2012). When she is not at work, Michelle enjoys outdoor activites, including beach volleyball and hiking, and spending time with her energetic one-year-old son.
- Alma Zavala joined EPSS in October as academic personnel coordinator, having served previously in the UCLA Graduate Division. Alma is a UCLA alumna (B.A. International Development Studies and Spanish 2011). Alma is a runner, triathlete, and avid hiker. She ascended Mount Whitney in 2013. Alma is also a U.S. Navy veteran who volunteers for several non-profit organizations.

There were also several departures over the past year.

- Jeremy Boyce is an EPSS alumnus (B.S. Geology 1997) who joined the research staff in 2007 as an assistant researcher. He became an adjunct assistant professor and earned high praise for the quality of his teaching (page 6). Jeremy is now a civil servant at the NASA Johnson Space Center in Houston, TX.
- Gloria Contreras retired after a career of over 30 years at UCLA. Gloria joined UCLA in 1985 and joined EPSS in 1997 as a purchasing assistant.
- Sheen He joined EPSS in 2016 as communications manager and left the University in the fall.
- Oscar Lovera retired after over 24 years of service at UCLA. Oscar was a staff research associate in geochemistry. Oscar also handled maintenance of some of the computer servers in the Department. Oscar is currently on recall to provide support to the geochemistry group.
- David Riley retired after over 37 years of service at UCLA. He came to EPSS in 2006 and served as a building manager and facilities coordinator.
- Richard Sadakane retired after 25 years of service at UCLA. He joined the Department as an illustrator in 1993.
- Yasmin Thomas is a UCLA alumna who joined EPSS in 2011 as a work-study student. She later joined the staff and performed in a variety of functions, most recently handling the academic personnel process while continuing her advisory role on payroll, benefits, and immigration issues. Yasmin has set her sights on Europe and graduate school as the next step in her career.

Gifts and Giving

We are extremely grateful for the gifts that enable our mission. Donors who made gifts to the Department of Earth, Planetary, and Space Sciences made between January 1, 2016 and June 30, 2016 are listed on the opposite page. Gifts made after June 30th will be acknowledged in the 2017 newsletter.

We would especially like to thank those donors who have contributed endowed gifts to the Department (listed below). Endowed gifts are particularly helpful because they enable initiatives in perpetuity. As we experience reduced state support and grant support, endowments will ensure that we can continue to improve the quality of EPSS research and teaching, and elevate the Department's reputation. For a limited time, EPSS has an opportunity to secure a one-to-one match for endowed gifts between $100,000 and $1,000,000. Please contact the EPSS Chair (chair@epss.ucla.edu) or Brooke Sanders (bsanders@support.ucla.edu) for details.

Donald Carlisle and Gloria Gálvez-Carlisle
Donald Carlisle Undergraduate Research Endowed Fund

W. Gary and Charlotte Ernst
W. Gary Ernst Endowed Graduate Fellowship

John and Frances Handin
John and Frances Handin Endowed Scholarship

Charlotte H. Johnston
Walter S. Harris Summer Field Endowed Fund

Joanne Knopoff
Leon and Joanne V.C. Knopoff Term Chair in Physics and Geophysics

Deane Oberste-Lehn
Deane Oberste-Lehn Endowed Scholarship

Robert and Jeannette Paschall
Robert and Jeannette Paschall Endowed Fund

J. William and Jane Shen Schopf
J. William and Jane Shen Schopf Endowed Faculty and Staff Enrichment Fund
J. William and Jane Shen Schopf Endowed EPSS Spousal/ Partner Employment Opportunity Fund

Wilbur B. Sherman
Wilbur B. Sherman Endowed Fellowship

Harold and Mayla Sullwold
Harold and Mayla Sullwold Endowed Scholarship

Eugene B. and Winifred Waggoner
Eugene B. Waggoner Endowed Scholarship

Donor Recognition

Donna and Larry Anderson
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Shirley Baher
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Wendy Bohrson
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Robert Brockway and Dana Ware
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Elizabeth Catlos
Liang Chen
Xingqiang Chen
Mark Ching
Ana Chu and George Wesley
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Samantha Walker
Shengli Wang
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John and Gudrun Wasson
Yushuai Wei
Jack and Catherine Wood
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Fengjie Yang
Zhuo Ye
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Yongqian Zhang
Jinsu Zhang
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Yu Zhou
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