



Features: New Horizons first to reach Pluto • 100-instrument MMS mission launched • SUDA to study Europa's habitability

Letter from the director

Dan Baker

New Space, New LASP



The nature of space research is changing around us. So-called *new space* is taking hold in the United States and around the world. New space means more

innovation, flexibility, and nimbleness in what research efforts are being undertaken and in how these efforts are being implemented. In many ways, LASP is ideally positioned and configured to play a central role in new space, now and for the foreseeable future.

It has been gratifying to see that our traditional federal partners in space exploration have recognized LASP's unique skills and capabilities in the new space context. What has also been fascinating is that emerging space organizations around the world have been seeking out LASP and CU-Boulder for possible partnerships in challenging and innovative ventures.

This issue of LASPSpace will tell about some recent tremendous successes of the lab in the traditional research mold. It will also mention some new thrusts and approaches. I am delighted that LASP can nurture traditional space efforts, while also embracing the latest in novel steps forward.

Hang on, it's going to be an exciting ride. 🚀

IN FOCUS

New Horizons first to reach Pluto

NASA's New Horizons spacecraft encountered Pluto on July 14 after a nine-year journey from Earth. What this first mission to Pluto and the Kuiper Belt discovered was well worth the wait. The images returned from Pluto and its five moons intrigue, puzzle, and captivate: bizarre landscapes of black, tar-covered craters; fresh snows of methane and nitrogen; jagged mountains of water ice; and glaciers slowly flowing over the surface.

But while the pictures may capture immediate attention, there is also a human story behind the project. No other research institute has used students to build a deep space instrument before and what it means to the 30 or so CU-Boulder students who worked on New Horizons is tremendous. Several credit their work on the Venetia Burney Student Dust Counter (SDC), designed and built at LASP, with helping them develop the skills necessary to launch a career in space science.

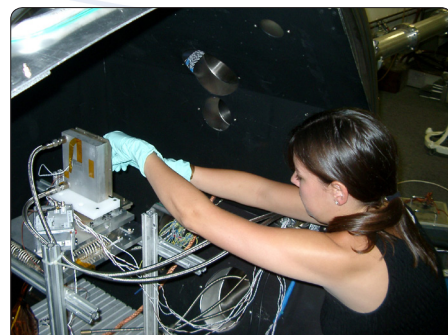
"It's one thing to graduate from school knowing, in theory, how things work. But having actually done it makes you much more valuable," said Beth Cervelli, who worked on SDC as a student and is now a LASP spacecraft programmer.

Named after the 11-year-old English girl who named Pluto soon after its 1930 discovery—and to honor the comprehensive involvement of students—the instrument provides information about dust that strikes the spacecraft during its journey across the solar system and has traveled farther than any dust counter before it.

"Dust particles are the building blocks of all planetary objects," said Professor Mihály Horányi, LASP researcher and principal investigator for SDC. "Understanding how they are produced, transported, and destroyed, provides important and unique clues about the history, evolution, and current processes of our solar system."

For more information, visit the SDC website at <http://lasp.colorado.edu/home/sdc/>. 🚀

By Fran Bagenal, research scientist at LASP.



Chelsey Bryant-Krug (then a CU-Boulder aerospace student) works with SDC at the Max Planck Institute for Nuclear Physics. She currently coordinates production of flight hardware at LASP. (Courtesy Mihály Horányi)

Mission status

Instrument Development (Pre-Phase A)

IIP Compact SIM (cSIM)
MatISSE LAMA

Phase A/B (funded concept study)

Europa Multiple-Flyby Mission/SUDA
Emirates Mars Mission (EMM)

Phase C (design and fabrication)

GOLD
Solar Probe Plus

Phase D (assembly and test)

GOES-R/EXIS FM-3 and FM-4
ISS-TSIS

Launch/Early Orbit [launch date]

MinXSS CubeSat [Dec. 6, 2015]
GOES-R/EXIS FM-1 [Oct. 2016]
GOES-R/EXIS FM-2 [2017]

Prime Mission [end date]

MMS, four spacecraft [2017]
STPSat-3/TCTE [2017]
New Horizons/SDC [2020]

Extended Mission [end date]

MAVEN [2016]
QuikSCAT [2016]
AIM [2017]
Cassini/UVIS [2017]
Kepler [2017]
SDO/EVE [2017]
SORCE [2017]
THEMIS and ARTEMIS [2017]
TIMED/SEE [2017]
Van Allen Probes REPT/FIELDS [2017]

For more information on current missions, as well as full instrument and mission names, visit <http://lasp.colorado.edu>.

100-instrument MMS mission launched and commissioned

LASP continues to push the boundaries in space system operations. In March 2015, four Magnetospheric MultiScale (MMS) spacecraft launched with 25 science instruments on board each. MMS is one of the most complex missions ever placed in orbit by NASA. In addition to building instrumentation, LASP is responsible for operating all 100 instruments. Prior to MMS, LASP controlled a total of 14 space instruments. With MMS, we now control more than seven times that.

MMS will investigate how the magnetic fields of the sun and Earth connect and disconnect, explosively transferring energy within the Earth's system. This magnetic reconnection governs many aspects of space weather. MMS will improve our understanding of this phenomenon, which impacts telecommunications, GPS navigation, electrical power grids, and even fusion power generation research.

LASP staff and students successfully completed a 5½-month around-the-clock commissioning period, and all MMS

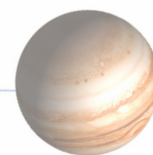


Flight controller Madeline Alanko and student Matt Muszynski, a command controller, prepare for the launch of MMS inside the science operations center. (Courtesy Kathryn Scott Osler, The Denver Post)

instruments are now operational and collecting valuable data. The students involved have gained invaluable hands-on experience bringing new space instruments into operations. LASP also hosts the MMS Science Data Center that provides access to these important measurements for the greater science community.

For more information on MMS, visit <http://lasp.colorado.edu/home/missions-projects/quick-facts-mms/>.

By Bill Possel, director of mission operations and data systems at LASP.



SUDA to study Europa's habitability

The SUDA (SURface Dust mass Analyzer) instrument was selected by NASA as one of nine instruments for an unprecedented mission to Europa. Discovered in 1610, the Jovian moon is a focus of exploration due to its potential for habitability. Similar in size to our Moon, its geologically young, icy surface hides more water than all of Earth's oceans combined. With

readily available energy sources, like tidal heating and possible underwater volcanic activity, Europa is a prime target for the question, "Is Earth the only place in the solar system capable of harboring life?"

Led by principal investigator and LASP researcher Sascha Kempf, SUDA will make a critical contribution to the mission goals by analyzing the composition of Europa's



Mission & technical stats

- LASP operates five satellites.
- LASP has 114 instruments in space on 15 spacecraft.
- LASP is currently developing 2 spacecraft and 11 instruments for 8 missions.

Education events

Events are held at LASP in Boulder, CO unless otherwise noted.

Research Experience for Undergraduates (REU) Program in Solar and Space Physics (Funded by the National Science Foundation)

June–August 2016

MAVEN's Red Planet Workshop, for elementary educators

June 2016

For more information, visit

<http://lasp.colorado.edu/education>.

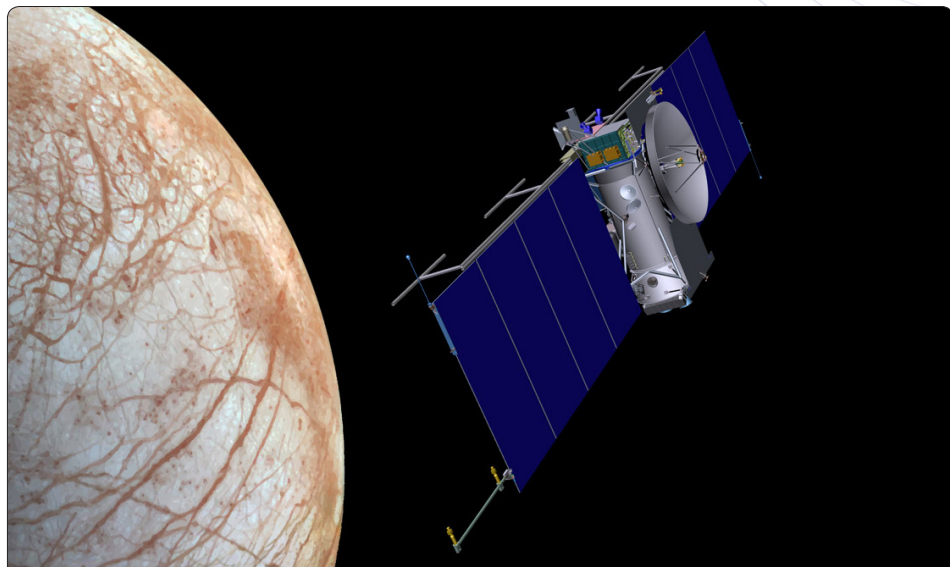
Student news

Mike Chaffin defended his PhD thesis in May 2015 and is a LASP postdoc working on the Mars MAVEN mission.

Taylor Graham received a bachelor's degree in computer science in the spring of 2015. He works as a software engineer at Spectra Logic in Boulder.

Alexia Newgord graduated in the spring of 2015 with bachelor's degrees in computer science, music, and art. She is now a software engineer at Qualtrics in Seattle.

Katherine (Wren) Suess graduated in May 2015 with a bachelor's degree in physics and is now working on her PhD in astrophysics at the University of California, Berkeley.



An artist's concept shows NASA's Europa mission spacecraft approaching its target for one of many flybys. (Courtesy NASA/JPL-Caltech)

surface material in-situ. Micrometeoroid bombardment elevates secondary ejecta particles up to flyby altitudes where SUDA will provide high-resolution mass spectra of hundreds, if not thousands, of samples during each encounter.

The Europa mission will place a spacecraft in orbit around Jupiter with

more than 40 planned flybys, which will allow SUDA to provide a compositional map of the most interesting regions. The launch is tentatively scheduled for the early 2020s.

For more information on SUDA, visit <http://lasp.colorado.edu/home/missions-projects/quick-facts-suda/>.

By Zoltan Sternovsky, research scientist at LASP and assistant professor of aerospace engineering sciences at CU-Boulder.

FIELD NOTES

Volcanic analog for life on Mars


Exploration of Mars' surface has revealed that volcanism has been widespread across the planet throughout its history, possibly continuing to the present day.

On Earth, volcanic environments support microbial communities that are able to thrive in spite of challenging environmental conditions that include elevated temperatures, high acidity, and exposure to toxic compounds, such as hydrogen sulfide. Could volcanoes on Mars have supported similar biological communities?

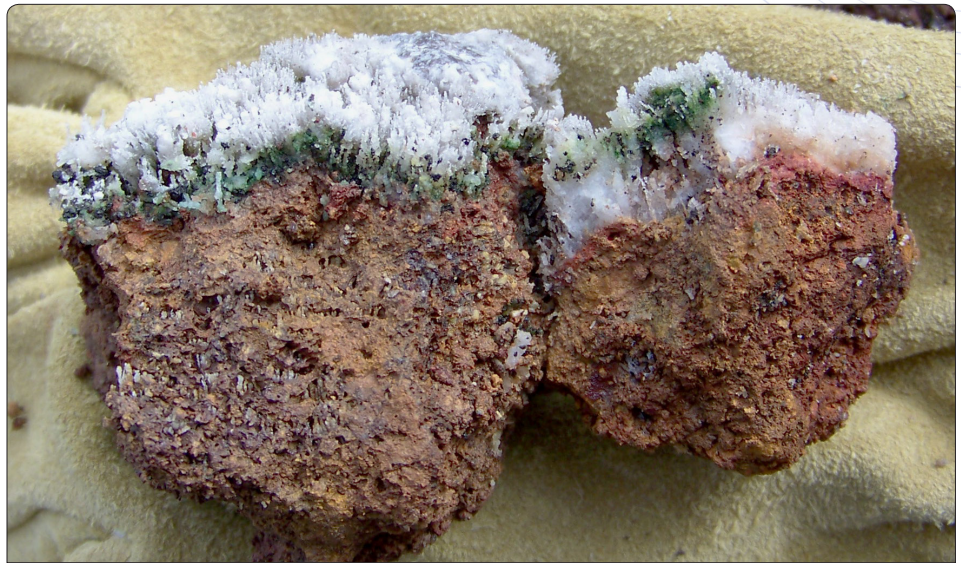
To investigate this possibility, LASP scientists Brian Hynek and Tom McCollom have been studying fumaroles at Nicaragua's Cerro Negro volcano as an analog for potentially habitable environments on Mars. One focus of this work is endolithic (inside rock), photosynthetic, microbial communities that inhabit cavities within minerals deposited by volcanic vapors at temperatures up to 65°C. Condensation of the steam-rich vapors within the cavities provides moisture and nutrients

that allow the cyanobacteria to grow and support a diverse microbial community.

On Mars, similar endolithic microenvironments may have provided moisture under otherwise arid conditions—as well as protection from ultraviolet radiation—establishing a habitable niche for photosynthetic organisms on the planet’s surface.

For more information about astrobiology at LASP, visit <http://lasp.colorado.edu/home/science/centers/center-for-astrobiology/>. 

By Tom McCollom, planetary geochemist at LASP.



This endolithic, photosynthetic, microbial community (green layer) established within silica (white) was deposited by volcanic vapors on top of altered basalt. (Courtesy Tom McCollom)

INNER SPACE

Public outreach

Emirati students join the Research Experience for Undergraduates

For nearly a decade, LASP’s Research Experience for Undergraduates (REU) has paired undergraduate students with research mentors to conduct near-graduate level research each summer. The National Science Foundation supports eight US students in the program, and with financial support from mentors, LASP’s REU includes additional US and international students.

As the lead US academic partner to the 2021 Emirates Mars Mission (EMM), LASP is supporting the development of UAE’s next generation of space scientists. Last June, along with fifteen US students and one from France, our program welcomed two students from the UAE. These women are part of the budding UAE planetary science community and will be among the first scientists to analyze data

from EMM. They are role models for future UAE students who have an eye on the sky, instead of on petrochemicals under the ground.

LASP is pleased to host such ambitious students, and will continue to involve scholars from the UAE during the partnership with EMM, and hopefully far into the future.

Achievement awards

Dan Baker, director of LASP and CU-Boulder professor of astrophysical and planetary sciences, traveled to India in February to receive the Vikram A. Sarabhai Professorship and Prize from the Physical Research Laboratory of India. The award inspires young Indian researchers by exposing them to new developments through interaction with distinguished scientists from around the world.

Dan Baker was also awarded the Shen Kuo Medal at the International Union of Geodesy and Geophysics meeting in Prague last summer. Awarded by the International Association of Geomagnetism and Aeronomy (IAGA), the medal recognizes prominent scientists for interdisciplinary achievements and contributions to IAGA science.

W. K. (Bill) Peterson, LASP research associate, was elected fellow of the American Geophysical Union by his peers for his outstanding work in Earth and space sciences. The fellowship is an honor bestowed upon no more than 0.1% of the membership annually. Peterson was recognized during the fall meeting on December 16 in San Francisco.

Administrative stats

(October 15, 2015)

Scientific researchers	60
Tenure-track faculty	19
Professionals	252
Graduate students	47
Undergraduate students	81
Total	459

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LASP homepage



Newsletter archives

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To view LASPSPACE archives, visit <http://lasp.colorado.edu/home/about/publications/newsletters/>.

Cora Randall, research scientist, professor, and chair of CU-Boulder's Department of Atmospheric and Oceanic Sciences, and **Michael King**, senior research scientist, were named 2015 fellows of the American Association for the Advancement of Science (AAAS). Randall is being recognized for her distinguished contributions to atmospheric sciences through innovative, multidisciplinary research and extensive, dedicated service. King will be honored for his distinguished contributions to remote sensing and analysis of clouds and aerosols, and for years of leadership of the multi-satellite Earth Observing System.

Administration update

LASP expands into third building

On October 8, LASP began moving staff into a third building on CU-Boulder's east campus: the Center for Astrophysics and Space Astronomy's Astrophysics Research Laboratory (CASA-ARL). This move supports emerging programs—including the Total and Spectral Solar Irradiance Sensor (TSIS) and the Emirates Mars Mission (EMM)—that require the use of unique test chambers (tanks) at ARL. For the EMM program, the high bay test and

They will be presented with official certificates and pins on February 13 at the annual AAAS meeting in Washington, DC.

LASP's MAVEN program won a CO-LABS Governor's Award for High-Impact Research in the Earth systems and space sciences category. CO-LABS is a consortium of federal laboratories, universities, businesses, local governments, and community leaders organized to establish Colorado as a global leader in research and technology. The award was presented on October 8 at the Denver Museum of Nature & Science.

office spaces are ideally suited for payload integration activities as they are adjacent to the tank area. This first phase of moves will be followed by facility upgrades and modifications in the spring of 2016 to prepare for TSIS testing in 2017; followed closely thereafter by EMM integration and test activities. Current CASA-ARL and ground-based laboratory research personnel are in the process of moving to the Duane building on CU-Boulder's main campus.

Distinguished visitors

LASP hosted Denver's Japanese Consul General Ito and Consul Izumi on July 17. After a tour of the facility, LASP management met with the visitors for an in-depth discussion about potential cooperation between LASP and a variety of Japanese partners. The group discussed how LASP successfully hosted a 25-person delegation from the Japan Aerospace Exploration Agency during the Space Symposium last April. As a result, LASP has been highlighted in discussions within the Japanese aerospace industry and among other government entities.

On October 13, LASP hosted the Government Aerospace Affairs Forum. The event was sponsored by the Colorado Office of Economic Development and International Trade as well as retired Major General Jay Lindel, USAF who was hired as Colorado's Aerospace and Defense Industry Champion. Attendees included staff from the offices of all Colorado congressional representatives and senators, major Front Range businesses, and CU aerospace and space research leaders.

