



**Features:** Colorado goes to Mars • Five launches, busy times • LASP secures two ICEE awards • New executive associate director

## Letter from the director

Dan Baker



### Partnerships in a New Space Age—

Since inception in 1948, LASP has honed a successful formula for research funding. This federal

research formula offers outstanding value for space exploration by providing science, engineering, operations, and management skills with a strong infusion of student involvement. For LASP, this approach traces its origins to post-World War II sounding rocket research supported by government agencies (pre-NASA) using captured German V-2 rockets.

Surprisingly, little university research of any kind was government-supported prior to World War II. But a seminal 1945 essay entitled *Science, The Endless Frontier*, by presidential advisor Vannevar Bush, made the extremely compelling case for government funding of academic research. This system of basic and applied research thrived and became the envy of the entire world.

Today, the funding model is changing in many science and engineering domains. This is true not only because of more scarce government dollars, but also because many aerospace companies have

## IN FOCUS

### Colorado goes to Mars—MAVEN

The Mars Atmosphere and Volatile Evolution (MAVEN) mission launched successfully on November 18, and is now in the middle of its ten-month trip to Mars. The mission is led by CU-Boulder/LASP, and is often referred to as “CU’s mission to Mars”.

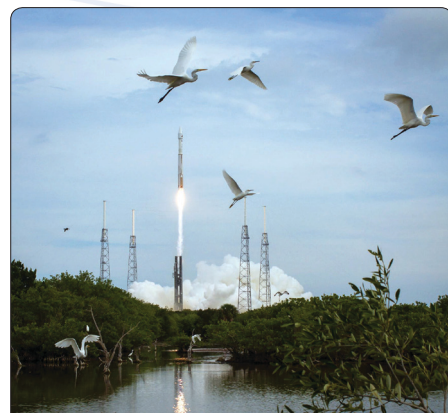
MAVEN continues LASP’s long-standing interest in the upper atmosphere of Mars and the evolution of the Martian climate. Its goal is to determine the structure and composition of the upper atmosphere, observe how it interacts with the Sun and the solar wind, and to understand how gas from the top of the atmosphere is lost to space. Evidence suggests loss to space is a key mechanism by which the atmosphere evolved over time; MAVEN is, in essence, a mission to determine why the climate of Mars and its potential habitability by microbes changed through time.

The spacecraft will arrive at Mars in September, 2014. After a one-month transition phase in which it will get to its final mapping orbit, deploy its booms, and test its instruments, it will begin its one-year primary science mission. MAVEN is the first spacecraft mission devoted to studying the Martian upper atmosphere, so measurements taken during that year should provide a new window into understanding Mars.

MAVEN is a joint effort between LASP, NASA’s Goddard Space Flight Center, UC Berkeley, Lockheed Martin Corp., and NASA’s Jet Propulsion Laboratory. LASP provided two of the science instruments and is carrying out the science operations, and Lockheed Martin (from Littleton, Colorado) provided the spacecraft and is carrying out the mission operations. In addition, the United Launch Alliance, also based here in Colorado, provided the Atlas V launch vehicle, making MAVEN a true Colorado endeavor.

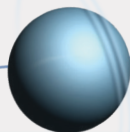
For more information, visit the MAVEN mission website at <http://lasp.colorado.edu/maven/>. 

By Bruce Jakosky, associate director of science at LASP and a professor of geological sciences at CU-Boulder.



MAVEN launched at the first second of its 20-day launch period, at 1:28 p.m. EST on November 18, 2013. (Courtesy NASA/Bill Ingalls)

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# Five launches, busy times

The Lab was bustling toward the end of 2013. With five launches between September and November, it made for exciting times at LASP. Here is a brief outline of each mission. Thanks to our many science, engineering, operations, and administrative team members—as well as our industry partners—for all their work on

these missions. We look forward to collecting abundant scientific results for a long time to come.

For more information about LASP missions and launches, visit <http://lasp.colorado.edu/home/missions-projects/>. 

By Laura Bloom, editor of LASPSPACE for the LASP Office of Communications & Outreach (OCO).

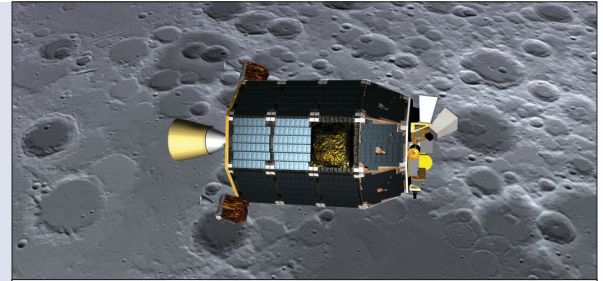
## Lunar Atmosphere and Dust Environment Explorer (LADEE)

**Launched:** September 6, 2013

**Target:** Earth's moon

**LASP provides:**

- The Lunar Dust Experiment (LDEX) instrument
- LDEX principal investigator: Mihály Horányi



(Courtesy NASA Ames/Dana Berry)

LADEE's scientific objectives are to study the lunar atmosphere, near-surface conditions and environmental influences on lunar dust. LDEX measures submicron-sized dust particles released from the Moon due to

bombardment by micrometeoroids, and strong surface electric fields. It maps the variability of size and density distribution, enabling safe and long-term operations of future Moon missions.



(Courtesy HySICS Team/Joey Espejo/LASP)

## HyperSpectral Imager for Climate Science (HySICS)

**Launched:** September 29, 2013 (inaugural flight)

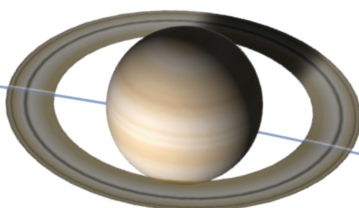
**Target:** Earth, Sun and Moon

**LASP provides:**

- HyperSpectral Imager for Climate Science (HySICS) instrument
- Principal investigator: Greg Kopp

HySICS's scientific objectives are to acquire extremely accurate measurements of the sunlight scattered by the Earth and its atmosphere relative to incident sunlight. Over time, such measurements can tell scientists about changes in land-use, vegetation, urbanization, and

atmospheric conditions on our planet, helping identify the drivers of climate change. Another flight is planned for September 2014 to demonstrate this new method of acquiring the most accurate radiometric measurements that have ever been made of the Earth from space.





## Solar Dynamics Observatory/EUV Variability Experiment (SDO/EVE) Calibration Rocket

**Launched:** October 21, 2013

**Target:** Sun

**LASP provides:**

- The Extreme Ultraviolet Variability Experiment (EVE) prototype instruments, Geostationary Operations Environment Satellite R-Series (GOES-R) Extreme ultraviolet/X-ray Irradiance Sensor (EXIS) X-Ray Sensor (XRS), and two new solar X-ray spectrometers
- EVE principal investigator: Tom Woods



(Courtesy NASA, White Sands Missile Range/James Mason/LASP)

The SDO/EVE calibration rocket's scientific objectives are to provide underflight calibration for the SDO EVE instrument that was launched in February 2010. This is the fourth rocket calibration flight, which occurs about once a year, to accurately determine the long-term variations

of the solar extreme ultraviolet irradiance. The rocket is flown for about 20 minutes in space at a peak altitude of 180 miles to obtain the necessary solar observations. The payload then re-enters and lands via parachute and is recovered for use on future suborbital flights.



(Courtesy NASA/GSFC)

## Mars Atmosphere and Volatile Evolution Mission (MAVEN)

**Launched:** November 18, 2013

**Target:** Mars

**LASP provides:**

- The Imaging Ultraviolet Spectrograph (IUVS) instrument, the Langmuir Probe and Waves (LPW) instrument [jointly with UC Berkeley] and its associated EUV sensor, interdisciplinary scientists, science operations, the science data center, and the education and public outreach lead
- Principal investigator: Bruce Jakosky

MAVEN's scientific objectives are to explore the Mars upper atmosphere, ionosphere, and interactions with the Sun and solar wind, to determine the role that loss of volatile compounds, such as  $\text{CO}_2$ ,  $\text{N}_2$ , and  $\text{H}_2\text{O}$ , from the

atmosphere to space has played over time. This mission will give insight into the history of Mars atmosphere and climate, liquid water, and planetary habitability.

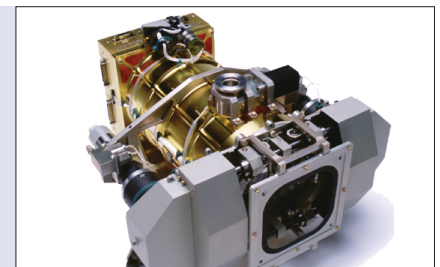
## Total Solar Irradiance Calibration Transfer Experiment (TCTE)

**Launched:** November 19, 2013

**Target:** Sun

**LASP provides:**

- The Total Irradiance Monitor (TIM) instrument
- TIM principal investigator: Greg Kopp



(Courtesy LASP)

TCTE's scientific objectives are to measure incoming solar energy to help scientists understand natural causes of climate change on Earth. The Earth's incident sunlight (light from the Sun that falls directly on a surface) is the primary

energy source that drives our climate. TCTE measures total solar irradiance (TSI), or the total light coming from the Sun at all wavelengths, in order to monitor changes in this climate driver at the top of the Earth's atmosphere.

## Letter from the director

*Continued from front page*

ceased doing their own in-house research. These large (and small) entities are increasingly looking to strong academic institutions like CU and LASP to provide the research needed for advanced space systems.

I can say with great confidence that LASP is ready, willing, and able to partner directly with aerospace companies to carry out basic and applied research. While LASP gladly pursues traditional government agency-sponsored research, the lab is also delighted to undertake new ventures with the many capable aerospace companies here on the Colorado Front Range and around the world. We believe that in change there is opportunity. We welcome this evolving world of research and seek to make it thrive. 📧

## Student news

**Matthias Brakebusch**, who graduated with a PhD in atmospheric and oceanic sciences in August 2013, is working in computational modeling at the University of Stockholm.

**Laura Holt** graduated with a PhD in atmospheric and oceanic sciences in spring of 2013. She is now working as a postdoctoral scientist at LASP.

## Key hires

**Cara Little** joined LASP as the contracts and compliance manager. She replaces Beth McGilvray who retired in early 2014 after 10 years with LASP.

**Randy Siders**—see story on page 6.

# LASP secures two ICEE awards

## Two awards lay groundwork for Europa mission

NASA recently awarded LASP a combined \$1.5 million to complete two instrument studies for a potential future mission to Europa, the smallest of Jupiter's Galilean moons. Europa is covered with a thick ocean of water capped by a lid of ice several miles thick.

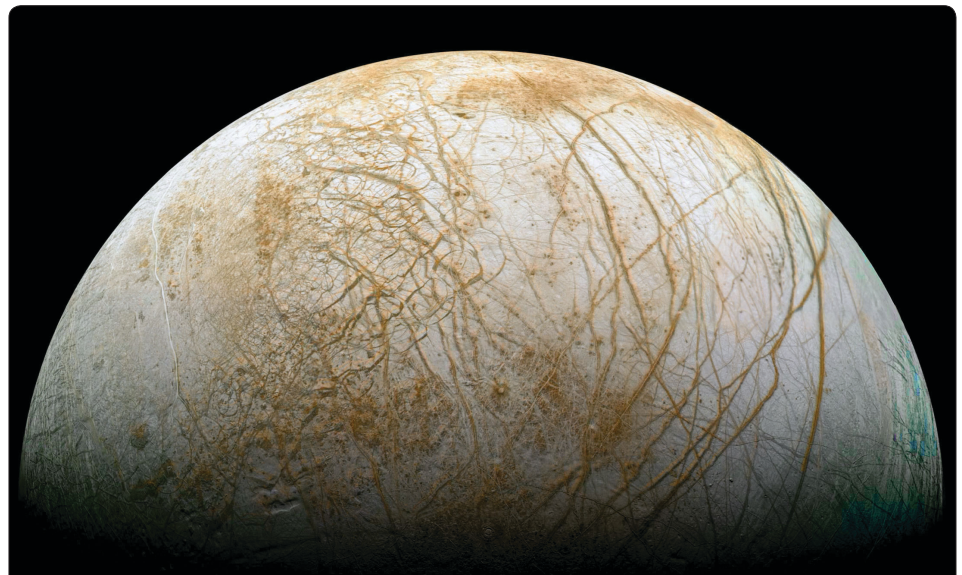
The goal of this Europa mission will be to study how water might escape through the ice crust. Europa is one of the places that astrobiologists—scientists who study life in the Solar System—are most anxious to visit.

Fran Bagenal, author of one of the successful proposals, said, "Instrument proposals give scientists a chance to team with engineers to dream up the best possible instrumentation to answer ongoing planetary mysteries." Bagenal's instrumentation study will develop the Colorado Europa Langmuir Probe (CELP) conceived to measure the ionized environment surrounding Europa. A better understanding of the ionization would help distinguish electrical currents flowing

in the ionosphere from those flowing in the ocean.

Sascha Kempf, author of the second proposal, will lead the design of an instrument that will measure the composition of dust particles propelled from the surface of Europa by various impactors. The in situ instrument will analyze the composition of the surface from where the dust was lifted in search of components, such as organic materials and ice. One goal is to identify the nature of the mysterious red stripes on Europa. Kempf said, "Determining the composition of the surface will help us better understand Europa as a possible host for life."

The goal of NASA's Instrument Concepts for Europa Exploration (ICEE) program is to ensure that, when NASA is ready to build a spacecraft to go to Europa, instruments and their technology are already developed and are ready for a flight program. 📧



Complex patterns embellish the surface of Europa. This false-color image is intended to resemble how the moon might appear to our eyes. (Courtesy NASA/JPL/Ted Stryk)

By LASP Office of Communications & Outreach (OCO), edited by Laura Bloom, editor of LASPSPACE.

## Mission status

*Phase A/B (funded concept study)*

GOLD

MatISSE LAMA

Europa Clipper Instruments

*Phase C (design and fabrication)*

Solar Probe Plus

*Phase D (assembly and test)*

GOES-R/EXIS

JPSS/TSIS

MMS

*Launch/Early Orbit [launch date]*

HySICS/IIP Hyperspectral/Balloon  
[09/2014]

*Prime Mission [end date]*

Van Allen Probes REPT/FIELDS [2014]

MAVEN [2015]

STPSat-3 / TCTE/TIM [2015]

LADEE / LDEX [2014]

SDO/EVE [2015]

New Horizons/SDC [2020]

*Extended Mission [end date]*

Kepler [2014]

MESSENGER/MASCS [2015]

AIM [2015]

THEMIS & ARTEMIS [2015]

TIMED/SEE [2015]

QuikSCAT [2015]

SORCE [2015]

Cassini/UVIS [2017]

CubeSat CSSWE [2014]

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



## LAB NOTES

### News

#### Kepler redux

The Kepler telescope, which is operated by LASP, relied on high-precision pointing to achieve its monumental discoveries in the search for planets in an Earth-like orbit around other stars. With the loss of a second reaction wheel in May 2013, data collection in the original field-of-view came to an end.

Data analysis will reveal Earth-like planets for years to come and the spacecraft and all of its assets remain in good condition. Teams recently submitted proposals for how to repurpose the high precision camera in its current state. One

of these proposals for Kepler's second life has aptly been named K2.

The novel concept behind K2 would evenly balance solar pressure about the center line of the solar arrays, in an effort to maintain the necessary precise pointing stability. The team has been invited to the 2014 NASA Senior Review. If successful, K2 will continue to introduce new opportunities to observe planets, stars, active galaxies, and supernovae for years to come.

*For more information on Kepler's next chapter, visit <http://1.usa.gov/1aTNiJQ>.*

### Public outreach

#### Keeping up-to-date with current standards

It takes ongoing adaptation to stay on top of science education research and national trends. LASP's science-literacy programs, created for elementary grades, are a reflection of our ability to do so.

Erin Wood, LASP educator, said, "Since 2010, the Common Core State Standards for literacy have been widely adopted nationally. They call for curricula that blend literacy and other subjects, such as science, together. That's one of the reasons we created a program like *Red Planet*."

*Red Planet* uses literacy and art to engage elementary students with the MAVEN mission and Mars research. Students

ultimately create a written and illustrated argument for human exploration of Mars.

"Scientists use literacy skills all the time," said Wood, "To separate literacy and science in a typical school day just doesn't make sense. We hope to expand students' views of what it means to 'do science', and attract more students to STEM fields."

*Red Planet* is a national program, and workshops for elementary educators are ongoing.

*For more information on Red Planet, visit <http://lasp.colorado.edu/home/maven/?p=1161>.*

### Achievement awards

LASP Director **Dan Baker** was promoted to associate fellow in the American Institute of Aeronautics and Astronautics (AIAA). Associate fellows are distinguished as having made notable and valuable contributions to the arts, sciences, or technology of aeronautics or

astronautics. He was inducted on January 13 during the AIAA SciTech meeting.

**Bob Ergun**, LASP researcher and CU-Boulder professor, was elected as a fellow of the American Geophysical Union (AGU) "...for his role in developing instruments, theories, and models of



## Education events

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

**MAVEN Red Planet Workshop**, for elementary educators

January 25 (Houston)

March 8 (Chicago)

September 21

**Dancing Lights: Exploring the Aurora Through Art and Writing**, for elementary educators

February 22

**Science at 100,000 feet!**, for middle school students

Spring 2014 (Nederland, CO)

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

June 9–August 3

**2014 Colorado Space Science**

**Teachers Summit**, for middle and high school teachers

June 16–20

**MAVEN Educator Ambassadors**

July 14–18

*For more information, visit*

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

## Mission & technical stats

- LASP has 23 instruments in space on 13 different satellites.
- LASP operates five satellites.
- LASP is developing 14 instruments for 11 different missions.

electric fields in space, to investigate auroral acceleration processes at Earth, Mars, and Jupiter.” This year’s class of fellows was honored on December 11 at the fall meeting in San Francisco.

Research Scientist **Michael King** was selected as a 2014 fellow of the Institute of Electrical and Electronics Engineers (IEEE). Only 0.1% of the IEEE membership receives this honor in any given year. He was recognized for his fundamental research in remote sensing of clouds and aerosols. Honors will be bestowed at the International Geoscience

and Remote Sensing Symposium (IGARSS) on July 14.

Professor and LASP researcher **Brian Toon** was selected to present CU-Boulder’s 2013 Distinguished Research Lecture. This lectureship is among the highest honors bestowed by the faculty upon a tenured faculty member. It honors one who is widely recognized for a distinguished body of academic or creative achievement and prominence, as well as contributions to CU’s educational and service missions. Toon delivered his lecture, *Dead Dinosaurs & Nuclear Wars*, on October 18.

## Inner space

LASP welcomes new executive associate director



Randy Siders joined LASP as the executive associate director for finance and operations on November 4. He serves as the executive

administrative officer for LASP and is responsible for all budgetary, financial, administrative, and human resource activities for the lab. He advises senior leadership in these areas by providing coordination and support to individual

programs across a number of business areas. Siders comes to LASP with more than 25 years of executive and program management experience in the civil and federal business sectors, most recently in federal service as the F-35B Joint Strike Fighter program manager for the Marine Corps. A native of Colorado, Siders graduated from the University of Idaho. We are very excited to welcome him to the LASP team.

## LASP creates new scholarship and fellowship

The Charles A. Barth Scholarship Endowment Fund in Space Research will provide support for one or more seniors at CU-Boulder in studies related to space research at LASP. It honors Charles Barth’s contribution as a leader and researcher in space physics, his dedication to undergraduate teaching, and his inclusion of undergraduates in space research projects at LASP. Barth was a CU-Boulder professor for the Astro-Geophysics and Astrophysical and Planetary Sciences departments for almost 40 years, director of LASP from 1965–1992, and served

as principal investigator for 11 missions. Since retirement, he has been a professor emeritus and continued work on projects, such as planetary data restoration for Mariners 6, 7 and 9, and using Google Earth to display ultraviolet spectra on a globe of Mars.

In April, LASP researcher John Gosling was formally honored at the U.S. National Academy of Sciences Academy’s 150th annual meeting in Washington, DC. He was awarded the 2013 Arctowski Medal for his outstanding contributions to the field of solar physics. The Arctowski Medal carries

## Administrative stats

Scientific researchers	49
Tenure-track faculty	16
Professionals	217
Graduate students	52
Undergraduate students	67
<b>Total</b>	<b>401</b>

## Visit LASP online



LASP homepage



Newsletter archives

*Links to a variety of social media networks can be found on our homepage, <http://lasp.colorado.edu>.*

*If you know someone who might like to receive LASPSPACE, please encourage them to email Laura Bloom, publisher, at [laura.bloom@lasp.colorado.edu](mailto:laura.bloom@lasp.colorado.edu) to subscribe. Should you prefer not to receive future issues, please email with “Unsubscribe” in the subject line.*

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

an award of \$20,000, plus \$60,000 to support research in solar physics and solar-terrestrial relations. Gosling generously donated the \$60,000 award to CU-Boulder/LASP—and supplemented it with a generous personal gift—to establish The John T. Gosling Endowed Fellowship Fund

directed toward first year graduate students.

LASP expects to award both the scholarship and the fellowship in the fall of 2014.

*To learn more about supporting LASP, please visit <http://lasp.colorado.edu/home/about/givingtolasp/>.*

## Distinguished visitors

LASP celebrated its 65<sup>th</sup> anniversary with a kick-off celebration on October 11. Among the distinguished guests was Sam Durrance, astronaut and former LASP graduate student. Durrance is now a professor at the Florida Institute of Technology and delivered LASP’s first public lecture of the season. He shared his experiences as a student in the 1970s, as a researcher, and as an astronaut on the space shuttle. Durrance said, “LASP holds a special place in my heart—for setting me on a path to participate in one of the greatest adventures of our time, human spaceflight. LASP is a unique place in the world of science where opportunities abound, where students are able to participate firsthand in some of the most exciting space research available anywhere.”

Along with many CU-Boulder top administrators, industry leaders, university alumni, and other honored guests, we would expressly like to thank Jack and Jeannie Thompson for supporting MAVEN at the launch on November 18. Longtime supporters of CU-Boulder, they met at the Sink restaurant (a Boulder institution) as students in the 1960s. As CU-Boulder’s chairs for the university’s Creating Futures Campaign, they oversaw our campus’s contribution toward the \$1.5 billion goal—resulting in the largest, most successful fundraising campaign in CU’s history. LASP was pleased to have the opportunity to host the Thompsons and discuss not only the accomplishment of a successful launch but the varied scientific achievements LASP has brought to the world of space research over the last 65 years.



The LASP Space Technology Building at night. (Courtesy Jim Fanson)

