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# NEW FRONTIERS TO THE MOON OR VENUS?

## JPL proposals would return samples from Earth's satellite or land a probe on our scorching planetary neighbor

By Mark Whalen

With the tantalizing prospect of new exploration adventures on one of our planet's two closest celestial neighbors, JPL is moving forward in supporting two proposals from the Laboratory up for NASA's New Frontiers Program.

NASA announced in December that three New Frontiers proposals were chosen as candidates for future missions. Two of them—MoonRise, which would travel to Earth's moon and return about two pounds of lunar rocks and soil, and the Surface and Atmosphere Geochemical Explorer mission, which would measure Venus' atmosphere and then land a probe on the searing planet—would be managed by JPL if selected for development.

A third New Frontiers proposal up for consideration, the Origins Spectral Interpretation Resource Identification Security Regolith Explorer, which would orbit a primitive asteroid and return samples to Earth, would be managed by Goddard Space Flight Center.

Each proposal team has received about $3.3 million this year to conduct a 12-month mission concept study that focuses on implementation feasibility, cost, management and technical plans. The selected mission must be ready for launch no later than Dec. 30, 2018.

For JPL, both mission opportunities present compelling challenges.

MoonRise, which would be the first NASA mission to robotically return samples from another planetary body, is targeted to visit the South Pole Aitken Basin, the largest and oldest recognizable impact basin on the moon. Principal investigator Brad Jolliff of Washington University of St. Louis, who has taken part in numerous studies of lunar regolith delivered by Apollo astronauts, makes the case that it's time to expand lunar studies beyond those 800 pounds of rocks and soil, last returned to Earth in 1972.

"The samples we have now come from a very small area on the moon, all on the near side, an area that's been heavily dominated by the latest of the large impact basins," he said. "We wouldn't be doing MoonRise if we didn't have a lot of knowledge from those samples. What we saw was evidence for a late, heavy impact bombardment of the moon, and you don't have to extrapolate much to realize that this would have occurred on Earth as well."

Scientists have debated whether this impact barrage is simply a tail-off of accretion or a singular event from the solar system's early history that somehow sent a rain of large impactors—such as asteroids—into the early solar system.

Jolliff said scientists recognized the importance of the South Pole Aitken Basin and its topographic and geochemical anomalies based on results from the orbiting Clementine and Lunar Prospector missions of the 1990s.

"Dating the South Pole Aitken Basin would give us a bookend to this period of bombardment," Jolliff said. "If it occurred 4 billion years ago, there would have been a really intense 100 million years or so where 50 or more asteroid-sized objects hit the moon and possibly did the same thing on Mars, Earth, Venus and Mercury. This is a key point in our understanding of early planetary development."

The second JPL proposal, the Surface and Atmosphere Geochemical Explorer, would release a probe to descend through Venus' atmosphere, during which instruments would measure atmospheric composition and meteorological data before the surface landing.

Principal investigator Larry Esposito of the University of Colorado, Boulder, noted that Venus is not hotter than Earth because it is closer to the sun, but because of greenhouse gases in its atmosphere. "This is global warming gone to an extreme that boiled the Venus oceans," he said, adding that terrestrial planets that

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**"The samples we have now come from a very small area on the moon ... We saw evidence for a late, heavy impact bombardment of the moon, and you don't have to extrapolate much to realize that this would have occurred on Earth as well."**

Brad Jolliff, principal investigator for MoonRise

**"Each portion of the mission contributes to our results: the approach photographs, the deceleration, chemical and physical measurements of the atmosphere, descent images, surface panoramas, microscopic images and spectroscopy of the surface."**

Larry Esposito, principal investigator for the Surface and Atmosphere Geochemical Explorer

# Station astronauts can breathe easier

## Shuttle flight will deliver Lab-developed instrument that will monitor air quality

**By Catherine Sum**

Members of the Vehicle Cabin Atmosphere Monitor team, from left: Ara Chutjian, Dan Karmon, Jim Hofman, Benny Toomarian, Murray Darrach, John MacAskill, Stojan Madzunkov, Arvid Croonquist and Richard Kidd.

Thanks to the upcoming delivery of a new instrument developed by JPL, astronauts aboard the International Space Station may soon be breathing a bit easier.

Aboard the STS-131 mission to the station for a scheduled April 5 launch is the Vehicle Cabin Atmosphere Monitor (VCAM), an instrument designed by a JPL team led by Ara Chutjian, supervisor of the Atomic and Molecular Physics Group.

The instrument, a gas chromatograph/mass spectrometer, will operate for one year aboard the space station. Its primary goals will be to analyze organic chemicals in the air, measure concentrations of the major atmospheric components (nitrogen, oxygen, carbon dioxide) and monitor any events such as chemical spills and cleanups within the cabin.

"The space station is the testbed for these sorts of long-duration space flights," said Murray Darrach, also from the Atomic and Molecular Physics Group, the co-investigator on the project. "Astronauts and everything on ISS give off gasses: their food, clothes, metabolism, all materials. They need to know what they're breathing and they need to be able to monitor those gasses."

Darrach said it took three-and-a-half years for several teams to bring the idea full circle. The proposal for VCAM came about after NASA sent out a broad call for instrument ideas, in which the idea submitted by JPL was awarded.

"VCAM is the first-ever gas chromatograph/mass spectrometer to be built and delivered by JPL," Chutjian said, adding that the Lab was responsible for providing the instrument's electronics and writing all software; system fabrication, assembly and testing were also carried out on Lab.

The atmosphere monitor is roughly the size of a microwave oven and weighs about 25 kilograms. Enclosed within its metal exterior are three main components that process the air: first, a small preconcentrator, followed by a gas-chromatograph column and a mass spectrometer. The steps in which the air is processed are important in order to get sensitive and accurate readings of trace species at parts-per-million to parts-per-billion concentration levels.

The technique by which chemicals are identified, the "fragmentation" or "fractionation" pattern, refers to how the gasses are broken down by ionization. The instrument identifies ions from the fragmentation pattern in conjunction with the length of time the chemicals spend in the gas chromatograph column. Each species spends a characteristic amount of time (known as the elution time) within the column.

Readouts from the instrument show the presence of "mass fingerprints" of chemicals as spikes on a graph in which the area of a peak corresponds to the concentration of each particular gas, said Darrach. If the instrument does detect a hazardous level of any particular chemical, the astronauts can be alerted, proper precautions taken and a subsequent cleanup process initiated, to remediate the atmosphere.

Once VCAM is powered up, it is no longer necessary for astronauts to operate the instrument. It is entirely self-contained and self-supporting, with internal gas canisters that allow it to work for up to a year. The instrument will be controlled by ground operations at JPL when needed, but will otherwise function autonomously, checking the air once a day and reporting back to computer servers on Lab.

Chutjian's team finished validating the flight unit in October 2009, after which it was taken to Kennedy Space Center and packaged into a multi-purpose logistics module.

But even in storage, awaiting delivery to STS-131 and launch, Chutjian said the instrument is still absorbing a lot of molecules, which "may obscure the operation of the mass spectrometer." Therefore, during the first several weeks onboard the station the instrument will be cleaned through pre-programmed operating steps: "It's ready to start working after all the molecular species are encouraged to desorb," he added. A replica of the VCAM flight model is being used on Lab to conduct further validation and testing.

Further plans for instruments such as VCAM include prototypes for a water module that will be able to extract organic species from the potable water on missions, as well as to keep tabs on the concentrations of both benign and toxic species in the water.

"The idea is to put together a testbed of a number of different monitors: air, water, surfaces, bacteria," Darrach said. "These instruments are all about heritage. Once you deliver and fly, it becomes easier because you have the gravitas already to get there."

Beyond VCAM's basic use as a "toxicology report for astronaut health," as Darrach puts it, Chutjian also noted the use of these instruments in almost any environment: for unmanned planetary missions, to measure isotopic ratios, for explosives detection and national security, and as terrestrial field instruments.

**MOON OR BEYOND** *Continued from page 1*

may be found by the Kepler mission could resemble Venus. "Our mission will develop detailed models based on our Venus findings that provide a context for these possible discoveries."

The Soviet Union landed a number of its Venera probes on Venus in the 1980s; the Surface and Atmosphere Geochemical Explorer would use the same style of descent system used by Venera as well as by JPL's Galileo and the Cassini-Huygens lander. A parachute, later discarded, draws the lander away from its heat shield. A soft landing allows pictures and spectroscopic studies of the surface. "Current technology can make decisive measurements of the elemental composition and surface mineralogy that are beyond the capabilities of the Soviet landers 25 years ago," Esposito said.

Esposito noted that although Venus' surface temperatures can reach upwards of 460 °C (860 °F), the lander's thermal inertia will allow it to stay cool for several hours before succumbing to the heat. He is confident about achieving significant data return.

"Each portion of the mission contributes to our results: the approach photographs, the deceleration, chemical and physical measurements of the atmosphere, descent images, surface panoramas, microscopic images and spectroscopy of the surface," he said. "The most important data will be sent to Earth first and replayed multiple times by the carrier spacecraft."

Both of JPL's New Frontiers proposals now lie in the mission-formulation phase, or phase A, during which technologies and concepts are brought to a more mature level of engineering design through identifying and mitigating risks. Concept study reports are due in January 2011, which will be followed by site visits by a NASA review board. NASA will select one New Frontiers mission for development in mid-2011.

If selected, MoonRise would be managed by JPL's Keyur Patel; if SAGE is selected, Jim Fanson would manage.

For more information, visit *http://moonrise.jpl.nasa.gov* and *http://sagemission.jpl.nasa.gov.*

Whether it's in icy Antarctica or in the Kepler cleanroom, Louise Hamlin has maintained her fascination.

# Dual passions inspire Hamlin

**By Catherine Sum**

At JPL, planning your life around the schedule of space missions becomes second nature for many employees. Besides fitting vacations into their work schedules, some have even planned the births of their children to take place during lulls between planetary encounters.

For engineer Louise Hamlin, a respite after finishing her work on one major mission gave her the opportunity to fulfill a lifelong dream—to spend nine months in Antarctica amid the ice, penguins and whales at the end of the world.

"It was absolutely amazing," said Hamlin, who joined the Lab in 2000. She noted that the opportunity to help protect the fragile, frozen environment made the trip to Antarctica a life-changing experience. "By far the most complex threat to the Antarctica ecosystem is the warming and melting of the continent. And when ice shelves melt or disappear, the ice-dependent species that live on them are hurt as well."

Hamlin's initial offer to join the U.S. Antarctic Program in one of the most fragile ecosystems in the world was delayed when she instead decided to become a part of JPL's landmark Kepler mission as a senior engineer. It was on that mission that the push and pull between her love for biology and deep-space exploration became apparent.

Just after Hamlin and the JPL team completed construction on Kepler after working for three years with partner Ball Aerospace in Boulder, Colo., she began a nine-month leave from JPL to work for the National Science Foundation Office of Polar Programs at Palmer Station, Antarctica.

The assignment came following postponement of several previous offers from the U.S. Antarctic Program. Then, the Kepler opportunity arose at the same time as the Antarctic Program, and Hamlin chose Kepler. The next time Antarctica called, she was finally ready to accept the offer.

"It was a point when I had finished my work that the chance came and the timing was good, so I took it," she said. "It had been a couple of years since they had an opening [at Palmer] and so I couldn't put it off any longer."

As a result, she watched Kepler's March 2009 launch via a satellite signal bounced off a Chilean weather satellite from her quarters at Palmer Station.

"Finishing Kepler was freeing for me," Hamlin said. "For a while I had wanted to transition from astrophysics back to Earth, and accomplishing Kepler gave me free rein to go back to biology."

Indeed, Hamlin's original offer was to work for a season at the South Pole, but when she learned about the marine environment at Palmer Station—situated on Anvers Island, some 800 miles from the southernmost point of Chile—she pushed for that instead, as she explained on her blog, 64South (*blog.louiseh.org*).

A typical day consisted of a 5 a.m. wake-up for group breakfast, which segued into individual assignments and several hours spent working in labs. Afternoons were typically spent in the field. Hamlin, the station's geophysics lead, installed and serviced GPS and meteorological stations on the glacier, collected air samples for the monitoring of greenhouse gas concentrations, took hourly sun measurements and conducted a bevy of other experiments.

She also collaborated with station marine biologists, helping in the field with penguins, seabirds, whales and seals.

The small team at Palmer (no more than 25 while Hamlin was there) meant individual members multitasked and took on different responsibilities at any given time, so Hamlin also served as a member of the search-and-rescue team and the station's fire marshal.

With Palmer Station being the smallest of the U.S. stations and one of the most isolated on Antarctica—it takes a week by boat to reach the station from Punta Arenas, Chile, the southernmost city in the world—Hamlin learned to give up all things familiar very quickly.

"I had to let go of most everyday technology," Hamlin said, laughing. "For a few weeks my thumbs kept reaching for my BlackBerry."

She also learned that day-to-day living in the alien landscape didn't mean she would grow accustomed to seeing miles and miles of snowy scenery. Even after a few months, Hamlin recalled, she imagined such objects as cars, squirrels and fallen leaves amidst the glaciers.

But acclimating to life on the far end of the world wasn't as bizarre as coming back to California. Hamlin said it took about six months to become fully comfortable within her old surroundings. "I had to learn how to make small talk again; cars were frightening!" she said. "The world felt like an enormous assault on my senses."

Despite the learning curve, Hamlin jumped back into her work, further reflecting her active and sometimes frenetic lifestyle.

"I'm fascinated by everything," said Hamlin, who has also contributed to the Cassini-Huygens mission and was a Team X senior engineer, proposal manager and instrument systems engineer. "I don't have a single focus but a lot of deep focuses."

She quickly accepted her new and current position with JPL, as deputy manager of the Next Generation Imaging Spectrometer project, which will deliver a visible and near-infrared instrument to map Earth's forests.

"It's a smart new way to monitor tropical rainforests," she said. "In the past you would need to land biologists in the actual terrain and have them spend a month cataloguing everything in one square mile. With this project, our customer can use every pixel of available light to see down through all the layers, mapping from the canopy down to the ground."

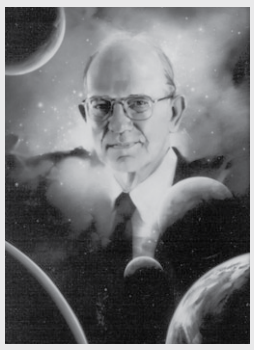
And as if her plate isn't already full enough, this fall Hamlin is planning her third trip to a village in Nepal with the U.S. branch of Engineers Without Borders to finish construction on a safe water source. She first became involved with the organization in 2006, attracted by its creed: "It's a group who feels a responsibility to less technologically-able people."

This particular project is in its final stages, and Hamlin said the upcoming trip is so the group can put finishing touches on the construction of a half-mile functional pipeline that provides water taps to villagers, much like those found commonplace in gardens. The goal is to have one tap stand for every 10 houses, Hamlin said.

Hamlin found that in addition to the people and places touched by Engineers Without Borders, she found the people she worked with to be particularly inspirational.

"I've never worked with concrete before and was surprised to find that it cures really well under water! I'm used to working with metal in propulsion and telescopes," said Hamlin. "So I think one of the best things about the organization is that it's a great mix of people who do different things, working together and learning. It reminds us that we can all play multiple, useful roles in this world."

# News Briefs



### Lew Allen tribute April 7

A memorial tribute for former JPL Director Lew Allen will be held Wednesday, April 7, at 11 a.m. in the Building 321 auditorium. Allen, who died Jan. 4 at age 84, served as Laboratory director from 1982 to 1990.

Carol Lachata / JPL Photo Lab

Lew Allen Award winners are joined by JPL Director Charles Elachi, left, and Chief Scientist Dan McCleese, right. From left are Cory Hill, Jeffrey Norris, Joshua Willis and Matt Bradford.

### Allen Award winners named

Four JPL researchers have been named winners of the 2009 Lew Allen Award for Excellence.

Charles (Matt) Bradford of the Astronomical Instrumentation Group (3265) was cited for the development of a novel design for a submillimeter/far-infrared grating spectrometer being used for ground-based discoveries and future observations from space.

Cory Hill of the Infrared Photonics Group (389G) was honored for technical innovation and leadership in developing epitaxial growth processes for advanced antimony-based optoelectronics and long-wave superlattice focal plane arrays for remote sensing systems.

Jeffrey Norris, supervisor of the Planning Software Systems Group (317F), was recognized for exemplary vision, innovation and leadership in fundamentally advancing the capabilities for scientific involvement in planning operations on NASA's missions.

Joshua Willis of the Ocean Circulation Group (3244) was cited for fundamental contributions to the understanding of global ocean circulation and sea-level change from analysis of satellite and in situ observations.

The Lew Allen Award is bestowed annually to recognize and encourage significant individual accomplishments or leadership in scientific research or technological innovation by JPL employees during the early years of their professional careers. The award consists of a wall plaque and $25,000 from the JPL Research and Technology Development Fund. The award is to be used at JPL in a manner consistent with the objectives and fiscal year constraints of the Research and Technology Development Fund.

### Optical award to Chahine

Moustafa Chahine

JPL researcher Moustafa Chahine is the 2010 winner of the George W. Goddard award in recognition of his exceptional achievement in optical science and instrumentation for aerospace and atmospheric research.

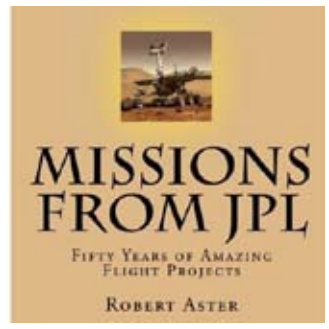
The annual award from the International Society for Optical Engineering is for the invention and development of a new technique, photonic instrumentation, instrument or system. An honorarium of $2,000 will be presented.

Chahine, science team leader for the Atmospheric Infrared Sounder instrument on NASA's Aqua spacecraft, is internationally recognized for his work in atmospheric remote sensing and its applications to weather and climate research. He is credited with developing an efficient inversion algorithm known as the "relaxation method" to convert satellite data to atmospheric variables, such as temperature, humidity and carbon dioxide. The AIRS $CO_2$ data from 2002 onward, at *http://disc.gsfc.nasa.gov/AIRS/data-holdings*, show a previously unknown belt of carbon dioxide enhancement surrounding the Southern Hemisphere at a height of three to 10 miles above the surface.

A time-series visualization of the global distribution and spatial variation of the concentration of mid-tropospheric $CO_2$ observed by the Atmospheric Infrared Sounder is available at *http://svs.gsfc.nasa.gov/vis/a000000/a003600/a003685.*

### New book spotlights 50 years at JPL

Robert Aster, a senior engineer in the Mission Systems Concepts Section (312), is the author of a new book titled "Missions from JPL—50 Years of Amazing Flight Projects." The heavily illustrated book is written for a general audience and describes every mission JPL has launched for NASA from 1958 through 2008.




Aster joined JPL in 1976 to work on photovoltaic technology development, moved to information systems in 1984, and finally to flight project planning in 1991. He has contributed material to many of JPL's project proposals and plans since that time.

### Muhlmann Award goes to Spitzer team

The Spitzer Space Telescope team has been selected to receive the 2010 Muhlmann Award from the Astronomical Society of the Pacific.

The award is given for recent significant observational results made possible by innovative advances in astronomical instrumentation, software or observational infrastructure. The team was cited "for important research results based upon development of groundbreaking instruments and techniques." Spitzer Project Scientist Michael Werner will accept the prize at an awards banquet in August.

### Explorer Awards bestowed

A ceremony honoring winners of JPL's Explorer Award took place March 23 at Caltech.

The Explorer Award, which recognizes significant individual technical/business accomplishments and outstanding performance, honors individuals based on four categories of excellence and is the highest individual award granted by JPL to its employees.

The event also included the Edward Stone Award for Outstanding Research Publication, administered by the Office of the Chief Scientist.

The 2010 Explorer Award honorees:

Strategic Leadership: Charles Bell, Lydia Dubon, Valerie Duval, Michael Gunson, Elizabeth Kolawa.

Scientific and Technical Excellence: Patricia Beauchamp, Ara Chutjian, Tracy Drain, Renaud Goullioud, Brian Kennedy, Thomas Ramsey.

Effective Business Management: Paul Averill, Robin Dumas, Julie Kung, Michael Stefanini.

Effective Partnerships and Relationships: Calvin Chambers, Brian Cooke, Kevin Hussey.

The 2010 Ed Stone Award honorees:

Eric Fielding, Michael Janssen, Michael Hecht.

For more information, visit *http://hr/compensation/reward/bonus.cfm.*



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**Editor**
*Mark Whalen*

**Design**
*Audrey Steffan*

**Production**
*David Hinkle*

**Photography**
*JPL Photo Lab*

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# Passings

**Dennis Nightingale,** 85, a retired engineer, died Jan. 16.

Nightingale worked at JPL from 1965 to 1993. He is survived by daughter Margaret Kitchens.

**Kenneth Halton Sr.,** 82, a retired administrative assistant, died Jan. 29.

Halton joined JPL in 1964 and retired in 1993 from Section 353. He is survived by his wife Mary; children Roy, Marie and Peter; five granddaughters and four great-grandchildren. Services were held Feb. 9 at Miller-Jones Mortuary in Hemet.

**Mary McGough**, 81, a retired Photo Lab technician, died Feb. 8.

McGough, who worked at JPL from 1956 to 1994, provided images to the science teams of all early missions at JPL up through Voyager.

She is survived by her husband, Marvin Moss, 13 nieces and nephews,

Mary McGough

some 40 great nieces and nephews, and more than a dozen great-great nieces and nephews. A memorial service celebrating McGough's life will be held April 24 at 12:30 p.m. at the Eaton Canyon Nature Center, 1750 N. Altadena Drive, Pasadena.

**Ralph Beal Jr.**, 93, retired wind tunnel test manager, technical facilities design and construction manager and facilities office manager, died Feb. 15.

Beal joined JPL in 1953 and retired in 1982. He is survived by sons Richard and John, grandchildren Chandra and Andrew, great granddaughter Rebekah and step-grandson Matthew.

Ralph Beal Jr.

Services were held in Pacific Grove, Calif. In lieu of flowers, the family suggests contributions to the Shriners Hospital for Children in Los Angeles.

# Letters

I would like to thank all my friends and co-workers for their love and support in the recent passing of my dad. Their kind thoughts and prayers are very much appreciated. I would also like to thank the ERC for the beautiful plant.

Rebecca Klages

My family and I would like to thank JPL and friends for the lovely plant that was sent upon our mother's passing in February. Your thoughtfulness was much appreciated.

Patricia L. Patterson and family

# Retirees

The following JPL employees retired in March:

**Jan Smith**, 33 years, Section 3210; **B.C. Lathrop-Pino**, 29 years, Section 2103; **Zdenek Sekanina**, 29 years, Section 3224; **Gail Yepez,** 27 years, Section 2200; **Eric Fuller**, 26 years, Section 2032; **Curtis Boswell**, 14 years, Section 3456; **Ida Young**, 14 years, Section 2221.