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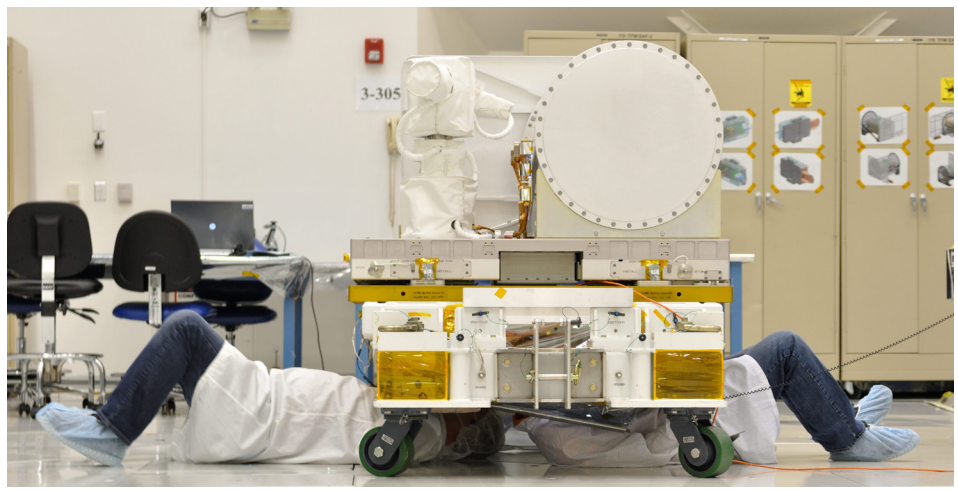
Breaking the bottleneck

Laser video demo on Space Station aims to vastly improve downlink rates

By Mark Whalen



Technicians at Kennedy Space Center unload and inspect the Optical Payload for Lasercomm Science payload after its arrival last summer. It's scheduled to launch no earlier than March 1.

Sometime in the near future, a group of young JPL engineers could look back on 2014 not only as the early days of their careers but also as the time they were part of critical research that's one of the keys to NASA's future success.

A group of about 20 JPLers in the lab's Phaeton early-career-hire program contributed to the Optical Payload for Lasercomm Science, or OPALS, which is preparing for a March 1 launch from Kennedy Space Center to the International Space Station. The goal? To lay the foundation that could boost the rate at which spacecraft send data to Earth by more than a factor of 10.

Major improvement in optical communications has the potential to be a "game-changer," said mission manager Matt Abrahamson. "Right now, many of our deep-space missions communicate at 200 to 400 kilobits per second, and OPALS would be a technology that brings it to 50 megabits per second," he said.

"It's like upgrading from dial-up to DSL," added project systems engineer Bogdan Oaida. "Our ability to collect data has greatly outpaced our ability to downlink it. You know how much we're limited trying to download a movie at home; it's essentially the same problem in space, whether we're talking about low-Earth orbit or deep space."

The technology demo—conceived, developed, built and tested at JPL—will be mounted on the station's exterior. When the orbiting lab passes over JPL's Table Mountain Observatory near Wrightwood, the payload will use a laser beam to transmit a video to Earth.

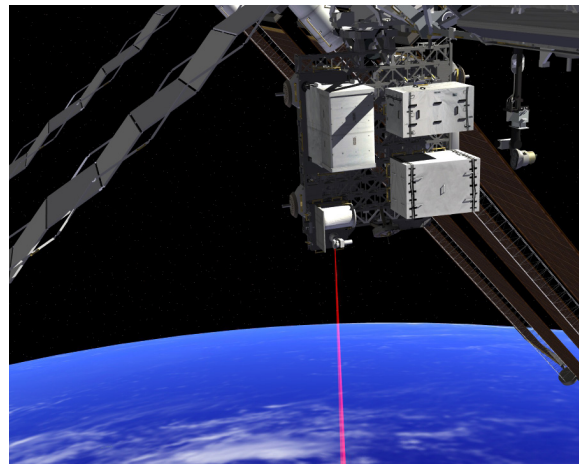
The 90-day mission is JPL's first payload to be mounted on the outside of the space station (two others have gone inside), and the first to launch on a SpaceX vehicle. When the Dragon capsule docks with the station, OPALS will be robotically extracted from the trunk of the Dragon, then manipulated by a robotic arm for positioning.

The JPL experiment won't be serviceable from its outpost. OPALS could operate for up to two years, noted Oaida.

What next? If OPALS is successful, the next step would be to try to miniaturize the technology for deep-space missions. "We were not constrained by mass, volume or power on this mission," said Abrahamson. "We think we could scale down that size by factor of 10 or better."

Throughout the five-year development process and at all levels of the project, an early career hire has been responsible for each aspect of hardware or software delivery. True to its mission, the Phaeton Program set up each of the young engineers with an experienced mentor to help them navigate the technical and programmatic hurdles that were certain to arise. There were instances, however, where a number of JPL senior technical staff were brought in to lead the development, such as the electrical systems, cabling and the ground system at Table Mountain.

Early missions can be daunting for newer JPLers. The space station "is a huge interface, both technically and bureaucratically," said Oaida. "For example, there were, at most, 30 of us on our team,



Artist's rendering shows laser beam transmitting from the space station payload to Earth.

but while working with staff at the space station, Kennedy Space Center and elsewhere in NASA, we interfaced with more than 300 people—for each one of us, there were 10 of them to communicate with."

As for many others at JPL before them, the mission has been a big learning experience for everyone involved as well. "It's not like we came in knowing what to do. We had to learn how to do it and do it at the same time," Oaida said. "There were growing pains, to be sure."

JPL's RapidScat, Orbiting Carbon Observatory 3 and Cold Atom Laboratory missions are due for space station visits over the next couple of years, and Oaida hopes his team's experiences will impart positive lessons. "Hopefully all of them will benefit not just from our technical success but also from knowing about what it takes" to get to the station.

Woodbury staff to move into 'open landscape'

By Mark Whalen

JPL and other federal facilities have a mandate to reduce their footprint. To make it happen, about 300 staff members will be relocated from the Woodbury complex to JPL's Oak Grove site beginning this summer.

To help achieve the plan, about 200 JPLers at Oak Grove will be relocated to remodeled facilities. The first of the newly remodeled areas, the second floor of Building 158, housing 85 people, began occupancy the first week of February with the collocation of Section 398, Instrument Software and Science Data Systems.

Building 171 will be extensively remodeled to accommodate Woodbury staff. This summer, 86 members of the Office of the CIO are scheduled to move from Building 602 to the third floor of 171 and the second floor of Building 111. Another 24 people from that directorate will move to the first floor of 230 as well. About 180 people from Enterprise Business Information Services, Financial Contract Management and Human Resources Information Systems will move from Building 601 to Building 171 and Building 202 by early fall.

Current Division 38 staff and laboratories in Building 171 first floor, along with the Regional Planetary Image Facility in Building 202 first floor, will be relocated.

Workspaces in the revitalized areas will be organized in an "open landscape" style with a higher density of office space and reduced-size cubicles, said Jose Coito, project manager for the move. Fewer hard-walled offices will be available.

The open landscape concept is nothing new for JPL, said Coito. The Flight Projects Center, Building 321, first adapted this office space concept that is being modeled for the Woodbury moves. The goal is for employees to make more use of common areas, such as break areas and conference rooms, he said, adding that the plan will set the standard for future building remodels throughout JPL.

Along with consultant Branka Olson, JPL Facilities is working closely with Woodbury organizations to understand their unique needs and maintain synergy among work groups.

Coito said JPLers will adjust to new digs with changes to various environmental parameters, including how to best reduce overall noise levels. "We're trying to be proactive, making it as habitable as we can," he said. "Part of this project is upgrading the heating, ventilation and air-conditioning system in 171 to be able to have better control of these areas."

When the 171 remodel is finished, Coito said, about 65 more staffers will occupy the building than currently. The third floor is planned to increase from about 75 to 90 people; second floor from about 70 to 100; first floor will have about 50 people, compared to about 30 currently.

"We are taking the opportunity in these large areas to reduce the footprint. As Facilities remodels other buildings throughout JPL, this new standard will be used," said Coito. "Overall, the footprint per worker will be reduced. We'll need to do similar things as we move forward, especially when organizations reorganize."

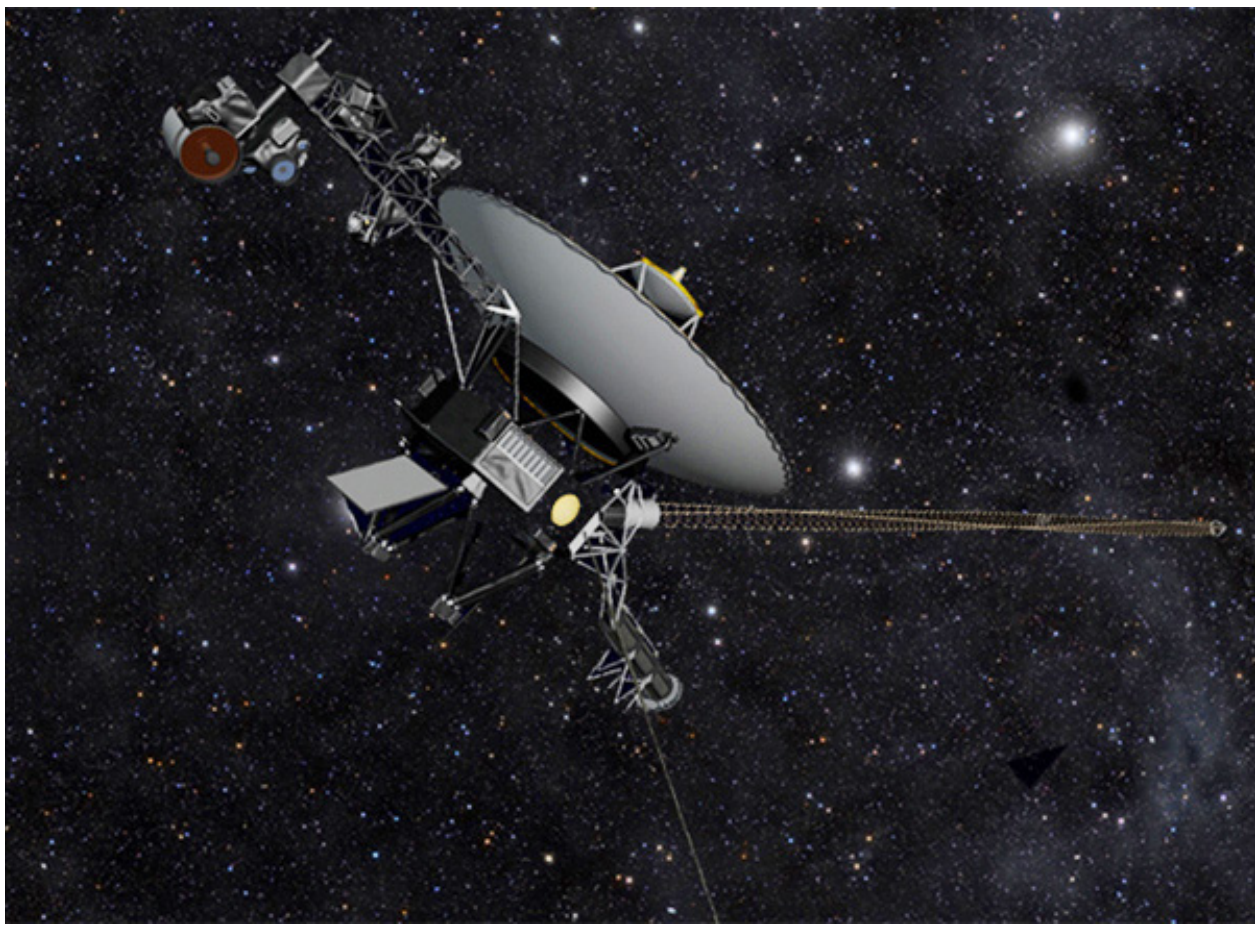
Mario López

Collaborative cubicle design in the newly remodeled second floor of Building 158.

Coincidentally, the new JPL parking structure should be fully operational in August, said structure project manager Randy Wager.

To complete the move out of the Woodbury facility, Coito said, plans are being developed for the data center and staff in Building 600.

'THE STUFF OF DREAMS,' FEB. 19



Recently, JPL's Voyager 1 spacecraft, after some 35 years of operation, reached the space between the stars—the first time a human-made object has ever gone beyond the breath of our sun's wind. What isn't widely known is that the project almost never got off the ground.

Written, produced and directed by Blaine Baggett, JPL's director for communications and education, a new documentary debuting Feb. 19—"The Stuff of Dreams"—describes the challenges mission managers and the lab had to face developing and launching the twin Voyager spacecraft and operating them during the encounters with Jupiter and Saturn.

Through first-hand accounts of those who were there, the film shows how the mission and JPL survived times of uncertainty and debate about the future of the U.S. space program and managed to fly the smartest robots of that age on the most ambitious planetary tour ever designed. Through this storm came the delivery of the first images of volcanoes erupting on another body in our solar system (Jupiter's moon Io), autonomous controls being built into every craft we send out into space today, and seeds for the Magellan mission to Venus, rovers on Mars, the Galileo mission to Jupiter and the Cassini–Huygens mission to Saturn.

The Stuff of Dreams
Wednesday, Feb. 19, 7:30 p.m.
Caltech's Beckman Auditorium
Free admission

Heavy metalworks

By Mark Whalen

High-tech alloys net Presidential nod for JPL's Hofmann

Doug Hofmann next to an arc melting system, used for melting and casting molten metal.

In the arc melter, pure elements are consolidated into homogenous ingots of metal alloys, which are then melted and cast into parts, either for prototyping or for mechanical behavior.

A progression of casting metallic glasses into the shape of a one-inch-diameter hollow cup, which will be later used as a casing for a gearbox.

In a small, nondescript building near JPL's Mars Yard sits a busy lab strewn with scraps of metal and the machinery to turn them into useful alloys and parts.

For researcher and former tennis semipro Doug Hofmann, it's a place to serve up a grand slam of materials innovation for JPL and NASA.

In December, Hofmann, who has been with JPL since 2010, was one of five NASA researchers named by President Obama to receive the 2013 Presidential Early Career Award for Scientists and Engineers.

They will receive their awards in a ceremony early this year in Washington. The honor is the highest bestowed by the U.S. government on scientists and engineers beginning their research careers and recognizes their leadership potential.

"This is a huge honor and I am privileged to represent JPL and NASA," said Hofmann, who founded JPL's new Metallurgy Facility.

His interest in tennis, as well as golf, helped seal his ticket to Caltech before joining JPL. After earning degrees in mechanical engineering from UC San Diego, where he ranked 50th in the nation in NCAA Division II tennis as an undergrad, an advisor recommended that he check out Caltech's research in liquid metal as a natural fit. The material is used for both tennis rackets and golf clubs.

While pursuing his Ph.D. at Caltech, Hofmann also served as the institute's assistant tennis coach and competed in some low-level pro events. For good measure, he threw in regular sessions as a hitting partner for world-class pros Serena Williams and Conchita Martinez.

Today, when Hofmann isn't working as a lecturer and visiting associate in materials science and applied physics at Caltech, he's leading a new group of three at JPL that develops and prototypes new alloys, fabbing up gears, structures, mechanisms and mirrors.

Most metals are known for a highly ordered crystalline structure when they are solids, but in recent years scientists have become intrigued by "metallic glass"—metals with a disordered, glass-like structure at the atomic level. Hofmann and others see it as a promising material to use in building the next generation of spacecraft.

Compared to conventional metals, metallic glasses can be produced that are exceptionally strong, elastic, hard, corrosion-resistant or wear-resistant. "Most notably, metallic glasses can be injection cast, allowing them to take advantage of the low-cost economics of plastics while being able to be formed into complex shapes," said Hofmann.

"In some cases we go to industry and teach them how to fabricate parts, with the downstream idea being that if industry knows how to fabricate them then JPL can consume them to put them on spacecraft," Hofmann said.

Hofmann is encouraged by renewed interest at the federal level for materials research. Last spring, the Obama Administration set up competitions to create three new manufacturing innovation institutes in five federal agencies, including NASA. "Materials and manufacturing are the big buzzwords now, largely based on the White House supporting $200 million worth of manufacturing centers," Hofmann said.

Why do the spacecraft of the future need new metals? "Every place we go in space has a new set of requirements," said Hofmann. "For whatever the environment is we're going to, particular materials behave well or don't behave well in those environments. In many missions, we have reached our limit with existing materials in terms of their mechanical performance."

To help keep up with current needs and trends, Hofmann spends about a quarter of his time as a core member of the Innovation Foundry's A-Team, which vets all of JPL's early-stage mission concepts. "Basically we go from the back of the cocktail napkin to the point where we can turn it over to Team X, which does advanced evaluation of mission concept designs."

Hofmann believes JPL can be a leader in materials science research, in fields such as metallic glasses and additive manufacturing.

"My ultimate goal is to establish JPL as one of the world's leaders in the development of materials and manufacturing technologies," he said. "My group and my section have done amazing work in supporting me, and I think our new effort has great potential for success. As we build our capabilities at JPL, I would like to see our group working on both basic materials science research as well infusing our technology into missions and industry."

News Briefs

Instrument Incubator funding awarded

JPL has been awarded six of 17 proposals recently selected for funding by NASA's Instrument Incubator Program in support of the Earth Science Division. JPL will lead four of the six selected and will be co-investigators on two of them.

Here are the JPL awardees, with proposal and principal investigator:

'A Compact Adaptable Microwave Limb Sounder for Atmospheric Composition,' Nathaniel Livesey

Proposes to develop an engineering model integrating key enabling system and subsystem technologies for a Compact Adaptable Microwave Limb Sounder for atmospheric composition. The team will develop the core receiver/spectrometer system for a 340-GHz instrument making unique and essential observations of composition, humidity, temperature and clouds in Earth's upper troposphere.

'Snow and Water: Imaging Spectroscopy for Coasts and Snow Cover,' Pantazis Mouroulis

This proposal addresses the NASA Earth Science focus areas of carbon cycle and ecosystems, and water and energy cycle. The team will develop and demonstrate a scalable imaging spectrometer system that is suitable for small satellites, including cubesats.

'Ka-band Doppler Scatterometer for Measurements of Ocean Vector Winds and Surface Currents,' Dragana Perkovic

The proposed first demonstrator instrument of a new measurement technique to measure both currents and winds using a compact radar instrument, a spinning Ka-band, pencil-beam Doppler scatterometer system that will demonstrate measurements that can be scaled to wide-swath spaceborne observations using a single, cost-effective instrument.

'Three Band Cloud and Precipitation Radar,' Gregory Sadowy

The team proposes to design and demonstrate key enabling technologies for cloud and precipitation radars capable of closing observational gaps left by current and upcoming missions. The instrument, employing Ku-, Ka- and W-band, enables the simultaneous three-band observation, Doppler measurement, cross-track electronic scanning and polarimetry.

'Wide-band Millimeter and Sub-Millimeter Wave Radiometer Instrument to Measure Tropospheric Water and Cloud ICE,' Steven Reising/Colorado State University (JPL co-investigator Pekka Kangaslahti)

A proposal to develop, fabricate and test a new, multi-frequency millimeter and sub-millimeter-wave radiometer instrument that will address the need for measurements of water vapor and cloud ice in the upper troposphere at a variety of local times, to provide data not currently available from microwave sensors in sun-synchronous orbits.

'MISTiC Winds,' Kevin Maschhoff/BAE Systems (JPL co-investigator Hartmut Aumann)

A proposed three-year effort to advance the readiness of an approach based on a miniature high resolution, wide field, thermal emission spectrometry instrument that will provide global tropospheric profiles of atmospheric temperature and humidity at high (two- to three-kilometer) spatial resolution. The capability would be a critical tool in the study of transport processes for water vapor, clouds, pollution, and aerosols.

For a complete list of the awardees, please visit *http://esto.nasa.gov/files/solicitations/IIP_13/ROSES2013_IIP_A40_awards.html.*

Cold Atom Lab proposals funded

Seven proposals to conduct physics research using the JPL-managed Cold Atom Laboratory, which is scheduled to launch to the International Space Station in 2016, have been funded by NASA's Physical Science Research Program.

One of the seven, "Fundamental Interactions for Atom Interferometry with Ultracold Quantum Gases in a Microgravity Environment," will be led by Jason Williams of JPL's Quantum Sciences and Technology Group.

The chosen proposals came from seven research teams, which include three Nobel laureates. The proposals will receive a total of about $12.7 million over a four- to five-year period.

Five of the selected proposals will involve flight experiments using the Cold Atom Laboratory aboard the space station, following ground-based research activities to prepare the experiments for flight. Two of the selected proposals call for ground-based research to help NASA plan for future flight experiments.

JPL is developing the Cold Atom Laboratory instrument in-house. Anita Sengupta is project manager.

More information is online at *http://coldatomlab.jpl.nasa.gov.* For a complete list of the selected proposals, principal investigators and organizations, visit *http://go.nasa.gov/M6hcRp.*

Weinreb receives society honor

Sander Weinreb, a researcher in the Microwave Systems Technology Group, has received the American Astronomical Society Joseph Weber Award for Astronomical Instrumentation. He was recognized for his seminal innovations that have helped define modern-day radio astronomy, including digital autocorrelation spectrometers and cryogenic low-noise amplifiers and mixers.

Sander Weinreb

Weinreb was also cited for providing outstanding leadership for radio-astronomy instrumentation, especially for the electronics system of the National Radio Astronomy Observatory's Very Large Array. His innovations have been utilized in all radio observatories and have enabled countless astronomical discoveries.

In addition to his JPL work, Weinreb is a faculty associate in electrical engineering at Caltech.

Passings

Helen McGehee, 90, a retired secretary, died Oct. 8.

McGehee, who joined JPL in 1983, worked in the Solar Irradiance Group within the Cometary and Atmospheric Section 324 as well as the section office. She retired in 1997.

Gordie Maughan

Gordon Maughan, 81, a retired photographer, died Dec. 6.

Maughan worked at JPL from 1954 to 1998. At the time of his retirement, he was group leader of the Photographers Group. For his work at JPL, Maughan in 1961 received a Grand Award from the Professional Photographers of California.

Maughan is survived by children Nadine Maughan, Sharon Connell, Alisa Mustoe, Dan Maughan and many grandchildren and great grandchildren. Burial was held in Green Bay, Wisc. A private service is to be held in spring 2014.

Roy Appleby, 81, a retired electrical engineer, died Dec. 10.

Appleby worked at JPL from 1962 to 1995 in flight systems and test operations. He contributed to the Surveyor, Ranger, Viking, Mariner, Magellan, Mars Observer, Voyager, Galileo, Cassini, Seasat and Topex projects.

Appleby is survived by his wife, Patricia, seven children, 10 grandchildren and one great-granddaughter. A memorial service was held at Tujunga United Methodist church.

Diane Montini, 61, a retired subcontracts manager, died Dec. 14.

Montini worked at JPL from 1987 to 2010 in the Acquisition Division. She was honored with a group and JPL Bonus Award for her outstanding performance and innovative approach on the Technology and Applications Programs Support Contract (2000–03).

Services were held Dec. 21 at All Souls Cemetery in Long Beach.

Joseph Fearey, 84, a retired Deep Space Network manager, died Dec. 22.

Fearey joined JPL in 1956. He managed the Deep Space Network's Station 62 in Cebreros, Spain, for five years, overseeing the construction of the antenna and facilities. He was a key contributor and developer of JPL's military training simulation program, and also contributed to Sergeant missile aerodynamics as well as lunar and deep-space vehicle orbit determination.

In 1993 Fearey earned NASA's Exceptional Achievement Award in Technology and Applications Programs for innovative leadership in the establishment, research, and development of large-scale computer simulation for training senior military officers. He retired in 1990.

Fearey is survived by his wife, Deirdre; son Joe; daughters Michelle, Cheryl, Cecile and Moira; brother Peter James Fearey and his wife Linda. Services were held Jan. 12 in Palm Desert, Calif.

Jim Scott

Jim Scott, 83, retired Magellan project manager, died Jan. 19.

Scott joined JPL in 1959. He was a systems engineer for the Ranger missions as well as Mariner, Viking and Seasat.

Scott led the Magellan flight team in being the first mission to perform aerobraking. Following his retirement in 1993, Scott served on the standing review board for Cassini until 1998.

Scott is survived by his wife, retired JPL employee Marilyn Scott; children Jim, Janet and JPL employee Charles Scott; and grandchildren Eren, Taner, Steven, Michael and Brian. In lieu of flowers, donations are requested to the Wounded Warrior Project, the American Indian College Fund or the Arbor Day Foundation. A remembrance of Scott's life is being planned for early March at his home in the Palmdale area.

Letters

My family and I would like to thank my JPL friends and colleagues for their thoughts, prayers and condolences on the recent passing of my father, Mike Ocampo. We would also like to thank JPL for the beautiful plant sent in his remembrance.

Juan J. Ocampo

I would like to thank my friends and colleagues and JPL for the condolences, kind thoughts, and lovely plants I received following the recent passing of my father. Your sympathies were greatly appreciated.

Tom Runge

Retirees

The following employees retired in January: **Fred Vescelus**, 48 years, Section 7000; **Terry Linick**, 39 years, Section 9300; **Esternola Lawrence**, 16 years, Section 1000; **Bruce Brymer**, 12 years, Section 394B.

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