

## Good year at Ceres

By Mark Whalen

### Dawn is in its closest and final orbit of dwarf planet

When the Dawn spacecraft tucked into orbit around the dwarf planet Ceres in early 2015, it was arriving at a completely unexplored world. A year later, the Dawn team knows vastly more about Ceres, but plenty of mysteries remain.

Dawn is now in its fourth and final mapping orbit around Ceres. Current plans call for the spacecraft to continue taking data in the close orbit through June 30, when the primary mission ends.

The latest images, taken from 240 miles above Ceres, show new details at Occator Crater, noted Dawn Deputy Project Manager Marc Rayman. When Dawn was farther away, the crater appeared to contain a single bright spot. But when Dawn reached its current orbit, the feature was revealed to be two spots.

“Now, this complex distribution of reflective material reveals a 57-mile-diameter crater with a complex and intriguing pattern of reflective material inside,” said Rayman.

Overall, the body’s defining feature, the bright spots, have been observed at multiple sites across Ceres—more than 130 locations so far by the science team, said Rayman.

Oxo Crater, about six miles in diameter, is notable for its mysterious bright materials inside and out. Rayman said a spectrometer on Dawn observed water on its surface, likely in the form of ice or hydrated minerals. It’s the only area where water was observed.

“Following the impact that excavated Occator Crater, scientists believe under-

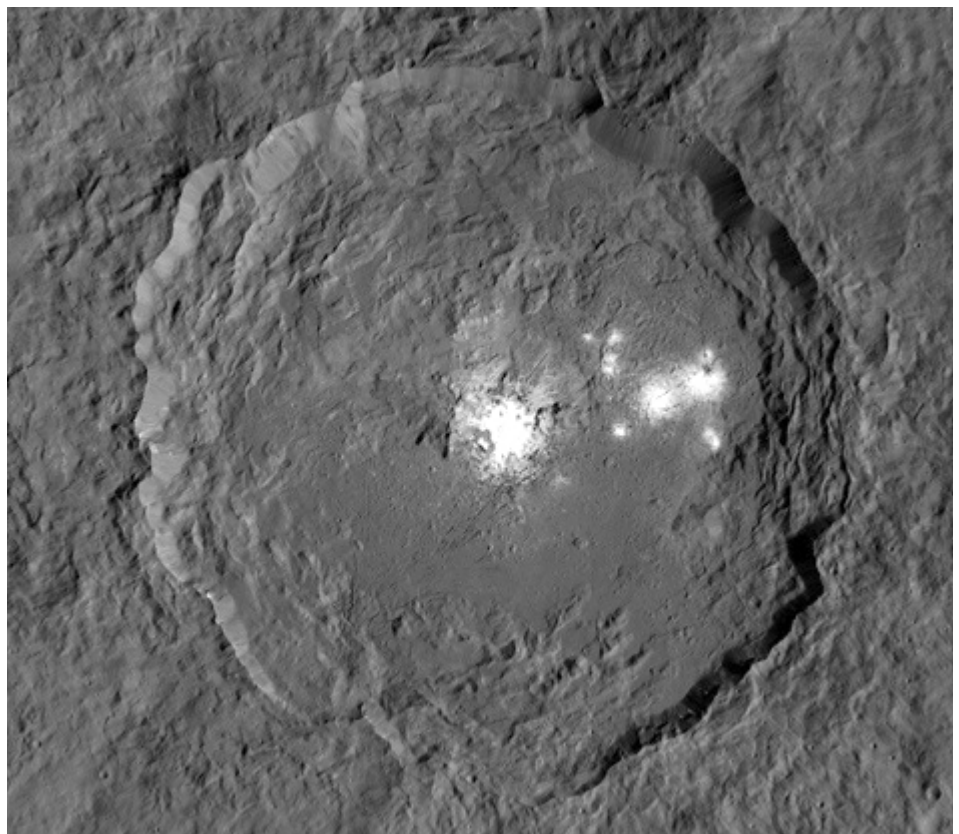
ground salt water probably rose to the surface,” said Rayman. The water would have been transformed to vapor, leaving behind dissolved salts, which are more reflective than the rest of the surface there, he added.

“Being able to see in Occator Crater, perhaps, the residue from salt water that’s departed, and in Oxo, being able to see the water itself—these are two important pieces in the puzzle of how this dwarf planet works,” said Rayman.

Another intriguing feature, Ahuna Mons, appears to rise up from the landscape suddenly in an otherwise-unremarkable area. The tallest mountain on Ceres, it has well-defined, steep sides with a summit that’s higher than any peak in the continental United States.

Dawn made history last year as the first mission to reach a dwarf planet, and the first to orbit two distinct extraterrestrial targets, both in the main asteroid

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Occator Crater, measuring 57 miles across and 2.5 miles deep, contains the brightest area on Ceres.

# Eyes on the skies

Studies of near-Earth objects accelerate

By Mark Whalen

*To meet potential dangers from asteroids and comets that could impact Earth, NASA has increased its efforts to find and study near-Earth objects, or “NEOs,” and it has formed a new Planetary Defense Coordination Office at Headquarters. Paul Chodas, manager of JPL’s Center for Near Earth Object Studies, discusses these new developments.*

## Does the reorganization affect your group at JPL?

Yes, in a good way. The formation of the new office at Headquarters reflects an increased emphasis on near-Earth objects within the agency, and our group’s contributions will continue and expand into new areas. Since the very beginning of NASA’s NEO Program in 1998, we’ve played a leading role, by performing high-precision orbit calculations, predicting close approaches, assessing potential impact probabilities, and supporting the observing community. We host NASA’s prime NEO website, <http://neo.jpl.nasa.gov>, where we post our continually updated results, including risk assessments from our Sentry impact monitoring software. Future new activities will include evaluations of the performance of NASA’s asteroid search programs, and finding ways to optimize their combined performance. Our group will also play a key technical role in coordinating planetary defense studies for specific objects, and strategizing on the best deflection approaches.

## Are JPL telescopes helping keep track of the asteroid population?

Our NEOWISE mission plays an important role. Although the vast majority of NEOs are discovered by ground-based optical telescopes, NEOWISE provides a complementary space-based discovery capability. Searching in the infrared, it has found some very interesting, large asteroids that we couldn’t easily find from Earth, and as a bonus, the mission provides much more accurate size estimates than we can get from the ground. NEOWISE was very successful at finding asteroids in its prime mission and it continues to be productive after being reactivated a couple years ago in its “warm” mission. But it can only operate for another

year or so before its orbit becomes unfavorable and its instrument warms up too much.

## Is the Spitzer Space Telescope still contributing?

Yes, but it’s used for characterizing known asteroids, not searching for new ones. Spitzer has observed hundreds of asteroids and acquired good data on their sizes and albedos, or brightness, and those observations should continue as long as the extended mission continues to be funded.

## JPL also uses radar to observe asteroids. How is that progressing?

JPL’s radar program has been observing asteroids for decades, and today there is accelerated interest in this tremendous capability. Radar is very useful for tracking orbits, but it’s also unique in its capability to image objects and determine their size, shape, surface roughness and albedo. As our capabilities for discovering asteroids improve, we’re finding more of them, and there are more opportunities to observe them with radar.

## What exactly is the main goal of NASA’s NEO Program?

To find as many potentially hazardous objects as possible, as early as possible, and determine where they are headed. Our JPL group is responsible for determining where all those NEOs are going. In 1998, Congress gave NASA the goal of finding 90 percent of the NEOs larger than 1 kilometer in size. Statistical modeling of the discovery rate indicates the total population of NEOs of this size is about 950, which means we reached the 90 percent goal several years ago. We know we’re approaching completion because for this size range, the vast majority of NEOs we’re detecting are already known.



Paul Chodas

Congress upped the ante in 2005 by asking NASA to find 90 percent of the NEOs larger than 140 meters in size, which we estimate to number about 25,000. This is a much more ambitious goal, of course. Currently, we know of about 20 percent of the population down to this size, but reaching 90 percent in a reasonable amount of time will require larger and more capable telescopes; smaller asteroids are simply much fainter.

## How does the asteroid confirmation process work?

A survey takes several images a night of each area of the sky and looks for objects that shift position from one image to the next, relative to the fixed stars. The coordinates of a suspected asteroid are sent to the Minor Planet Center in Cambridge, Mass., which determines whether it’s a known object. They post coordinates of new objects on a special web page and seek confirming observations from independent observers, often on another night. We have a special software system called Scout, which monitors suspected NEOs even during the confirmation stage, and predicts their future motions so that we would have the earliest possible warning in case one of these is headed for Earth.

Once confirmed, the Minor Planet Center assigns a designation that includes the year

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# It's fun, no kidding

By Mark Whalen

JPL astronomer shows kids that science isn't always serious

Oh, to be a kid again.

In Amy Mainzer's case, a PBS kid.

The JPL astronomer, inspired as a youngster watching *3-2-1 Contact*, *The Electric Company* and other children's programs, today enjoys showing kids the fun side of science on a new PBS series.

*Ready Jet Go*, which debuted in February, is an animated production about two neighborhood playmates and their new friend, an outer-space alien named Jet Propulsion. Jet and his family put their saucer down in a tiny town in the Pacific Northwest built up around a facility called the Deep Space Array.

"We wanted to set aside the preconceived notion that you shouldn't be having fun, that science and learning have to be very serious at all times," said Mainzer, deputy project scientist for the Wide-field Infrared Survey Explorer and the principal investigator for the NEOWISE mission using that spacecraft to study minor planets.

KOCE-TV, the PBS station in the greater Los Angeles area, airs the half-hour show at 7:30 a.m. and 4 p.m. daily (check local listings). Each features two 11-minute animated episodes along with 90-second interstitials hosted by Mainzer. Besides visiting interesting facilities like the Deep Space Network and Palomar Observatory, she has explained science concepts such as making an electromagnet and visualizing sound waves, just right for the production's target audience, children age 3 through 8.

"We wanted to have a way of helping kids distinguish what is real and what is science fiction," said Mainzer. "We're giving them a behind-the-scenes viewpoint of what it's like to work in the space business—how to operate a telescope or drive a spacecraft, for example.

"It's very important that we reach kids when they're little," she added. "Kids can make very big, far-reaching decisions about their lives. I decided I wanted to be a scientist when I was about 6 or 7. There are a lot of people who work in technical fields who are like that. And we



Amy Mainzer explains how JPL's Stardust mission used aerogel to pick up pieces of a comet's tail.

want to build up kids' love of science and learning how things work so they have less chance of getting pushed away from these subjects when they get to middle school."

Mainzer was a Voyager kid too, clipping photos from the flagship tour of the solar system. "I saved every image from Voyager that I could find in newspapers and magazines; up-to-date information was hard to come by." She later followed astronomer Carl Sagan's acclaimed PBS series *Cosmos*, which showcased JPL's research as well. "So I was dimly aware that JPL was probably an important place," she added.

Production is wrapping up on the show's first season, and a follow-up season is under consideration. Its popularity could keep it going.

"The surprising thing is that even though the show has only been on the air since mid-February, I've already gotten some pretty amazing responses from kids and parents," said Mainzer. "The first season focuses on teaching kids about Earth's back yard, our solar system. One of my favorite responses so far is a picture of a little girl holding up her drawing of the solar system. It's cool to

see kids get excited about science and astronomy, and it's great to see so many parents who encourage their curiosity."

Several JPLers have made appearances, Mainzer said, "just because people at JPL have such amazing jobs. We want to show kids that this world and this life is for them. Science is for everyone. The kind of work we do here is something that they can do too."

Why not JPL, indeed?

"If our oldest audience member is 8 years old today," she mused, "I'm really hoping that in 10 to 12 years we get a boatload of applications from kids who want to do internships and who watched the show when they were young."

Working with the *Ready Jet Go* production team reminds Mainzer of working with her NEOWISE team on Lab. "They're fun people, like family," she said. "Everyone gets along well, and they're invested in the same issues—trying to get kids excited about science and math.

"This has been a wonderful complement to my day job," she said, "because it's good to think about the big picture—why we do science, what we're trying to accomplish, what it all means."

# InSight to fly in 2018

Launch targeted for May, landing in November

By Mark Whalen

JPL and its partner teams on the InSight mission to study the interior of Mars have embarked on a series of design modifications and tests to achieve a launch in May 2018, with landing targeted for November of that year.

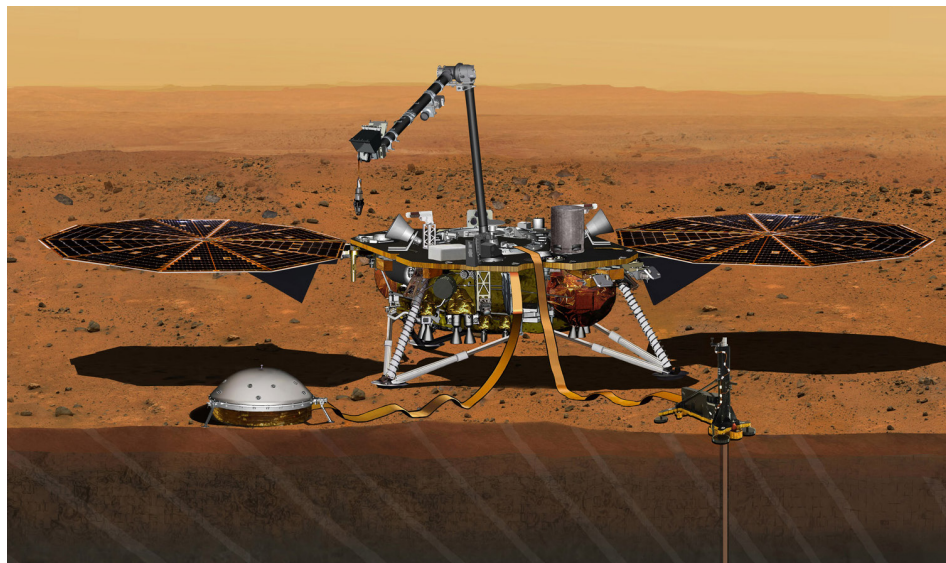
The Lab has taken over responsibility to redesign, build and conduct qualification testing of a new vacuum enclosure for the French Seismic Experiment for Interior Structure, a seismometer that failed in December. The unit will then undergo instrument-level integration and test activities in France under the direction of the French space agency Centre National d'Études Spatiales (CNES).

"It's a reasonably tight schedule in terms of rebuilding the seismometer," said JPL's Bruce Banerdt, Dawn's principal investigator, who noted a litany of work before it can be delivered to Lockheed Martin for final integration with the lander.

"JPL will build a qualification model for testing to overcome any hidden issues, then build the flight model," he said. "Then the seismometer is inserted. Once that's built it's integrated with the rest of the seismometer system.

"We do have plenty of time to do it, but we have no time to waste," added Banerdt.

Since the seismometer was never delivered to the spacecraft, previous integration tests were done without it. "Most of the testing would certainly benefit from the presence of the seismometer, so we're going to go through the whole test process to make sure we have a spacecraft and integrated payload systems that is thoroughly checked out, ready to



go," said Banerdt.

The main assembly of the seismometer will be done in France. Banerdt said several JPL InSight team members have worked there, while a CNES engineer has been working at JPL. "This helps keep the team integrated," he said.

More than 100 JPL personnel were on staff for the scheduled March 2016 launch, but that's been reduced to about 25 to 30 full-time equivalents currently.

The 2018 mission is scientifically a carbon copy of 2016, except for the redesign of the vacuum enclosure. "As of now, there shouldn't be many surprises," Banerdt noted.

"We were so close to being able to launch this year," he said. "If we had a couple of months more we could have sufficiently repaired the seismometer. But unfortunately, Mars doesn't wait for you, so we didn't have that opportunity. This is a relatively straightforward thing to fix, and I'm extremely confident we'll be able to get it done this time around."

The seismometer, provided by CNES, is designed to measure ground movements as small as the diameter of an atom. The instrument requires a vacuum seal around its three main sensors to withstand the harsh conditions of the Martian environment. But a tiny leak in the container that keeps the sensors operating in a vacuum has caused the delay.

"If you had this kind of leak in your tire, you could drive it for about 50 years and never notice anything different," said Banerdt.

InSight is short for the Interior Exploration using Seismic Investigations Geodesy and Heat Transport. The mission is expected to help reveal how all rocky planets, including Earth, formed and evolved. Banerdt said Mars retains evidence about the rocky planets' early development that has been erased on Earth by internal churning that Mars lacks.

# News Briefs

## Water resources award for JPL trio

JPLers Tom Farr, Cathleen Jones and Zhen Liu have received the California Department of Water Resources' Remote Sensing and Drought Science Service Award.

The award recognizes ongoing assistance provided by researchers who have been working closely with the department on drought or climate science projects.

The trio used airborne data from JPL's Uninhabited Aerial Vehicle Synthetic Aperture Radar instrument and interferometric synthetic aperture radar data from Japanese and Canadian satellites to map the ongoing sinking of land in California's San Joaquin Valley. Their research found that some parts of the valley sank more than a foot during the 2014 irrigation season alone.

## JPL researcher will study aerosols

NASA has selected two proposals for new Earth science investigations, including one from JPL, that will put new instruments in low-Earth orbit to track harmful particulate air pollutants and study the development of tropical cyclones.

JPL's David Diner is principal investigator for Multi-Angle Imager for Aerosols, whose observations will be combined with health information to determine the toxicity of different particulate matter types in airborne pollutants over the world's major cities.

The imager will use a twin-camera instrument to make radiometric and polarimetric measurements. The team has extensive experience in polarimetry, air pollution and human health. Diner has led numerous polarimetry observations from sub-orbital platforms.

## Robotic visitor



JPL recently hosted Disney Studios at the Mars Yard, and who showed up? Paying a visit to Curiosity was BB-8, the astrometric droid that moves like a rotating ball in *Star Wars: The Force Awakens*.



Accepting the Collier Trophy are, from left, Joseph Makowski of Orbital ATK, Keyur Patel of JPL, Robert Mase of JPL, Marc Rayman of JPL and Michael Violet of Orbital ATK.

## Two top honors for Dawn

The Dawn project team has earned two prestigious awards.

In March, the National Aeronautic Association announced selection of Dawn for its Robert J. Collier Trophy. Dawn competed with nine finalists for the award, which will be presented June 9. Previous

JPL recipient teams included those from Mars Science Laboratory (2012) and Voyager (1980).

Also in March, the Dawn team was honored with the National Space Club's Nelson P. Jackson Award at the organization's 59th Annual Robert H. Goddard Memorial Dinner in Washington.

### DAWN *Continued from page 1*

belt between Mars and Jupiter. The mission conducted extensive observations of Vesta during its 14-month orbit there in 2011-12.

But it almost didn't happen. During Dawn's flight, two of the spacecraft's four reaction wheels were lost.

"Dawn is an outstandingly successful mission, more productive than we ever anticipated, despite this double fault that could have been catastrophic," said Rayman. "It's a real testament to the flight team. Even with what could have been a truly dire loss, the team has surpassed all of the original objectives for exploring Vesta and Ceres."

## Naderi, Proia retire

JPL Executive Council members Firouz Naderi and Steve Proia have recently retired.

Naderi worked at the Lab for 36 years, retiring as director for solar system exploration. He was formerly associate director for project formulation and strategy, and



Firouz Naderi

headed the Mars Exploration and Origins programs.

Proia, chief financial officer and

director for business operations, leaves the Lab after more than 30 years of service. He held increasingly responsible positions in contracts management and finance at JPL before ascending to the council.

Appointments of successors to both are pending the selection of the



Steve Proia

new JPL director, who will take over following Charles Elachi's retirement in June.

## Passings

John Heie, 80, a retired Executive Council member, died Dec. 14.

Heie joined JPL in 1966 and retired in 1995. He served as assistant Laboratory director for business operations and earned the NASA Outstanding Leadership Medal. Following his retirement, Heie published the book "Leading from the Heart: What Workers Say About Good Leaders."

He is survived by his wife, Dorine; children Tami, Todd and Troy; nine grandchildren and three great-grandchildren. Services were held at Forest Lawn in Palm Desert.

Retired secretary Lynn Patterson, 75, died Jan. 27.

Patterson worked at JPL from 1969 to 1996. She is survived by her husband, Ron; children Terri, Lynette, Douglas and Jeffery; five grandchildren and one great-grandchild. No services were held.

Hugo Velasquez, 86, a retired facilities engineer, died Feb. 23.

Velasquez worked at JPL from 1963 to 2006. He was awarded a NASA Exceptional Service Medal in 2001 for exemplary coordination, implementation and maintenance of the technical facilities infrastructure of JPL's Microdevices Laboratory. He also supervised JPL's wind tunnel testing facility.



Hugo Velasquez

Velasquez is survived by his wife, Beverly; daughters Terri, Jennifer and Allison; five grandchildren, eight great-grandchildren and one great-great-grandchild.

Services were held in Seattle.

Retired engineer Donald Backofen, 84, died Feb. 27.

Backofen, who worked at JPL from 1958 to 1997, developed ground-support test equipment to simulate spacecraft science instrumentation in support of JPL's early missions

including Ranger, Surveyor and Mariner. He retired as administrator for the Telecommunications and Data Acquisition Section.

Backofen was preceded in death by his wife, Diane. He is survived by son Paul Backofen and daughter Anne Wavra—both former JPL employees—as well as 10 grandchildren and 13 great-grandchildren.

Clyde King, 80, a retired mechanical engineer, died March 13.

King worked at JPL from 1963 to 1998. He contributed to numerous JPL projects including Pioneer, Mariner, Viking, Voyager, Galileo and Deep Space One.



Clyde King

He is survived by his children Cathy, Seaton, Caroline and James and granddaughters Kailyn and Emily. Services were held March 20 in Lake Havasu City, Ariz.

### NEAR-EARTH *Continued from page 2*

of discovery, and it enters into our database. Follow-up observations are essential, especially in the early days following discovery, because otherwise our orbit determination would be very inaccurate. We need observers to track each object as long as possible before it becomes too faint, in order to make the best possible orbit predictions. The Minor Planet Center collects about 1,000 NEO observations every night, and we process all of that data to continually compute the most accurate orbits possible, and make them available to the community. Astronomers who want to characterize the physical properties of an asteroid, for example, use our Horizons system to find out where they should point their telescopes to observe it.

#### What have been your biggest challenges?

Dealing with the media is certainly a challenge. One really exciting day comes to mind: Feb. 15, 2013. For months we had been predicting that a particular asteroid would pass extremely close to Earth that day, actually flying inside the ring of communications satellites orbiting Earth. But the night before the flyby, social media lit up with news of a large meteor over Chelyabinsk, Russia. A colleague sent links to YouTube videos showing a brilliant fireball and effects of the huge

shock waves that followed. Many injuries were reported. I was scheduled to talk about the asteroid flyby the next day on NASA TV, but I knew the Chelyabinsk airburst would preempt everything and become the main story. We had no data on this thing: it approached from the direction of the sun, where we can't search. After some late-night e-mails and 6 a.m. phone calls with some colleagues, I had the basic facts: this was a half-megaton explosion produced by a 20-meter asteroid, and probably a once-in-a-lifetime event. Trickier to explain was the coincidence of two independent and unrelated rare events happening on the same day!

#### How much of your work is dedicated to dispelling bogus asteroid threats?

Wild and crazy stories seem to be happening more frequently. Just last year somebody claimed there would be a huge asteroid hitting Earth in September, and a surprising number of people believed it. The story gets repeated, and the next thing you know we have people asking why this big event is not listed on our website's table of upcoming close approaches! Of course there wasn't a shred of evidence of any object heading our way, let alone a big one.

#### If an asteroid is discovered with a near-certain Earth impact, how would you tell the world?

In fact, that's already happened! In 2008 the Catalina Sky Survey detected a small asteroid heading our way. The Minor Planet Center first alerted Steve Chesley from our group early that morning, and Don Yeomans and I found out about it when we got in to work. Steve ran our software and calculated that this new discovery had a 100-percent probability of impacting in Sudan, in the Namibian Desert, and the impact time was only 12 hours away. Fortunately, the brightness data indicated that it was a small object, roughly 5 meters in diameter, and we were confident it would burn up in the atmosphere. Of course, there's quite a process to announce an event like this, with NASA Headquarters playing a key role. I'm told that the chain of notifications went all the way up to the White House. We wrote a story for our NEO website, and JPL issued a news release, but it took an hour or so to get approvals to release the stories. As it turned out, there were no reported injuries, and when the impact area was explored a month later, meteorites were found very close to our predicted entry path. I'm confident that another small asteroid will be found heading our way someday soon, and hopefully with a little more warning so that scientists can go out to our predicted impact coordinates and actually make observations of the event. We are ready for that!

## Letters

Thanks to everyone who planned, helped, attended and contributed to my awesome retirement celebration Feb. 4. It has been a privilege and honor to work at JPL for the last 35 years, the most amazing place in the universe. Thank you for the opportunity to work with you and for you, and for the memories that I will cherish. I will miss you all.

**Annie Aroyan**

To section and group members, thank you very much on behalf of my family for the sympathy card and plant sent in re-

membrance of my sister Amelia who passed away in February.

**Hope Norton**

I want to thank all my JPL friends for the flowers and cards that were sent upon the passing of my husband, Mickey. He was only 70 and left too soon. I also want to thank those who could attend the funeral and reception. We all made one final toast to Mickey with a shot of Irish whiskey.

**Kathy O'Hara**

Thanks to Section 393 and the JPL community who expressed their condolences to me and my family for the loss of my mother, Karen. Your kind words and cards mean so much to us. The plant we received is very beautiful as well.

**Rob Sweet**

## Classifieds

Ads submitted March 25 to April 1. To submit an ad, e-mail [universe@jpl.nasa.gov](mailto:universe@jpl.nasa.gov).

### For Sale

**APPLIANCES:** Frigidaire full-sized (7') refrigerator, model LFHT1817F4, stainless-steel finish (bought for ~\$800 in 2013); Whirlpool washer, model WT-W4800XQ4, white (purchased for ~\$550 in '13); Whirlpool dryer, model WGD4800XQ3, white (bought for ~\$350 in '13); all three bought new from Lowes and have worked without issue since purchase; all in like-new cond., but washer has cosmetic scratches on the inside; about 2 miles from JPL (Altadena, pickup only), open to reasonable offers, provided items picked up April 7 to 20. Brian: [bryn@disambiguate.info](mailto:bryn@disambiguate.info) or 323-638-7684.

**MISC.:** Pedometer, mini steam iron, Rollerblades (men's 8), head/neck/shoulder massager, soft-sided cooler, bloody Mary set, stemless decanter set, woman's M "Galileo Flt. Team Mbr" LS red turtle-neck and white roller rink skates (sz. 7); winter sports items, everything from boots to helmets, M/F sizes M-XL 818-272-3262.

**STROLLER & TRAVEL BAG,** 2015 Uppababy G-Luxe stroller and bag in excellent condition; paid \$280 for stroller and \$50 for travel bag, nothing wrong with either; selling to transition to a double stroller; asking \$200 for stroller and bag together. [peachyday84@gmail.com](mailto:peachyday84@gmail.com) or 518-878-5348.

### Wanted

SPACE INFO/memorabilia from U.S. & other countries, past & present, for personal use (see <http://www.youtube.com/watch?v=S7PvjGp7mCU>). [mrayman@alumni.princeton.edu](mailto:mrayman@alumni.princeton.edu), 818-790-8523, Marc Rayman.

### Real Estate for Sale

LEBEC-area mountaintop retreat, spectacular views, 4 br./2 ba., 3,210 sq. ft. custom-built house on 20 acres, surrounded by vast fields of wildflowers in spring, but stunning year-round; only about an hour from JPL north on I-5; includes spacious workshop or artist's studio; see <http://www.tourfactory.com/idxr1308594>; \$574,900. 805-358-1626 or [Robert.A.Preston@icloud.com](mailto:Robert.A.Preston@icloud.com).

### For Rent

ALTADENA, furnished bedrm. & private bath in beautiful 4 bd. / 2 bath house, share common areas with 2 considerate prof. women; avail. for 3 months, or shorter time; large kitchen w/ample storage, quiet/safe neighborhood, large, fenced

## Retirees

The following JPL employees recently announced their retirements:

### December:

**Laurence Reinhart, 33 years, Section 352G.**

### January:

**Kathryn Little, 27 years, Section 366; Ariana Vicente, 22 years, Section 2142; Shiao-Ping Siao Yen, 47 years, Section 353.**

yard with mature fruit and shade trees; detached garage, easy bike distance to JPL (1 mile); includes all utilities, high-speed Internet; \$975/month. Louise, 818-653-9600, [louise@louiseh.org](mailto:louise@louiseh.org)

PASADENA, 2 furn. rooms in a lovely 4-bd./2-bath house, big backyard, hardwood floor, big closet, shared bathroom, kitchen + laundry privileges; 2 miles to JPL, close to public transport; short- or long-term lease; must like dogs and be very clean; \$800 and \$850 + \$800 deposit. 818-960-8654.

TUJUNGA "Hobbit House," famous "tree house" room, fully furnished, shared bathroom, utilities and Wi-Fi included, summer intern OK, no smoking. clean and tidy person with pleasant personality, no pets, awesome room, awesome house; \$700/month. [dale\\_190029@yahoo.com](mailto:dale_190029@yahoo.com).

### Vacation Rentals

BIG BEAR lakefront, luxury townhome, 2 decks, tennis, pool/spa, beautiful master bedrm. suite. 949-786-6548.

JACKSON HOLE, WY: Luxurious bed and breakfast on 3 acres of solitude on Snake River near Jackson Hole Mountain Resort and south entrance to Grand Teton Natl. Park; see <http://www.bentwoodinn.com/>; mention JPL for discount. [info@bentwoodinn.com](mailto:info@bentwoodinn.com), 307-739-1411.

HAWAII: Kauai condo, Pacific Fantasy, Kapaa, 1 bedrm., sleeps 4, \$950/wk.; MEXICO (1 bedrm.): Mayan Palace: Acapulco, Nuevo Vallarta, Riviera Maya, Puerto Vallarta; Sea Garden: Acapulco, Nuevo Vallarta, Mazatlan; trades available with II and RCI based on availability. 818-272-3262.

MAMMOTH, Snowcreek, 2 bd., 2 ba. + loft, sleeps 6-8, fully equip'd kitchen incl. microwave, D/W, cable TV, VCR, phone, balcony w/mtn. vw., Jacz., sauna, streams, fishponds, close to Mammoth Creek, JPL discount, no pets. 626-798-9222, 626-794-0455 or [valeriee@caltech.edu](mailto:valeriee@caltech.edu).

MAMMOTH, Snowcreek, beautiful updated condo, 2 bd., 2 ba. + loft (sleeps 6-8), great location by pond/meadow, new appliances, TVs, DVD players, free wireless Internet and washer/dryer, no pets. 818-952-2696 or [BigMtnPrettySky@gmail.com](mailto:BigMtnPrettySky@gmail.com).

MAMMOTH, remodeled 2 bed/2 bath + loft, short walk to Canyon Lodge; Courchevel 6 features full kitchen, cable and Internet TV, DVD & Blu-Ray, wireless high-speed Internet, 2-car garage, Jacuzzi, summertime grill and pool; no pets. <http://Courchevel6.com>.

OCEANSIDE condo, on the sand, watch the beautiful sunsets, charming, 1 bedroom, panoramic view, walk to pier or harbor, pool/spa, game room, sleeps 4 max, all amenities. 949-786-6548. ■



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Universe

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