

A slice of pi for all JPLers

JPL's use of the mathematical constant was on display March 14

By Taylor Hill

What do marsquakes, helium rain on Jupiter, and exoplanet detection have in common? It's pi, also known by the Greek letter π : the ratio of a circle's circumference to its diameter, or approximately 3.14.

Demonstrations of the mathematical constant — and how JPL uses pi — were on display Wednesday afternoon in celebration of Pi Day.

The demonstrations included an orrery — an apparatus that represents the positions, motions and phases of the planets in the solar system — and light curve showing how exoplanets are identified, and how pi is used to help determine how big a star and its orbiting planets are.

Another demo showed how Mars In-Sight will be pinpointing and measuring marsquakes with only one seismometer from a single location on the planet, when it takes three seismic stations to triangulate quakes on Earth. "It turns out pi comes to the rescue," said education program specialist Ota Lutz. "So, the math problem here asks for students to use pi, and figure out when the simulated marsquake occurred, and where."

The education group also used vegetable oil and red-dyed water droplets to illustrate how helium condenses into droplets within Jupiter's atmosphere that fall like rain — a phenomenon that helps explain why scientists observe less helium in the planet's clouds than expected.

The exhibits were presented by the Education Office's K-12 Elementary and Secondary Group, which organized the pop-up booth on the Mall. Lutz said the



Kim Orr of JPL's Education Office (right) shows JPLers some surprising aspects of pi.

displays and celebration of Pi Day are an opportunity to show how JPLers can utilize the education office in planning presentations, lessons, and talks that are appropriate for K-12 classrooms.

"So, when someone comes up to you, and says 'Hey, my sixth-graders would love for you to come to the classroom!' and you're not sure what to do, come to the Education Office, we can help you," Lutz said. The group has varying lessons and presentations appropriate for any grade level, and any JPLer's level of comfort with math or science, and even gives pointers on how best to interact with kids.

"We just want to make sure that you are as prepared and equipped as possible for your school visit," Lutz said.

Todd Barber, Cassini propulsion lead engineer and self-proclaimed pi nerd, said the education team has been a tremendous asset for his public outreach and education talks through the years.

"It's so nice that they do this internally to try and fire up the JPL community," Barber said. "Pi Day has become way more mainstream in the last five or 10 years, and it's a great opportunity to educate people about what JPL does."

Lutz believes the 1.5-hour event was successful in educating JPLers on what the education group can do for them.

"We had lots of people come up and say they would love to work on their talks with us," Lutz said. "It was fun to be able to talk to people who are doing hyper-focused work on a mission or project somewhere else on Lab, and help them gain understanding a little more conceptually of JPL's broader missions."

But the education group doesn't stop at pi. The team is planning more pop-up demonstrations on Lab later this year to show off other interactive displays and experiments JPLers can use for outreach, including stomp rockets.

JPLer is a Fellow in National Academy of Inventors

Shouleh Nikzad is the first woman from JPL and only the second JPLer elected

By Mark Whalen

JPL's Shouleh Nikzad has been named a Fellow in the National Academy of Inventors for her wide-ranging and high-impact technology innovations, for her contributions to nanoscale engineering, and her leadership in developing ultraviolet instrument technologies and detectors for space science and exploration.

She was formally inducted on April 5 in Washington, DC.

As a senior research scientist and technical group supervisor for JPL's Advanced Detectors, Systems & Nanoscience Group (389E), Nikzad leads technology research and development efforts to identify and help rectify specific needs for NASA missions. She also leads the delivery of sub-systems to missions.

Nikzad has built a career on using nano engineering to make high-performance devices and enabling instrument technologies for space applications. She holds 19 patents, with more pending.

"Almost entirely, my patents have to do with a novel way of photon detection or a novel application of the detectors," Nikzad said.

Many of Nikzad's patents have been licensed by industry. One of her inventions, inspired by the imaging array that is the human retina, contributed to the miniaturization of digital cameras in smartphones.

"The retina, the imager in our eyes, is curved, which enables us to have good imaging capability and a large field of view — all in a compactly packaged camera," she said.

"Making detectors curved removes multiple optics (lenses) — these extra lenses act as matchmakers between the flat detector surface and the curved light



Shouleh Nikzad

wavefront. Fewer optics pieces will make the camera more compact while improving their image quality and throughput. That's why we now have curved arrays in some of our smartphone cameras."

The technology also translates to big telescopes. Leaders at the European Extremely Large Telescope have contacted Nikzad's group to discuss creating a big, curved focal plane, and she is also eyeing possible inclusion of her high-performance detectors in the Large UV Optical Infrared Surveyor (LUVOIR), a multi-wavelength space observatory concept led by the Goddard Space Flight Center, as well as the JPL-led Habitable Exoplanet (HabEx) characterization mission concept.

More recently, she has also been interested in bridging outer space and the inner workings of the body. She has mentored students and has organized lectures and seminars for JPL's Medical Engineering Forum, which she co-leads. About 60 JPLers from across the Laboratory have been involved and are working with medical-related activities. She also created and continues to teach a class in

medical engineering at Caltech.

Nikzad was interested in science and technology from an early age. Then, as a high school student, she read a book on NASA's Apollo Moon Landing Program and fell hard for space exploration.

The realization of the link between space and medicine came later. Nikzad had already been at JPL for more than 10 years when, based on discussions between JPL, Caltech and the Keck School of Medicine of USC, she became one of the founding members of the Society for Brain Mapping in 2003.

Her role, in part, was to determine whether space technology could be used to respond to the needs of neuroscience and neurosurgery.

"To me, the synergy is entirely obvious that space technology — as well as some space engineering practices — can directly translate, with a bit of investment, into medical applications," she said.

"The same sensitivity that we have developed to detect really faint objects that emit only a few photons and are very far

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Bon Voyage, Chris Jones

JPL veteran played a major role in Lab's successes for almost 50 years

By Mark Whalen

JPL's Chief Engineer, Chris Jones, is retiring after 49 years of service to the Laboratory. Since joining JPL in 1969, he has contributed to the design, test and flight operations of numerous spacecraft including Mariner 9, Voyager and Galileo; served as spacecraft development manager for Cassini; and managed the Space Interferometry Mission. He also served as Director for Solar System Exploration and Associate Director for Flight Projects and Mission Success.

Jones reflects on almost half a century at JPL.

When you wake up and not get ready to come to work, what will you miss the most?

Well, the JPL experience is all about the people, the friends you make, and how we banded together to overcome problems in our work. I'll be thinking about them.

How would you recall your early days here?

I started in 1969, working on Mariner '71. At that time no one had ever built a spacecraft to orbit another planet. Computers were relatively new to the unmanned spacecraft architecture, and there were very few software engineers compared to today.

I was not particularly ambitious. I felt that just getting the work done — and getting it done right — was a big enough challenge for me. And I noticed that if I did those things, I'd get good raises, along with compliments from my supervisor, and maybe even from the section manager. One thing I noticed was that work

got accomplished by teams. There were some stellar individuals, of course, but for the most part teamwork got things done.

Think back to August 1977, and Voyager 2's mission-threatening fault-protection issues on its way to Jupiter. Is that event still fresh in your mind?

You must be referring to the "close call" we had on launch day that could have been mission-ending, but turned out okay. The telemetry was giving us evidence that successive fault protection entries were being called — some during powered flight of the launch vehicle, then again minutes later following the propulsion module injection burn.

We had done so much testing of the fault protection leading up to launch that we knew that no single failure could be the cause of what we were seeing. But at the same time, one wouldn't expect that we were witnessing a great number of separate failures occurring in the short period comprising the launch sequence.

Was there a sense of panic, or a sense of confidence?

For me, somewhere in between. Data analysts looking at the real-time data were announcing what they were seeing, but the anomalies were coming too fast for an explanation to be formed. So, patience won the day. A request was made to reset the CCS, halting all fault responses. But after a minute of consideration I recommended letting the fault-protection finish — hopefully — rather than forcing an end to the autonomous corrective action. Minutes later, the spacecraft, finished with the launch sequence, became quiet with only the familiar Sun-search sequence running in the background. Soon the spacecraft



Chris Jones

settled into its Sun/star-acquired attitude and Voyager 2 was on its way.

Twenty-four hours later, we were explaining to the director of the Laboratory, Bruce Murray, what had happened, and what we thought might have been the root causes. I think he came away from that session somewhat relieved and with an appreciation of the complexity of the systems we had designed and built.

Looking back on Voyager, it's a fairly simple system. But at the time, it was more than anyone had tried to pull off.

What were the best lessons learned?

We were able to track down where the problems were initiated. And most of it was traceable to very tight time constraints in the fault protection code. We were trying to get things done too quickly, and there wasn't enough time to communicate among the subsystems and get them to take their corrective actions before another problem symptom would hit.

That aspect of it was the most significant lesson learned.

The science boom hadn't latched prop-

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erly, and as a result there had been a mis-pointing of the system. In this instance, the spacecraft was not pointed at the Sun at the conclusion of the sequence. We were mis-pointed, but the system knew what to do in that circumstance and found the Sun, and ultimately re-established communications with Earth. The “failure” was not envisioned as a possible threat to spacecraft pointing, but the fault protection was robust to any number of error conditions that would result in miss-pointing, in general.

Fault protection changed after Voyager. New projects went down a different path; whether it was the right path or not remains to be seen. I think it’s time to dust off the last 40-plus years of fault protection, have a hard look at it, and see whether that’s exactly what we want. The Mars missions — the rovers, certainly — have taken some very positive steps in terms of dealing with managing fault-containment regions.

But the Holy Grail in fault protection is the recovery from failure in an operable way, so that science is not lost. The technology today is certainly closer to where it needs to be to do that, compared to 1977 with Voyager.

Is there a big difference between today’s new JPLers and when you started? Is today’s college grad better prepared for success as they start here?

Over the years, between all the complaints from the young up-and-comers, there has always been, “this technology is so old; this computer is too slow.” And there’s a good reason for that.

It’s just that we don’t want to bite into a new technology and then find that five years after launch it’s not going to last. So, we take things that are proven over time, proven with earlier missions, and



Jones, left, with NASA Planetary Science Division Director Jim Green at Juno’s Jupiter orbit insertion, July 4, 2017.

hang our hat on those.

Eventually, we’ll take the next technological step, but we don’t want to move too fast. That’s probably a little frustrating for the young engineers.

They are quite capable. They take to this work with the same kind of enthusiasm we had when we were young. The complexity has increased, but it’s natural to them.

What do you think inspires young people today to consider a career in space exploration?

I think back to Mars Science Laboratory, landing on Mars — we couldn’t see it, but we had simulations describing how it would look if we were there — and it was pretty exciting stuff.

We shared that with the world for all to see. And I think in seeing that, maybe a 12-year-old boy or girl would say, “Hey, I’d like to do that. I’d like to be in that room where people are giving high-fives and seeing the movie of this thing landing.”

Cassini’s launch and its final hour also come to mind. The conclusion of the mission was an emotionally moving

event. The mission team’s best work was on display.

What you most proud of?

I’m most proud that I got to work with and for the world’s finest, most creative engineers, scientists and managers during my career and that, together, we accomplished missions that were the first of their kind. My personal high points were the years I spent on Voyager. That project returned the world’s first close-up images of the solar system’s outer planets and gave a young engineer a chance to create something called “fault protection” that has sustained its two missions for over 40 years.

What’s next for you?

My wife and I enjoy a few hobbies. We are interested in art. There was a time, back when I had more of it, when we would jump on a plane and fly across the United States to see an art exhibit. That was a lot of fun. We’d get to see the cities we hadn’t been to in a while.

Now I have time to start it up again. So, we’ll go back.

I’ve also been working on the house;

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App helps commuters find their space

By Taylor Hill

Having trouble finding a parking space at JPL? Check your phone.

A new parking app is now available, aimed at improving JPLers' chances of locating open spaces in less time. The app, called JPL Park, uses real-time data to show commuters how many spots are open in the Arroyo parking structure and the west lot.

"While this won't alleviate the overall scarcity of parking spots, we hope the app will give some guidance to users of where available parking is," said Brent McWatters of the Custom Application Consulting and Development Group.

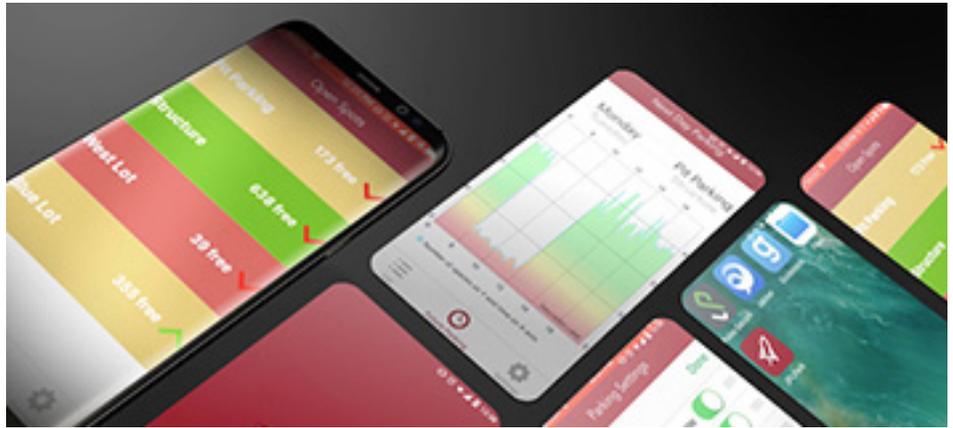
Additionally, Protective Services will have access to the app, so officers can divert drivers away from full lots and toward available parking spots. The app was pushed automatically to all JPL phones, and is available to download onto personal Android and iOS mobile devices at mysteries.jpl.nasa.gov/static/parking.

JPL Park is the result of last August's app competition put on by JPL Spark and the Leadership Mentoring Program. Teams made up of JPL employees and summer students vied to design an app that would help improve the parking problems at JPL.

"We ended up incorporating features from multiple entries in the contest to create a working app as it is now," McWatters said. He worked with his team to turn the contestant's early designs, which were based on parking simulations, into an operational product.

Laura Fisher, institutional processes and assessment specialist at JPL, said the competition and implementation of the parking app is a great example of how Spark can benefit the Lab.

"This competition was an opportunity for JPLers to come together and improve how we work at JPL, which is exactly



It's a new day for parking at JPL.

what Spark is about," Fisher said. "Because how we work is as important as what we do."

Here's how it works: In-ground sensors along entry and exit points at both the Arroyo parking structure and the west lot count incoming and exiting cars, giving a running count of exactly how many cars are in either location. So, for instance, as the 1,400 spots in the structure fill up, the app displays how many available spaces are left, updating each minute on JPL phones. When a lot is full, a pop-up message tells drivers to see a security officer for parking information.

"This should really help cut down time that drivers spend circling around the parking structure when there aren't any spots available," McWatters said.

To avoid distractions while driving, the app includes a special voice notification feature that verbally alerts users of parking lot and structure status as they approach the Lab. The system uses Geofencing technology that triggers a voice command once a vehicle gets within range of JPL.

"We wanted to be able to convey the parking information without distracting the driver on their way to work," McWatters said. "When you're driving to work, the app will tell you what the parking status is without drivers having to look down, open the app, or anything like

that. For example, if you are on the freeway, it could alert them that the structure is full, and so the driver will know to skip the Windsor exit, and head on to Oak Grove Boulevard and the west lot instead."

Facilities is also installing electronic signs at the Lab's main entrance and east gate, which will display updated parking figures for the parking structure and west lot as commuters enter JPL.

The app also includes a "future parking" feature, which predicts parking space availability for every hour of every work day on Lab, based on historical parking data. So, if you want to know when you can go to lunch and actually find a spot when you get back, check the app. The historical parking data could help decision-makers determine the best use of the Flex-Work program, too. "Our data shows Monday and Tuesday are historically the worst days for parking on Lab, so it might make sense to encourage more Flex-Work days be scheduled for early in the week," McWatters said.

The first version of JPL Park gives parking lot status information for the Arroyo structure and west lot, but plans are in place to include the Blue Lot and the Pit Parking area (by Building 171) into the system in the future.

JONES *Continued from page 4*

it's pretty old and needs help. I enjoy that.

Final thoughts?

I often tell the story that in high school, my math teacher would let the students read a book of magazine that they brought from home, so long as they had completed that day's homework assignment. My choice of reading was always *Scientific American*. One day I started reading about a new space mission that was being planned to visit the planet Mars. It described the various "systems" that would comprise the mission and I was especially interested in the spacecraft description. All of this work was centered at the Jet Propulsion Laboratory in Pasadena. I made a mental note of this place called JPL, thinking that maybe one day I could work there.



Jones (center right) in the Mariner 9 operations area, Oct. 10, 1972. Mariner 9 was the first spacecraft to orbit another planet.

Five years later, in 1967, I signed up for a special summer session between my collegiate junior and senior years. It was called the NASA Space Science Summer Institute and the session's faculty were

some professors from USC and engineers from JPL. The six-week course only served to reinforce my desire to end up at JPL and two years later, it became reality.

It has been all I had hoped it would be.

Passings

Robert Toth, 78, a retired spectroscopist, died March 2.

Toth worked at JPL from 1970 to 2012. He was a molecular spectroscopist with an emphasis on researching the various isotopes of water. He was credited with authoring more than 100 scientific articles.

He is survived by daughters Nicole, Lydia, Alexis and Amy, and grandchildren Steven, Robert, David and Kayla.

JPL rideshare coordinator John Miranda, 64, died March 12.

Miranda, a veteran of the U.S. Navy, had been with JPL since 1979. He was a security officer and dispatcher for his first 10 years, then spent the remainder of his tenure as the parking and rideshare coordinator.



John Miranda

Miranda also led JPL's growing vanpool program, and provided key input to the Los Angeles County Metropolitan Transit Authority and the South Coast Air Quality Management District.

He is survived by his wife, Vicky, sons Nathan and Tosh, grandson Ilias, and granddaughters Amandelyn and Ariadne. Memorial services are scheduled for Saturday, April 14 at 1 p.m. at the Fraternal Order of the Eagles, 1596 Yosemite Dr., Los Angeles 90041.

Letters

On behalf of my family and myself, I would like to thank my colleagues and friends for their condolences and kind thoughts on the recent passing of my father, Rev. Charles Whetsel Sr., at age 84. He was the best father I could have asked for and touched so many people's lives throughout his own. Thanks also for the beautiful plant, the cards, and for all of the people who helped out back here at JPL during my absence from the Lab.

Charles W. Whetsel

Thank you to my JPL friends and colleagues for your kindness and words of sympathy during the passing of my father. Thank you also for the beautiful plant and card sent to my house. My

family and I sincerely appreciate your support during this time of deep sorrow. My father was 81 and immigrated to the U.S. in the mid-60s. He worked hard to ensure that his children would have a better life, and was very proud to see his children achieve the American Dream.

Karen Lum

My spouse, Regina Wong, and I wish to express our thanks and appreciation to JPL, Section 349, and the Voyager project team for their support and kind words, thoughts, flowers, plants and donations received during the illness and subsequent passing of Regina's mom, Yung Mut Wong. Yung was an exceptional woman who treated everyone with love and kindness, and will be sorely missed. Regina and I are forever grateful for your understanding and support.

Eric Nicolich

Thank you to my JPL family for all your support during this most difficult time upon the recent passing of my mother, Marie Hughes. Your heartfelt thoughts give respite and much comfort and have made her loss a little more bearable. My mom and dad were an absolute beautiful love story and it gives me reassurance to think of them hand in hand once again. They were one another's biggest fans. Thank you as well for the lovely plant; I shall look upon it and think of them.

Sally Heapy

NIKZAD *Continued from page 2*

away or very, very old can be applied to detect faint biological fluorescence signals," she added.

Nikzad's group includes 11 full-timers. Additional members include interns, graduate students, and post-docs from collaborations with several universities.

"Every year, we have a number of summer or year-round interns," she said. "Graduate student interns who are part of university collaborations often will perform part of their thesis work with us. Sometimes we even end up hiring the interns into the group.

"I really enjoy mentoring students, and it's been very gratifying to see many in our group go off and become leaders in their fields," Nikzad added.

"I also hope to see more female interns and scientists at JPL. I endeavor to make ours a welcoming and fascinating field for aspiring scientists to get into — much like I was once inspired by NASA years ago."

Universe

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For Sale

COACHELLA TICKETS (2), general admission wristbands in box for Coachella Weekend 2 April 20–22, \$800/obo for both. Justin Foley: justindfoley@gmail.com, 626-298-5453.

Vehicles / Accessories

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'09 HONDA Civic hybrid, metallic dark blue with dark blue interior, daily driver, in good condition, regularly maintained, 80K miles, \$6,500/obo. Text 310-779-5678.

'13 HYUNDAI Elantra, exc. cond., preferred package (heated seats, hands-free Bluetooth, USB, alloy wheels, tinted windows, beige interior), pearl white exterior, automatic, clean title, no accident or mechanical issues, 72K miles, \$9200. Call or text: 310-710-0926 for photos or test drive.

PORSCHE LICENSE FRAME, brand new, solid brass with 2 brass screw covers, email for photo, \$15. mb275c@gmail.com.

'15 SUBARU BRZ coupe, almost-new cond. (barely driven), white w/black interior, 2K miles, stylish/sporty/fun, photos avail., \$30,000/obo. Bob: 661-941-4669 or text Kat: 310-994-7324.

'02 SUBARU Outback Impreza Sport Wagon 4D, good condition, gray with gray interior, BBS rims, regularly performed maintenance, 199K miles, photos available, \$5,500/obo. Bob: 661-941-4669 or text Kat: 310-994-7324.

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, 818-790-8523, Marc Rayman.

For Rent

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ALTADENA, furnished bedroom in a beautiful 4-bd./ 2-bath house; includes desk, dresser, bedding, towels, WiFi, etc.; share common areas w/2 considerate JPLers; large kitchen w/ample storage, quiet, safe neighborhood; large, fenced yard

with mature shade trees, easy bike distance to JPL (1 mile); includes all utilities; \$825/month. Louise: 818-653-9600, louise@louiseh.org.

ALTADENA (91001) 2-bdrm apt. (ground floor), available May; appliances optional, freshly painted, 1 bath, fireplace, good size closets and bedrooms, carpeting TBD, gray linoleum tile (slate look) in kitchen + bath, miniblinds, carport parking, storage, laundry on site, very close to bus stop/JPL/Odyssey Charter/grocery stores/shops/pharmacy/24 hour fitness, clean; \$850 share or \$1,700 rent entire apt. 818-370-0601.

GRANADA HILLS house for lease, 4 bedrooms, 1.75 baths, 1,486 sq. feet, in quiet neighborhood near Knollwood Country Club, central air, 2-car attached garage with laundry hookup, new carpet, tiles; \$2,700/month plus security deposit, no pets. homarellc@gmail.com.

MONTROSE room, for a non-smoker, in a lovely single-story air-conditioned home to share, just 4 miles from JPL; private room, bath and entry; Wi-Fi and utilities included, washing facility onsite, full kitchen available, a peaceful garden to reflect and relax; street parking available in a safe and friendly neighborhood, just one block to the village with coffee shops, boutique stores and multi-cultural cuisine restaurants; \$1,000 per month. 818-437-1970, Jane.

PASADENA, 248 E Washington St., gated community, 3 bedrooms, 2 baths, living room with vaulted ceiling, kitchen with new granite countertops, 2-car garage with entrance from unit, new washer & dryer, close drive to JPL; \$2,800/month. dlutz70@gmail.com, Debra.

PASADENA, unfurnished room in 3 bed, 2½ bathroom, off of Del Mar & Arroyo; unit is beautiful, updated with hardwood floors throughout, includes dishwasher, washer/dryer, patio area; female roommates preferred; includes water & trash; move in April 15 – May 1; \$900/month + \$900 deposit. 661-350-6300, Nicole.

PASADENA, furn. room in a lovely 4-bd./2-bath house, big backyard, hardwood floor, big closet, shared bathroom, kitchen and laundry privileges; 2 miles to JPL, close to public transpo; short- or long-term lease available; must like dogs and be very clean; \$900 + \$900 deposit. 818-960-8654

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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, 626-840-3749 or valeriee@caltech.edu.

MAMMOTH, Snowcreek, beautiful updated condo, 2 bd., 2 ba. + loft (sleeps 6-8), near pond/meadow, new appliances, TVs, DVD players, free wireless internet, washer/dryer, no pets. 818-952-2696 or BigMtnPrettySky@gmail.com.

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