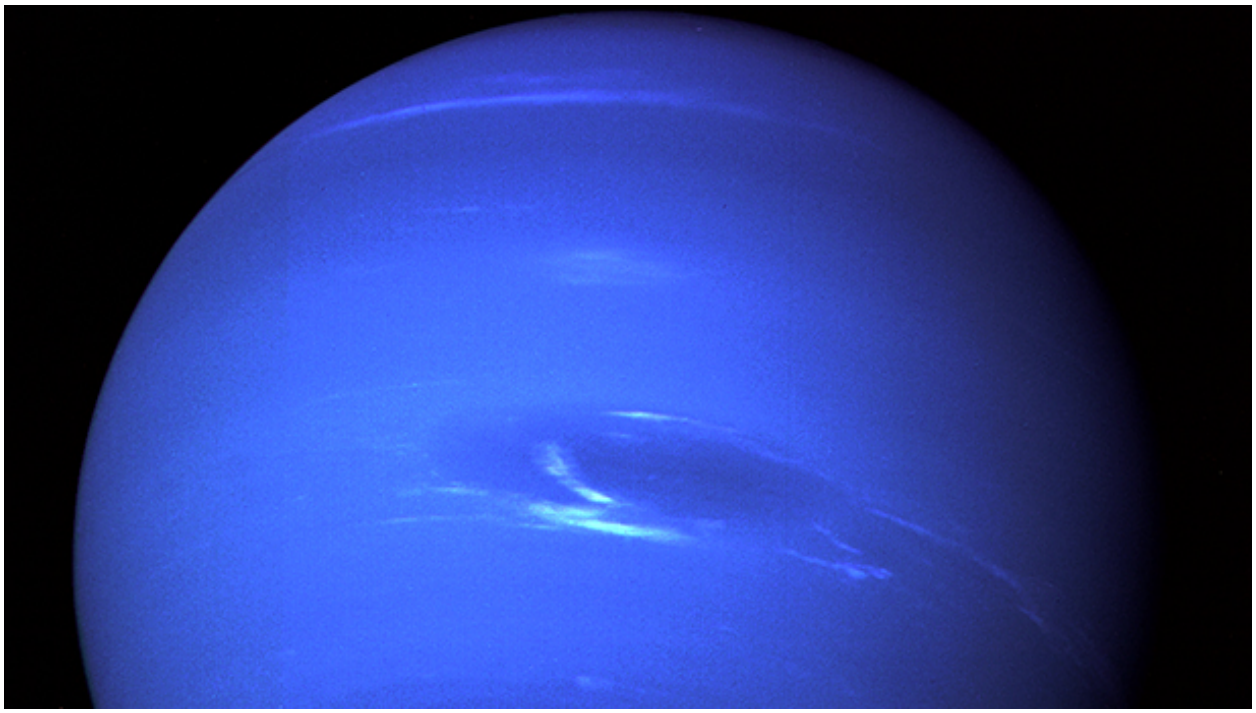
Featured Stories



Neptune during the Voyager flyby, with the nearly Earth-sized Great Dark Spot prominently displayed.

Thirty Years Since Voyager 2 Swooped Past Neptune

By Erik Conway with additional material from Calla Cofield

On August 25, 1989, Voyager 2 made its last planetary encounter, a dramatic flyby of Neptune and its large moon, Triton. Getting there took 12 years, 4.4 billion miles, and three gravitational boosts from encounters with Jupiter, Saturn and Uranus.

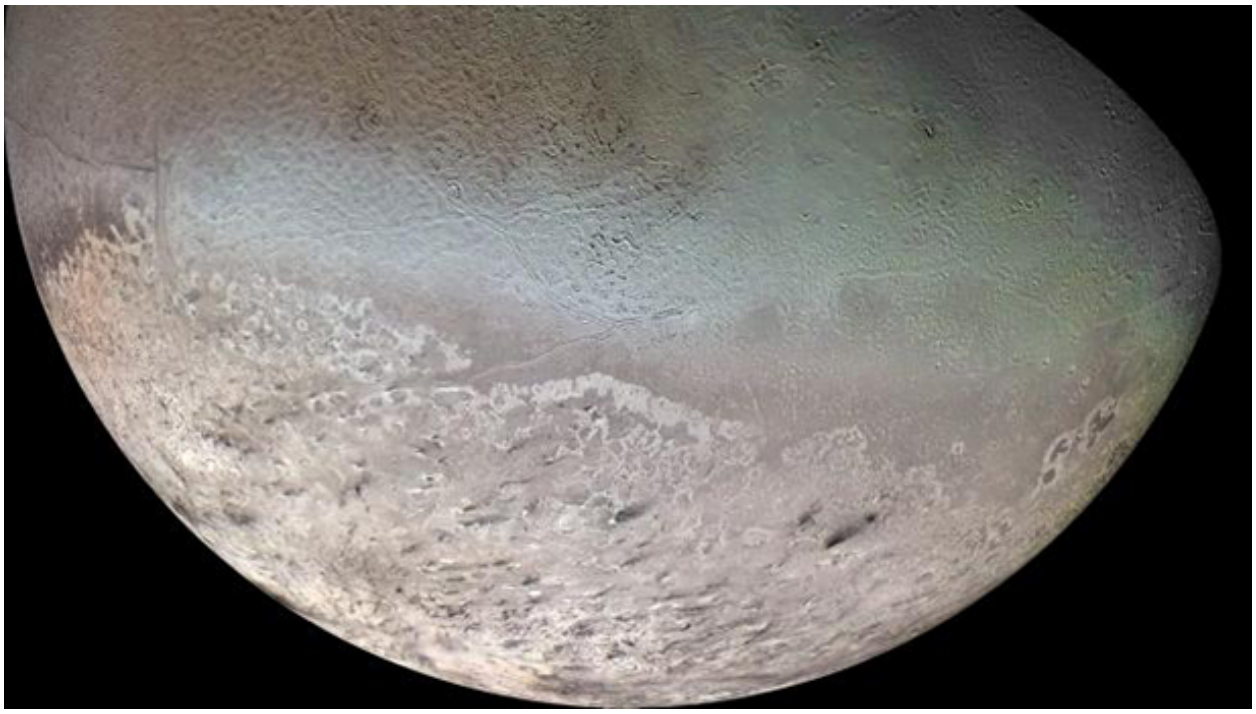
This was the last stop on an outer planet “Grand Tour” conceived more than two decades earlier.

The basic idea arose at JPL in 1965-66. To make this lofty goal possible in an era when spacecraft rarely lasted more than a few months, JPL set up a program called TOPS—Thermoelectric Outer Planet Spacecraft. TOPS studied the use of radioisotope thermoelectric generators for spacecraft power, self-checking and correcting electronics and computers, thermal control at great distances from the Sun, and very low power telecommunications.

While TOPS itself was cancelled, much of what the Laboratory's engineers had already learned was embedded in the Voyager project when NASA finally approved it, as Mariner Jupiter Saturn 1977, or MJS '77, in 1972.

As the name implies, by the time NASA had approved it, the project's ambitions had shrunk to Jupiter and Saturn. Uranus and Neptune became possible destinations again after Voyager 1 reached Saturn and Titan. The science team, led by Project Scientist Edward C. Stone of Caltech, decided Voyager 2 would not learn anything new from Titan, as the spacecrafts' instruments could not see through the moon's thick hydrocarbon atmosphere. Why make a second blind pass when Uranus and Neptune waited unexplored?

During the development phase, engineers had worked to ensure that nothing in their purview prevented reaching distant targets. But it's fair to say the spacecraft systems were not optimized for Neptune. In particular, the extremely low light available meant that images would be smeared if the team didn't compensate for the spacecraft's own motion, and the very long distance meant low data return without upgrading the Deep Space Network.



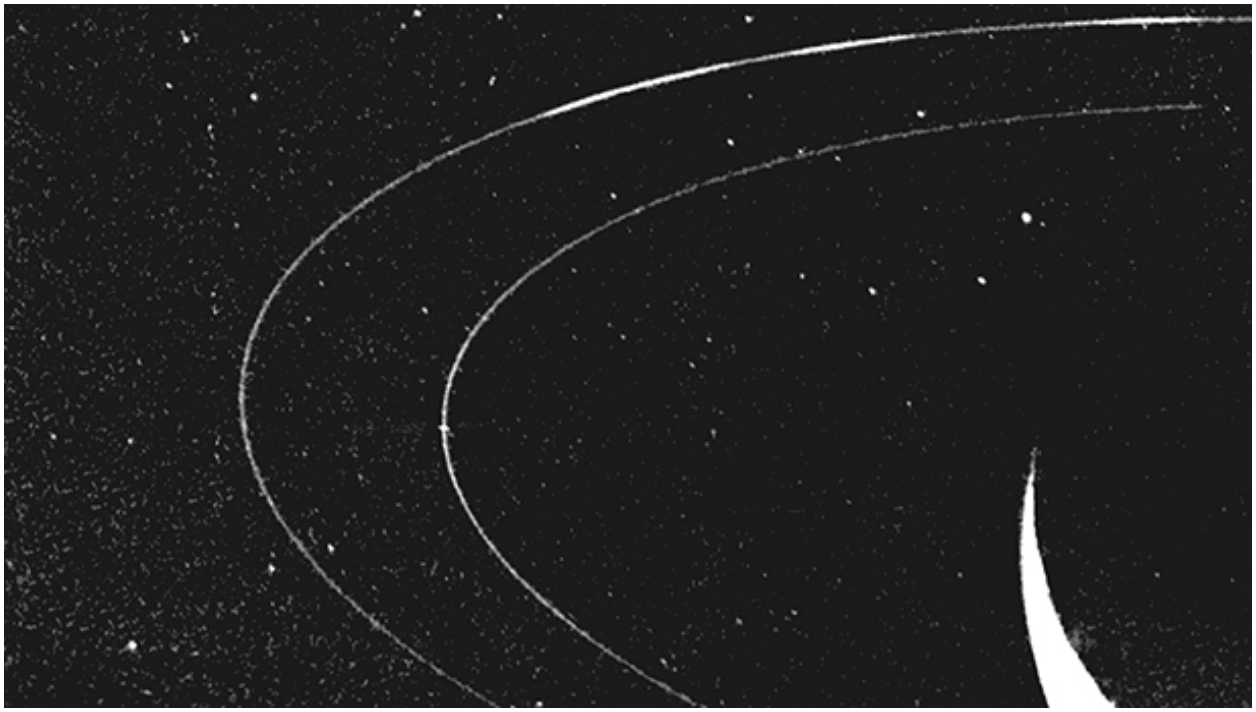
A color mosaic of Neptune's largest moon, Triton. The black streaks were interpreted as geyser deposits, while the pinkish terrain is probably methane ice.

A data dilemma

Data rate posed a particular problem due to timing; the spacecraft would zip by Triton five hours after its Neptune encounter, making management of the spacecraft's data recorder difficult. There would not be enough time to transmit all the recorded data during that five-hour window, so the team wanted some data to be returned in real time.

The project's engineers implemented two new motion compensation techniques via software updates. One used very short thruster firings to rotate the spacecraft while keeping the high-gain antenna aligned with Earth. The second method utilized the spacecraft's scan platform to compensate for motion, though it was to be used sparingly due to an earlier sticking episode.

On Earth, the Deep Space Network was upgraded and temporarily expanded. During the 1980s, NASA had funded broadening the 64 meter antennas at Goldstone, Canberra, and Madrid DSN stations to 70 meters. These were arrayed with smaller 34 meter antennas at those sites, and the Deep Space Network also borrowed antennas from others. Goldstone was arrayed with the National Radio Astronomy Observatory's Very Large Array in New Mexico, while the Canberra station was linked with the Parkes Radio Observatory's 64 meter antenna.



Neptune's rings, as seen by Voyager

Neptune arrival and beyond

Voyager 2 started observing Neptune in June 1989, and continued for six months. The most intensive "near encounter" phase of the Neptune flyby began on August 24 and lasted five days. During it, Voyager 2 flew over Neptune's north polar region, made a close approach of 4900 kilometers (3400 miles), and flew within 40,000 kilometers (24854 miles) of Triton. The probe discovered six new moons of Neptune and revealed that Triton had geyser activity despite its vast distance from the Sun and its extreme cold—Voyager 2 measured a surface temperature of 38K (-235C, or -391F) Fahrenheit.

Linda Spilker, then a scientist on the infrared radiometer team and later Cassini project scientist, remembered in 2013 that the geysers looked "like little lollipops sticking up with their trails going off in one direction. Triton was a very fascinating world!" A partial ring of Neptune had been identified by ground observatories prior to Voyager 2's arrival, but images during and after the flyby revealed four rings. The outermost ring had more and less dense segments, giving the appearance from Earth of being disconnected arcs.

In a JPL Universe interview days after the flyby, project scientist and JPL Director Ed Stone called it "the final movement in the Voyager symphony." Of course, 30 years later, the twin Voyagers continue to explore. But the Neptune flyby was the end of the mission for many Voyager team members. With no more planetary encounters, some instruments and the spacecraft cameras would be permanently shut down, and the operations team would shrink significantly.

Carl Sagan came to JPL for the dramatic Neptune/Triton encounter, eloquently explaining the science and the images being beamed to Earth for throngs of reporters in von Karman Auditorium, and for the world at large. JPL hosted a celebration on the Mall for the Voyager team after the Neptune flyby. Chuck Berry provided the evening's entertainment, with team members literally dancing for joy. His classic song, "Johnny B. Goode" is on both Voyagers through their Golden Records.

Chuck Berry and Carl Sagan at the post-Neptune encounter party on the Mall, August 25, 1989

Voyager's spacecraft development manager, William Shipley, commented in 1997 that Voyager had been so successful because of its origins in TOPS.

"In Voyager, when we did our cutback from TOPS we did that fairly carefully," he said. "We put in enough hardware; we had enough units; we had an almost complete set of spares in the PTM (Proof Test Model); we had two flight spacecraft. We put in a complete reliability and quality program. We didn't stint on anything to start out with. Where we had uncertainties, we put in an adequate amount of stuff to cover our uncertainty."

The unanticipated requirement for extensive radiation hardening to survive their Jupiter encounters helped too: it forced reexamination of all the designs "to take into account the effects of degradation of parts with aging and with radiation." And it forced the engineers to get much better at selecting and testing parts. The Proof Test Model was loaned to the National Air and Space Museum in Washington, but then was recovered and sent to Venus as part of the Magellan radar mapping mission in 1989.

Voyager 2 sticker from 1989

The two Voyager flight spacecraft are still operating at very reduced power levels, and both have crossed into interstellar space, much to the delight of multiple generations of space fans. They each send data back to Earth via 23-watt transmitters, about as much power as a refrigerator light bulb.

"Every day they travel somewhere that human probes have never been before," said Stone recently. "Forty-two years after launch, and they're still exploring."

Current Voyager Project Manager Suzanne Dodd takes her responsibility to heart.

"I hear a lot of stories from people about how the Voyager images and all the mission firsts inspired them to get into science and technology careers," Dodd said. "And because I know that this mission has touched so many lives around the world, I have a sense of responsibility to keep it going as long as possible."

(Photos by Greg Waigand/Photolab)

The Rolling Stones Rock the Rose Bowl…and Mars

By Jane Platt

At the Rolling Stones' "No Filter 2019" tour stop last night at the Rose Bowl, a NASA announcement—delivered by actor/space aficionado Robert Downey Jr.—revealed that the Mars InSight team has named a Martian rock "Rolling Stones Rock."

"I've been entrusted with gathering support for a very cool and cosmic cause," Downey said on stage after opening act KALEO and just before the Rolling Stones came out to begin their set. He pointed out that "in 1964, two epic launches occurred—the first Rolling Stones album…and Mariner 4, which was the first Mars flyby satellite."

He said the Stones asked him to gather 60,000 votes to make the name Rolling Stones Rock official. The crowd responded with a loud chorus of ayes, then Downey seconded the motion and requested an exuberant cheer that "needs to be heard on Mars." The audience cooperated.

The Rolling Stones are getting a lot of satisfaction from this turn of events. Mick Jagger told the Rose Bowl crowd, "NASA has given us something we've always dreamed of—our own rock on Mars. I want to hurry back and put it on our mantlepiece."

The Rolling Stones mentioned the naming of the Mars rock during their two-hour set

Why did the rock roll on Mars?

When Mars InSight landed on Nov. 26, 2018 with its thrusters firing, a small rock apparently rolled a short distance across the ground. InSight images revealed divots in the soil behind the rock, indicating that the rock had, in fact, rolled away from the spacecraft.

“It's so clear it happened—it moved a full meter away from the spacecraft,” said Matt Golombek, InSight geology lead. This is the farthest NASA has seen a rock roll during a spacecraft landing on another planet.

The team initially dubbed the rogue rock Rolling Stone, “because that’s what it looked like,” Golombek said. A subsequent suggestion to name it Rolling Stones Rock led to the intersection of Mars and music at the Rose Bowl.

Robert Downey Jr. announced the official naming of the rock as Rolling Stones Rock

A timeless milestone

In a collective statement before the concert, Jagger, Keith Richards, Charlie Watts and Ronnie Wood, said: "What a wonderful way to celebrate the Stones No Filter" tour arriving in Pasadena. This is definitely a milestone in our long and eventful history. A huge thank you to everyone at NASA for making it happen."

Golombek agrees that it's a special milestone. He has been connected in one way or another to every Mars mission, starting with Pathfinder and its Sojourner rover in 1997. He and his teams have scrutinized and counted rocks in Mars images, in large part to pick safe landing sites for future missions.

While Golombek has received numerous awards and other professional recognition, "I don't think this has ever happened on all the missions I've worked on," he said with a hearty laugh. For example, during the planning for the naming and the concert event, he got a phone call where he heard, "Hello, this is Robert Downey Junior." Well, technically he knew the call was coming because Laurie Cantillo, deputy director for the Communications and Education Directorate, let him know that Downey would be on the line.

And can we assume Golombek likes the Rolling Stones? "Who doesn't!" he said, noting that InSight geology team members, regardless of how long they've been on Planet Earth, are excited about this Mars naming. "Some of them weren't even born when the Rolling Stones had their first single, 'Satisfaction,'" he said. "But the Stones—well, they're timeless."

What's in a name, and who chooses?

Although you won't see it as Golombek's official title in the JPL directory, his nickname is the "Mars Naming Czar." Besides being a respected scientist, he gained the reputation as a rock namer with such cartoon character designations as Yogi and Barnacle Bill during Pathfinder's mission. Most Mars missions since then have had a theme for rocks it finds.

Officially, the International Astronomical Union approves names for asteroids, comets and planetary features, but they don't mess with naming rocks during surface operations. Scientists mostly use the names to help them refer to them in science papers. So it's true--Rolling Stones Rock will appear on Mars

maps used by the scientists. Scientists follow a couple of rock-naming rules: they can't be named for living people, and they can be fun but not political.

Robert Downey Jr. with InSight geology lead Matt Golombek and InSight Deputy Principal Investigator Sue Smrekar

Go to https://go.nasa.gov/MarsRocks to see clips from last night's show, including Mick Jagger and Robert Downey Jr., and an animated video that mixes InSight imagery with imagination and the Rolling Stones song, "It's Only Rock and Roll." The band gave NASA the music rights to use their song for the video. As you can imagine, that's a privilege rarely granted.

In addition to the concert inside the Rose Bowl, there were displays outside, including a half-scale InSight model, to get concert-goers into the Mars mood, and the contingent of JPL concert attendees who joined Golombek included Principal Investigator Bruce Banerdt, Project Manager Tom Hoffman, and Deputy Principal Investigator Sue Smrekar. The Lab's Deputy Director Larry James and Caltech President Thomas Rosenbaum had an opportunity to meet the band.

One special touch was seeing the NASA meatball logo on jumbo screens on the stage, side-by-side with the iconic tongue-and-lips logo of the Rolling Stones. Visual confirmation that Mars rocks!

Dramatic nighttime view from south side of JPL (John Gregoire/Photolab)

When the Flames Reached JPL's Backyard in 2009

By: Jane Platt

Ten years ago this week, the power of nature played out in all its fury behind JPL and surrounding communities. The late-summer 2009 Station Fire became the deadliest fire in L.A. County history and caused extensive damage to local communities.

The fire started on Aug. 26 and made for some jitters at JPL for the next several days when rapidly spreading flames galloped over the hillsides within 1/8th of a mile of the Lab's Mesa. Flames damaged a tower supporting antennas that transmit test signals toward the Mesa Antenna Measurement Facility, but the fire never reached buildings on Lab. As a precaution, JPL crews removed brush and pine needles from gutter and rooftops.

Because of air quality concerns, JPL was closed for three days, except for mission-essential personnel and first responders. About 140 employees had to evacuate their homes. Read a full article (archived) in the Sept. 2009 Universe, which was printed as a hard-copy newspaper at the time.

Ironically, in a sense, life imitated art for JPL's emergency operations teams. They had already scheduled a detailed emergency drill for September of 2009, using a hypothetical scenario of a major brush fire near JPL. After the extensive and invaluable real-life practice of protecting the Lab's people and property during the Station Fire, the drill was called off.

This 10-year anniversary reminds us that not only do we work in a foothill area prone to fires, but many of us also live in similar areas. It's always a good idea to prepare yourself and your family for the possibility of a fire. You can download Your Personal Wildland Fire Action Guide, part of the Ready, Set, Go program. Also check out the JPL Protective Services Division's Family/Personal Preparedness site.

If you see a fire or other emergency on Lab, call 911 from JPL phones, and 818-393-3333 from your cell phone. Pre-program these numbers now so you'll be ready when you need them.

Fixed-wing aircraft drops fire retardant on flames threatening homes just northwest of the Lab. (Jane Platt)

JPL supported helicopter operations on the mesa by the U.S. Forest Service, Bureau of Land Management and L.A. County Fire (Jane Platt)

Thick smoke billowed behind and over the Lab, as seen from the southeast. (John Gregoire/Photolab)

L.A. County Fire drops water to protect nearby homes (photographer unknown)

View from the NB Glendale Freeway (Ian Pinkham)

Events

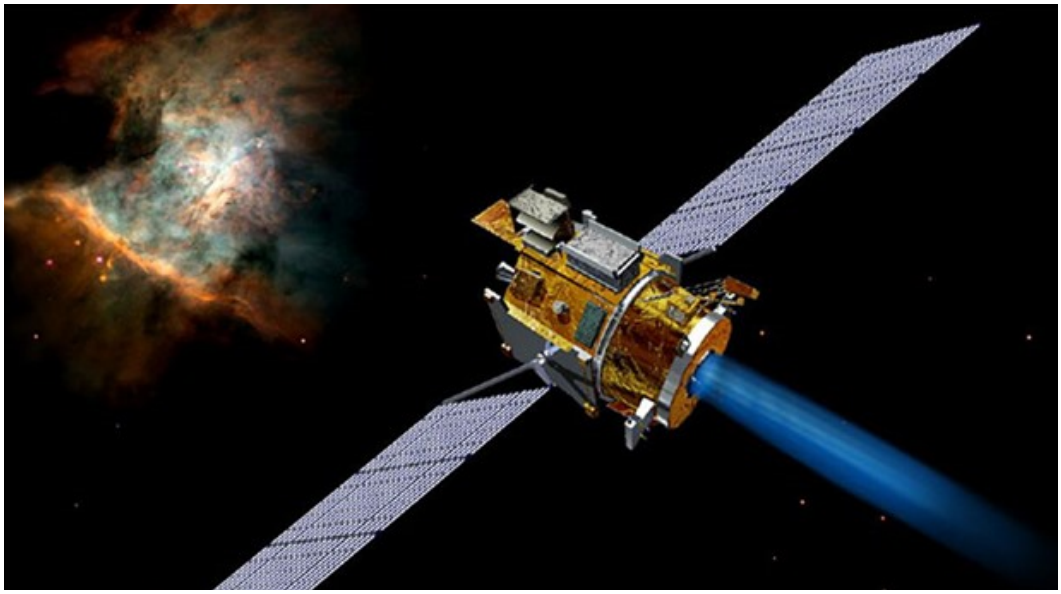
Leadership Lessons: Managing the Moonshot

Thursday, Sept. 19
3 to 4 p.m.
von Karman Auditorium

Speaker: Basil Hero, former NBC investigative reporter
Presentation: Leadership Lessons: Managing The Moonshot

How did NASA create the “flat organization” to manage the 400,000 engineers and 20,000 contractors working on the moonshot? Former investigative reporter for NBC, Basil Hero conducted an in-depth analysis of the “management techniques” pioneered by NASA during the Apollo era to land men on the moon within the short eight-year deadline set by President John F. Kennedy in 1961. Wernher Von Braun famously said, “Our two greatest problems are gravity and paperwork. We can lick gravity, but sometimes the paperwork is overwhelming.”

Science magazine, as early as 1968, recognized in a lengthy article that NASA’s leadership methods during Apollo would prove to be as important in the long run as its technological achievements: “It may turn out that the space program’s most valuable spin-off of all will be human rather than technological: better knowledge of how to plan, coordinate, and monitor the multitudinous and varied activities of the organizations required to accomplish great social undertakings."



Von Karman Lecture Series: It Broke! How We Fixed It

Thursday, Sept. 19
7 p.m.
Von Karman Auditorium

Friday, Sept. 20

7 p.m.
Caltech's Beckman Auditorium

This is a story of how JPL repaired and saved a spacecraft that was millions of miles away. Hosted by Brian White. Speaker is Marc Rayman, Deep Space 1 mission director/chief engineer/project manager

For more information on this series, visit:
https://www.jpl.nasa.gov/events/lectures_archive.php?year=2019&month=9.

JPL Family News

Retirees

The following JPL employees recently announced their retirements:

Bonnie Dean, 40 years, Section 2143; **John C Shields,** 36 years, Section 3315; **Barry S. Colman**, 13 years, Section 313B; **Cynthia D. Copeland**, 35 years, Section 3317; **Thomas G Farr**, 44 years, Section 329F; **Gary R Gray**, 29 years, Section 252F; **Gary W. Glass**, 32 years, Section 337C; **Raymond J Kariger**, 25 years, Section 357B; **Laurie J. Lincoln**, 31 years, Section 2145; **Vivian Pahati**, 19 years, Section 2126; **Jayshree Sampat**, 26 years, Section 252F; **James Zumberge**, 29 years, Section 3300

Letters

I do not have words to express my gratitude to my JPL family (as well as Al's), for all the support that was offered to both of us not just during Al's illness, but also after his passing away. The outpouring of love and respect shown to him has touched our children Yasin and Shaira as well as myself deeply, and we will cherish this kindness forever. It's what's keeping us strong.

No more two (or three) part voice mail messages for any of us; or trying to hear him giving us one more action item as his flight to D.C. Madrid or Canberra was taking off! Thank you and God bless.

Our thanks and appreciation also, to the JPL Hospitality Group for the beautiful plant.

Sincerely,
Shehenaz Bhanji

Passings

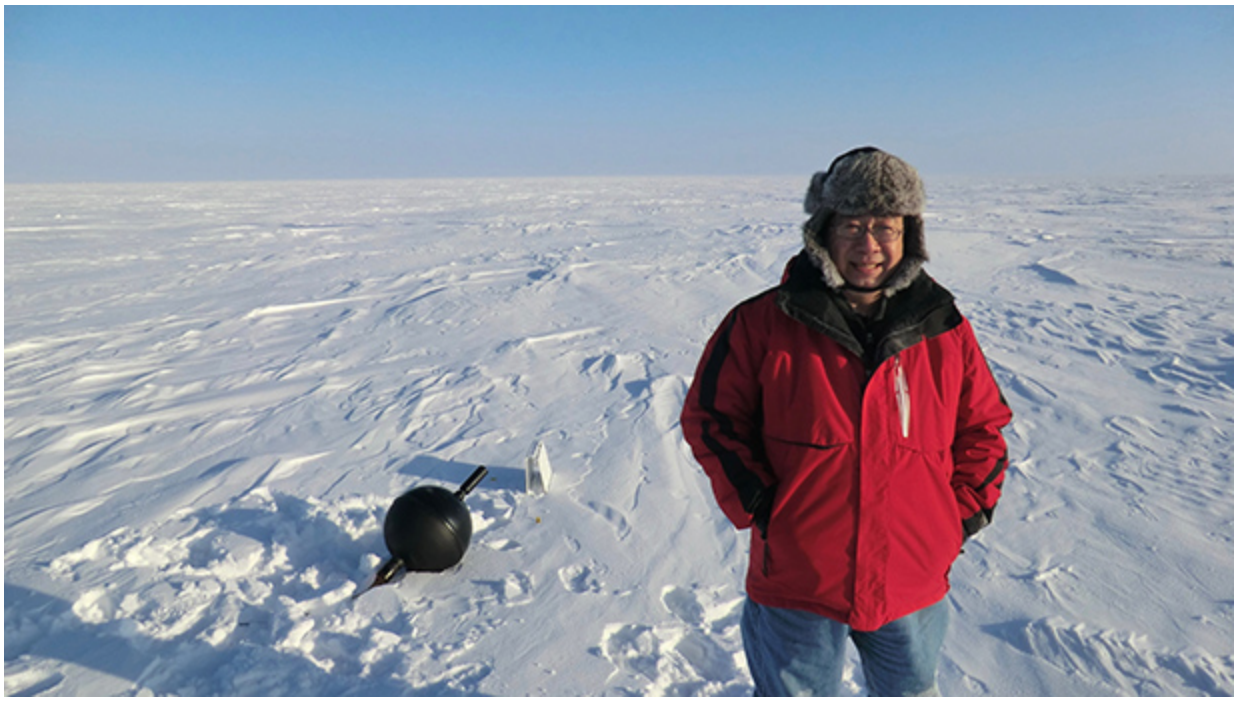
Paul Penzo, an eminent astrodynamicist, was born April 17, 1928, in Youngstown, Ohio, and passed away August 7, 2019, at Fairfax Hospital, Falls Church, VA. He had been a resident of Greenspring for the past nine years. He graduated from Youngstown College (now Youngstown University) in 1950 in Physics and received a Ph.D. from the University of Pittsburgh in 1957 in Mathematics.

Penzo applied his knowledge of physics and mathematics to mission design in the aerospace industry. He worked on the Apollo program while at TRW (now a part of Northrop). From 1970 until his retirement in 2001, he worked on many planetary missions, including Voyager, at Jet Propulsion Laboratory (JPL) in Pasadena, CA. On a special one-year assignment from JPL to NASA headquarters in Washington, DC, he was the lead person for space tether research and technology. After retiring from JPL, Paul worked part-time for Global Aerospace Corporation designing orbits for Earth-to-Mars transportation systems. Paul received many NASA awards, including the Apollo Award and the Voyager Exceptional Service Medal. His colleagues remember him for his generous advice and friendship.

Penzo was active in many professional organizations, including the American Astronautical Association and the American Institute of Aeronautics and Astronautics. He was a charter member of The Planetary Society, founded in 1980 as an advocacy foundation for space exploration. Paul is survived by his wife Mary Jane and by his brother Leonard Penzo.

Announcements

Awards



Son Nghiem standing on snow cover in the Arctic tundra near Utqiagvik (the U.S. northernmost town in Alaska) in March 2012 during the Bromine Ozone and Mercury Experiment (BROMEX), lending science support to the Minamata Convention, a global treaty to curb mercury pollution. The black buoy measured ice temperature, which was a part of an extensive network for surface temperature measurements during BROMEX.

Senior Research Scientist Son Nghiem Named AGU Fellow

The American Geophysical Union has selected senior research scientist Son Nghiem to join its 2019 class of Fellows.

Since starting at JPL in 1991, his research topics have included the tropics, polar landscapes, the oceans, the atmosphere, the Greenland ice sheet, and Arctic changes (as evidenced by the photo accompanying this story, taken in the Arctic tundra).

“It is a great honor to be recognized as an AGU Fellow from past achievements, which encourage more extensive research for more significant science findings in the future," Nghiem said.

His body of work includes active and passive remote sensing, development of advanced satellite radars and radiometers, electromagnetic scattering and emission modeling, and Earth science and applications.

Nghiem is currently the Science and Applications Development Lead of the Radar Science and Engineering Section, and the JPL Hydrology Discipline Program Manager of the Hydrology Office in the Earth Science Research and Mission Formulation.

Nghiem holds a Ph.D. from MIT. He has published over 110 peer-reviewed articles and over 400 conference articles and holds a patent for his invention on high-resolution wind measurements with satellite data for offshore wind energy development. His NASA/JPL awards include the 1999 Lew Allen Award for Excellence, 2006 NASA Exceptional Achievement Medal, 2008 NASA Exceptional Scientific Achievement Medal, 2010 NASA Exceptional Technology Achievement Medal, 2013 Edward Stone Award, and 2017 Magellan Award.

In 2012, he gave presentations about science findings on Arctic change and impacts to the Office of Science and Technology Policy in the White House, and on global mega urbanization to the Science and Technology Advisor of the Secretary of State.

Nghiem and the other 61 new Fellows will be honored at the organization's fall meeting in San Francisco on Dec. 11.

Each year since 1962, AGU has elected as Fellows members whose visionary leadership and scientific excellence have fundamentally advanced research in their respective fields. Only 0.1% of AGU membership are selected as Fellows in any given year.

Read more about the AGU 2019 Class of Fellows.

Jean-Pierre Fleurial and Thierry Caillat have received a prestigious international award in honor of their contributions to the understanding and development of thermoelectric materials and devices that generate electricity for space missions in extreme environments. The two researchers stand next to a model of NASA's Curiosity Mars rover and its Multi-Mission Radioisotope Thermoelectric Generator.

International Thermoelectric Society Honors Two NASA Scientists for Contributions to Advancements in Radioisotope Power Technology

International Thermoelectric Society Honors Two NASA Scientists for Contributions to Advancements in Radioisotope Power Technology

Two NASA scientists studying next-generation thermoelectric materials and converters for applications to radioisotope power systems (RPS) have been awarded the 2019 Outstanding Achievement Award by the International Thermoelectric Society for their decades-long leadership and contributions to the field.

The honor celebrates the seminal contributions to the development of novel thermoelectric materials and devices for space power applications made by Jean-Pierre Fleurial and Thierry Caillat, both from NASA's Jet Propulsion Laboratory in Pasadena, California.

"It is a great honor to be recognized by our peers," Fleurial said. "It's a testament to JPL and NASA's recognized leadership and expertise in the field for the last 50 years."

The award is equivalent to a "Lifetime Achievement Award." It recognizes Fleurial's and Caillat's contributions to the understanding of thermoelectric materials and device properties under extreme space conditions.

Fleurial and Caillat's work has helped establish two new radioisotope thermoelectric generator (RTG) system development projects at NASA with this advanced technology for the first time in 50 years.

The new technology could be used by upgraded or new RTGs in support of future science and human exploration missions in the solar system and beyond.

Fleurial is a senior research scientist. Caillat is a principal member of the technical staff. Both earned their PhDs in Materials Science from National Polytechnic Institute of Lorraine, France, on the topic of high-performance thermoelectric materials, with a focus on solid state physics and condensed matter.

The award was presented to Fleurial on behalf of both honorees at the 38th International Conference on Thermoelectrics, held in July 2019 in Gyeongju, Korea.
