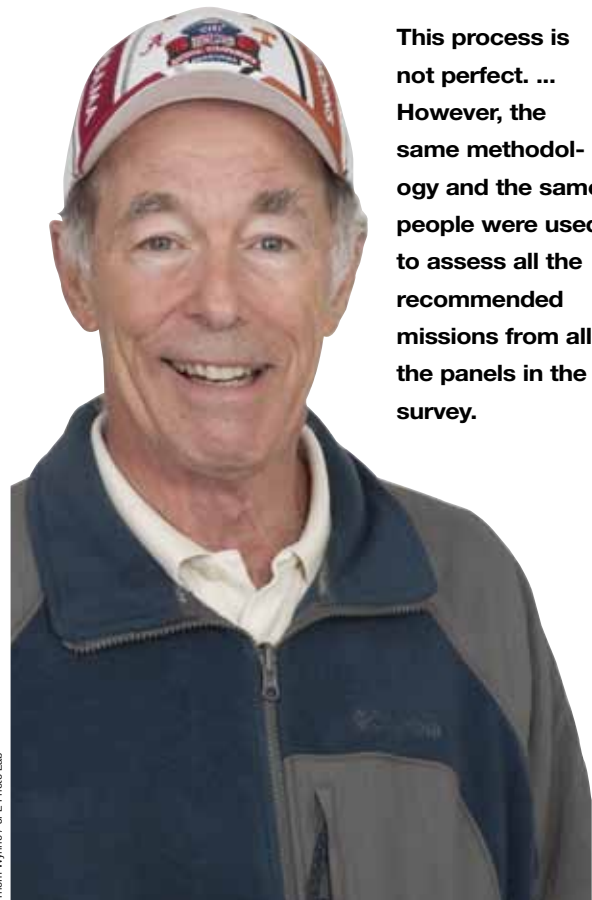


## Decadal survey shows challenging path ahead

By Mark Whalen



This process is not perfect. ... However, the same methodology and the same people were used to assess all the recommended missions from all the panels in the survey.

The National Research Council in early March released its once-a-decade report that reviews the status of planetary science in the United States and also prioritizes future research, missions and programs. Among the steering committee members for the extensive study was JPL's Gentry Lee, who discusses the process in light of today's tight budget considerations.

**Q: HOW DID YOU COME TO BE ON THE STEERING COMMITTEE? WAS THIS YOUR FIRST TIME PARTICIPATING IN THIS SURVEY?**

I was invited by Steve Squyres, the chairman of the decadal survey, to be a member of the Survey Steering Group. This was my first time to be a member of the survey. Being on the steering group was both an honor and a privilege, as well as an amazing learning experience.

**Q: HOW DID THE SURVEY WORK?**

In addition to the steering group, the survey had five panels—primitive bodies, Mars, inner planets, outer planets and satellites. To start the process of obtaining a community consensus, the survey solicited from the planetary science community white papers, of which

I think there were 199, on what should be the goals, objectives and missions associated with the time period from 2013 to 2022.

The steering group and its panels then met with members of the scientific community for more than a year and a half. Each of the panels then made recommendations in the areas that were most important to them, and subsequently the steering group triaged across the panels to come up with the final prioritized recommendations.

It was an extremely interesting and stimulating process, but this time the process was slightly different than in the past. Science was still the top priority, but for the first time in decadal survey history, we were instructed to make certain that the program we recommended could be done assuming a nominal runout of the current Planetary Science Division budgets. More importantly, all the assumed costs associated with the missions were to be determined by an independent cost and technical evaluation that was free from any advocacy.

We used the Aerospace Corporation's Cost and Technical Evaluation process. This process is not perfect. It is not flawless. However, the *same* methodology and the *same* people were used to assess all the recommended missions from all the panels in the survey. And a significantly large database of past estimated and actual mission costs informed the results.

*Continued on page 2*

### Passings

## Moustafa Chahine, former chief scientist

Moustafa Chahine, a remote-sensing pioneer and JPL's former chief scientist, died March 23.

Chahine came to JPL in 1960 and was the founding leader of the Division of Earth and Space Sciences, later serving as the Laboratory's chief scientist from 1984 to 2001. He was the science team leader for JPL's Atmospheric Infrared Sounder instrument, which was launched onboard the Aqua satellite in 2002.

Chahine's primary interests were in remote sensing of planetary atmospheres and surfaces, and in climate-change processes. He is credited with the development of the analytical "relaxation" method for inverse solution of the radiative transfer equation, and also developed a multispectral method using infrared and microwave observations to enable infrared remote sensing through clouds, methods that were applied to studies of Earth, Venus, Mars and Jupiter.

Chahine served as a member of NASA's Earth System Sciences Committee and as chair of the World Meteorological Organization's Global Energy and Water Cycle Experiment Science Steering Group from 1989 to 1999.

In 2005, Chahine was one of 15 international participants invited to speak at the Pontifical Academy of Sciences' Working Group on Water and the Environment at Vatican City, a gathering assembled to address the scientific frontiers of the main environmental issues related to the impact of hydrologic dynamics on sustainable development.

A member of the National Academy of Engineering and the International Academy of Astronautics, Chahine was also a Fellow in numerous other science associations in the U.S. and abroad. He received NASA's Exceptional Scientific Achievement, Outstanding Leadership and Exceptional Achievement medals. He was also a recipient of the William T. Pecora Award from NASA and the U.S. Department of the Interior, the Jule G. Charney Award of the American Meteorological Society, the Losey Atmospheric Sciences Award of the American Institute of Aeronautics and Astronautics and the William Nordberg Medal from the Committee on Space Research. In 2010 he received the George W. Goddard Award from the International Society for Optical Engineering in recognition of his exceptional achievement in optical science and instrumentation for aerospace and atmospheric research.

"All of you who knew him—or know of him—realize what a loss this is for JPL," said JPL Director Charles Elachi. "He was an extraordinary gentleman and scientist. He was also a mentor and dear friend to many of us."

A memorial web page (<http://bit.ly/chahine>) and blog (<http://bit.ly/chahine-blog>) have been established in Chahine's memory. Services were pending.



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**DECADAL SURVEY** *Continued from page 1*

Throughout the time that we were dealing with the cost issues, there was a lot of concern in the scientific community that our process might be unduly conservative. We continually revisited the issue of the conservatism in our process, using as our guide the database from all the previous missions.

**Q: SO WERE THE RECOMMENDATIONS MORE FOCUSED ON AFFORDABILITY AS OPPOSED TO DESTINATION OR TECHNICAL CAPABILITY?**

Both science and affordability were primary considerations. Our conclusions were straightforward: existing missions should continue as long as they are generating worthwhile science; there should be a new Discovery mission every two years; there should be at least two New Frontiers missions in the decade, with each mission having a cost cap of 1 billion FY'15 dollars, excluding the launch vehicle; the research and analysis program should be modestly increased; a technology program should be 6 to 8 percent of the planetary science budget and should be protected from incursions; flagship missions should be included if and only if there is budgetary room for them after these higher priority activities are accomplished. We laid out these decision rules to make it clear how to proceed no matter what the budget turns out to be.

**Q: WHAT SPECIFIC FUTURE NEW FRONTIERS MISSIONS WERE RECOMMENDED BY THE SURVEY?**

For the New Frontiers-4 opportunity, for which the announcement of opportunity will probably be released early in FY'14, the five recommended missions are as follows: Trojan Asteroid Tour and Rendezvous; Saturn Probe; Comet Surface Sample Return; Lunar Sample Return from South Pole/Aitken Basin; and Venus Atmosphere and Surface Mission.

**Q: WHERE DOES IT STAND, IN TERMS OF THE REPORTED COST OF THESE FLAGSHIP MISSIONS VERSUS THE AVAILABLE BUDGET?**

Well, let's differentiate between two different things. There's a lot of discussion right now about the available budget. That is different from the "nominal budget" that we were told to use for the survey. We were asked to use the funding levels that existed in the FY'11 budget, plus a modest increase for inflation.

Now, the predicted budget has turned out to be substantially lower, at least based upon the current FY'12 projections.

Flagship missions are very expensive. If the budget is extremely limited, then there may not be enough money to fund them. Nevertheless, we recommended priorities for flagship missions also. Top priority flagship is the Mars Astrobiology Explorer Cacher (MAX-C) rover concept, but only if it can be done for less than \$2.5 billion in FY'15 dollars. Second priority is the Jupiter Europa Orbiter, but only if it is de-scoped and is a new line item in the budget. The third flagship was a Uranus orbiter with probe mission, but we stressed that this flagship should only be undertaken if the first two fell out because of their cost constraints.

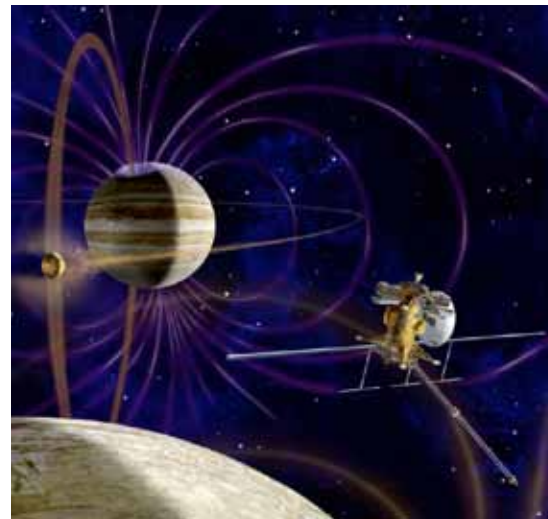
**Q: WHAT'S NEXT IN THIS ENDEAVOR? WHERE DOES THE EUROPEAN SPACE AGENCY FIT IN, REGARDING DISCUSSED FUTURE COLLABORATION?**

The NASA-ESA agreements for the future exploration of Mars are going to have to be revisited, based not just on the decadal survey but on two other factors as well. One factor is the lowered NASA budget, and the second is the European contractor bids for the ESA elements of the planned missions. We don't have any specific details, but it has been suggested that the European costs for the Mars 2016 and 2018 missions may be higher than expected.

The decadal survey is clear that these kinds of international agreements are the right way to get the kind of planetary science that we would like to do in the future. But, again, I want to stress that there are two separate factors influencing the future. There's the decadal survey release, and then there is the 2012 budget.

Before everyone becomes too gloomy, I would like to point out that budgets come and budgets go, and they're redone every year. The current runout in the planetary science budget does show a decrease, but it is entirely conceivable that at some time in the future it might show an increase. Therefore, the real value of the decadal survey is providing a set of priorities that can be used no matter what the size of the budget is.

News sources have said it doesn't look good for flagship missions. That is not a result of the decadal survey; that is a result of the projected budgets. The decadal has said flagship missions should be evaluated in terms of science value as a function of cost, but we have still advocated flagships—if affordable.



Artist's renderings depict the Jupiter Europa Orbiter, left, and Mars Astrobiology Explorer Cacher, below. The Mars mission was recommended as the top-priority flagship mission by the decadal survey.



**Q: WHAT WERE THE BASELINE GUIDING PRINCIPLES THE DECADAL SURVEY USED IN TRYING TO DECIDE WHAT THE RECOMMENDED PROGRAM SHOULD BE?**

The most important factor was science value per unit cost. Number two was balance, both in targets and cost range across the missions. Number three was technological readiness. All of these elements were weighted in some sense in trying to come up with the recommended program.

Both Ed Weiler [NASA associate administrator for the Science Mission Directorate] and Jim Green [NASA Planetary Science Division director] have indicated that the results of the decadal survey have been embraced throughout the scientific community, that people have recognized that the recommendations may not meet everybody's desires, but they do represent a consensus.

Steve Squyres and Charles Elachi have pointed out that it is in all of our best interests to try to see to it that the ambitious program outlined in the decadal survey report gets the support of Congress and the people. We are very fortunate that NASA has by far the most complete and the best-funded planetary exploration program in the world. The decadal survey and the future budgets, even though they are decreasing, would continue to leave us

in that role. I personally have made this my life career, and I'm enthusiastic about the future.

**Q: IS IT POSSIBLE THAT THERE WON'T BE A FLAGSHIP MISSION IN THE COMING DECADE?**

It's possible, but it's very unlikely, in my opinion. I believe that there will be at least one flagship mission. However, I will say under any outcome of the budget and its application, the percentage of business done by JPL that is derived from competition will continue to grow, and the percentage of our business that is directed will continue to decrease. We need to be aware of this fact at JPL and must institute changes that are consistent with that future outlook.

**Q: YOU AND THE OTHER STEERING COMMITTEE MEMBERS WILL BE HOLDING TOWN HALL MEETINGS ACROSS THE COUNTRY TO DISCUSS THE RAMIFICATIONS OF THE SURVEY. WHEN IS YOURS?**

Wednesday, April 13 at 12:30 p.m. in von Kármán Auditorium. The public is invited.

**Q: MEANTIME, HOW CAN PEOPLE FIND OUT MORE?**

Visit <http://solarsystem.nasa.gov/2013decadal/>.

# So the story goes

**Dreaming of a JPL career as a teen, Nagin Cox now delights in sharing her passions**

By Mark Whalen



Engineer Nagin Cox's schedule may find her (from left) onstage in "The Three Musketeers" at Caltech; at Serengeti National Park with husband, Earl; at work at JPL; and at Yosemite National Park's Half Dome, with Earl.



Dutch Slagter/JPL Photo Lab

When Nagin Cox agreed to take part in Caltech's production of *The Three Musketeers* in February, joining several other JPLers, she thought her role would be as an "extra," appearing in a few scenes and going mostly unnoticed.

But as rehearsals for the swashbuckling production progressed, she soon realized that due to a shortage of actors in the play she would in fact appear in a third to a half of the scenes, in multiple very small roles. This was her first involvement of any kind in a stage play. But that was OK. Like many other ventures she's tried, she gave it a shot, immersed herself in the moment, and had a blast.

"The similarities to a flight project were palpable," said Cox, an engineer on the Mars Science Laboratory mission operations development team. "You have a group of people, working as a team to accomplish a goal, and you have a launch date: opening night. It even had the same angst and stress two weeks before, then it all came together.

"The camaraderie was wonderful," she added. "I've done a ton of public speaking, but I would never have guessed that there was any theater blood in me at all. I just know it was creative and fun, and the teamwork was wonderful.

"I don't know if I'll ever do theater again, or to what extent, but I shared their world just long enough to understand it a little bit. That's how I try to choose—not just to try this new thing or that one, but something that opens up new worlds."

Indeed, Cox has often strived for grand adventures—including dreaming of working for JPL since she was 14. She recalls as a teenager watching the PBS series *Cosmos*, hosted by Carl Sagan, who was a Cornell University professor. "That was the first time I had ever heard of Cornell and it was very clear that 'going where no one has gone before' was being done by the robots. And at the time, it was only JPL that was doing that. And as you get older, that crystallizes a bit more—what kind of degree do you need and how do you go about doing it?"

She ended up attending Cornell on a U.S. Air Force scholarship, where she secured bachelor's degrees in

engineering and psychology. Her subsequent six years in the force included earning a graduate degree in space operations system engineering and an assignment to the Space Surveillance Center/U.S. Space Command at Cheyenne Mountain in Colorado.

Although enjoying the service, Cox also developed an interest in "looking outward and exploring," and JPL beckoned. She joined the Lab in 1993, also serving in the Air Force Reserves for a number of years, but found it to be complicated. "I was doing operations for Galileo, and found that both needed to be priority 1," she said. "I was serving as the weekend network director for the Air Force Satellite Control Network, and if there was an anomaly on Galileo, that just wasn't going to work."

To separate from the Air Force was tough, she said, "but I was fortunate that JPL was as wonderful as I ever thought it would be. Eighteen years later, it still is."

Cox said her experiences both in the military and at JPL have led her to have a mission-oriented outlook, which she tries to convey to audiences at her public appearances. "These are people who don't know about the space program but are paying for it," she said. "I feel a real obligation to share what we're doing with taxpayers.

"In general there's always one word that comes up: enthusiasm. I tell them, 'Do what you feel passionate about.' In my career, I have not been ambitious in the traditional sense. I always choose based on the mission. It doesn't matter to me what I'm doing on a project; what matters is what we're doing, and why."

"I didn't start out thinking in terms of storytelling," she said. "I tend to be melodramatic anyway, so it seems to fit. But the stories of Galileo, Kepler, the Mars Exploration Rovers and MSL—they're so easy to tell."

Cox is now working on her ability to deliver a talk without a PowerPoint presentation—"literally just standing up there and trying to tell a story about our missions with nothing but my voice and my body language"—something she tried for the first time at the amateur tent at the 2010 International Storytelling Festival.

About a week after *The Three Musketeers*, Cox was a guest speaker at "Women Fly!," a Women's History Month event at the Seattle Museum of Flight, providing robotic

spaceflight as a new component to their agenda. She shared the podium with Wally Funk, one of the "Mercury 13" women astronaut candidates, who in 1961 were the first women chosen to enter the space program until NASA canceled the plan later that year. "The civilian aerospace community up there is so strong and vibrant," she said. "I was totally struck by the energy they had.

"That's why I do outreach: to share the possibilities. I just try to tell the general public what it's like to be on a flight team, because they often don't know the stories of the people behind the robots. And they are inevitably amazed and drawn in, and now they look at the robotic missions with new eyes."

Cox's public service isn't limited to speeches. She has served on the board of directors for Griffith Observatory and is currently involved with the Women's Rights Committee of Human Rights Watch. "It's not as cut and dried as building a spacecraft and launching it; the issue of the oppression of women around the world isn't something you just fix," she said. "And as an engineer, that's hard."

She's also been on the board of Impact Personal Safety, a non-profit women's self-defense program that is dedicated to men and women working together to end the cycle of violence. "I was born in India," Cox said. "And although I grew up here, I'm immensely grateful for the opportunities that women have in this country, and I'm deeply aware of how there are places in the world where women can't drive or vote or own property or are even getting stoned."

In *The Three Musketeers* effort, Cox joined JPLers Ashley Stroupe, Dave Seal and Steve Collins, who have been contributing to Caltech theater for years, she noted.

When Cox and her husband return from vacation to Peru in late March she's looking forward to working with JPL outreach Jane Houston Jones and the Old Town Pasadena astronomers. "I've only joined them once or twice, but I learn a lot doing it," she said. "But this and almost everything else could be on hold for a while with MSL launching this year. We have a date with destiny in 2012 and launching successfully in 2011 is the first step."

# News Briefs



Charles Elachi

## Four major awards to Elachi

JPL Director Charles Elachi in March was granted an honorary doctorate by Occidental College in Los Angeles, one of four major awards he will receive in 2011.

Occidental honored Elachi at the university's 40th annual President's Circle Dinner March 5 at JPL. Elachi was one of five to eight people to whom Oxy will confer honorary degrees this academic year.

In late March Elachi received the 2011 Carl Sagan Memorial Award from the American Astronautical Society. The award is given to individuals who demonstrate leadership in research or policies advancing exploration of the cosmos, and is awarded in cooperation with the Planetary Society. Previous winners include former JPL Directors Ed Stone and Bruce Murray. Elachi was scheduled to receive the honor March 30 at the society's Robert H. Goddard Memorial Symposium in Greenbelt, Maryland.

The Space Foundation will confer on Elachi the 2011 General James E. Hill Lifetime Space Achievement Award April 13 at the National Space Symposium in Colorado Springs, Colo.

Elachi is the first NASA center director to be selected for the award, which honors the Space Foundation's former chairman, Gen. James E. Hill, USAF (retired). The award recognizes "outstanding individuals who have distinguished themselves through lifetime contributions to the welfare or betterment of humankind through exploration, development and use of space, or through use of space technology, information,

themes or resources in academic, cultural, industrial or other pursuits of broad benefit to humanity."

In an honor announced last December, the director was awarded the Chevalier de la Legion d'Honneur, France's highest decoration.

Although Elachi is a native of Lebanon and the award is traditionally restricted to natives of France, the honor has gone to foreign nationals "who have served France or the ideals it upholds." Being honored at age 16 as Lebanon's top science student enabled Elachi to attend the college of his choice, France's University of Grenoble, where he received a bachelor's degree in physics in 1968. That same year, he received an engineering degree from the Polytechnic Institute in Grenoble, where he graduated first in the class.

Elachi will receive the award at a future date this year.

## Former JPLer honored for pixel sensor invention

The National Inventors Hall of Fame is inducting former JPL physicist and engineer Eric Fossum, who led a team that invented a semiconductor active-pixel image sensor that is widely used in cell phone cameras, webcams, digital still cameras, medical imaging and other applications. Fossum is now an engineering professor at Dartmouth College in Hanover, N.H.

The image sensor chip was created at JPL in the early 1990s. Fossum and his team discovered it while researching ways to drastically reduce the size of cameras on interplanetary spacecraft

while maintaining the scientific image quality.



Eric Fossum

The result was the invention of the complementary metal-oxide semiconductor active-pixel sensor, which consolidates various functions of the prevalent image sensor of the time, but with one-hundredth of the power of its predecessors and with the ability to make its own conversion from analog to digital for output on computer monitors. Fossum soon realized that the technology would be useful not only for space exploration, but here on Earth as well.

In 1995, Fossum and a group of JPL engineers founded Photobit, in Pasadena, which exclusively licensed the CMOS-active-pixel sensor technology from JPL, becoming the first company to commercialize CMOS image sensors.

National Inventors Hall of Fame induction ceremonies will be held May 4 in Washington, D.C. For more information, visit [http://solarsystem.nasa.gov/scitech/display.cfm?ST\\_ID=2364](http://solarsystem.nasa.gov/scitech/display.cfm?ST_ID=2364).

## Russell book on life's origins

Michael Russell, a research scientist in the Planetary Chemistry and Astrobiology Group, recently contributed to and edited an issue of the Journal of Cosmology with an entry on the origins of life that has been published as a book.

Citing contributions from more than 40 expert scientists worldwide, "Origins, Abiogenesis and the Search for Life in the Universe" takes on the questions of how life began and possible life on other planets. The volume from Cosmology Science Publishers also includes an article titled, "Why Does Life Start, What Does It Do, Where Will It Be, and How Might We Find It?," which Russell co-authored with JPL principal scientist Isik Kanik.

For more information, visit <http://journalofcosmology.com/Contents10.html>.

Russell, who earned a bachelor's degree with honors in geology and chemistry from the University of London (1963) and a doctorate in mineral deposit geochemistry from the University of Durham, England (1974), joined JPL in 2005 as a distinguished visiting scientist.



Michael Russell

## Passings

Retiree **Kamal Soliman**, 71, died Dec. 30.

Soliman worked at JPL from 1977 to 1996. He is survived by daughter Michele and son William. Services were held at Rose Hills in Whittier.

Retiree **Ruth Gates**, 89, a retired executive secretary in the former Facilities Maintenance and Operations Section, died Jan. 12.

Gates worked at JPL from 1963 to 1984.

Retiree **Audrey Snyman**, 91, died Jan. 21.

Snyman worked at JPL from 1965 to 1981. As a team member of JPL's Image Processing Laboratory she earned a NASA Group Achievement Award for improved computer processing for space photographs.

She is survived by son Royce and granddaughter Kristen.

Retiree **Karen Boyle**, 75, a retired software system engineer, died Feb. 1.

Boyle joined JPL in 1980 and worked as a configuration management engineer on projects such as Galileo, Comet Rendezvous Asteroid Flyby, Cassini and the Space Interferometry Mission.

She contributed to the development of a first-generation JPL requirements management tool called Tracer—which became a model for the development of

the commercial Doors tool—and also helped develop a paradigm for its application to JPL projects and co-taught the approach in a JPL Professional Development course.

Boyle is survived by sons John, Timothy and Dennis, and grandchildren Jennifer, Michael, Jeannine, Ian and Sean. Services were held Feb. 16 at Riverside Memorial Cemetery.

Retiree **Mary Kisting**, 81, died Feb. 11.

Kisting joined the Lab in 1980 and retired in 1995. She is survived by her sister Dorothy.



Albert Laxdal

Former JPL engineer **Albert Laxdal**, 78, died Feb. 17.

Laxdal joined JPL in 1971. He worked in the Computer Applications and Data Systems, Information Systems Research and Mission Control, and Sequence Systems Design sections. After leaving JPL in 1981, he worked at the Aerospace Corp. on inertial upper-stage rockets that carried Department of Defense and NASA payloads into space. He later

served as mayor of Thousand Oaks.

Laxdal is survived by his wife, Kitch, three children, eight grandchildren and 11 great-grandchildren. Services were held in Thousand Oaks.



Lyle Skjerve

**Lyle Skjerve**, 70, an engineer in Section 335, died Feb. 23.

Skjerve joined JPL in 1974 and became one of the pioneers in Very Long Baseline Interferometry experiments. He went on to play a major role in JPL's Radio Reference Frame, the first space VLBI demonstration, and was deeply involved in all of the system's technology upgrades for nearly 40 years.

Skjerve is survived by his wife, Anne, 13 children, 32 grandchildren and seven great-grandchildren.

Services were held March 5 at Trinity Baptist Church in Barstow. Friends and colleagues may visit Skjerve's memorial website at [http://memorialwebsites.legacy.com/lyle\\_skjerve/Homepage.aspx](http://memorialwebsites.legacy.com/lyle_skjerve/Homepage.aspx).

**Paul Parsons**, 77, a retired telecommunications engineer, died Feb. 26.



Paul Parsons

Parsons worked at the Lab from 1964 to 1992. He is survived by his wife, Linda. Private services were held in Prescott, Ariz.

## Retirees

The following JPL employees retired in March: **Allan Eisenman**, 47 years, Section 3444; **Robert Bunker**, 42 years, Section 314; **David Otth**, 41 years, Section 355D; **Richard Carnas**, 39 years, Section 333H; **Ronald Boain**, 36 years, Section 310; **Ben Toyoshima**, 36 years, Section 314D; **Yvonne Zieger**, 34 years, Section 500; **Robert Glaser**, 32 years, Section 355K; **Sven Grenander**, 31 years, Section 317; **Gloria Kobbe**, 25 years, Section 6011; **Karen Jolicoeur**, 22 years, Section 1141; **Margaret Porter**, 22 years, Section 184; **Chia-Ho Chien**, 16 years, Section 173A; **Martin Marcini**, 15 years, Section 383H; **Bruce Scardina**, 13 years, Section 355G; **Deborah Cowan**, 12 years, Section 312A.



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# Universe

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