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Tiny device helps determine it's a flat universe

By Michelle Viotti

Inspired by the elegant efficiency of spider webs, JPL researchers have designed a tiny, web-shaped sensor that maps faint structures in the early universe, reinforcing theories that the cosmos is flat in its geometry.

Carried on an internationally sponsored balloon experiment called BOOMERANG (Balloon Observations of Millimetric Extragalactic Radiation and Geophysics), the dime-sized sensor known as a "micromesh bolometer" is a prime example of NASA's success in developing miniaturized, high-performance technologies for space missions.

"Just as spiders spin their webs with the least amount of silk possible, we were able to eliminate 99 percent of the material used by conventional

bolometers," said Dr. James Bock of the Astrophysics Research Element 3231, who led in the detector's development at JPL's Microdevices Laboratory. "The supporting material for our detector even has the same thickness as a strand in a spider's web—about one micron thick, or 100 times finer than a human hair."

Using advanced micro-machining techniques, each section of the sensor's web was designed to be smaller than the millimeter wavelength of radiation streaming in from the cosmic microwave background. Created when the first atoms formed in the early universe, the cosmic microwave background has cooled 1,000 times from its original temperature—comparable to the hot surface of the Sun—to the cold, faint radiation seen today.

Bock noted the efforts of several people at JPL who also contributed to the sensor's success: Anthony Turner and Srinivasan Sethuraman, who fabricated the devices at the Microdevices Laboratory, and Warren Holmes, who originally suggested silicon nitride as a material for the device. He also acknowledged Viktor Hristov at Caltech, who developed the stable, low-noise readout electronics for BOOMERANG.

While the cosmic microwave background is almost perfectly uniform in all directions, the sensitivity of

JPL's bolometer allows scientists to capture temperature variations of only 100 millionths of a degree (0.0001 C) in just a few seconds of observing time.

"That's sensitive enough to detect the heat given off by a coffee maker all the way from the moon," Bock said.

By measuring one small patch of sky after another over several days of observation, the bolometers plot a map of the cosmic background radiation, providing a snapshot of the universe when the radiation formed about 300,000 years after the Big Bang. At this time, regions with a higher density of matter and energy left a record in the background radiation. Wherever dense regions existed, they left a faint imprint of slightly higher temperatures. These fluctuations in the background serve as a kind of fingerprint, allowing scientists to discriminate between theories of cosmic development.

With the bolometer's high level of sensitivity, the BOOMERANG project was able to reveal density patterns in the young universe that are consistent with an inflationary theory of cosmic development. The theory proposes that, in the first moments after the Big Bang, the universe went through a period of extreme, exponential inflation. The theory further predicts a "flat" geometry for the universe, because the immense stretching of space during an inflationary period would have removed any initially strong curvature in the smaller and denser early universe.

"If we were to balance on a large ball, we would certainly feel the curvature beneath our feet," explained Bock. "Expand that ball to the size of the Earth, and we experience that space as flat. Now think about blowing up that ball to a cosmic scale, and you can imagine how inflation would vastly flatten the visible universe."

To test cosmic development theories even further, future JPL bolometers will fly on the European Space Agency's Far Infrared and Submillimetre Telescope (FIRST) and Planck missions, both scheduled for launch in 2007. Using bolometers with 10 times higher performance, Planck is expected to provide the definitive map of variations in the cosmic microwave background, while FIRST will survey some of the earliest galaxies.

Gary Parks, project manager for FIRST and Planck, said he looked forward to future scientific discoveries provided by the JPL bolometers.

The BOOMERANG results were obtained through a 1998 balloon experiment that carried JPL's bolometer in a sensitive receiver 36 kilometers (23 miles) above the atmosphere in Antarctica. The scientific results were published in the April 27 issue of *Nature*. More information on BOOMERANG can be found online at <http://www.physics.ucsb.edu/~boomerang>.

Open house set for June 3, 4

Preparations are underway for JPL's annual open house, scheduled for Saturday, June 3 and Sunday, June 4. The Lab will be open to the public from 9 a.m. to 5 p.m. each day of the festivities, which are free of charge.

The theme for this year's event is "JPL in the 21st Century." Exhibits and demonstrations about the Laboratory's ongoing research and space exploration will be showcased along the lines of the Earth, Mars, solar system, universe and technology theme areas.

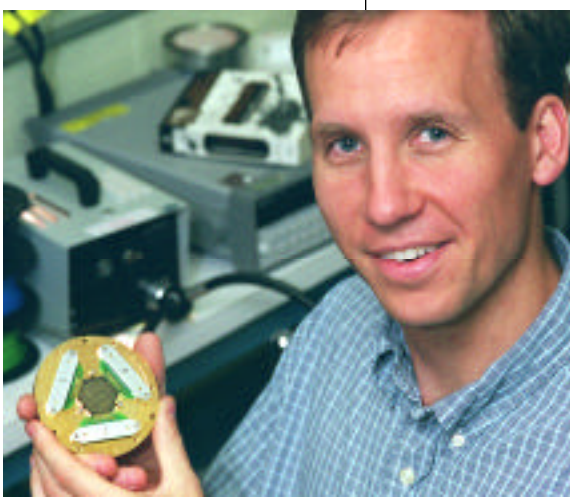
Among the many facilities available to the public will be JPL's 25-foot Space Simulator, used to produce spacelike conditions of extreme temperatures, high vacuum and intense solar radiation; the Mars Yard, a replica of Martian terrain; and the Deep Space Operations Center, through which all communications to spacecraft in the solar system are sent.

Many of the Lab's scientists and engineers will be on hand to answer questions about the Laboratory's work.

Special hands-on activities designed for kids will be offered, and food and beverages will be available. The ERC will be selling space souvenirs and NASA and JPL merchandise.

Last year, a record crowd of 55,000 attended Open House. The success of the event depends largely on the efforts of JPL volunteers, who are sought to serve as bus tour guides, help with kids' activities, monitor lines at buildings, and other activities. If interested, call the Public Services Office at 4-0112.

Dutch Steger/JPL. Photo



Dr. James Bock holds the tiny bolometer developed at JPL that was used to map the early universe.

Dog bone-shaped asteroid observed

By Jane Platt



Asteroid 216 Kleopatra as imaged by a 305-meter (1,000-foot) telescope at the Arecibo Observatory in Puerto Rico.

NASA astronomers have collected the first-ever radar images of a "main belt" asteroid, a metallic, dog bone-shaped rock the size of New Jersey, an apparent leftover from an ancient, violent cosmic collision.

The asteroid, named 216 Kleopatra, is a large object in the main asteroid belt between Mars and Jupiter; it measures about 217 kilometers (135 miles) long and about 94 kilometers (58 miles) wide.

Kleopatra was discovered in 1880, but until now, its shape was unknown.

"With its dog bone shape, Kleopatra is one of the most unusual asteroids we've seen in the solar system," said JPL astronomer Dr. Steven Ostro, who led a team of astronomers observing Kleopatra with the 305-meter (1,000-foot) telescope of the Arecibo Observatory in Puerto Rico. "Kleopatra could be the remnant of an incredibly violent collision between two asteroids that did not completely shatter and disperse all the fragments."

The astronomers used the telescope to bounce radar signals off Kleopatra. With sophisticated computer-analysis techniques, they decoded the echoes, transformed them into images, and assembled a computer model of the asteroid's shape.

These new radar images were obtained when Kleopatra was about 171 million kilometers (106 million miles) from Earth. Traveling at the speed of light, the transmitted signal took about 19 minutes to make the round trip to Kleopatra and back.

Kleopatra is one of several dozen asteroids whose coloring suggests they contain metal. Kleopatra's strong reflection of radar signals indicates it is mostly metal, possibly a nickel-iron alloy. These objects were once heated, melted and differentiated into structures containing a core, mantle and crust, much as the Earth was formed. Unlike Earth, those asteroids cooled and solidified throughout, and many underwent massive collisions that ex-

posed their metallic cores. In some cases, those collisions launched fragments that eventually collided with Earth, becoming iron meteorites like the one that created Meteor Crater in Arizona.

"But we don't need to worry about Kleopatra—it will never hit Earth," Ostro said.

"The radar observations indicated the surface of Kleopatra is porous and loosely consolidated, much like surface of the moon, although the composition is different," said Dr. Michael Nolan of the Arecibo Observatory.

"We can think of some possible scenarios (for the asteroid's peculiar shape), but at this point none is very satisfying," Ostro said. "The object's existence is a perplexing mystery that tells us how far we have to go to understand more about asteroid shapes and collisions."

The team's findings appeared in the May 5 issue of the journal *Science*. Ostro's team includes Dr. Donald Yeomans of JPL.

News Briefs

Galileo finds volcanoes as dust source

Fiery volcanoes on Jupiter's moon Io are the main source of dust streams that flow from the Jupiter system into the rest of the solar system, according to new findings from JPL's Galileo spacecraft analyzed by an international team of scientists.

The scientists, led by AMARA GRAPS of the Max Planck Institute of Nuclear Physics in Heidelberg, Germany, analyzed the frequency of dust impacts on Galileo's dust detector subsystem. They found peaks that coincided with the periods of Io's orbit (approximately 42 hours) and of Jupiter's rotation (approximately 10 hours).

Although dust scientists had suspected Io as the source of the dust streams, it was difficult to prove. They ruled out several possible sources, including Jupiter's main ring and Comet Shoemaker-Levy 9, but Jupiter's gossamer ring and Io remained as candidates. The dust scientists studied several years of Galileo data to show that the motion of the dust stream particles is strongly influenced by Jupiter's magnetic field, with a unique signature that could exist only if Io were the main contributor to the dust streams.

A paper on the findings appears in the May 4 issue of the journal *Nature*.

JPLers invited to robotics 'scrimmage'

Student teams in the FIRST (For Inspiration and Recognition of Science and Technology) program from nine Southern California high schools will bring robots built by them to JPL for a robot scrimmage on Thursday, May 25 from 11 a.m. to 1 p.m. in the mall. The robots, about 3 ft. wide by 2-1/2 ft. deep by 4 ft. high in size, compete by tossing a ball through a hoop.

Students will work with JPL engineers on their projects and get an inside look at the engineering profession.

"JPL is the lead center for robotics for NASA and is interested in promoting robotics education," said DR. SAMAD HAYATI, manager of JPL's Robotics and Mars Exploration Technology Office, which is sponsoring the

scrimmage. He said JPL has volunteered to help organize a first-ever Southern California regional next year.

Hayati added that the event is being publicized to Los Angeles County schools for their awareness and participation for next year.

FIRST is a non-profit organization whose mission is to generate an interest in science and technology. The FIRST robotics competition is a national contest for high school students.

Senior caregiver group to start

JPL's Employee Assistance Program has begun the sponsorship of a Seniors Caregiver Support Group.

The group's first meeting will be held June 6 from noon to 1 p.m. in Building 167-111. The group will continue to meet the first Tuesday of each month in the same location.

Licensed Clinical Social Worker ADRIA EMBERSON of the Huntington Hospital Senior Care Network will facilitate the meetings.

For information, call the Employee Assistance Program at ext. 4-3680.

Planet-hunting fellowships awarded

JPL recently awarded three post-doctoral and four graduate fellowships to students with innovative proposals for enhancing NASA's search for planets around other stars.

The annually awarded fellowships, given through the Michelson Fellowship Program, funded by NASA's Origins Program and JPL's Space Interferometry Mission, are named for DR. ALBERT MICHELSON, known as the father of interferometry, a technique that combines and processes light from multiple telescopes to obtain a clear image of distant objects.

The fellowships sponsor three years of graduate research at the student's host institution. The graduate student award is about \$30,000 per year, while the post-doctoral awards range from \$60,000 to \$80,000 per year, depending on the nature of the research.

More information is available online at <http://sim.jpl.nasa.gov/michelson>.

NASA is taking the first steps toward Internet-like connectivity among its future Earth-sensing satellites with the funding of 30 research proposals from industry, academia, government and NASA centers in advanced information system technology.

Of the 30 proposals selected for funding, eight were submitted by JPL researchers.

Known as "Sensor Web," this is the first in a series of information technology research initiatives that will help NASA's Office of Earth Sciences solve the massive challenge of collecting, processing, routing and storing Earth science measurement data. Of the 117 proposals submitted, the 30 selected cover a variety of topics ranging from satellite on-board processing, data collection and analysis, information transmission and wireless networks, to satellite platform control.

"With the increasing number of Earth observing satellites planned over the next decade, information technology will be the key to collecting and distributing Earth science data and information products to the global science community," said Dr. Ghassem Asrar, associate administrator for Earth Sciences at NASA Headquarters. "The 'Sensor Web' is similar to the Internet in that scientists and other users will be able to direct and control those sensors in the same manner as we access information on the Internet today."

The Sensor Web concept also will take full advantage of the revolution occurring in information and telecommunications technologies for direct delivery of space-based Earth observations to the end-user at the cost of placing a long distance telephone call, according to Asrar.

Research funded by this program will proceed over three years. During that period, a second increment of research projects will be initiated, focusing on other aspects of information technology essential to the next generation of Earth science missions.

The 30 research proposals selected by the Advanced Information System Technology Program will have a total value of approximately \$26 million over a three-year period and will involve government, industry and university partners in 12 states and the District of Columbia.

A description of all of the selected proposals can be found on the Internet at <http://earth.nasa.gov/nra>. The JPL researchers and their selected proposals are as follows.

Payman Arabshahi (Section 331): Intelligent Sensor and Satellite Networks for Earth Science and Exploration.

Yoaz Bar-Sever (Section 335): Precise Global Real-Time Onboard Navigation Capability for Earth Science Remote Sensing.

Andrew Berkun (Section 334): FPGA-Based On-Board Processor/Controller for Satellite-Borne Precipitation Radars.

Samuel Dolinar (Section 331): Region-of-Interest Data Compression with Prioritized Buffer Management.

Hamid Hemmati (Section 331): Multi-Gigabit/second Optical Communications Transceiver for Earth Science.

Braden Hines (Section 383): Advanced Infrastructure for Dynamic Instrument Reconfiguration and Autonomy Integration.

Adrian Hooke (Section 900): Next Generation Space Internet Communications Services.

Tien-Hsin Chao (Section 344): Advanced Holographic Memory.

Special Events Calendar

Ongoing Support Groups

Alcoholics Anonymous—Meeting at 11:30 a.m. Mondays, Tuesdays, Thursdays (women only) and Fridays. Call Occupational Health Services at ext. 4-3319.

Codependents Anonymous—Meeting at noon every Wednesday. Call Occupational Health Services at ext. 4-3319.

Gay, Lesbian and Bisexual Support Group—Meets the first and third Fridays of the month at noon in Building 111-117. Call employee assistance counselor Cynthia Cooper at ext. 4-3680 or Randy Herrera at ext. 3-0664.

Parent Support Group—Meets the third Thursday of the month at noon in Building 167-111. Call Greg Hickey at ext. 4-0776.

Senior Caregivers Support Group—Meets the first Tuesday of each month in Building 167-111. For information, call the Employee Assistance Program at ext. 4-3680.

Friday, May 12

Finland: Land of Contrasts—This travel film will be shown at 8 p.m. in Caltech's Beckman Auditorium. Tickets are \$9 and \$7. For information, call (626) 395-4652.

Fri., May 12–Sat., May 13

Spring Concert—The combined Caltech Glee Clubs and the Caltech Occidental Chamber Orchestra will perform a program to be determined at 8 p.m. in Ramo Auditorium. Admission is free. For information, call (626) 395-4652.

Saturday, May 13

Folk Music—Singer/songwriter Lui Collins will accompany herself on guitar in this 8 p.m. performance in Caltech's Dabney Lounge. Tickets are \$12 for adults, \$4 for children under 12. For information, call (626) 395-4652.

Tuesday, May 16

JPL/Red Cross Blood Drive—To be held from 10 a.m. to 4 p.m. in von Kármán Auditorium. Signup sheets will be available prior to the blood drive at Occupational Health Services (Building 310), and Occupational Health Services' home page at http://eis/medical/blood_form.html. If you have not signed up ahead of time, or wish to change your appointment, call the Pasadena Red Cross at (626) 799-0841, ext. 630.

JPL Hiking Club—Meeting at noon in Building 303-209.

Wednesday, May 17

"A Different View of the DNA Double Helix: A Conduit for Charge Transport"—Caltech chemistry professor Dr. Jacqueline Barton will give this free lecture at 8 p.m. in the campus' Beckman Auditorium. For information, call (626) 395-4652.

JPL/Red Cross Blood Drive—To be held from 7 a.m. to 1 p.m. in von Kármán Auditorium. See May 16 for signup information.

Thursday, May 18

JPL Astronomy Club—Meeting at noon in Building 198-109.

"The Importance of Quality Childcare"—Child Educational Center Executive Director Elyssa Nelson, who also conducts training for childcare workers and center directors, will speak on the impor-

tance of childcare in nurturing and fostering children's physical and emotional development. At noon in Building 167-111.

Saturday, May 20

Bandorama—The Caltech Jazz and Concert Bands will perform this free concert at 8 p.m. in Beckman Auditorium. The Jazz Band will feature two student vocalists and perform music from the swing era to the present. For information, call (626) 395-4652.

Rummage Sale—The Child Educational Center's annual spring sale will be held from 8 a.m. to 3 p.m. in the main parking lot at 140 Foothill Blvd., La Cañada. For more information, call ext. 4-3418.

Tuesday, May 23

JPL 2000 Lecture Series—Mars Global Surveyor Project Scientist Dr. Arden Albee will speak at 11 a.m. in von Kármán Auditorium.

Wednesday, May 24

JPL Toastmasters Club—Meeting at 5:30 p.m. in the Building 167 conference room. Guests welcome. Call Mary Sue O'Brien at ext. 4-5090.

XML For Data Exchange—Karl Fast, consultant and Web developer, Northern Lights Internet Solutions, will discuss how e-commerce is driving the development and implementation of applications derived using extensible markup language and how JPL can use this language to move scientific data, engineering specs and other information quickly and easily. To be held from 11:30 a.m. to 1 p.m. in von Kármán Auditorium.

XML Style Sheets—Karl Fast will provide an introduction to XML style sheets, transforms and patterns, and discuss how the pattern schema chosen affects the layout and composition of an individual Web page or an entire site. To be held from 2 to 4 p.m. at the northeast side of Building 167 cafeteria.

Thursday, May 25

Caltech Architectural Tour—The Caltech Women's Club presents this free service, which is open to the public. The tour begins at 11 a.m. and lasts about 1 1/2 hours. Meet at the Athenaeum front hall, 551 S. Hill St. Call Susan Lee at (626) 395-6327.

Elder Caregivers Lecture—Licensed Clinical Social Worker Adria Emberson of Huntington Hospital Senior Care Network will speak at 11:45 a.m. in von Kármán Auditorium. Guest speakers will also discuss legal issues, insurance and long-term care, elder assessment and placement, and caregiver stress and burnout. Hosted by JPL's Employee Assistance Program.

JPL Golf Club—Meeting at noon in Building 306-302.

Von Kármán Lecture Series—"The Hubble Space Telescope: Ten Years in Flight" will be the topic of a panel discussion at 7 p.m. in von Kármán Auditorium. Open to the public.

Friday, May 26

Von Kármán Lecture Series—"The Hubble Space Telescope: Ten Years in Flight" will be the topic of a panel discussion at 7 p.m. in The Forum at Pasadena City College, 1570 E. Colorado Blvd. Open to the public.

Eight JPL proposals selected to study satellite information technology



Daughters, sons enjoy their day at JPL

By Gia Scafidi



"Fun" and "fabulous" were widely used descriptions by children and parents alike in referring to JPL's eighth annual "Take Our Daughters to Work Day" April 27, sponsored by the Laboratory's Advisory Council for Women. This year's theme, "Free To Be You and Me," attracted about 400 girls and boys.

The event "was designed to benefit those children who need career guidance, or are facing issues in their adolescent phases," said Kimberly Simpson of Section 368, a member of the council.

The day's activities allowed children to sit in on interactive presentations, participate in a variety of science projects and enjoy an ice cream feast after lunch. The youngsters, ranging in age from 9 to 15, also spent time in their parents' work environment, getting a feel for what mom and dad do during the week.

"I think this is a great incentive for kids," said parent Anna Chavez, who works with JPL's Advanced Thermal and Structural Technology Group. "This encourages [kids] to stay in school and stay motivated."

Karen Lee, senior engineer with the Microwave and Lidar Technology Section Section 386, added, "I think it's fabulous, especially for young girls. This gives them the opportunity to see that science technology is a viable career choice for women."

The national event, started in 1992, was conceived by the Ms. Foundation in response to a study conducted by Harvard University and the American Association of University of Women. The study found that girls tended to have lower expectations than boys of the same age, and that female children often valued themselves based on physical appearance as their primary determinant.

"As always, all children are welcome to attend the event at JPL," Simpson said, noting that the format for next year will be altered. The current plan is to change the name of the event to "Take Our Children to Work Day" and also include an optional two- to four-hour series of events led by the Advisory Council for Women and targeted specifically for girls.

Various JPL employees volunteered to put on this year's activities. Lee hosted simulated Pathfinder model and soda straw rocket projects. "The projects were designed to be simple, using materials the kids could easily find at home," she said. Kids made mock Pathfinder landers out of cardboard, using balloons for airbags and newspaper for the parachutes. "We then put a raw egg inside and dropped the lander from the rooftop and

the second floor. Neither time did the egg break. This was a hit with the kids."

"The egg drop was my favorite activity," said Natasha Lush, 10, who came to the Lab with her mother, Cindy, of Section 369.

The rockets were pretty popular too. The kids constructed paper rockets and slid them onto the end of a straw. By blowing into the straw, they were able to launch the missiles.

Thomas Valdez, a member of the technical staff in Section 346, taught the kids about a direct methanol fuel cell. Using several volunteers, Valdez said he "turned them into little molecules," and physically showed the children how the chemical reaction of the fuel cell involved the oxidation of methanol and the reduction of oxygen to water. "They loved it," he said.

The kids also enjoyed demonstrations by Kimberly Spellman, a rover and robotic arm system engineer, who familiarized the kids with the Pathfinder rover and the way in which it receives commands. She also lined up volunteers on the ground and let a rubber-wheeled rover climb over them.

"My favorite was the rover running over people," said 12-year-old Ricky Espinoza, who attended the festivities with his father, Rick, of Section 214.

Spellman also taught the children about Mars' atmosphere, extreme temperatures, sunsets and sunrises, and surface composition. She brought Martian soil simulant samples and Martian basaltic rocks for the kids to handle.

Annie Richardson, education and outreach coordinator for the Shuttle Radar Topography Mission, spoke to the children about the importance of having a plan for the future. She stressed that "it's okay to ask for help when you run into problems."

In addition, Richard Shope, the education and outreach coordinator for the Outer Planets/Solar Probe Project, led the kids in an interactive, "up and out of their seats" activity, which explained ion drive propulsion.

For some children, not even these activities compared to the time they got to spend with their parents. Ashlan Foster, 10, daughter of Edward Tunstel of Section 345, summed it up in a few words: "Yeah, today was cool, but my favorite part was having lunch with my dad."

Curious visitors gather as

Thomas Valdez of Section 346

demonstrates fuel cells during

Take Our Daughters to Work

Day. Above, Deborah

Underwood, left, daughter of

Mark Underwood, supervisor

of the Power Electronics

Engineering Group in Section

344, and her pal Emily

Spencer, whose dad, Michael,

is a radar systems engineer in

Section 334, enjoy ice cream

near the end of the day.

'Daughters Day' one of many services of women's council

By Mark Whalen

Take Our Daughters To Work Day has been a rousing success since its inception at JPL in 1993. It is but one of a myriad of activities sponsored by the Laboratory's Advisory Council for Women (ACW).

The 15-member council provides input to the director and deputy director in the development of Lab policies, processes and practices that support equal opportunity for women at JPL. In addition to this management advisory role, the council serves as a vital career-development resource for women employees and sponsors a number of activities of interest to women.

"We encourage women on Lab to be proactive in coming to us with issues and concerns about their careers," said Dr. Ann Tavormina, manager of the Exploration Systems Autonomy Section 367 and ACW vice chair.

In fulfilling its role to monitor the perceptions and attitudes of women about their employment at JPL, the council

has begun a couple of new activities: forming focus groups to better understand the issues and needs for women on Lab, and collecting what Tavormina calls JPL women's history—stories of their employment-related successes and failures on Lab and elsewhere.

"We need more raw material from women about their experiences in order to make things better," she said. "This will help us achieve one of our long-term goals of putting the ACW out of business, by eventually attaining a state where there is no longer a need for the council. We'll know we've reached that state when there is broad consensus that gender is no longer a factor in employment-related matters."

Established in 1977, the council has played key roles in a number of initiatives, including establishing a career counselor program on Lab, streamlining maternity leave policies and procedures, and helping establish the Child Educational Center in La Cañada, which has provided child care for infants through school-age children for 21 years and provides tuition discounts to JPL families.

At an ACW-sponsored Women's History Month panel discussion in March, Tavormina, former deputy mission manager and flight engineering office manager on the Magellan mission to Venus, noted that part of her personal success is

due to the fact that "quality childcare made it possible for me to continue to contribute to Magellan right through the births of my children and their early years."

JPL's Executive Council has been working to form a closer relationship with the ACW. "The EC and the ACW are jointly committed to creating and maintaining an organizational climate which embraces equal employment opportunity for women employees," Tavormina noted. Added ACW member Susan Pocino of Section 388, "most women don't know that by sharing their concerns with us, issues can be forwarded to the highest levels of management on Lab. We need to hear from people so we can do our best for them. On our Web site [<http://eis.jpl.nasa.gov/acw>], people can find contact information for current council members."

Shortly the ACW will announce the availability of the annual administrative professionals briefing workshop tape titled, "Overcoming Overload: Strategies for Staying on Top." In addition to continuing its ongoing series of seminars, the council's goals for 2000 include completing an update of its charter and operating procedures.

The council is also in need of three new members. Council members serve two-year terms with an option to extend for a year.

