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A new look at the Sun

By Jim Sahli

Initial observations by the recently launched Solar and Heliospheric Observatory (SOHO) spacecraft reveal unexpected activity on the Sun and the best views yet of the sources of strange, chaotic "plume" structures that extend from the solar poles to high altitudes within its outer atmosphere, or corona.

SOHO was specifically designed to observe the Sun during a supposedly "quiet" period near the bottom of its 11-year sunspot cycle, when solar disturbances are at a minimum and the undisturbed solar atmosphere and interior could best be studied.

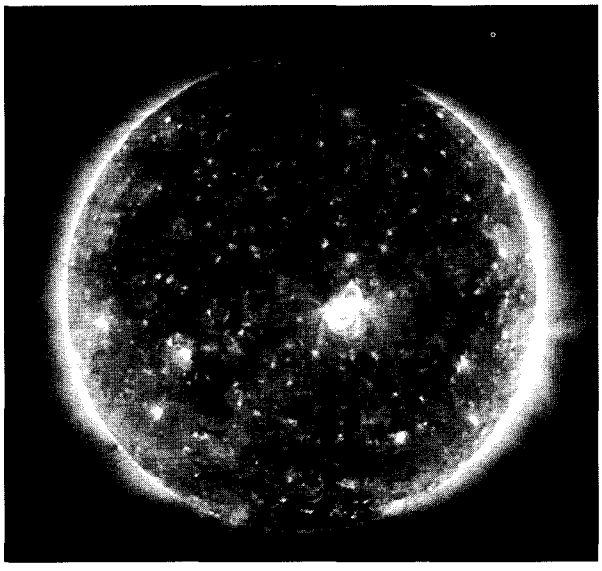
To the surprise and excitement of SOHO's scientific investigators, "movies made from SOHO ultraviolet data show there is continuous motion and action everywhere on the Sun," said Dr. Joseph Gurman of Goddard.

Disturbances are occurring even within so-called "coronal holes," areas of particularly low density, low temperature and open magnetic field lines in the corona where such disturbances were least expected. An open magnetic field is one in which the lines of magnetic force stretch out indefinitely into interplanetary space, rather than looping back downward onto the Sun.

The dramatic new ultraviolet movies from SOHO also have revealed the source areas of the long, feathery plumes that extend from regions near the poles of the Sun to more than 13 million miles into interplanetary space. The sequences of ultraviolet images, combined into movies by SOHO researchers, show the polar plumes standing in the solar wind, an outward streaming of electrified gas from the corona. The movies clearly reveal the bases of the plumes, never characterized before, to be seething regions of wildly gyrating magnetic fields and turbulent solar gases.

"Polar plumes are a natural laboratory to explore two of the main objectives of the SOHO mission," explained Dr. Craig DeForest of Stanford University, Palo Alto, Calif. These goals are to learn how the Sun's corona is heated to about 3.6 million degrees Fahrenheit and why the solar wind in some places reaches speeds of almost 2 million miles per hour. The plume data may even shed light on the third main goal of SOHO, to determine what occurs below the solar surface to generate the strong flows and intense magnetism that produce solar disturbances such as sunspots and solar flare explosions.

The chaotic conditions discovered by SOHO at the base of the polar plumes are also under analysis. Early data show that often the base of a plume is a bright point in the solar atmosphere, as seen in ultraviolet light. These bright points fluctuate rapidly in intensity and are at locations where magnetic fields are rapidly changing. "These magnetic changes may represent the release of significant amounts of energy on the Sun, and they contribute to the heating of the corona," according to NASA's Gurman.



NASA/ESA Image

This image illustrates 1.5-million degree Celsius gas in the Sun's thin, outer atmosphere (corona) taken March 13, 1996 by the Extreme-ultraviolet Imaging Telescope which is onboard the Solar and Heliospheric Observatory (SOHO) spacecraft. Every feature in the image traces magnetic field structures. Because of the high quality instrument, researchers can see more subtle and detailed magnetic features than ever before. This image is the first time scientists have been able to get such images except during five-minute rocket flights. Because of SOHO's view of the Sun, science researchers have been able to make movies that show the dynamic, ever changing nature of the "quiet Sun."

A chief aim of the SOHO polar plume research is to see if plumes can be positively identified as the sources of high-speed streams of solar wind that were directly sampled by the European Space Agency's Ulysses spacecraft when it passed over the poles of the Sun in 1994 and 1995. In earlier work with sounding rocket experiments, DeForest concluded that the plumes may contain high-speed outward gas flows. "Now, we are trying to determine whether the plumes are in fact the fundamental source of the high speed streams," he said.

The dramatic changes found at the foot of the polar plumes "appear to include the breaking open of small

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Director's Update

by Joe Rothenberg

I believe that the Center must redirect civil servants into areas of work which have a new emphasis consistent with the roles and missions assigned to Goddard by the Agency. A major challenge in implementing these shifts is matching the skills of available employees to the required skills of the available work of the future.

The successful launch of several flight projects, the near term completion of other projects, and the availability of civil servants who are supporting areas that will be reshaped in the future affords us an immediate opportunity to proactively reconfigure the future of the Center and its workforce.

Center management is committed to making these matches through voluntary transfers. As I announced in recent Center Town Meetings and All-Hands addresses, reassignment opportunities will be prominently displayed. Additional training and career development activities will be provided, as necessary, to ease the transition for employees who are interested in changing organizations and/or career directions.

More than 30 opportunities at the Center have already been identified. Additional positions will be identified in the near future. These opportunities are now being publicized throughout the Center in a variety of ways.

The first, Refocusing Opportunity Notices, will be sent to employees through mailroom distribution, posted on vacancy announcement bulletin boards in buildings around the Center, and available electronically on the Office of Human Resources Home Page (http://ohr.gsfc.nasa.gov, then click on "Information for GSFC Staff," then click on "Reassignment Opportunity Bulletins"). These Refocusing Opportunity Notices contain information about specific positions, eligibility requirement for non-competitive consideration, how to apply, and a point of contact to obtain additional information.

Let me reiterate that employees are encouraged to apply not only for the opportunities for which they may already be fully qualified, but also for opportunities in areas of work for which they do not possess the experience. If selected, additional training and development necessary to reach full capability in the job will be assessed with the help of the Employee and Organizational Development Office.

New Millennium first mission selected

By Ernie J. Shannon

An advanced, lightweight scientific instrument designed to produce visible and short-wave infrared images of Earth's land surfaces has been selected as the focus of the first NASA New Millennium program mission dedicated to the agency's Mission to Planet Earth enterprise. The project will be managed by Goddard.

The capabilities of the Advanced Land Imager instrument to be demonstrated on the flight will serve multiple purposes, according to Dr. Charles Kennel, NASA Associate Administrator for Mission to Planet Earth.

The new instrument will demonstrate remote-sensing measurements of the Earth consistent with data collected since 1972 through the Landsat series of satellites, which is used by farmers, foresters, geologists, economists, city planners and others for resource monitoring and assessment. In addition, it will acquire data with finer spectral resolution, a capability long sought by many elements of the Earth observation data user community, and it will lay the technological groundwork for future land imaging instruments to be more compact and less costly.

"We looked at nearly a dozen different mission concepts in some detail, and a land surface imaging mission clearly was at the top of this year's priority list," Kennel said. "It will ultimately enable first-class science, by validating breakthrough technology with clear potential capabilities, both commercially and to the future of NASA's Earth Observing System."

As designed, the Advanced Land Imager represents an approximate sevenfold decrease in mass and electrical power usage demands compared to the current Landsat 5 multispectral instrument. In addition, it extends the existing measurement capabilities through the incorporation of an advanced high resolution hyperspectral imaging "spectrometer-on-a-chip." This novel, wide-field observing system requires no scan mirror. It is built around a lightweight integrated silicon carbide structure and optical system, with an innovative in-flight calibration system.

The Advanced Land Imager will be developed from instrument technologies proposed by members of the existing New Millennium Integrated Product Development Teams.

For this mission, the team of industry partners will be led by the Massachusetts Institute of Technology's Lincoln Laboratory, Lexington, Mass., a federally funded research and development center. Lincoln Lab and its partners will provide open access to U. S. industry regarding the design and performance of the Advanced Land Imager, with the explicit purpose of expediting the transfer of this technology into the commercial sector.

The instrument will feature ten-meter ground resolution in the panchromatic (black-and-white) band and 30-meter ground resolution in its other spectral bands, using a four-chip multispectral focal plane array that covers seven of the eight bands of the current Landsat. Hyperspectral capabilities, which further split these bands into highly differentiated images, will be tested to show that they can be combined into traditional Landsat-equivalent data sets.

"The combination of multispectral and hyperspectral capabilities in a future operational system would preserve and continue the invaluable Landsat-based record of global land cover change, while opening up new windows on the Earth in areas like precision vegetation studies and more accurate mineral identification," Kennel said.

The spacecraft support structure, including advanced electrical power and data-handling subsystems, will be provided by Swales & Associates, Inc., Beltsville, Md., and Litton Industries, College Park, Md. The effort also will incorporate advanced spacecraft technologies made available through the New Millennium Integrated Product Development Teams.

The power and data subsystems will be provided through a Space Act cost-sharing agreement that calls for Litton to develop the hardware and integrate it into the New Millennium spacecraft, while providing the company with a two-year license to commer-

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XTE discovers fluctuations in intensity of X-ray emissions

by Jim Sahli

Astronomers working with NASA's Rossi X-Ray Timing Explorer (XTE) spacecraft have discovered rapid fluctuations in the intensity of X-ray emissions from three unusual binary star systems that appear to be the signatures of the fastest vibrations ever detected in celestial objects.

In one case, the oscillations reached frequencies as high as 1,130 times per second. The new findings were reported April 30 at a meeting of the High Energy Astrophysics Division of the American Astronomical Society in San Diego, Calif.

The observations made using Rossi XTE offer scientists a new window on the strange physical conditions that scientists envision on neutron stars, which are believed to form when massive stars reach the ends of their lives and then explode as supernovas. The outer layers of a supernova are expelled into space, while its inner core remains and becomes a neutron star. Unlike normal stars, which are balls of hot gas, neutron stars are believed to possess solid crusts.

The first detection of the remarkable fluctuations by Rossi XTE was made in February 1996. Astronomers led by Dr. Tod Strohmayer of the Universities Space Research Association (USRA) at Goddard were observing the binary star 4U 1728-34, located in the general direction to the center of the Milky Way galaxy in constellation Sagittarius.

This star pair was already well known to astronomers as a frequent source of powerful bursts of X-rays, which are thought to originate in hot gas that has streamed downward onto a very small and dense star known as a neutron star from a companion star. As the gas accumulates on the neutron star, it turns into a natural nuclear bomb, burning with a thermonuclear flash that produces a burst of X-rays lasting about 10 seconds.

Fortunately, 4U 1728-34 was in a bursting state when the Rossi XTE observations commenced. The astronomers were able to detect both the powerful bursts and the weaker "persistent" X-ray emission that is always emanating from the binary star.

"We were very excited to catch several X-ray bursts in our first pointing at the object. We were even more excited when a quick look at the persistent X-ray data revealed very high frequency oscillations which no one had ever seen before," said Strohmayer. "The observations seem to confirm long-standing theoretical ideas suggesting that physical conditions on a neutron star can change in less than one millisecond." (A millisecond is one-thousandth of a second.)

The oscillations detected in 4U 1728-34 occurred at varying rates, reaching as high as 1,100 times per second. In subsequent Rossi XTE observations, investigators under Michiel van der Klis of the University of Amsterdam, The Netherlands, have detected even faster oscillations in X-rays emitted by the binary star system Scorpius X-1, which is named for the constellation in which it is located.

Scorpius X-1 was the first object beyond the solar system to be detected as a source of X-rays. In Scorpius X-1, the oscillations observed with the Rossi XTE have reached rates as high as 1,130 times per second.

Further observations by the spacecraft's instruments have found oscillations of up to 900 times per second in a third binary star, 4U 1608-52, in the constellation Norma. Research on that star was led by Jan van Paradijs of the University of Alabama, Huntsville, and the University of Amsterdam, and by Dr. William Zhang of USRA, who is also from Goddard. Each of these three binary star systems contains a neutron star, and all of them are located in the southern sky.

"It's possible that the oscillating X-ray emissions come from gas orbiting very close to the neutron star," according to Strohmayer. For example, material orbiting at 10 miles above a neutron star would circle it about 700 times per second. "We have also measured a 363 times per second oscillation during the bursts from 4U 1728-34. This may be the period at which the neutron star is spinning," he added. Other Rossi XTE data support this interpretation.

"A more controversial possibility," he added, "is that we may be detecting for the first time the influence of waves on the surface of the neutron star or within its solid crust." Such waves occur in the gaseous layers of the Sun and other stars, but have not previously been found in neutron stars. "The detection of such waves might allow us to probe the unseen interiors of neutron stars, just as seismologists use earthquake waves to explore the inner layers of the Earth."

The possibility that the Rossi XTE has detected actual waves in neutron stars or a very fast rotation period of one such star is of great scientific interest, says Dr. Jean Swank, RXTE Project Scientist at Goddard and a collaborator in the research on all three binary star systems. If surface waves have been detected, that would be a scientific first. If a very fast rotation period has been detected in a neutron star in an X-ray binary system, the finding would tend to confirm a theory that certain very fast radio pulsars, known to be rotating neutron stars, are descended from fast-rotating members of X-ray binaries.

In any case, "we have succeeded in one of our prime goals for this spacecraft, to detect and characterize rapid changes in celestial X-ray sources that may reveal their underlying physical conditions," Swank said.

XTE was launched by a Delta II rocket on Dec. 30, 1995. Subsequently, NASA renamed it in honor of the late Professor Bruno Rossi of the Massachusetts Institute of Technology in Cambridge, one of the pioneers of X-ray astronomy. The Earth-orbiting spacecraft carries the largest X-ray detector yet flown in space, the Proportional Counter Array, which was developed at Goddard by Swank and her team members.

Space Flight Awareness

Technology Experiments for Advancing Missions in Space (TEAMS)

Aboard Space Shuttle Endeavour when it begins the STS-77 mission in May will be a Goddard-managed Hitchhiker (HH) carrier.

The carrier will be loaded with four experiments called Technology Experiments for Advancing Missions in Space (TEAMS). Those experiments are the Global Positioning System (GPS) Attitude and Navigation Experiment (GANE); the Vented Tank Resupply Experiment (VTRE); the Liquid Metal Thermal Experiment (LMTE) and the Passive Aerodynamically Stabilized Magnetically Damped Satellite (PAMS).

The Hitchhiker is a primary Shuttle payload of STS-77. Of the four experiments, one is a Goddard project. The experiments are flown together at reduced cost and with the Hitchhiker carrier providing the needed resources (power, data, etc.) to each experiment.

The Hitchhiker carrier can carry equipment mounted in canisters and also has mounting plates of various sizes for user equipment. The carrier provides electrical power, command signals, and "downlink" data interfaces. Hitchhiker customers operate their payloads from a Goddard control center using their own ground support equipment (usually a personal computer) to send commands and display data.

The Goddard Passive Aerodynamically Stabilized Magnetically Damped Satellite (PAMS) experiment is a technology demonstration of the principle of aerodynamic stabilization. PAMS consists of a small deployed satellite and a measuring system to observe the satellite during the Space Shuttle mission.

Aerodynamic stabilization is a method that can be used to position a satellite in a specific orientation while in low Earth orbit. Aerodynamic stabilization works the same way as a dart. The front of the dart is weighted and once the dart is thrown, it will always right itself with the head facing forward. In the same manner, the PAMS satellite will eventually be oriented with the heavy end facing forward in orbit. This principle can be used to partially control the attitude of small satellites.

Most instruments need a satellite to point at a specific feature that will be measured from space, such as telescopes. For instruments that do not have precise pointing requirements, aerodynamic stabilization can be used with other methods to obtain the desired orientation. A satellite can be aerodynamically stabilized by building it heavy at one end, but well balanced. Designing satellites that use this principle means that a simpler attitude control system can be used on the satellite, making the satellite less complicated, more reliable, and cost-effective.

Cameras on the Shuttle will record the satellite as it is deployed. Later during mission the Shuttle will rendezvous with the satellite on two separate days. The Shuttle will trail 2,000 feet behind the satellite and point the PAMS measuring system. The cameras aboard the Shuttle will record the satellite movements over eight orbits.

NASA SCIENTIST ELECTED TO NATIONAL ACADEMY OF SCIENCES

Dr. James E. Hansen, Chief of the Goddard Institute for Space Studies (GISS), New York, a division of Goddard Center, has been elected to the National Academy of Sciences. This honor is bestowed annually on individuals or team in recognition of significant contributions to science.

Hansen began his career at GISS from 1967 as a National Research Council Resident Research Associate. He came to GISS full-time in 1972 as a space science researcher. In 1981, he was appointed as Chief of the Goddard Institute for Space Studies. He has served as principal and co-principal investigator on several planetary missions including the Galileo (Jupiter Orbiter) Deep Space Probe. Most recently, he has specialized in the broad study of global change on earth.

Hansen has received NASA awards for his contributions to the Galileo mission and a NASA Exceptional Service Medal for his work in radiative transfer. He received a public service award from the National Wildlife Federation.

In addition to his duties at NASA, Hansen is an adjunct professor at Columbia University in the Department of Geological Sciences.

A native of Denison, Iowa, Hansen graduated from the University of Iowa in 1963, in Iowa City, where he received a bachelor of science degree (with the highest distinction) in physics and mathematics, a masters of science in astronomy in1965, and a Ph.D. in physics in 1967. Hansen and his wife, Anniek, live in Ridgewood, N.J., and have two children.

A new look at the Sun

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magnetic arches to form 'jets' that expel mass at coronal temperatures," Gurman added. Such jets have been observed in the X-ray portion of the spectrum by a telescope on Japan's Yohkoh spacecraft, "but this is the first time that small-scale jets have been observed outside large active regions on the Sun," he said. "In fact, we are seeing them in a coronal hole at the south pole, along with the plumes."

Much of the new information on polar plumes and on the unexpected disturbances on the "quiet Sun" comes from the SOHO Extreme-ultraviolet Imaging Telescope (EIT). Dr. Jean-Pierre Dela-boudiniere, of the Institut d'Astrophysique Spatiale, Orsay, France, is principal investigator for EIT. The EIT images show the portion of the plumes from their bases in the solar surface layer out to heights of about 93,000 miles. At its base, a plume is about 1.5 times as wide as the diameter of the Earth. (The diameter of the Earth is 7,928 miles.)

Other important information comes from SOHO's Michelson Doppler Imager (MDI), which measures underlying magnetic fields and gas flow patterns on the solar surface, and from the Large-Angle Spectroscopic Coronagraph (LASCO), which images the plumes as far as 30 solar radii from the surface of the Sun. (The radius of the Sun is about 440,000 miles.) Professor Philip Scherrer of Stanford University is the principal investigator for MDI and Dr. Guenther Brueckner of the Naval Research Laboratory, Washington, D.C., is the principal investigator for LASCO.

SOHO is on location in space near the L-1 Lagrangian point, where the Earth's and Sun's gravitational forces balance, some one million miles sunward from the Earth. This vantage point enables solar astronomers to observe the Sun continuously, with no intervening "night."

SOHO is a project of international cooperation between NASA and the European Space Agency. It was launched on Dec. 2, 1995 from the Cape Canaveral Air Station, Fla. The Extreme-ultraviolet Imaging Telescope is the product of laboratories in France, Belgium, and the U.S. The Large-Angle Spectroscopic Coronagraph was fabricated at laboratories in the U.S., Germany, France, and the United Kingdom. The Michelson-Doppler Imager was produced at laboratories in the United States.

Space Pods and Knots viewed by Hubble

by Tammy Jones

Resembling a bizarre setting from a science fiction movie, dramatic images sent back by NASA's Hubble Space Telescope have surprised astronomers by uncovering thousands of gigantic tadpole-shaped objects surrounding a dying star.

Dubbed "cometary knots" because their glowing heads and gossamer tails superficially resemble comets, they are probably the result of a dying star's final outbursts. Although ground-based telescopic observations have hinted at such objects, they have not previously been seen in such abundance, say researchers.

The knots were detected by Hubble astronomer C. Robert O'Dell and graduate student Kerry P. Handron of Rice University in Houston, while exploring the Helix nebula, a ring of glowing gases blown off the surface of a sunlike star late in its life.

O'Dell expects the gaseous knots, which are each several billion miles across, will eventually dissipate and vanish into the cold emptiness of interstellar space. However, he speculates that if the objects contract to form permanent solid bodies, they may contribute to a fraction (less than ten percent) of the missing mass of our galaxy, simply because of their sheer abundance around a typical dying star.

The mysterious "space pods" came into view as O'Dell used Hubble's Wide Field Planetary Camera-2 to survey the Helix nebula, located 450 light-years away in the constellation Aquarius and the closest planetary nebula to Earth — so close that its angular size is almost half that of the full Moon.

The most visible cometary knots all lie along the inner edge of the ring, at a distance of trillions of miles from the central star. Their comet-like tails, each stretching a hundred billion miles, form a radial pattern around the star like the spokes on a wagon wheel. Though previous ground-based observations show a spoke pattern in the Helix, and some structure, O'Dell emphasizes that the Hubble images reveal an underlying population of many more smaller objects.

O'Dell made the observation because he was curious if these objects were the result of the star's final outburst which would bring comets out of "cold storage" by boiling off the icy, solid comet nuclei. This is how comets behave as they swing near our Sun.

The knots have just the right appearance and are at just the right distance from the dying star to be a long-sought comet cloud — much like the hypothesized Oort cloud encircling our solar system. However, each gaseous cometary "head" is at least twice the diameter of our solar system — far too large for the gaseous shell, called a coma, that surrounds an active comet as we know it.

The most likely explanation is the objects have been formed during the final years of a star's life when it ejects shells of gas into space. This "planetary nebula" formation happens in stages where, toward the end of the process, a faster moving shell of gas ejected off the doomed star collides with slower moving gas released ten thousand years before.

Standard models predict that the knots should expand and dissipate within a few hundred thousand years. However, dust particles inside each gas ball might collide and stick together, snowballing to planet-sized bodies over time. The resulting objects would be like Earth-sized copies of the frigid, icy planet Pluto. These icy worlds would escape the dead star and presumably roam interstellar space forever.

If this phenomena is common among stars, then our galaxy could be littered with trillions of these objects, O'Dell concludes. "Planetary nebulae have been formed in our galaxy for billions of years and about one new one is created every year since this is the usual ending for the billions of sunlike stars inhabiting our Milky Way galaxy."

Hubble will be used to search more distant planetary nebulae for similar features. O'Dell hopes to revisit the Helix in a few years and take more images which might reveal the outward motion of the knots.

MOST AMBITIOUS SPARTAN MISSION

Goddard's Spartan 207 and the Jet Propulsion Laboratory's Inflatable Antenna Experiment (IAE) together make up the Spartan 207/IAE, a primary payload scheduled for deployment this spring during Mission STS-77.

According to Mark Steiner of the Special Payloads Division and the Spartan 207/IAE Mission Manager, this is the most ambitious Spartan mission ever undertaken.

The IAE is an inflatable, deployable, antenna reflector structure that is 50 feet in diameter and is mounted on three 100 foot struts. Once inflated, a camera will monitor the IAE for any problems. The Spartan carrier is rectangular in shape with experiments occupying half its volume and support systems occupying the rest.

The mission objective is to validate and characterize the mechanical function and performance of a 14-meter-diameter inflatable deployable antenna reflector structure in the space environment.

On Flight Day Two after deployment and the Shuttle moves the proper distance from the Spartan, a command will be issued to begin the inflation sequence. During this sequence the IAE will be illuminated and photographed. The experiment takes approximately 90 minutes to complete. At the conclusion of the experiment on Flight Day Three, the IAE is jetissoned from Spartan 207. The Shuttle then rendezvous with and retrieves Spartan 207.

11 GAS Payloads on STS-77

The Get Away Special Project, which is also managed by the Special Payloads Division, is flying 11 payloads on STS-77. The project has been in operation for 14 years and allows students, individuals or organizations an opportunity to perform experiments on the Space Shuttle.

GAS experiments on this mission are from the following organizations: California Institute of Technology, The German Space Agency, NASA Lewis Research Center, Utah State University, The Canadian Space Agency, Penn State University, and The European Space Agency.

After this mission, GAS would have flown 138 payloads. While opportunities for flying GAS payloads will be slim for the next two years, Clarke Prouty, GAS mission manager, says once the International Space Station flights begin, GAS will be very active. To date, 446 applications have been submitted for payload reservations.

Goddard host to a record turnout for Community Day

by Nina Desmond

It may have been the great weather, or perhaps an increased interest in space exploration, or possibly excellent public awareness efforts. Something managed to bring a record turnout of 6,100 visitors to Community Day on April 28. Whatever the reason, Goddard's Spring Open House was a huge success.

Dr. Robert Price gave a special presentation on NASA's Mission to Planet Earth to standing room only crowds. All who attended came away with a better understanding of this crucial NASA program and Goddard's important contributions to Earth Science.

The Goddard Amateur Radio Club and the Goddard Model Airplane Club continued their long standing tradition of participation at Community Day. The clubs demonstrations proved as popular as ever.

The RXTE Project was represented throughout the day by Dr Jim Lochner. Also, the Facilities Management Division in celebration of Earth Week provided a display on energy saving lighting and environmental issues.

"All the credit for such a successful Community Day goes to the Visitor Center Team Volunteers and all the Goddard employees who volunteered their valuable time to host our tour facilities", says Steve Moore, assistant manager of Goddard's Visitor Center.

Photo by Marc DeBord

Visitors to Goddard's Community Day look at model rockets at the Visitor Center.

In Memoriam

Hongsuk H. Kim passed away suddenly at Goddard May 8th while playing soccer with the Goddard League after work. Hongsuk began his career at NASA thirty years ago at the Electronics Research Center in Cambridge, MA after receiving his M.S. in Physics from Northeastern University. When the Center closed he went to Wallops where he spent six years and pioneered in lidar ocean bathymetry and fluorescence research. The legacy of this work is the Airborne Oceanographic Lidar currently at WFF. He transferred to Greenbelt twenty years ago where he became the principal investigator in developing the Ocean Color Experiment. This was one of four experiments which flew on the Space Shuttle's maiden flight to include science experiments (SPS-2), resulting in his receiving a special Presidential citation from Ronald Reagan in a ceremony at the Smithsonian. He continued to work with atmospheric, land, and oceanic energy processes. He was currently testing the use of lasers for measuring atmospheric temperature using Brillouin scattering. He also had submitted ground breaking research on the role of solar forcing in climatic changes which will have an impact on how the significance of the greenhouse effect will be viewed. Mr. Kim leaves a wife, Armida, and three sons.

2 Goddard employees selected for the 1996 astronaut class

Two Goddard Space Flight Center employees are among 35 individuals selected for the 1996 astronaut class.

Dr. Piers Sellers of the Laboratory for Terrestrial Physics in the Earth Sciences Directorate and Paul Richards of the Space Technology Division of the Engineering Directorate will report to the Johnson Space Center in Houston in August to begin a two-year training program. They will be joined by 33 others which represents the largest astronaut class since 1979.

"It's the culmination of a life-long dream," said Sellers who first became enthralled with the space program watching the Apollo astronauts from his home in England. "I've known since those days that I wanted to pursue space flight."

For Richards as well, it has been a long effort. "I first applied to the astronaut program before I was old enough to qualify because I wanted to become familiar with the process."

Sellers and Richards report to Houston Aug. 12 where they will begin a year's worth of training and evaluation. After another year or so, they will be assigned to a Space Shuttle mission.

Shuttle Launch Honorees view STS-76

On March 22, after a 24-hour delay due to high winds, Goddard Space Flight Awareness Launch Honorees got to view the 3:13 a.m. launch of the STS-76 from the VIP viewing site at Banana Creek. The flight was the third of nine planned Space Shuttle–Mir link ups between 1995 and 1998, including rendezvous, docking and crew transfers, which will pave the way toward assembly of the International Space Station beginning in November 1997.

In addition to a VIP tour of KSC, the honorees attended a reception held in their honor with astronauts and high level management in attendance to congratulate them. In a separate ceremony, astronaut Dave Walker, a veteran of four Space Shuttle missions, presented the Goddard honorees with their Certificate of Merit and pin.

This NASA-sponsored award recognizes individuals for their exceptional dedication to quality work and flight safety. It is one of the highest and most prestigious awards available to employees of the NASA/ industry Space Shuttle/payloads team.

The next Space Flight Awareness Launch Honoree Event will be held in conjunction with the STS-79 mission, currently scheduled for launch July 31, 1996.

Photo by Marc DeBord

Honorees pictured left to right: Jerry Zgonc/542; Denis McCloskey/Lockheed Martin Technical Operations Company, Inc.; Cheryl Dry/Allied Signal Technical Services Corporation (ATSC); Avanaugh Showell/ATSC; Roy Idehara/Lockheed Martin Missiles and Space Company, Inc.; Russ Snyder/Swales and Associates, Inc.; Marc Harlacher/Stanford Telecommunications, Inc.; Eric Krupacs/442; Mary Galloway/ Computer Sciences Corporation (CSC); Paul Nelson/CSC; Doug Ward (CSC); and Jody Fillman/205.1. Not available for photo: Mark Lupisella/511 and Sara Leung/ATSC.

Photo by Marc DeBord

NASA's Charles Kennel is shown receiving a momento from, left, Center Director Joe Rothenberg, Deputy Director Al Diaz, Earth Science Director Dr. Vince Salomonson and Associate Director for Mission to Planet Earth Dr. Bob Price. Kennel departed the Agency in May.

Boricuas en la NASA

"Boricuas en la NASA," or Puerto Ricans at NASA, was the headline of the Jan. 14 Sunday Magazine of *El Nuevo Dia,* the primary Spanish language newspaper of Puerto Rico. The artlicle highlighted the many achievements of 31 graduates of the University of Puerto Rico, Mayaguez who are currently working at Goddard. The article has brought fame to those who appeared in it, both locally and on the island, and even resulted in a special declaration by the Senate of Puerto Rico recognizing them for being role models for Puerto Rican youth.

A New Millennium mission

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cialize the technology. "This innovative arrangement, which includes a major commitment from Litton to integrate and deliver the hardware, represents an exciting new way of doing business for Goddard," said Center Director Joseph Rothenberg.

Further potential industry partnerships in the mission beyond those already identified will be solicited in a workshop to be held during upcoming advanced definition studies.

The total NASA cost of the first New Millennium Earth science mission, including its Small Expendable Launch Vehicle, has been capped at $90 million. Launch is planned for late 1998.

The current mission operations concept for the New Millennium flight has the spacecraft flying autonomously several minutes ahead of the ground track flown by the planned Landsat 7 satellite, to provide accurate paired-scene comparisons between the new and the traditional observing technologies. Evolutionary versions of the Advanced Land Imager would be candidates for flight on future generations of NASA Earth Observing System missions, beginning with the AM-2 spacecraft.

Formally started in NASA's FY 1996 budget, the goal of the New Millennium program is to identify, develop, and flight-validate key instrument and spacecraft technologiesthat can enable new or more cost-effective approaches to conducting science missions in the 21st century. The overall program is managed by the Jet Propulsion Laboratory,

Pasadena, Calif., for NASA's Office of Space Science, Office of Space Access and Technology, and Office of Mission to Planet Earth, Washington, D.C.

The American Red Cross will accept blood donations on June 5, 1996, from 8:30 a.m. – 2:15 p.m. in the building 8 auditorium. To schedule a donation appointment, please call Janice Gelder at 6-5025 by 2 p.m. on June 4. To call the Bloodmobile directly on June 5, please call 6-7180. Please note that the number of appointments the Red Cross has is used to determine the American Red Cross' nursing staff.

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Deadline to submit material is the first of each month. For additional information contact Ernie Shannon (301) 286-8955.
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