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Goddard Space Flight Center

Goddard News

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NASA declares Hubble servicing mission successful

NASA administrator Daniel S. Goldin announced earlier this month that the December 1993 space shuttle mission to service the Hubble Space Telescope (HST) was successful in correcting the vision of the telescope's optical components. The announcement, accompanied by the first new images from HST, followed the initial five weeks of engineering check-out, optical alignment and instrument calibration.

Word of the Hubble success came at a press conference held at Goddard's Visitor Center. Goldin was joined in making the initial announcement by Dr. John H. Gibbons, Assistant to the President for Science and Technology, and Senator Barbara A. Mikulski (D-Md.), Chair, Appropriations Subcommittee on VA, HUD and Independent Agencies.

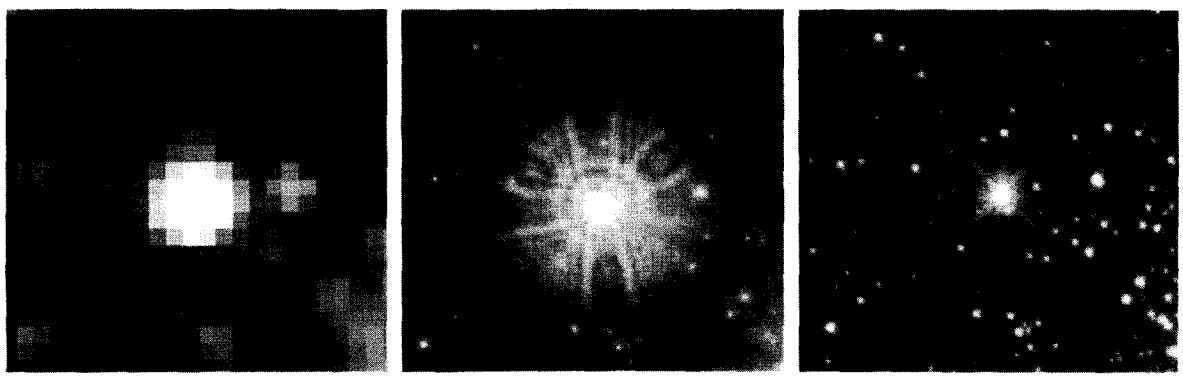
"This is phase two of a fabulous, two-part success story," Goldin said. "The world watched in wonder last month as the astronauts performed an unprecedented and incredibly smooth series of space walks. Now, we see the real fruits of their work and that of the entire NASA team.

"Men and women all across this agency committed themselves to this effort. They never wavered in their belief that the Hubble Space Telescope is a true international treasure."

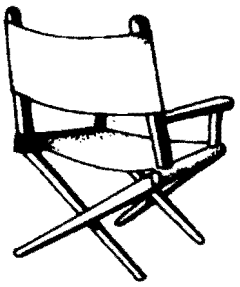
Mikulski, who unveiled two new HST pictures at the press conference, said, "I am absolutely delighted that Hubble is fixed and can see better than ever. This is tremendous news. Now we are going to look at the origins of our universe. What a wonderful victory this is for the Hubble team of astronauts, astronomers, scientists and engineers. Together, they are moving American science and technology into the 21st century with exciting new opportunities for scientific and economic progress."

Pictures were released from two cameras that received corrective optics during the servicing mission—the Wide Field/Planetary Camera II and the European Space Agency's Faint Object Camera.

Comparison of ground-based observations of a field of stars in 30 Doradus with Hubble Space Telescope images taken before and after replacement of the first Wide Field and Planetary Camera with WFPC-2



Ground image at 0.6 arcsec resolution | WFPC-1 image (before servicing) | WFPC-2 image (after servicing)



Directors' Dialogue

Q: I think smokers continue to be a health risk to others on this center. Why are smokers allowed to smoke directly outside of the entrance doors, right on the landing; and outside of the loading docks. Everyone must breathe in this second hand smoke when entering the building. At times, the smoke filters into the building. This is encouraged as large combination ash trays/ trash cans are placed in the immediate areas near the doors. Some of them actually impede opening the door fully. These containers stink!! On rainy days these ash trays fill with brown water with cigarette butts floating in them and sometimes wash out on the landing. On windy days, the disgusting mess is blown all over the area; sometimes the ashtray portion, and sometimes the entire container leaving another unsightly mess for someone to clean up which is unnecessary. Will something be done to remedy this? It's bad enough that smokers have no concern for the beauty of the center and discard smoking materials all over the grounds and parking lots.

A: We have come a long way on this issue. It has only been over the last five years that we have moved from smoking anywhere, to offices, to designated smoking areas, to no smoking inside buildings. Keep in mind that smoking is not an illegal act, yet those who choose to smoke have an obligation not to bring harm (from second hand smoke or a fire risk) to others. Because it is impractical to ban smoking from the entire Center and we want smokers to smoke outside and to extinguish their cigarettes and matches in proper fire resistant containers; locations outside and out of the weather, are the only logical choice. The actual locations for each building are determined by the FOM and approved by the Safety Staff. The location of the ash trays is monitored and corrected periodically. The cleaning of the ash trays will also be reemphasized.

Ronald Kaese,
Code 205,
chief Safety, Environmental, and Security Office

Questions for Directors Dialogue may be sent in to Directors' Dialogue, Code 130, with or without identification. Due to space limitations, not all questions can be answered. Questions are sent to the appropriate directorate office as written but may be edited for space and clarity before being printed. Some questions may be answered outside of this forum.

Goddard year in review: reflections on 1993

Editor's Note: This is the second installment of a two part article.

July

A ribbon-cutting ceremony this month marked the official opening of the latest addition to the Goddard campus. The 58,000-square-foot (5,388-square-meter) Quality Assurance and Detector Development Laboratory (QUADDL) is providing office and laboratory space for Goddard's Material Branch and a state-of-the-art Class 100 cleanroom laboratory — a virtually dust-free environment — for the Electron Device Development Section.

August

Preparations continued this month for the HST Servicing Mission in December. In August, the Wide Field/Planetary Camera II and the Corrective Optics Space Telescope Axial Replacement (COSTAR) departed Goddard for delivery to the Kennedy Space Center, Fla., for integration.

The end of summer brought closure to many educational programs sponsored by Goddard. Among Goddard's annual summer programs, the Summer High School Apprenticeship Program (SHARP), which targets minority students, had another successful season. Thirty-five SHARP students at Goddard and two at Wallops got "hands-on" experience working with scientific and engineering mentors.

The National Oceanic and Atmospheric Administration (NOAA-I) weather satellite was launched from Vandenberg Air Force Base, Calif., on August 9. NOAA-I suffered what appeared to be a failure in the spacecraft's power system on August 21. NASA, through Goddard, serves as an agent for NOAA in the procurement, development and launch of NOAA satellites.

September

Goddard's Upper Atmosphere Research Satellite (UARS) celebrated its second birthday on September 15. Following more than 24 months on orbit, UARS continued collecting data on the chemistry of the upper atmosphere.

Goddard celebrated Hispanic Heritage Month in September. Approximately 170 people attended the Hispanic Heritage Month luncheon, which included keynote speaker Representative Esteban Torres (D-Calif.), who was introduced by Astronaut Franklin Chang-Diaz.

Goddard's Fall Community Day offered a multitude of activities for visitors of all ages. An Engineering Fair, showcasing the work of Goddard's Engineering Directorate, was a highlight of the day.

October

The first phase of the reboost for Goddard's Compton Gamma-Ray Observatory began in early October. The observatory is being nudged higher in two phases to compensate for orbit decay, which is the result of solar activity slowly pushing the satellite toward Earth over a period of time.

New software is giving researchers a remarkably improved look at data from the 15-year-old International Ultraviolet Explorer, the agency's longest-running astronomical satellite in orbit. Called the New Spectral Imaging Processing System (NEWSIPS), the software uses algorithms — mathematical instructional codes — that reveal previously hidden information in the IUE data.

Atmospheric scientists at Goddard and the National Oceanic and Atmospheric Administration reported this month that Antarctic ozone levels reached record lows. These record low levels were recorded at the South Pole and confirmed by data from NASA's Total Ozone Mapping Spectrometer (TOMS) onboard the Russian Meteor-3 satellite.

November

Scientists at Goddard and the U.S. Agency for International Development (AID) reported this month that they are using satellite data, processed to study the expansion and contraction of the deserts and semiarid land of Africa, to provide early warning of developing famine and control of desert locust swarms in Africa. The data for this project are from the Earth-observing National Oceanic and Atmospheric Administration (NOAA-7, -9 and -11) polar-orbiting meteorological satellites.

December

COBE science operations are scheduled for completion this month. Although operations will cease, scientists will be studying COBE data for years to come.

One of the most memorable events of the year, and perhaps in the history of NASA, occurred early this month—the HST First Servicing Mission. For five nights, the world was glued to its television sets watching the drama of astronauts working in space. Accomplishments included replacing solar arrays and installing new scientific instruments, gyroscopes, fuse plugs and electronic units instruments. All the activity was not in space or in Houston. The team in Goddard's Space Telescope Operations Control Center worked around-the-clock sending commands to the telescope and troubleshooting glitches during the mission. The calibration and alignment of instruments is underway and the first images were released.

Wallops Flight Facility

Wallops personnel pulled together during a turbulent year to meet the needs of the scientific community and got set for a busy 1994. The notable and successful Pegasus/Brazilsat mission began 1993. Although considerable confusion was present in the initiation of the flight, it was the start of Wallops successful support of the commercial ELV industry.

Sounding rockets and balloons continued their notable support of a variety of scientific disciplines. Eighteen sounding rockets and 26 scientific balloon missions were conducted in 1993.

To meet NASA's transition to "smaller, cheaper, faster," Wallops developed the Transportable Orbital Tracking Station. The station will be deployed worldwide to assist in the tracking and data aquistition of NASA's Explorer class satellites.

As part of NASA's Mission to Planet Earth, Wallops conducted accurate measurements of Greenland's southern glacier and participated in the unique Iron Enrichment Experiment to study phytoplankton growth in the Pacific Ocean. Also, the TOPEX/Poseidon NASA altimeter, of which Wallops managed the development, continues to perform extremely well.

Looking Ahead

Goddard began the new year with attention on HST. The first new images from Hubble were released on Jan. 13, with the announcement by NASA administrator Daniel S. Goldin that the servicing mission was a success. (see story on page 1.)

Nineteen-ninety-four will keep Goddard busy. The 100th GAS payload is scheduled to launch on STS-60 in February and other Goddard payloads pegged for launch in 1994 include the TOMS/Earth Probe, GOES-I, two Spartans, NOAA-J, WIND and POLAR, and the Fast Auroral Snapshot Explorer.

For Wallops, there are more than 50 sounding rocket missions scheduled for 1994, including a campaign in Brazil which will include more than 30 rockets. The upcoming Poker Flat sounding rocket campaign will include the most complex ever developed by Wallops.

Ron Moltere

Goddard employees get together for a little Spring exercise

NASA succeeds with Gamma-Ray Observatory reboost

by Michael Finneran

NASA has successfully boosted its Compton Gamma-Ray Observatory into a higher orbit around the Earth, a move that will keep the 17-ton (15.4 metric ton) satellite from reentering the atmosphere, according to Goddard officials.

The reboost is a significant accomplishment because it extends the mission life of the observatory by five years and prevents a reentry in which large parts from the spacecraft could have struck Earth, they explained.

The reboost, which concluded December 17, 1993, had been anticipated when the two-year-old spacecraft was designed. It was necessary because of solar activity that slowly pushed the satellite back toward Earth. Initially scheduled earlier in the mission, the reboost was delayed because of the high risk of operating the spacecraft's propulsion system after a problem that occurred shortly after launch, officials said.

"Although this reboost always was planned, its successful completion involved solving some complex problems never before encountered by NASA," said Tom LaVigna, Code 490, former deputy project manager for the observatory, who retained management responsibility for the reboost.

Complex Procedure

NASA managers had to compensate for a balky rocket thruster on the observatory, LaVigna said, and devise a new way to inject fuel into the sensitive plumbing lines leading to the thrusters.

The complex procedure for boosting Compton was developed by Goddard engineers after extensive analysis and simulations. It employed a novel way to operate the observatory propulsion and the attitude control subsystems together to achieve a controlled boost.

The observatory has the largest propulsion system ever launched by NASA, carrying 4,200 pounds (1,910 kilograms) of propellant. It has eight attitude control thrusters and four larger orbit adjust thrusters, with half of each split between the "A" and "B" sides of the spacecraft.

Through mathematical analyses and tests, engineers determined that very high fuel-line pressure surges had compromised the A-side propulsion system when the system first was operated shortly after launch. After extensive study and test, a unique fuel-line priming procedure was developed to prepare the redundant B-side thrusters for use in the reboost

Quick Action

The priming worked well, but the reboost was terminated when the B2 attitude control thruster performed significantly below the other thrusters and caused the observatory to go unstable and tumble. Quick action by ground controllers terminated the thruster firings and, using a contingency procedure, brought the observatory back into a stable mode.

With the standard procedure no longer usable, Goddard engineers developed a novel way around the problem. The procedure involved firing two of the four 100-pound (45.4-kilogram) orbit adjust thrusters for 60 to 90 seconds. The five-pound (2.3-kilogram) attitude control thrusters and reaction wheels were used together to limit unstable conditions and errors in pointing the observatory. A total of 18 propulsion system burns were used, one each day.

The reboost was accomplished in two phases, one that concluded in October and another spanning November and December. The first phase lifted the observatory's apogee — or highest point in orbit — to 280 miles (452 kilometers). The apogee had descended to 214 miles (346 kilometers). The two-part second phase of the reboost nudged the spacecraft's perigee — lowest point — to the same 280 miles (452 kilometers), making Compton's orbit around the Earth almost perfectly circular.

If the satellite had descended below 180 miles (290 kilometers), it could have lost the stability required for reboost, LaVigna said. If the observatory was not reboosted, he added, it would have dropped to that altitude in late April of 1994.

Two instruments on the spacecraft would not have burned up entirely if they had reentered the atmosphere — the Energetic Gamma-Ray Experiment Telescope (EGRET) and the Compton Telescope (COMPTEL). Each have very heavy, dense, sodium-iodide gamma-ray detectors.

The EGRET detector is 2.3 feet (0.7 meters) square by eight inches (20 centimeters) thick and weighs 900 pounds (408 kilograms). The COMPTEL detector is 3.4 feet (1.04 meters) in diameter and two inches (five centimeters) thick and weighs 300 pounds (136 kilograms).

When the gamma-ray observatory's life is over, NASA managers plan a controlled reentry so that the unburned debris falls harmlessly on an uninhabited area.

The $550-million observatory, a collaboration between the United States, Germany and The Netherlands, has a mission goal of two to six years and carries four science-gathering instruments. The satellite exceeded its minimum life in April, 1993.

The observatory was sent aloft to study the gamma-ray universe. Gamma rays are the highest energy radiations in the electromagnetic spectrum, created by some of the most violent events in the universe, such as the explosion of stars. Gamma rays can be studied effectively only from space because Earth's atmosphere prevents them from reaching the ground.

The Compton Gamma-Ray Observatory is managed by Goddard for the Office of Space Science at NASA Headquarters in Washington, D.C. The observatory was launched April 5, 1991, on the Space Shuttle Atlantis and is the heaviest civilian spacecraft ever deployed by a shuttle.

NASA to celebrate the flight of the first 100 GAS payloads

by Tammy Jones

NASA's Get Away Special (GAS) program flies its 100th payload on STS-60 in early February. The GAS program, managed by Goddard, provides low cost access to space to everybody. The program was initiated in the mid-1970s, and NASA began flying small self-contained payloads in 1982.

"The program works as planned," said Clarke Prouty, Code 740.3, GAS mission manager. The program encourages the use of space by all, enhancing education with hands-on space research opportunities, inexpensively testing ideas in space and generating new space activities.

The first GAS payload reservation was purchased by R. Gilbert Moore. Moore enthusiastically advocated the GAS program throughout aerospace circles. Soon, others began depositing money for GAS payload reservations. When Moore, a Martin Thiokol Corporation executive, donated the first GAS payload to Utah State University (USU), he presented USU students with a new world of hands-on space research.

USU's first payload was very ambitious. Students put ten experiments into a five cubic-foot (.14 cubic-meter) GAS container. One experiment grew successive generations of fruit flies to see if microgravity would affect their genetic structure. Other tests examined the effects of microgravity on epoxy resin-graphite composite curing, brine shrimp genetics, duckweed root growth, soldering, homogeneous alloy formation, surface tension, growth rate of algae, and thermal conductivity of a water and oil mixture.

From this first payload, a scholarship program emerged in which undergraduate students could design and build experiments to be flown in GAS payloads. Students since have generated numerous experiments and assisted other universities and institutions with their GAS projects.

The most recent GAS flight was in June 1993, when Endeavour flew ten GAS payloads from the U.S., Canada, Japan and Europe. The canisters contained experiments studying crystal growth, the pooling process, and materials experiments on semi-conductors and superconductors. Students from elementary to high school flew multiple experiments on the effects of radiation on bacteria, the effects of microgravity on sprouting seeds, and bacteria survival in radiation and zero gravity. Students from the Charleston school district in Charleston, S. C., conducted an experiment in which a camera took 1,000 photos of the Earth, allowing students to make observations and document global change. These examples demonstrate how anyone can take advantage of the GAS program to perform small experiments in space, Prouty said.

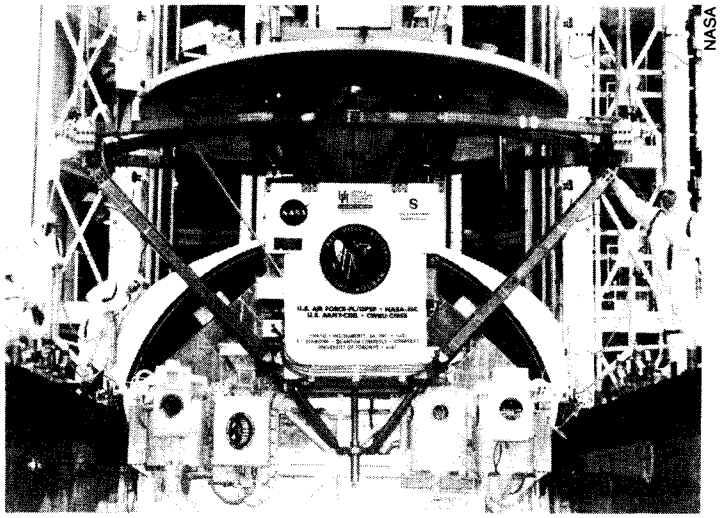
Discovery will fly four GAS experiments when it lifts off from Kennedy Space Center, Fla., the first week in February. There will also be three Hitchhiker payloads on the GAS bridge — the Capillary Pumped Loop (CPL), the Orbital Debris Radar Calibration Spheres (ODERACS), and the University of Bremen Satellite (BREMSAT).

A NASA Headquarters and Lewis Research Center experiment is the 100th GAS payload. The objective of G-536 – The Pool Boiling Experiment – is to improve the understanding of the boiling process in microgravity. This will be the third flight of this payload. The two previous flights have been extremely successful.

G-557 – The Capillary Pumped Loop experiment – is sponsored by the European Space Agency. G-071 – The Orbiter Ball-Bearing experiment – is sponsored by California State University, Northridge, and G-514 – The Orbiter Stability experiment – is sponsored by Goddard. Goddard's experiment measures high frequency variations of the orbiter's orientation due to vibrations present in its structure during routine in-flight operations. Goddard's payload also contains experiments conducted by students at Morgan State University, Baltimore, Md., and Howard University, Washington, D.C. They will fly over-the-counter medications to evaluate the potency of common medications after exposure to the orbiter space flight environment.

Also piggy-backing on Goddard's payload is an experiment by native-American high school students from South Dakota. These students are in a NASA-sponsored program called The NASA Scientific Knowledge for Indian Learning and Leadership (SKILL). The students are conducting an experiment on how seeds are affected in zero gravity. "This is the type of opportunity that gets students interested in learning about science and math," said James Houston, who manages the Goddard payload. Houston said he would like to see more of these opportunities. "It will serve two purposes; inspire young people and prevent NASA from flying dead weight ballast," said Houston. Ballast cans do not contain experiments but are used to balance the shuttle.

The GAS project is sponsoring a reunion in March to celebrate the 100 GAS payloads flown between 1982 and 1994. The reunion will kick off with a social hour followed by a buffet dinner and a few words from old friends. Those interested in attending should contact the Special Payloads Division.



NASA

Workers in the Vertical processing Facility at the Kennedy Space Center, Fla., transfer the Wake Shield Facility into the payload canister/transporter. A Get Away Special bridge assembly holding six GAS cans is already in place.

Goddard scientist leads space studies in the "Big Apple"

by Karen Davis

The NASA Goddard Institute for Space Studies (GISS) is a New York division of Goddard Space Flight Center's Space and Earth Sciences Directorate. GISS was established in May 1961 by Dr. Robert Jastrow to do basic research in space and earth sciences in support of NASA Goddard programs. Current research at GISS, under the direction of Dr. James Hansen, is directed toward the broad study of Global change.

Dr. James Hansen

Hansen was born on a farm in Charter Oak township in western Iowa and grew up in nearby Denison, Iowa. His mother and five sisters and brother still live in or near Iowa, except one sister, who lives in Washington, D.C. He married Anniek Dekkers, whom he met while completing a post-doctorate in Holland at the Sterrewacht, Leiden University. The Hansens have two children: Erik, a sophomore at Ursinus College in Pennsylvania, and Christine, a junior in Ridgewood High School in New Jersey. Hansen's hobbies include: reading, softball, planting and nurturing trees on their one acre in Ridgewood.

Hansen was educated in physics, astronomy and mathematics at the University of Iowa, principally in James Van Allen's Physics Department. He wrote his Ph.D. thesis in 1966 while in Japan with an astronomy professor, where he saw an advertisement for NASA post-doc positions at GISS. Hansen started his post-doc at GISS in February 1967 and has been there since then. He has been Director of GISS since 1981.

Hansen says that he has changed the focus of the GISS research program, beginning in 1981, to a broad interdisciplinary study of global change on Earth and continuing planetary studies. "We believe this change to be helpful for placing the terrestrial problems in context. Our approach is to have a small flexible civil service staff, working with the academic community, including a large number of students and postdocs, and collaborating with private industry and GSFC engineers for space-based measurements".

Hansen's goal is to help people understand the environment and the effects of changes on Earth. "I view my goals and purpose at Goddard now as trying to help create and maintain a dynamic research environment able to make significant contributions to improved understanding of the global environment," Hansen said. He is also a strong believer in the back to basics teaching method. "I believe strongly in the can-do, results-oriented spirit of the 1960's NASA, and I oppose the cancerous growth of bureaucracy with its emphasis on formality rather than the needs of the public. I want to help provide an opportunity for young people to discover and demonstrate their abilities. With our inner city location, we have the potential to be a positive example, with a work force that looks like the face of America".

Hansen mentioned a couple of new programs and developments for continuing and future research at GISS. "We are beginning next summer, an expanded program with local high school students, their teachers, community college students and their professors, involving them centrally in our research. I am an advocate for a small satellite system, called Climsat, which measures precisely climate forcing and feedback quantities needed to understand the causes of long-term climate change. In addition to its scientific and environmental objectives, our special emphasis would be on using this program to enhance science curricula, thus improving the understanding of teachers and students about how research is carried out," Hansen explained.

Hansen hopes to enable us to learn more about our environment, how it affects us and what we can do to preserve it. He also hopes to make learning easier by teaching us to understand the research process involved in environmental studies. His efforts observers say, are crucial in helping students and adults mature into environmentally conscious decision-making individuals.

The JASON Project Voyage V: Live from Belize

JASON Project broadcasts are the educational opportunity of the year. They have been designed to motivate students' interest in science and geography for grades 4 through 9 and to increase their awareness of career opportunities in the sciences. Through telepresence, live telecasts via satellite, students have the opportunity to join teams of scientists as they carry out a wide range of environmental research projects in Belize, Central America.

The Goddard Space Flight Center is pleased to announce that it recently has been selected as a Primary Interactive Network Site (PINS) for the JASON Project Voyage V: Live from Belize. All of the JASON broadcasts will be shown in the GSFC Visitor Center auditorium which has a total seating capacity of 70 people. Because broadcast sessions will fill up quickly, call as soon as possible to reserve a space. The Educational Programs Office is taking reservations from Goddard employees for the 2:30 p.m. and 4 p.m. sessions, scheduled Monday through Friday, February 28 to March 11, 1994. Reservations can be made by calling either Rebecca Allen or David Stevens at 6-7205. Plan on arriving at least fifteen minutes prior to the broadcast time. Each one-hour JASON broadcast session will be followed by a ten minute question period.

Retirees

Congratulations to the following employees who recently retired!

Name	Code	Years
Melvin Clark	513	43
John Donley	506	43
Clell Scearce	685	42
Isadore Harris	914	39
Thomas Savage	820	38
George Kronmiller	531	38
Ervin Summerfield	542.1	38
Robert Grigsby	931	36
Ray Gladding	833.1	36
Richard Long	440	36
Edgar Mosier	480	34
Donald Capretti	291.4	33
Paul Mowatt	400	32
Joseph Sperty	284.8	31
Kent Kwiatkowski	411	31
James Scott	502	30
Crockett Lowe	685	29
Temple Jarrell	750.2	29
Patricia Ratkewicz	130	28
Arnold Wenger	402	28
Joseph Yienger	470	28
Roger Nolan	470	27
John Sudey Jr.	723	27
Robert Gray Jr.	722.4	27
Paul Boudrot	722.4	27
John Volpe	291	26
David Provost	733	26
Helen Layton	741	26
James Jew	442	26
Sally Burneskis	703.1	23
Herbert Chapman	271.4	22
Elaine Brown	564	21
Janet Paquin	480	20

Goddard employee first NASA scientist to win Heineman Prize

Dr. John C. Mather, Code 685, head of Goddard's Infrared Astrophysics Branch, recently received the 1993 Dannie Heineman Prize, which is given jointly by the American Astronomical Society (AAS) and the American Institute of Physics.

Mather delivered the Heineman Prize Lecture at the 183rd meeting of the AAS on Jan. 15, at the Crystal Gateway Marriott, Arlington, Va. The Heineman Prize is given annually to recognize outstanding work in astrophysics.

Mather is the first NASA scientist to receive the award. He was chosen for his major scientific achievements in far infrared astronomy and cosmology. He is the project scientist for NASA's Cosmic Background Explorer (COBE) satellite.

COBE, was launched Nov. 9, 1989 on a Delta rocket. It was built, tested, operated and analyzed at Goddard. COBE was the first space mission to address basic questions of modern cosmology: How did the universe begin? How did it evolve to its present state? And what forces govern this evolution?

COBE is famous worldwide for its measurements, which confirm very precisely the Big Bang theory, and for its detection of the largest and oldest objects ever discovered in the universe. COBE, the first NASA spacecraft to explore the origins of the universe provided four years of landmark research, including confirmation of the Big Bang theory that says the universe was created in a single momentous explosion. COBE science instrument operations were terminated December 23, 1993.

Mather began his career in 1974 as a Postdoctoral Fellow at the Goddard Institute for Space Studies, New York. He organized the first proposal for the Cosmic Background Explorer (COBE) Satellite in 1974 and was appointed Study Scientist in 1976 and Project Scientist in 1982. He is also the principal investigator for the Far Infrared Absolute Spectrophotometer (FIRAS) on COBE.

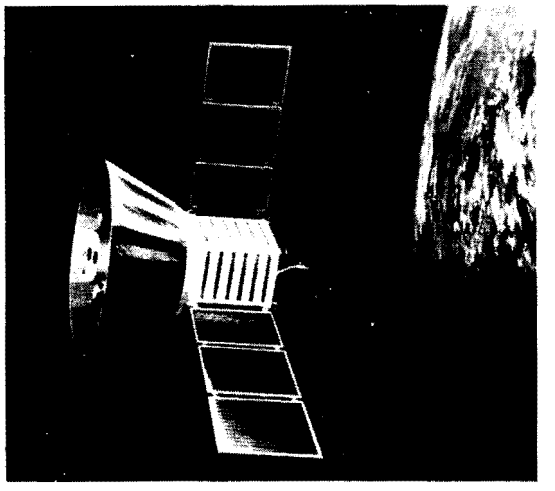
Mather, a native of Sussex County, New Jersey, received his PhD. in physics at the University of California, Berkeley, in 1974, and a Bachelor of Arts in Physics with highest honors and Phi Beta Kappa from Swarthmore College, Pa., in 1968.

During his tenure at Goddard, Mather has received several NASA and Goddard Awards, including the John Lindsay Memorial Award from Goddard in 1990 for his work on COBE, the NASA Exceptional Scientific Achievement Award in 1991, and the Rotary National Award for Space Achievement in 1991. He also received the National Air and Space Museum trophy in November 1991 and the American Institute of Aeronautics and Astronautics Space Science Award in January 1993.

COBE is supported by NASA's Astrophysics Division. The Goddard Space Flight Center designed, built, tested it and analyzed the data, under the guidance of the COBE Science Team.

NASA turns off COBE, the satellite that "saw" BIG BANG

by Michael Finneran



The first NASA spacecraft to explore the origins of the universe has been turned off after four years of landmark research, including confirmation of the Big Bang theory that says the universe was created in a single momentous explosion.

Science instrument operations were terminated December 23, 1993 on the Cosmic Background Explorer (COBE), which is managed by Goddard. Engineering operations will conclude in January, after which operation of the spacecraft will be transferred to NASA's Wallops Flight Facility in Virginia for use as a test satellite.

"COBE has more than achieved its technical goals," said Goddard's Dr. John Mather, Code 685, project scientist. "It has observed the universe as it was at its birth. It's done everything we asked it to do, and it's a proud day for us to declare our flight operations complete."

COBE, launched Nov. 9, 1989 on a Delta rocket, was built, tested, operated and analyzed at Goddard. It was the first space mission to address basic questions of modern cosmology: How did the universe begin? How did it evolve to its present state? And what forces govern this evolution?

COBE is famous worldwide for its measurements, which confirm very precisely the Big Bang theory, and for its detection of the largest and oldest objects ever discovered in the universe. According to the Big Bang theory, the universe was created about 15 billion years ago in a single violent cosmic explosion that hurled primeval matter in all directions and established the beginning of time.

Scientists have puzzled over the epic mysteries of conditions in the early universe and how it started to assemble itself into stars and galaxies. COBE shed light on these mysteries by its precise measurements with three instruments:

The Far Infrared Absolute Spectrophotometer (FIRAS), designed to measure the spectrum of the Cosmic Microwave Background to great accuracy.

The Differential Microwave Radiometers (DMR), designed to measure the "lumpiness," or anisotropies, in the universe that existed just 300,000 years after the Big Bang.

The Diffuse Infrared Background Experiment (DIRBE), designed to search for the glow from the first generation of objects in the universe.

The FIRAS instrument measured the spectrum of the Cosmic Microwave Background radiation with unprecedented accuracy, showing that it is the same as the spectrum predicted by the Big Bang theory. Because the COBE measurements show no deviations from the spectrum predicted by the Big Bang, we know now that 99.97 percent of the energy of the universe was released within the first year after the Big Bang itself, Mather said.

Theories that attempt to explain how the universe started to divide into galaxies from that hot beginning now have actual measurements from COBE to help constrain the possibilities. The FIRAS also showed that the temperature of the afterglow of the radiation from the Big Bang some 15 billion years ago has cooled to 2.726 degrees above absolute zero, with an uncertainty of only 0.01 degrees. At the moment of the Big Bang, the temperature of the universe was trillions upon trillions of degrees.

The DMR instrument detected the primordial hot and cold spots in the Big Bang radiation that could eventually grow into huge clouds of galaxies — the cold spots — or the great empty spaces — hot spots. Scientists hailed these findings because this first detection of primordial seeds explains how matter was able to form into galaxies, clusters of galaxies and superclusters of galaxies, and huge empty spaces with no galaxies.

The hot and cold spots found by COBE are only 30 millionths of a degree — one part in 100,000 — warmer or colder than the regions next to them. The COBE results show that these seeds are truly primordial and were present just 300,000 years after the Big Bang.

Goddard News

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