



National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland/Wallops Island, Virginia

June 25, 1999

The Goddard News is published weekly by the Office of Public Affairs, Goddard Space Flight Center, Greenbelt, MD 20771

FUSE Launch Successful

A Boeing Delta II rocket successfully launched NASA's Far Ultraviolet Spectroscopic Explorer (FUSE) spacecraft at 11:44 a.m. on June 24 from the Cape Canaveral Air Station in Fla. FUSE was inserted into a near-circular orbit of 414 nautical miles above the Earth. For more information about the mission, go to:
<http://fuse.pha.jhu.edu/>

SERTS to Explore Magnetic Regions of the Sun

A NASA 2-stage Terrier-Black Brant sounding rocket lifted off from the White Sands Missile Range in New Mexico on June 24. It propelled the Solar Extreme ultraviolet Rocket Telescope Spectrometer (SERTS) experiment to an altitude of 200 miles on a sub-orbital flight to study wavelengths in the extreme ultraviolet region.

The experiment is intended to study magnetic regions of the Sun. These wavelengths are typical of the Sun's hot atmosphere, which ordinarily ranges from one and three million degrees Fahrenheit. The corona is at the base of the Sun's extended atmosphere, which reaches far beyond Earth's orbit in the solar system.

Disturbances in this magnetic atmosphere can be responsible for satellite failures, communication disruptions and increased radiation exposure for astronauts," said SERTS Principle Investigator Dr. Joseph Davila of Goddard.

SERTS was designed and built primarily by personnel assigned to the Laboratory for Astronomy and Atmospheres at Goddard. Participants from the Optics (Code 541) and Instrument Electronics Branches (Code 564) at Goddard along with the Naval Research Laboratory rounded out the satellite team. See the SERTS web site at: <http://orpheus.nascom.nasa.gov/serts>

QuikSCAT Spacecraft Goes Into Orbit

NASA's Quick Scatterometer (QuikSCAT) was carried into space June 19 at 10:15 p.m. EDT atop a Titan II launch vehicle from Vandenberg AFB, Calif. Goddard managed development of the satellite, which was designed and built by Ball Aerospace & Technologies Corp., Boulder, CO.

Gnews Articles for June 25, 1999

FUSE Launch Successful

A Boeing Delta II rocket successfully launched NASA's Far Ultraviolet Spectroscopic Explorer (FUSE) spacecraft at 11:44 a.m. on June 24 from the Cape Canaveral Air Station in Fla. FUSE was inserted into a near-circular orbit of 414 nautical miles above the Earth. For more information about the mission, go to:

<http://fuse.pha.jhu.edu/>

SERTS to Explore Magnetic Regions of the Sun

A NASA 2-stage Terrier-Black Brant sounding rocket lifted off from the White Sands Missile Range in New Mexico on June 24. It propelled the Solar Extreme ultraviolet Rocket Telescope Spectrometer (SERTS) experiment to an altitude of 200 miles on a sub-orbital flight to study wavelengths in the extreme ultraviolet region.

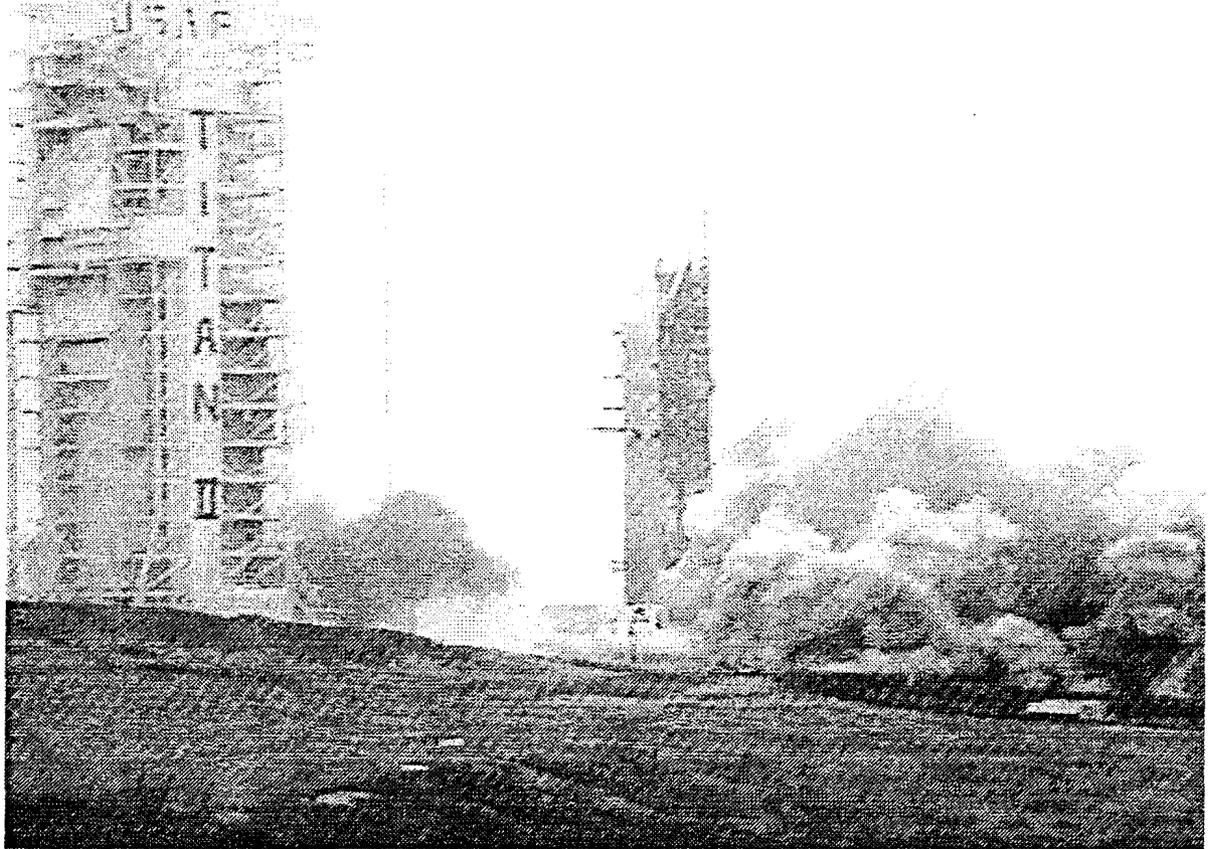
The experiment is intended to study magnetic regions of the Sun. These wavelengths are typical of the Sun's hot atmosphere, which ordinarily ranges from one and three million degrees Fahrenheit. The corona is at the base of the Sun's extended atmosphere, which reaches far beyond Earth's orbit in the solar system.

Disturbances in this magnetic atmosphere can be responsible for satellite failures, communication disruptions and increased radiation exposure for astronauts," said SERTS Principle Investigator Dr. Joseph Davila of Goddard.

SERTS was designed and built primarily by personnel assigned to the Laboratory for Astronomy and Atmospheres at Goddard. Participants from the Optics (Code 541) and Instrument Electronics Branches (Code 564) at Goddard along with the Naval Research Laboratory rounded out the satellite team. See the SERTS web site at: <http://orpheus.nascom.nasa.gov/serts>

QuikSCAT Spacecraft Goes Into Orbit

NASA's Quick Scatterometer (QuikSCAT) was carried into space June 19 at 10:15 p.m. EDT atop a Titan II launch vehicle from Vandenberg AFB, Calif. Goddard managed development of the satellite, which was designed and built by Ball Aerospace & Technologies Corp., Boulder, CO.

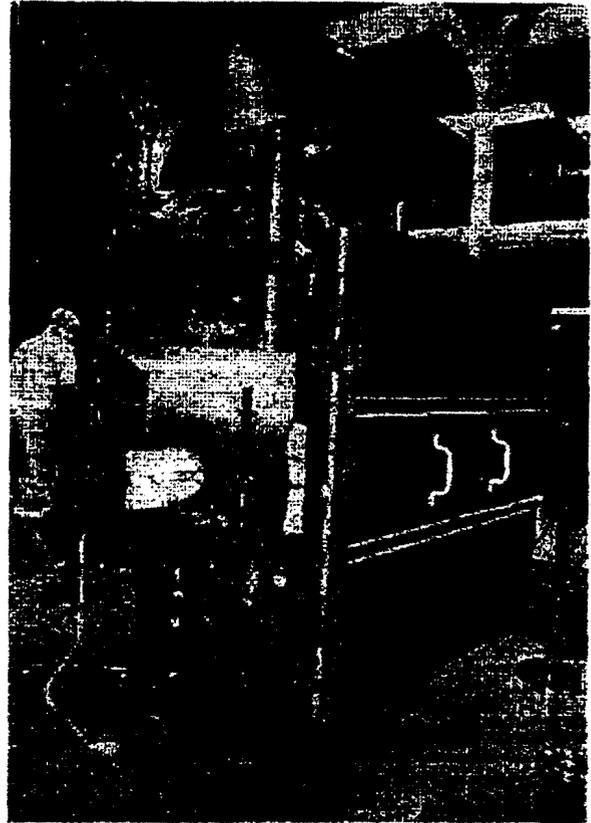


During the next two weeks, QuikSCAT will fire its thrusters to gradually fine-tune its polar orbit. Eighteen days into flight, the scatterometer onboard QuikSCAT will be turned on and members of the project engineering and science teams will spend the next 12 days performing detailed checks of the instrument and initially calibrating its radar backscatter and ocean wind measurements.

QuikSCAT is scheduled to formally begin its primary mission of mapping ocean wind speed and direction about 30 days after launch. The SeaWinds/QuikSCAT project is managed for NASA's Earth Science Enterprise by the Jet Propulsion Laboratory. For details, go to the QuikSCAT web site at:

<http://pao.gsfc.nasa.gov/gsfsc/missions/projects/quikscat.htm>

EO-1 Arrives at Goddard



The EO-1 spacecraft arrived at Goddard on June 7 to undergo integration and testing. The spacecraft is scheduled for shipment to Vandenberg AFB, Calif. on Sept 16, with launch scheduled for sometime in December.

EO-1 is the first in a line of New Millennium Program Earth-orbiting missions designed to identify, develop and validate spacecraft technologies that can lead to cost effective missions in the 21st century. EO-1 also will validate technologies contributing to the reduction in cost of follow-on Landsat missions.

NASA's Strategic Enterprises

NASA implements and executes its space and aeronautics programs and activities through four Strategic Enterprises. Each Enterprise has identified a unique set of goals, objectives, and strategies to meet the requirements of their primary customers. The four Enterprises are:

- Aero-Space Technology
- Earth Science
- Human Exploration and Development of Space
- Space Science

Aero-Space Technology -- The mission of this Enterprise is to pioneer the identification, development, verification, transfer, application and commercialization of high-payoff aeronautics and space transportation technologies. The Associate Administrator for the Office of Aero-Space Technology is Lt. Gen. Spence M. (Sam) Armstrong (USAF, Ret.).

Web page: <http://www.hq.nasa.gov/office/aero/>

Earth Science -- The mission of the Enterprise, formerly the Mission to Planet Earth Enterprise, is to use the unique vantage point of space to provide information about Earth's environment that is obtainable in no other way. In concert with research and industry partners, the Enterprise is developing the understanding needed to support the complex environmental policy and economic investment decisions that lie ahead. The Associate Administrator for the Office of Earth Science is Dr. Ghassem Asrar.

Web page: <http://www.earth.nasa.gov/>

Human Exploration and Development of Space --The mission of the Enterprise is to open the space frontier by exploring, using and enabling the development of space and to expand the human experience into the far reaches of space. The enterprise is managed jointly by the Office of Space Flight and the Office of Life and Microgravity Sciences and Applications. The Associate Administrator for the Office of Space Flight is Joe Rothenberg. The Associate Administrator for the Office of Life and Microgravity Sciences and Applications is Arnauld Nicogossian, MD.

OSF Web page: <http://www.hq.nasa.gov/osf/>

OLMSA Web page: <http://www.hq.nasa.gov/office/olmsa/>

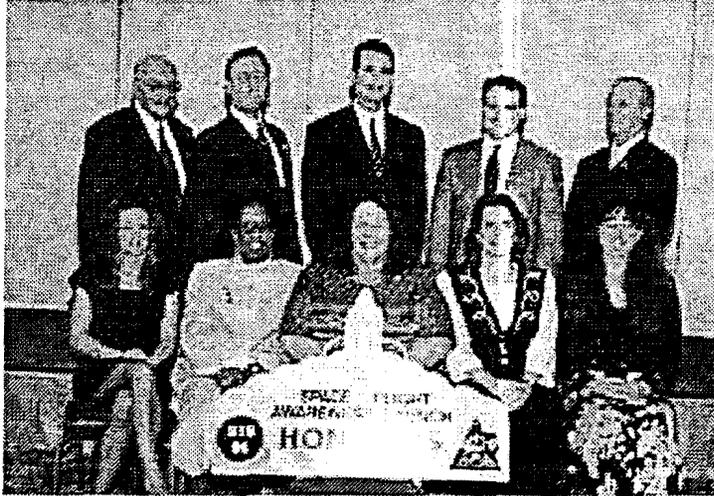
Space Science --The mission of the Space Science Enterprise is to solve mysteries of the universe, explore the solar system, discover planets around other stars, search for life beyond Earth from origins to destiny, chart the evolution of the universe and understand its galaxies, stars, planets, and life. The Associate Administrator for the Office of Space Science is Dr. Ed Weiler.

Web page: <http://spacescience.nasa.gov/osshome.htm>

Space Flight Awareness Honorees View Shuttle Launch

Ten Goddard employees were among approximately 250 from other NASA Centers, private industry and the U.S. Air Force who were recently honored with NASA's Space Flight Awareness Award, the highest tribute paid by NASA's SFA program to government and private industry employees.

The awardees were recognized by Astronaut Joe Tanner at a special reception held in their honor on May 27 and also were invited to view the launch of STS-96.



Pictured in front row from left to right are Victoria Odom (Code 240), Allora Cyrus (Code 730), Mary Kathryn Greer (OSC), Kay Byers (CSC) and Mary Faller (Swales).

Pictured in rear row from left to right are Roger Phillips (LMTO), Brian Woodworth (LMTO), Ken Wagner (Code 564), Glenn Lightsey (Code 573) and Edward Hedman, Jr. (CSC).

ISO Certification at Goddard

Goddard's ISO 9001 certification date is scheduled for August 23. Are you ready? The Center has many tools available to help employees prepare for this important event.

An ISO 9001 Quality Management System (QMS) tutorial, along with frequently asked questions, is available on the Internet at: <http://arioch.gsfc.nasa.gov/iso9000/index.htm>

GSFC Quality Policy:

With customer satisfaction as our primary goal ☒

GSFC is committed to meeting or exceeding our customer's requirements.

We achieve excellence in all of our efforts.

GOES-7 Moves West

NASA's 12-year-old Geostationary Observational Environmental Satellite, GOES-7, is being relocated to a position over the Pacific Ocean southwest of Hawaii to become part of PEACESAT, the Pan Pacific Education and Communications Experiment by Satellite.

PEACESAT is a public service satellite telecommunications network that links educational institutions, regional organizations and governments in the Pacific Islands.

Launched Feb. 26, 1987, NOAA used the GOES-7 spacecraft to aid in weather prediction, studying wind direction and the speed of clouds to help meteorologists understand atmospheric circulation patterns. It also relayed data sent by rain gauges, seismometers, tide gauges, buoys, ships and automatic weather

stations, duties that are now being handled by two new weather satellites.

PEACESAT will provide maintenance for the spacecraft, while NOAA continues to provide engineering support. The 23-year-old satellites PEACESAT previously used for communications ☒ GOES-2 and GOES-3 ☒ are being removed from service.

NIAC Awards Grants For Development of Advanced Concepts

Where does NASA go for new and exciting ideas for space exploration? The NIAC.

Managed for NASA by the Universities Space Research Association of Columbia, Md, the institute provides an independent, open forum for external analysis and definition of space and aeronautics advanced concepts to complement advanced concepts activities conducted within NASA Enterprises. It focuses on revolutionary concepts, specifically systems and architectures that could have a major impact on future NASA missions 10 to 40 years in the future. NASA intends that the best products of the institute will be infused into NASA's and the nation's future programs.

☒ NIAC's mission is to develop a vision of the spectacular possibilities for the future of aeronautics and space,☒ said NIAC Director Dr. Robert Cassanova, ☒ and to create an atmosphere for unlocking the imagination of the science and engineering community.

We have come a long way from the early experiments of flight nearly a century ago, but there are still many challenges to provide inspiration for creative researchers. NIAC is embarking on a quest to define revolutionary concepts by stretching our imaginations far into the next century.☒

Goals of the institute include reinvigorating the public's interest in revolutionary concepts of alternative aerospace futures, attracting revolutionary ideas from a greatly expanded community and creating a dynamic interchange of competing future options.

NIAC conducted its first Call for Proposals in two phases. Phase I, which was open to anyone except NASA and JPL employees, consisted of small grants valued up to \$75,000 each for a six-month study to add depth and technical definition to the concept. Phase II proposals, solicited from Phase I grant recipients, will result in contracts worth up to \$500,000 for an 18 to 24 month study to define enabling technologies, analyze potential cost factors and add technical depth to the concept. One hundred-nineteen research proposals were submitted in response to Phase I Calls for Proposals, and on Oct. 28, 1998 NIAC awarded 16 grants for the development of advanced concepts.

The institute received 63 proposals in response to the second call for proposals issued Nov. 23, 1998 and awarded 14 grants on April 22. Proposal topics range from advanced transportation and propulsion systems to revolutionary systems for exploring planets and the cosmos.

Abstracts of awards and final reports are available on the Web at: <http://nptio.nasa.gov/niac/> and <http://www.niac.usra.edu>

Goddard supplies administrative support to the NIAC, which includes NASA's Internet-based management system, conference facility support, coordination of possible NASA systems engineering analysis and any relevant NASA-developed administrative software/communication tools as a means of reducing duplication and cost. Goddard also will facilitate any other NASA-unique technical assistance required for the advanced concepts studies.

Cassanova and Goddard's Sharon Garrison, NASA Coordinator and COTR for NIAC, will complete their first annual visit to NASA Centers in mid-July to inform top management and directors of advanced concept programs about the purpose/objectives of the NIAC and describe plans for accomplishing its mission. Garrison and Cassanova also want information about Center activities that are relevant to the development of advanced concepts.

Wayne Hudson is Goddard's representative to the NASA NIAC Review Team. The team, which is comprised of representatives from NASA Centers and Strategic Enterprises, will provide support to Garrison on NIAC coordination and COTR responsibilities.

Employees Can Now Use the Web to Book NASA 8 Flights

Direct passenger scheduling is now available through a Web-based automated scheduling program.

Passengers should go to: <http://wff-aerobee.wff.nasa.gov/nasa8/> on the Internet, enter their information on the left side of the screen and select available travel options on the right side of the screen. A simple keystroke submits this data for processing and an itinerary is presented on the screen for the passenger to print for their records.

Effective July 1, this computer-based scheduling service will be the primary means for passengers to schedule flights aboard NASA 8. Can't access the Web, or is your computer down? A direct telephone service is available for emergencies only by calling 757-824-1473 or 757-824-1922.

Another Goddard First

Launched Aug. 12, 1978 on a Delta rocket from Cape Canaveral, Air Station, Fla., the International Sun-Earth Explorer 3 was renamed in 1985 to the International Cometary Explorer (ICE).

ICE was directed into a series of lunar swing-bys for the first ever comet encounter. ICE passed 7,860 km behind a comet named Giacobini-Zinner on Sept. 11, 1985. Goddard controllers feared comet dust could have coated its solar cells and damaged its 91 meter-span antennas. However, during the spacecraft's 20-minute passage, its 5-watt transmitter and small antenna transmitted 70.8 million km of data back to Earth.

Initial analysis of the data revealed water ice to be the primary constituent, with cold slow-moving plasma and water and carbon monoxide ions inside the tail.

ICE, which passed within 40.2 million km of Halley's Comet on March 28, 1986, has since been maneuvered into an Earth-like orbit so that on August 10, 2014 it can return for capture by the Earth-Moon system and be retrieved for analysis of its cometary dust coating.

Hale-Bopp Fails Emission Tests But Reveals Comet's Origin

(release 99-76)

Thrill seekers may want to hitch a ride on the giant comet Hale-Bopp, but they would fail vehicle emission tests miserably. When it was the same distance from the Sun as Earth, Hale Bopp produced carbon monoxide (CO) emissions equal to that given off by 5.5 billion cars every day.

Just like the results of an emission test help a mechanic diagnose an engine problem, the results of NASA measurements help pin down where Hale-Bopp and many other comets formed. When compared to the quantity of water in the comet, the amount of CO indicates that comet Hale-Bopp was formed in the region between Jupiter and Neptune, according to recent observations.

"Comets are interesting because they are frozen relics from the formation of our solar system, and by studying them, we can learn more about how we got here," said Dr. Michael DiSanti of Catholic University and NASA's Goddard Space Flight Center (Greenbelt, Md.). "Our observations of Hale-Bopp indicate that comets now in the distant Oort cloud were originally part of the solar system's ancient proto-planetary disk. It was thought that comets could have formed in the cold, dense cloud of gas and dust that existed before the proto-planetary disk formed. However, if this were so, we would have seen even more carbon monoxide emission from Hale-Bopp. The amount of carbon monoxide ice compared to water (12 percent) indicates that these comets formed somewhere between the orbits of Jupiter and Neptune. We hope to learn more about what was going on when the giant planets formed by investigating the chemistry of this comet."

CO is a molecule made from a carbon and an oxygen atom. It is normally a gas on Earth, and is monitored in vehicle emissions because it is toxic.

The new results were announced by a team of astronomers from Goddard, Catholic University of America, Rowan University, Iona College, and Notre Dame University. The researchers used an infrared spectrometer on a three-meter telescope - the NASA Infrared Telescope Facility (IRTF), Mauna Kea Observatory, Hawaii - to make the observations. "Our observational approach combined with the unusually large size of Hale-Bopp permitted the first definitive measurements of the amounts of carbon monoxide and water present as ices in comets," said Dr. Michael Mumma of Goddard. The research will be published in the June 17 issue of Nature.

Comets, nicknamed "dirty snowballs," are lumps of ice and dust a few miles to a few tens of miles in diameter. Conditions were warmer in the proto-planetary disk than in the gas and dust cloud that preceded it, due to radiation from the nascent sun. Since water ice freezes at higher temperature than carbon monoxide ice, comets forming in the relatively warm disk would have more water and less carbon monoxide, the researchers believe. After the comets formed, gravitational pulls from gas giant planets in the outer solar system cast them into cold storage about a trillion miles from the Sun, in a roughly spherical region called the Oort

cloud. Over the ages, gravity from passing stars perturbs some of these comets, sending them back toward the solar system as celestial visitors from our distant past.

As a comet approaches the Sun, solar heat and radiation liberate gas and dust from the comet's frigid surface, forming a cloud of material (the coma) that is later pulled into the familiar comet tail by pressure from solar wind and radiation. Gas molecules in the coma absorb light from the Sun and emit it again as specific colors. The colors are unique for each chemical in the gas, and serve as an optical "fingerprint" to identify various substances, including CO. Special instruments called spectrometers separate the emitted light, much like a prism separates white light into a rainbow of distinct colors, permitting the identification of these fingerprints.

As the comet nears the Sun, solar heat and light break down different chemicals in its coma. This creates a distributed source of additional carbon monoxide, making it difficult to determine the original amount present as ice in the comet nucleus. The NASA spectrograph can detect the amount of carbon monoxide near the comet nucleus as well as farther out in its coma. "Because Hale-Bopp was so bright, we were able to observe it while still very distant from the Sun before the distributed source was activated. We were thus able to measure carbon monoxide emission solely from the nucleus, and determine the true carbon monoxide to water ratio. Later, as the comet approached the Sun, both sources were active and our measurements then revealed the characteristic spatial signature of the distributed source of CO," said Dr. Neil Dello Russo of Catholic University and Goddard.

"There is another group of comets that may be more like the cold, dense cloud that preceded the solar system disk. Kuiper belt objects lie beyond the orbit of Pluto, and probably formed from remnants at the fringes of the proto-planetary disk. They are believed to be the source of comets with short orbital periods and low inclinations to the ecliptic plane. This region is remote from the Sun, and that part of the disk would have been less influenced by radiation from the young Sun, so ices in Kuiper belt objects are probably more like those in the original cloud from which the solar system formed," said Mumma. "Future measurements may reveal this difference."

SOHO Glimpses Far Side of Sun, Looks At A Comet's Shadow (release #99-77)

Scientists have found that they can peek around the Sun and see whether solar storms on its far side will shortly appear on the side facing the Earth. This surprising discovery using the joint European Space Agency (ESA)/NASA Solar and Heliospheric Observatory (SOHO) spacecraft could help foresee the solar storms that sometimes affect spacecraft and radio communications. SOHO has seen something else extraordinary - the biggest shadow ever observed in our solar system, that of a comet projected on the sky behind it.

Using the Solar Wind Anisotropies (SWAN) instrument on SOHO, researchers have seen hot spots on the far side of the Sun as they light up a cloud of hydrogen atoms in space with strong beams of ultraviolet light. Like searchlight beams shifting across low clouds, this moving glow in the sky (invisible from Earth) could give several

days' warning of an active region on the Sun's surface that will come into view as the Sun rotates.

"Strong ultraviolet emissions from active regions on the back of the Sun behave like beams from a lighthouse on the landscape," said Dr. Jean-Loup Bertaux, of the CNRS Service d'Aéronomie in France, and principal investigator for SWAN. "They move in the sky in accordance with the Sun's rotation, which takes about 26 days. We can monitor the activity on the backside of the Sun without looking at it directly. This method could be used in future studies on space weather, which can affect orbiting satellites and other technological systems on Earth."

SWAN is used to map the whole sky in ultraviolet light. It sees a huge cloud of interstellar hydrogen that bathes the entire Solar System and interacts with the solar wind. The cloud is relatively tenuous - about 3,000 atoms per cubic foot - yet it is thick enough to shine when illuminated by the Sun's ultraviolet light.

This kind of observation is impossible from Earth because the atmosphere completely filters the short-wavelength ultraviolet light. Even spacecraft in orbit around the Earth are blinded to the hydrogen haze of the Solar System by a large swarm of hydrogen atoms that surrounds our planet.

But that's not the case for SWAN - one of 12 instruments aboard SOHO, which operates from a special vantage point one million miles out in space, on the sunward side of Earth. The SWAN scientists detect hot spots when the hydrogen cloud beyond the Sun glows more strongly than would be expected if the Sun were uniformly bright on its far side.

Bertaux will report his team's discovery on June 22-25 at a scientific meeting where more than 200 scientists from all over the world will discuss their findings on the dynamics and diagnostics of the solar transition region and corona. This meeting, which is the eighth in a series of SOHO workshops, takes place in Paris. Bertaux will present an amazing video sequence from images gathered by SWAN. These show the reflection of big solar spots imprinted in the sky and rotating with the Sun. Eventually, they come around the limb, on the eastern (left-hand) side of its visible surface.

"With SOHO, we have studied the Sun from the inside out, as well as its surroundings. It is fascinating to think that now we could foresee even what's in store for us on the other side of the Sun," said Dr. Martin Huber, head of ESA's Space Science Department.

Although most of the hydrogen atoms in the Solar System blow in from interstellar space, comets are surrounded by large hydrogen clouds of their own. When comet Hale-Bopp flew near the Sun parading its 62 million-mile long tail in 1997, SOHO was already in orbit. In SWAN observations from that time, the scientists have now spotted a remarkable feature - never before seen by astronomers - the elongated shadow of a comet projected on the sky beyond the comet. The shadow is at least 93 million miles long, about the same distance as the Earth from the Sun.

"Taken together with the sixty-nine sungrazing comets discovered by the SOHO LASCO coronagraphs, these new results from SWAN are another exciting example of how SOHO is dramatically expanding our knowledge of the inner solar system," said Dr. Joseph Gurman, the NASA SOHO project scientist.

Says Dr. Bernhard Fleck, SOHO project scientist for ESA: "The nice thing about this discovery is that with SOHO we're not just confined to

studying the Sun. Here we are contributing to a different and intriguing field. We're learning more about comets and their physics."

"This phenomenon provides an absolute determination of the amount of hydrogen and water released by the comet - about 300 tons per second," said Bertaux.

As Hale-Bopp neared the Sun - at a distance of about 93 million miles - water ice in the comet's nucleus began to vaporize. As expected, the Sun's ultraviolet radiation split the water molecules, liberating a cloud of hydrogen atoms, which glowed in the ultraviolet light.

With the distance between the comet and the Sun quickly decreasing, the amount of solar radiation hitting the comet increased, as did the release of vapor from the nucleus and the consequent production of hydrogen. As a result, in a huge, six million-mile wide region around the nucleus, the comet absorbed most of the ultraviolet light it received from the Sun.

In ultraviolet light, the comet projected a distinct shadow on the hydrogen haze of the Solar System. For an imaginary onlooker with ultraviolet vision, situated on the side of the comet opposite the Sun, it would have been a perfect opportunity to observe a total solar eclipse by a comet!

Dr. Roger Bonnet, ESA's Director of the Scientific Program, expressed his appreciation for the SOHO results.

"After the dramatic loss in space last year and a miraculous recovery in the following months, SOHO is back at work and fully operational. As in the case of the comet's shadow, it keeps making discoveries and amazing observations."

SOHO is a project of international cooperation between ESA and NASA. The spacecraft was launched on an Atlas rocket from Cape Canaveral Air Station, Fla. Dec. 2, 1995.

Images of the far side of the Sun and of the comet's shadow are available at: <http://sci.esa.int/soho>

More information on SOHO can be found on the SOHO website at: <http://sohowww.estec.esa.nl>

Klein Selected for Flemming Award for Outstanding Government Service (release 99-75)

Timothy A. Klein of NASA's Goddard's Space Flight Center (Greenbelt, Md.) will receive the Arthur S. Flemming Award June 10 for his outstanding work in the Federal government.

The 50th Annual Arthur S. Flemming Awards program selected 11 people from all areas of the federal service for this year's award. Awards are presented to those individuals who have made extraordinary contributions to the federal government and who have less than 15 years of service.

Klein is the Program Business Manager for the New Millennium/Earth Observing Program at Goddard. In this position, he is responsible for all financial, budget, analysis, future mission planning, procurement and general business activities for all flight missions and advanced technology developments for New Millennium activities at Goddard.

Klein was recognized for his exceptional leadership and sustained accomplishments in providing expertise in project and program management, resources management and administration for

flight projects at Goddard. The NASA employee has demonstrated outstanding leadership skills, resourcefulness and dedication in helping the Goddard Center overcome some of its most difficult project management challenges. His success at reducing uncosted obligations, returning over \$50 million in savings for use by other NASA missions, shows his commitment to the American taxpayer to make the most efficient use of public funds. His abilities in project management and control allowed several NASA missions, threatened with cancellation, to be successfully launched and operated.

Klein joined NASA in June 1986 as a Presidential Management Intern. He progressed through a series of increasingly responsible management and staff positions before assuming his current job. In addition to his financial management background, Klein has hands-on experience in launch vehicle integration, launch site ground processing for expendable launch vehicles, flight hardware transportation and handling, international and U.S. Customs, procurement, and facilities.

Klein is a 1980 graduate of North Penn High School in nearby Lansdale, Penn. In 1984 Klein received a Bachelor of Arts degree in Public Affairs from the George Washington University. Two years later, he received a Master's in public administration, also from George Washington.