



Goddard View

Goddard Engineers and Divers Multitask for *Hubble*

Pg 4

Custom-Made Blankets for a World Class Observatory

Pg 2

Closing in on a Hot Mystery

Pg 7

Custom-Made Blankets for a World Class Observatory

By Dana Martinez and Kelsey Paquin



Photo credit: Chris Gunn

Caption: Goddard Engineer Ben Reed studies a portion of a multilayer blanket from Hubble, which astronauts returned to Earth after Servicing Mission 3A in December 1999.

The *Hubble Space Telescope* Servicing Mission 4, scheduled for August 2008, aims to complete multiple upgrades and repairs, many of which are crucial for prolonging the telescope's operational life. One of the mission's many objectives is the refurbishment of its outer thermal blankets.

The Importance of Thermal Blankets

"Thermal blankets are to spacecraft as clothes are to people," says Mike Weiss, *Hubble's* Technical Deputy Program Manager. "Just as

clothes cover our skin and help protect us from nature's elements... the cold winter wind and the scorching summer Sun, thermal blankets protect *Hubble* from the harsh environment of space."

Hubble orbits Earth at 5 miles per second, meaning that it fully circles the planet in 97 minutes and completes about 15 orbits each day. As it travels through Earth's shadow, over the side lit by the Sun, and around again, the telescope is exposed to both the extreme cold of deep space and the powerful heat of the Sun in rapid and constant cycles.

"The thermal blankets' outer layer swings about 215 degrees Fahrenheit every 45 minutes," says Ben Reed, a group leader assigned to the Materials Engineering Branch at Goddard. So the blankets must be able to insulate *Hubble's* equipment from such extreme temperature changes.

To provide adequate insulation for *Hubble*, the blanketing material used on the telescope is essentially 16 layers of dimpled aluminum with an outer Teflon skin. It effectively protects the onboard instruments against extreme temperature swings even though the blanket is incredibly thin, measuring less than one-tenth of an inch thick when laid flat.

"The space environment is extremely harsh," Reed says. "It begins to degrade the telescope's external surfaces from day-one in orbit. Not surprisingly, because *Hubble* has been up there since 1990, the outer Teflon layer has started to crack." Thus, it is crucial to repair or replace the blankets from time to time.

[Continued on Page 3](#)

Table of Contents

Goddard Updates

Custom-Made Blankets for a World Class Observatory - 2

Goddard Engineers and Divers Multitask for *Hubble* - 4

Magnetospheric Multiscale Project Passes Key Milestone - 6

Closing in on a Hot Mystery - 7

NASA Climate Change 'Peacemakers' Aided Nobel Effort - 8

Suzaku Explains Cosmic Powerhouses - 9

NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) - 10

Air Quality Forecasts See Future In Space - 11

Employee Spotlight

Charles (Gibran) McDonald - 12

[Cover: Engineers and divers working underwater in the NBL.](#)

[Read the full story on Page 4.](#)

Photo credit: Chris Gunn

GoddardView Info

Goddard View is an official publication of the Goddard Space Flight Center. It is published biweekly by the Office of Public Affairs in the interest of Goddard employees, contractors, and retirees. A PDF version is available online at:

<http://www.nasa.gov/centers/goddard/news/index.html>

Managing Editor: Trusilla Steele

Editor: Alana Little

Deadlines: News items and brief announcements for publication in the Goddard View must be received by noon of the 1st and 3rd Wednesday of the month. You may submit contributions to the editor via e-mail at alana.m.little@nasa.gov. Ideas for new stories are welcome but will be published as space allows. All submissions are subject to editing.

Custom-Made Blankets for a World Class Observatory

Continued from Page 2



Photo credit: Chris Gunn

Caption: After cutting the raw material needed for the thermal blanket, technician Brenda Estavia carefully sews on a piece of Velcro, using a commercial machine.

Goddard's Unique Role

Tucked away in a basement building at the Goddard Space Flight Center, is a truly unique facility. Workers here precisely measure, cut, and carefully sew custom-made thermal blankets for *Hubble* and other space missions. The telescope already sports several that astronauts installed on previous servicing missions.

According to Shirley Adams, group leader for blanket fabrication, her employees come from very diverse backgrounds. "Some have designing backgrounds in upholstery work, costume designing, and one even has a background in ice skating costume-making," said Adams.

Such talents have proven very beneficial because sewing, stitching, and custom-fitting the different thermal blankets for the telescope is accomplished in-house at Goddard. Coupled with experts in materials and mechanical engineering, the expertise at Goddard makes the Center the logical home for the development and production of the blankets, as well as analysis of blankets the astronauts have brought back from previous servicing missions.

Repairing and Replacing Blankets

Because the harsh space environment has taken its toll on *Hubble's* exterior, astronauts were tasked with temporarily patching cracks on some of the blankets during Servicing Mission 2 in 1997. Several other blankets were removed and replaced with new ones during Servicing Mission 3A in 1999.

The three remaining original sections of blankets on *Hubble* are now exhibiting cracking and degradation and may be replaced during the next servicing mission in 2008.

Lessons Learned to Benefit Future Missions

Knowledge gained from the thermal blankets returned from Servicing Mission 3A is helping Goddard engineers to develop more reliable versions, not just for *Hubble*, but for a host of future space-based missions.

"Certainly the people working on the sunshield for the *James Webb Space Telescope* have read our papers, and they have taken those lessons learned to heart in choosing the appropriate material for their sunshield," Reed says.

Sharing information and data is just one of several ways the engineers at Goddard are working to ensure future spacecraft are durable enough to survive their mission lifetimes.

"Protecting *Hubble* from the harsh environmental effects of space with thermal blankets is like protecting a mountain climber ascending to the summit," Weiss says. "Over time, the wind and elements might crack and tear the outer layer of the hiker's insulated clothing. The clothing might look tattered, but the hiker is still receiving the thermal protection needed to allow him or her to continue their exploration efforts. The same can be said of the thermal blankets currently on *Hubble* and the ones to be installed on Servicing Mission 4, which will allow *Hubble* to continue its incredible exploration of the universe." ■

Goddard Engineers and Divers Multitask for *Hubble*

By Susan Hendrix



Photo credit: NASA

Caption: Hubble Carrier Manager Mark Hubbard of Goddard's Extra-Vehicular Activity (EVA) and Crew Systems Engineer Steve Schneider of SGT, Inc., prepare for a two-hour scuba run at the neutral Buoyancy Laboratory water tank in preparation for Servicing Mission 4.

Ever wonder how NASA astronauts prepare for *Hubble Space Telescope* (HST) servicing missions? I wish I could say it's rocket science, but what it really comes down to is lots of preparation, with the astronauts spending many hours practicing on intricate, full-size models of the telescope.

In planning for Servicing Mission (SM) 4 to *Hubble*, the crew is dividing their time between NASA's Johnson Space Center (JSC) in Houston, working under water on a *Hubble* mock-up to simulate the effects of weightlessness, and here at Goddard where they practice scheduled mission tasks on a *Hubble* mock-up inside a large clean-room facility.

"When servicing *Hubble*, spacewalking time is our most precious resource," said Mike Weiss, *Hubble's* Technical Deputy Program Manager at Goddard. "Every second counts, so every activity performed by the crew must be meticulously engineered, choreographed, and practiced ahead of time."

The best way for the astronauts to be able to do the most during their limited spacewalks is to practice on intricate models of *Hubble*. One such model is in a huge water tank at Johnson. This water environment closely replicates the weightlessness of space, allowing the crew to perfect their techniques so, by the time they actually reach *Hubble*, there are little or no surprises.

The astronauts' practice sessions on Earth help them prepare for any issues they could face once they open *Hubble's* bay doors and begin working.

"During the mission, the astronauts perform on-orbit tasks inside *Hubble*, wearing bulky, pressurized gloves and under lighting conditions that are not always optimal," said Justin Cassidy, Crew Aids and Tools Lead Systems Engineer at Goddard.

The mock-ups of the telescope are so precise that the crew becomes acutely aware of how they need to move and how much clearance they will have once they get inside of *Hubble*. And because each spacewalking task is unique, the team develops new tools and crew aids that ensure the job gets done as easily and efficiently as possible.

"It's not enough to assume that since a past spacewalk went well, the next will too. Every time we do a mission, there's always a new task that hasn't been done before, so we often have to make new astronaut tools," said Cassidy. "Consequently, there is a constant need for a facility where spacewalking procedures can be developed, and ideas and equipment can be tested."

Such a place is the Neutral Buoyancy Laboratory (NBL) at Johnson. The NBL houses an enormous water tank. This 202 foot long by 102 foot wide by 40 foot deep structure contains a whopping 6.2 million gallons of purified water, which is completely filtered and recycled every 19.5 hours, providing the astronauts and NASA divers with exceptional water clarity.

Working underwater closely simulates the weightless environment encountered by spacewalking astronauts. The underwater environment helps them learn how to position their bodies and how to maneuver themselves during an EVA or spacewalk. Because they are actually in pressurized space suits, they also have an opportunity to evaluate reach, access, and visibility to specific work areas. While being underwater comes pretty close to replicating the effects of zero gravity, water drag can be a hindrance, making some things easier to do in the water than in space and other tasks more difficult. In order to compensate for this "negative" training, astronauts receive additional training on a special air-bearing floor at Johnson in order to learn the effects of dealing with large masses in space.

Goddard's Role

Underwater engineering development and flight training is referred to by the *Hubble* team as 'dive runs.' The team will complete about 12 dive runs before the scheduled August 2008 mission to *Hubble*.

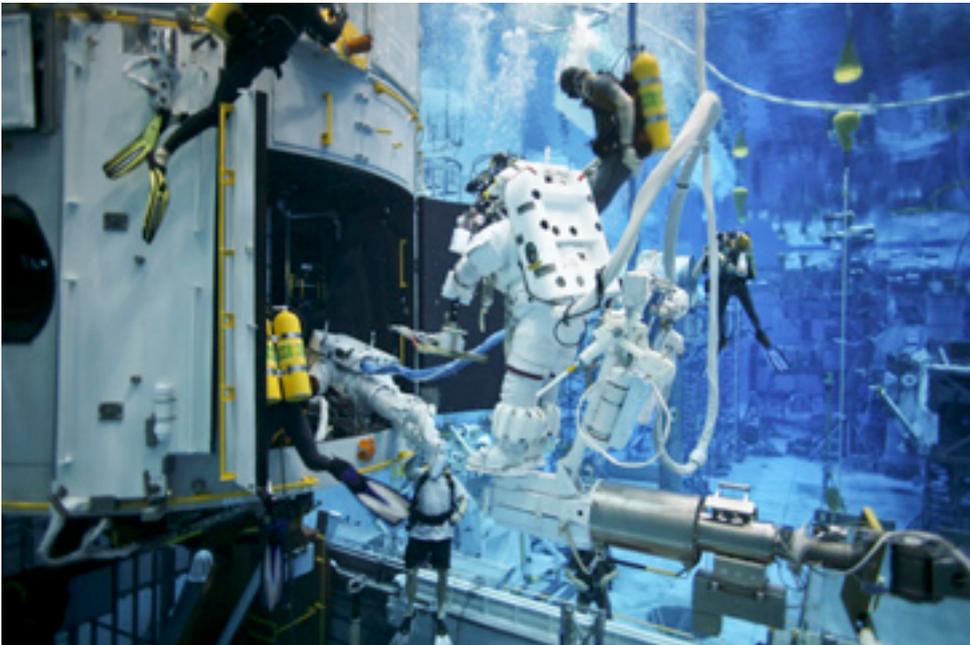
According to Weiss, every hour of work performed during an actual spacewalk equals about 20 hours of underwater engineering development. Once NASA assigns an astronaut crew and the engineering products are turned over to the astronaut's training team for actual flight training, the crew then spends about 14 hours training under water for every hour they actually spend performing spacewalking tasks.

Goddard provides the *Hubble* engineers, who dive with the astronauts, to define procedures and tool requirements, as well as training the crew in the use of the tools and crew aids.

[Continued on Page 5](#)

Goddard Engineers and Divers Multitask for *Hubble*

Continued from Page 4



Caption: Servicing Mission 4 astronauts practice on a Hubble mock-up under water at the Neutral Buoyancy Lab in Houston under the watchful eye of NASA engineers and safety divers.

Johnson supports the dive runs with safety divers to ensure the crew's well-being. Video photographers and still photographers are also employed to document the crew's activities. The team then studies the images captured in the tank to evaluate each run and modify tool designs, which increases efficiency.

But how did the Goddard engineers get involved in diving? "Way back, when we were going through engineering development for the first servicing mission, we decided that instead of hiring divers we'd have to train on *Hubble* terminology, mechanical operations, and complexities of the interfaces and then have them debrief us on what they learned under water, it would be more efficient to just put our engineers in the water," said Weiss. "This efficiency allowed the Johnson divers to focus on their primary duties."

"The divers that Johnson supplies us with at the NBL are wonderful," elaborated Cassidy. "But because operations and hardware change so much, it would be impossible for them to keep up with all the new developments. It's extremely important that we bring our own people who are intimately familiar with the ins and outs of a particular dive run."

As the Center primarily responsible for *Hubble* servicing development, Goddard manages all pre-dive development and keeps its designs up to date during the testing period leading up to launch. It is not unusual for the team to make tweaks to tools and crew aids after each run. By having the Goddard engineers experience the dive runs along with the astronauts, the entire team gains instant insight into what improvements are needed.

"Rather than just developing drawings and building and testing hardware for the *Hubble* mission, our engineers get up close and personal with the crew,"

remarked Mark Hubbard, Deputy Carrier Manager and team diver for *Hubble* at Goddard. "When I dive, it's almost like I'm in space with the astronauts, so I get a sense of what they need to do in order to accomplish a task."

Hubbard equated the dive experience to learning a subject in school. "When you are in school, you learn a lot from books, but the actual hands-on experiences help things really sink in."

The Dive Experience

NBL dives involve the EVA astronauts and about 20 to 25 other people at a time, all focused on a particular spacewalking task. With

such a high volume of bodies in the tank, it becomes a veritable beehive of divers swarming around the astronauts.

Despite the number of people in the tank, the Goddard divers still have the ability to interact with the astronauts when their guidance is needed. And because communications between astronauts and divers is somewhat limited (the astronauts are fitted with microphones, whereas the divers are not), immediately following each dive, all participants go topside for a debriefing. This after-dive meeting enables necessary dialogue between the Goddard engineers and astronauts to discuss in detail what they observed and how they can make future dive runs more efficient.

Currently, about 25 *Hubble* personnel are certified to dive in the NBL. A group of four *Hubble* divers rotates in two-hour shifts during a simulated six-hour EVA dive run. This once-in-a-lifetime experience comes with high expectations, though. The *Hubble* divers are tasked with ensuring that each spacewalk will be executed as safely and efficiently as possible.

When asked what engineer Mark Hubbard finds most rewarding about his unique opportunities with the *Hubble* mission he said, "I was in the water one day preparing for a dive just looking around and realizing here I am in the space program...and it just struck me, this is incredible! Not too many people get to do stuff like this. I am working side by side with these extraordinary men and women who most people only get to read about in newspapers and magazines." ■

Magnetospheric Multiscale Project Passes Key Milestone

By Bill Steigerwald

The team designing Goddard's Magnetospheric Multiscale (MMS) mission passed a key milestone, allowing the project to proceed from developing the mission concept and technology (Phase A) to the preliminary design and completion of the technology development (Phase B). The milestone, called "Key Decision Point B," was passed November 29 when the Agency Program Management Council authorized the MMS Project to advance to Phase B.

"The MMS Project consists of a talented team of scientists, engineers, system assurance, and business experts, who worked together to finish Phase A," said Project Manager Karen Halterman. "We are extremely pleased to progress to Phase B and look forward to completing the preliminary design for this exciting mission."

MMS is being built to investigate magnetic reconnection, which occurs when oppositely directed magnetic fields are forced close together. When this happens, the two magnetic fields join together and explosively release energy. It is a violent, but common, process throughout the universe. For example, space weather effects that can disrupt satellites and radio communication are ultimately caused by magnetic reconnection on the Sun and in the region of space around Earth dominated by its magnetic field, called the magnetosphere. Farther away, magnetic reconnection may help propel enormous jets of matter blasted from near the poles of black holes at almost the speed of light.

The mission will consist of four spacecraft that will fly in a tetrahedral (pyramid) formation. "Because reconnection is a 3-D process involving the rapid

inflow and outflow of charged particles, a cluster of four satellites is needed," said Halterman.

The spacecraft will fly into reconnection zones in the magnetosphere around Earth. The MMS mission will probe known magnetic reconnection sites with the highest-resolution charged particle-, electric-, and magnetic field measurements yet performed in space.

"The next major milestone is the mission Preliminary Design Review (PDR) in February 2009," said Halterman. "At PDR, the preliminary design of the instruments developed by the Southwest Research Institute (SwRI) team and the spacecraft design developed by GSFC will be reviewed by the

MMS Standing Review Board, an independent review board that will follow the MMS mission throughout its lifetime."

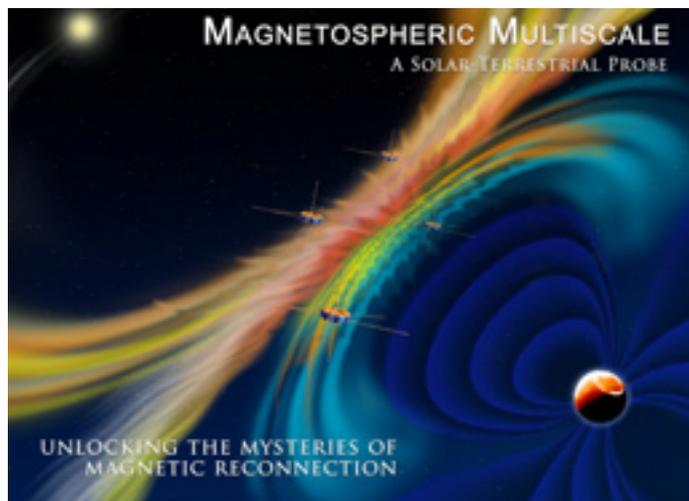
MMS is a Science Mission Directorate mission in the Solar Terrestrial Probes (STP) program. Goddard manages the MMS mission and will design and build the four satellites in-house, including the interspacecraft ranging and communication system.

The instrument suite will be provided by SwRI, San Antonio, Texas, under contract to God-

dard. Instrument investigations will be lead by SwRI, the University of New Hampshire, Goddard, and the Johns Hopkins University's Applied Physics Laboratory. Kennedy Space Center will provide launch services. All four satellites will be launched together in October 2014 on one rocket (an Evolved Expendable Launch Vehicle).

For more on MMS, please visit:

<http://stp.gsfc.nasa.gov/missions/mms/mms.htm>



Caption: An artist's concept of the MMS constellation flying through a magnetic reconnection site in its magnetosphere.

Closing in on a Hot Mystery

By Bill Steigerwald

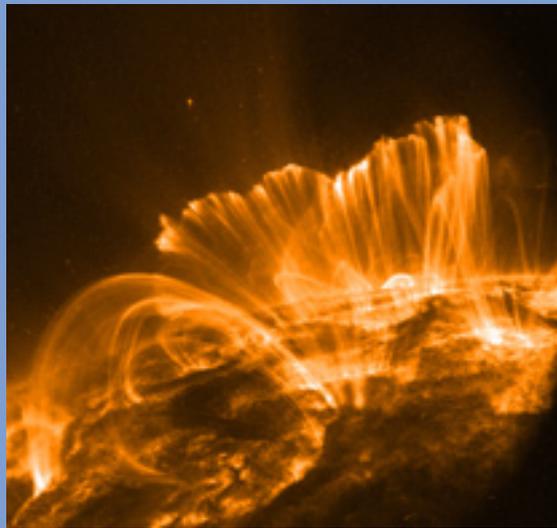
Imagine you are sitting around a campfire. Move closer to the fire, and you get hotter. Move away, and you get cooler. Pretty basic, right? Well, the closest star, our Sun, doesn't seem to be getting this. As you move away from the solar surface, into the Sun's outer atmosphere, the corona, it actually gets a lot hotter before it cools off. The solar surface is about 10,000 degrees Fahrenheit, while temperatures in the corona soar to millions of degrees.

Although scientists have some ideas of what might heat the solar corona, there is no universally accepted explanation yet. Many mechanisms might contribute to coronal heating; a few leading contenders are magnetic reconnection (when twisted magnetic fields break apart and rejoin), sound waves produced in the Sun's churning outer layer, and waves of magnetic energy called Alfvén waves.

Alfvén waves were a long-time suspect in the coronal heating mystery, but until now, evidence of their presence in the solar corona was only circumstantial. "With help from the *Hinode* spacecraft, we now have irrefutable evidence of Alfvén waves moving along coronal loops," said Dr. Leon Ofman, a solar physicist at Goddard.

Coronal loops are fountains of plasma (a gas made up of electrically charged particles) trapped by the Sun's magnetic fields. Coronal loops look like giant arches sticking out of the solar surface, and many are large enough to span several Earths.

An Alfvén wave is a vibration of a magnetic field line that carries the charged particles in plasma along with it. "In other words, it is similar to a vibrating string with beads," says Ofman. "This type of wave was first proposed to exist in 1942 by Hannes Alfvén, a Swedish scientist who won the Nobel Prize in Physics in 1970. Alfvén waves were later found to exist in laboratory experiments with magnetized plasma, and in space," said Ofman.



Caption: This is a false-color image of coronal loops taken with NASA's Transition Region and Coronal Explorer satellite on November 9, 2000.

Photo credit: NASA

Alfvén waves can be caused by an impact to a magnetic field. In the case of the new *Hinode* observations, they were caused by an explosion of magnetic energy, called a solar flare, which immediately preceded the observations, according to Ofman.

"*Hinode* detected the Alfvén waves with its Solar Optical Telescope instrument. This is a high-resolution telescope in space that is sensitive to the emission of relatively cool material that can fill coronal loops due to eruptions caused by a flare. A movie made from a sequence of images showed a clear pattern of periodic motion of coronal loops. The loops vibrated side-to-side, which is typical for an Alfvén wave. The relation between the period of the vibrations and the parameters of the loop (its length, density, and temperature) further reinforced the conclusion that what we see is really an Alfvén wave," said Ofman.

According to Ofman, Alfvén waves could heat the solar corona by their vibrations: "As the magnetic field lines vibrate, they experience friction with the surrounding magnetized material. The friction results in heating of the corona and damping of the wave motions."

The next step to understand the Sun's mysteriously hot atmosphere is to discover how much Alfvén waves contribute to coronal heating, and to see whether it's the dominant force or if the other possible heating mechanisms play major roles.

Ofman will present these results in the upcoming American Geophysical Union meeting in San Francisco, Calif. His co-author is Dr. Tongjiang Wang, a postdoctoral researcher at the Catholic University of America, Washington, who works at Goddard. This research is part of a series of papers about observations of Alfvén waves with *Hinode*. *Hinode* (formerly Solar B)

is a mission to investigate the interaction between the Sun's magnetic field and its corona. It is a collaboration among the space agencies of Japan, the United States, the United Kingdom, and Europe.



NASA Climate Change ‘Peacemakers’ Aided Nobel Effort

By Steve Cole



Photo credit: courtesy of the Norwegian Nobel Community.

Caption: The 2007 Nobel Peace Prize, awarded this month, honors the work of climate scientists around the world, including many at NASA.

It's not every day that a NASA scientist can wake up and think, "Hey, I did something for world peace today." But Monday, Dec. 10, was one day when many of NASA's Earth scientists could do exactly that.

In Oslo, Norway, the King of Sweden presented the shared 2007

Nobel Peace Prize to former U.S. Vice President Al Gore and to representatives of a United Nations panel that has spent two decades investigating the state of Earth's changing climate and predicting where it is headed. Hundreds of scientists from across NASA contributed to the United Nations effort in ways large and small, along with thousands of their colleagues in over 100 countries.

When the Norwegian Nobel Committee, which awards the Nobel Prizes, announced this year's recipients in October, it said the scientific reports issued by the United Nations Intergovernmental Panel on Climate Change (IPCC) since 1990 have "created an ever-broader informed consensus about the connection between human activities and global warming." The peacemaking value of this scientific finding, according to the committee, is that human-induced changes in climate may cause "large-scale migration and lead to greater competition for the Earth's resources," and an "increased danger of violent conflicts and wars."

This year, the fourth in the series of reports came out in three parts: the state of climate science, the impacts of climate change, and strategies to adapt to future changes. A summary of the nearly 3,000-page report was also issued specifically for policymakers. With NASA's extensive expertise in many areas of Earth science, most of the Agency's contributions have been to the climate science portion of the report.

"NASA is best known for its cutting-edge satellite instruments and global measurements of Earth from space, but we contribute a lot more than that to climate change science," says Michael Gunson, acting Chief Scientist in the Jet Propulsion Laboratory's (JPL) Earth Science and Technology Office, Pasadena, Calif. "At JPL, our specialty is analyzing global observations to gain new insights into how Earth's climate works. This new understanding can then be used by scientists worldwide who specialize in simulating climate changes with computer models, such as our NASA colleagues at the Goddard Institute for Space Studies (GISS) in New York."

NASA instruments, data analysis, and modeling all contributed to the bedrock of the IPCC report: the hundreds of papers published each year in scientific journals.

The authors of the report draw on this ever-growing body of new knowledge from scientists around the world to form their conclusions about the state of Earth's climate. Many of these papers use information from NASA, and many are written by NASA scientists.

"The most remarkable thing about the process of assembling an IPCC report is that you can actually get thousands of independent-minded and critical scientists to work together without killing each other," says Bruce Wielicki, Senior Scientist for Earth science at NASA's Langley Research Center in Hampton, Va.

Wielicki contributed a portion of a chapter in the latest science assessment on how Earth's "energy budget," the ebb and flow of radiant energy from the Sun and our planet, has changed as measured by satellites. He began the project in October 2004 and, working with a team of 10 scientists, completed a compact summary of the latest research on the topic 20 months later. Like each section of the IPCC reports, Wielicki's section went through repeated rounds of critiques by other scientists.

NASA's Cynthia Rosenzweig, a plant and soil scientist at GISS, had the daunting task of coordinating the creation of an entire chapter in the new report on the impact of climate change—an effort that took four years. "There were many late nights as we worked under strict deadlines to draft the chapter and revise it based on thousands of comments from reviewers, each of which had to be documented and responded to," Rosenzweig recalls. Thanks to special support from NASA Headquarters, Rosenzweig was able to travel all over the world for meetings with the international team of 40 authors contributing to the chapter on natural and managed ecosystems.

"But the toughest part of the entire effort was the last step: reviewing our final draft with government officials," Rosenzweig says. Before each IPCC report is published, the lead authors sit down with diplomats, lawyers, and environmental officials from around the world to review their findings, page by page. "These week-long meetings are very challenging as you respond to all sorts of concerns and questions. But this process is the real beauty of the IPCC. The final documents that emerge from it represent both the views of the world's scientific community and decision makers."

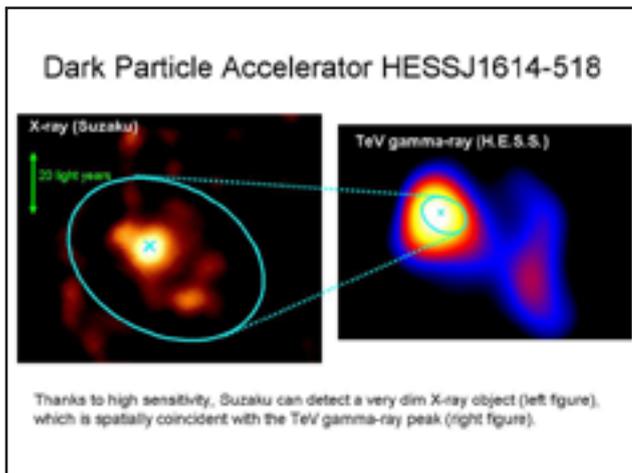
The IPCC effort has also boosted public awareness of this critical area of science. "By collecting the current scientific thinking on climate change, the IPCC showed the world the value of the type of science we are doing at NASA," says JPL's Gunson. ■

Suzaku Explains Cosmic Powerhouses

By Robert Naeye

By working in synergy with a ground-based telescope array, the joint Japanese Aerospace Exploration Agency (JAXA)/NASA Suzaku x-ray observatory is shedding new light on some of the most energetic objects in our galaxy, but objects that remain shrouded in mystery. These cosmic powerhouses pour out vast amounts of energy, and they accelerate particles to almost the speed of light. But very little is known about these sources because they were discovered only recently. "Understanding these objects is one of the most intriguing problems in astrophysics," says Takayasu Anada of the Institute for Space and Astronautical Science in Kanagawa, Japan. Anada is the lead author of a paper presented last week at a Suzaku science conference in San Diego, Calif.

These mysterious objects have been discovered in just the last few years by an array of four European-built telescopes named the High Energy Stereoscopic System (H.E.S.S.), located in the African nation of Namibia.



Caption: Suzaku resolved an x-ray source (left) that was also seen in gamma rays by the H.E.S.S. array (right). The object, HESS J1614-518, is accelerating protons to nearly the speed of light.

H.E.S.S. indirectly detects very-high energy gamma rays from outer space. These gamma rays are the highest-energy form of light ever detected from beyond Earth, so H.E.S.S. and other similar arrays have opened up a new branch of astronomy.

The gamma rays themselves are absorbed by gases high up in Earth's atmosphere. But as the gamma rays interact with air molecules, they produce subatomic particles that radiate a blue-colored light known as Cherenkov radiation.

H.E.S.S. detects this blue light, whose intensity and direction reveals the energy and position of the gamma-ray source. The H.E.S.S. observations were ground breaking, but the array's images aren't sharp enough to reveal the exact location of where or how the particles are being accelerated. To solve this problem, several teams aimed Suzaku in the direction of some of these H.E.S.S. sources.



Caption: These four telescopes comprise the H.E.S.S. array, located in the African nation of Namibia. The telescopes indirectly detect high-energy gamma rays.

Any object capable of emitting high-energy gamma rays will also produce x-rays, and Suzaku is particularly sensitive to high-energy (hard) x-rays.

When Anada and his colleagues pointed Suzaku at a source known as HESS J1837-069 (the numerals express the object's sky coordinates), the x-ray spectrum closely resembled x-ray spectra of pulsar wind nebulae—gaseous clouds that are sculpted by winds blown off by collapsed stars known as pulsars. Pulsar wind nebulae emit hard x-rays, and their x-ray output remains relatively constant over long timescales. "The origin of the gamma-ray emission from HESS J1837-069 remains unclear, but we suspect that this source is a pulsar wind nebula from the Suzaku observation," says Anada.

NASA's Chandra x-ray Observatory and the European Space Agency's XMM-Newton x-ray Observatory have revealed that other H.E.S.S. sources are also pulsar wind nebulae. These combined gamma-ray and x-ray observations are revealing that pulsar wind nebulae are more common and more energetic than astronomers had expected. Another group, led by Hironori Matsumoto of the University of Kyoto in Japan, targeted Suzaku on HESS J1614-518.

This source belongs to a class of objects known as "dark particle accelerators" because their ultrahigh energies suggest they are accelerating particles to near-light speed, turning them into cosmic rays.

Continued on page 10

Suzaku Explains Cosmic Powerhouses

Continued from Page 9

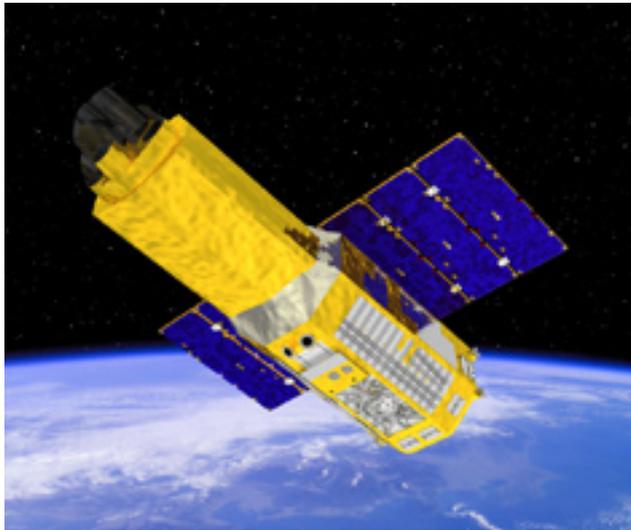


Photo credit: JAXA

Caption: An artist depicts the Suzaku x-ray observatory in Earth orbit.

But what are these objects, and what kinds of particles are being accelerated?

Although the nature of these objects remains a mystery, Suzaku's observations do reveal the identity of the particles. When electrons are accelerated to high speeds, they spiral around magnetic field lines that permeate space, generating copious x-rays. But because protons are 2,000 times more massive than electrons, they emit few x-rays. Matsumoto and his colleagues reported at the conference that HESS J1614-518 is a very weak x-ray emitter. "This result strongly suggests that high-energy protons are being produced in this object," says Matsumoto.

Suzaku also observed two other H.E.S.S. dark particle accelerators, but found no obvious x-ray counterparts at the H.E.S.S. positions. These sources must also be weak x-ray emitters, indicating they are accelerating mostly protons. As Matsumoto says, "Using the high sensitivity of the Suzaku satellite, we can find strong candidates for the origin of cosmic rays."

Launched in 2005, Suzaku is the fifth in a series of Japanese satellites devoted to studying celestial x-ray sources. Managed by JAXA, this mission is a collaborative effort between Japanese universities and institutions and NASA Goddard. ■

NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES)

Supporting research in science and technology is an important part of NASA's overall mission. NASA solicits this research through the release of various research announcements in a wide range of science and technology disciplines. NASA uses a peer-review process to evaluate and select research proposals submitted in response to these research announcements. Researchers can help NASA achieve national research objectives by submitting research proposals and conducting awarded research. This site facilitates the search for NASA research opportunities.

For more information, please visit <https://nspires.nasaprs.com>

Solicitations:

Chandra x-ray Observatory—Cycle 10 Call for Proposals

Released: 12/14/2007

Proposal Due: 03/20/2008

Dual Use Technology Development at NASA John C. Stennis Space Center

Released: 12/03/2007

Proposal Due: 09/30/2008

Experimental Program to Stimulate Competitive Research (EPSCoR)

Released: 12/17/2007

Proposal Due: 03/14/2008

Hubble Space Telescope—Cycle 17 Call for Proposals

Released: 12/03/2007

Proposal Due: 03/07/2008

Landing Sensor Advanced Component Technologies

Released: 12/05/2007

Proposal Due: 02/05/2008

NASA ARMD Research Opportunities in Aeronautics (ROA) NRA

Released: 06/12/2007

Proposal Due: 10/11/2008

NASA Earth and Space Science Fellowship/08

Released: 11/01/2007

Proposal Due: See Announcement

For a complete list, please visit: <http://nspires.nasaprs.com/external/solicitations/solicitations>

Air Quality Forecasts See Future in Space

By Kathryn Hansen

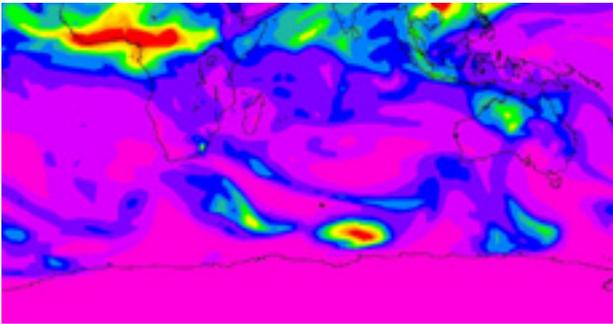


Photo credit: Jean-Jacques Morcrette/MWF

Caption: A preliminary forecast by Europe's GEMS project predicts regions expected to have elevated levels of aerosols (yellow and red) on Dec. 5, 2007.

Weather broadcasts have long been a staple for people planning their day. Now with the help of NASA satellites, researchers are working to broaden daily forecasts to include predictions of air quality, a feat that is becoming reality in some parts of the world.

Some scientists predict that an operational system of routine, global forecasts of air pollution near the ground, where it affects human health, is only a few years away. Such a system could prove useful in efforts to improve air quality, assess the effectiveness of environmental regulations, and address the challenge of climate change. Advances in air quality monitoring and forecasts were discussed at the American Geophysical Union meeting in San Francisco in December. "Regional modeling is already getting quite meaningful," says Richard Engelen of the European Centre for Medium-Range Weather Forecasts in Reading, United Kingdom. He notes that air quality forecasts are now possible up to a few days in advance in Europe where there has been a concerted effort to combine atmospheric composition data from satellites and ground stations into the existing backbone of weather forecast computer models.

The European project—the Global and regional Earth-system (atmosphere) Monitoring using Satellite (GEMS) and *in situ* data project—is currently in the experimental stage. In the United States, planning for the application of satellite data in regional air quality forecast model is underway at the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Environmental Protection Agency (EPA). "But for forecasts to become more accurate and global, researchers need more and better observations," Engelen says. That's where NASA satellites are helping to fill in the gaps.

"To really do an accurate job of forecasting air quality, you have to know what pollution is coming in from upwind," says Kenneth Pickering of Goddard, who studies the chemistry and movement of gases through the atmosphere.

For example, a recent study conducted by researchers from NASA's Langley Research Center, Hampton, Va., and Jet Propulsion Laboratory (JPL), Pasadena, Calif., used satellite instruments to look at air quality in Houston, Texas, a city with major air quality problems. Using data from two instruments on NASA's Aura satellite, researchers found that not all of Houston's pollution was locally caused and there was significant long-range transport from the Midwest and Ohio Valley. "Although the finding was made possible by a computer model, it was greatly aided by the Aura satellite data," Pickering says.

Researchers at centers, including Goddard, are also experimenting with blending satellite ozone data with the output from computer models to continuously improve a forecast's accuracy.

NASA satellites are helping researchers evaluate the Clean Air Interstate Rule instituted in 2005 by the EPA. The rule calls for eastern U.S. power plants to cut sulfur dioxide by 73 percent and nitrogen oxide emissions by 60 percent, by 2018. Coal burning plants emit plumes containing sulfur dioxide and nitrogen oxides into the atmosphere, where they undergo chemical reactions and form aerosol particles, which lead to adverse health impacts, degrade visibility, and can influence Earth's climate. These aerosols are usually transported by wind away from their source to distant regions. Satellite instruments, as well as models and other information sources, allow researchers to create a history describing how much aerosol is transported and where, helping them to evaluate the rule.

"Satellites add considerable vertical and horizontal spatial detail, enabling a more scientifically sound way of understanding whether or not programs are making progress in reducing air pollution in the long term," says Rich Scheffe of the EPA in Research Triangle Park, N.C.

Satellite data still pose challenges, however, and researchers are trying to find ways to tease out specific information, such as how much of each gas exists at a specific altitude. This is a particularly challenging measurement to make in the air closest to Earth's surface, where the information is most relevant for air quality regulations. More research is needed to determine the value of the current data and to develop improved sensors for future satellites, Pickering says.

The advances in forecasting air quality are happening fast, spurred in part by concern about global warming. At Earth's surface, warmer temperatures can accelerate the reaction between chemicals in the air that form ozone. "The combination of the increase of transported air pollution and the interaction of climate change and air quality really puts a greater premium on satellite imagery for air quality applications," Scheffe says. ■

Employee Spotlight:

Charles (Gibran) McDonald

By Leslee Cork



Photo credit: Pat Izzo

Caption: Charles (Gibran) McDonald.

Working for NASA Goddard Space Flight Center never crossed Gibran McDonald's mind. However in 2004, while working on his MBA at Morgan State University, all that changed after an encounter with a NASA recruiter. Her casual attire and down-to-earth demeanor dispelled all misconceptions he had about the science institution and its employees. During his first summer in graduate school, Gibran landed an internship with the Summer Institute in Engineering and Computer Applications (SIECA) Program where he worked in the *Hubble Space Telescope* (HST) Operations Office, Code 441. Roughly a month later, he was accepted into the Cooperative Education Program (Co-Op) where he continued to flourish and demonstrated an exceptional work ethic. Under the Co-Op program, Gibran spent his days on the source evaluation board, securing procurement for the robotic servicing mission for HST.

Upon graduating from Morgan State, Gibran began working as a resource analyst for HST, where he is currently employed. As a resources analyst, the majority of his experience has been in contract management. He has served as the Resources Analyst for both of the major HST operations contracts, in addition to the mission operations portions of the Swift mission, as well as the Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI). Currently, he is the Resources Analyst for the HST Mission Operations and Sustaining Engineering Support (MOSES) contract, which is part of the Combined Hubble and Associated Mission Products (CHAMP) contract with Lockheed Martin.

Despite the above accomplishments and responsibilities, Gibran recalls his most memorable moment was as a result of his involvement with the Spirit mission concept study.

Unbeknownst to him, Dr. John Mather was a co-author for the study, which was later published. Gibran's name was printed right behind Dr. Mather's, (the 2006 Nobel Laureate in Physics), on the document. In this world, very few people get the opportunity to meet, let alone have an article published with a Noble Laureate, which is an honor he will never forget.

Although he is proud of his work as a resources analyst, Gibran is most proud of his work as a facilitator for the Center's Diversity Dialogue Project (DDP). The DDP enables employees to explore and express human characteristics that affect an individual's values, opportunities, and perceptions of self and others at work. As a result of this program, Goddard hopes to create an organizational climate where employee diversity and mutual respect are catalysts for creativity and team effectiveness. According to Gibran, facilitating is most rewarding because "there are a lot of diversity issues on Center. It is important to create an environment where people can share experiences and perspectives, and explore the impact of perception on the workplace reality."

When Gibran is not at work, he spends his days practicing yoga and blending teas—hobbies that he's had for over two years. Yoga not only leaves him feeling energized, but it allows Gibran to "explore how the elements within his body interact and what their capacities are." To Gibran, blending teas is just an extension of that, with his menu featuring teas that contain herbs specifically designed for particular health benefits. For instance, the "Fight from Within" tea is a fruity blend that combines echinacea, astragalus, hibiscus, cinnamon, cloves, and other herbs designed to promote the body's immune response system. "Pop's Blend" is a naturally sweet, fruity blend that contains herbs that are beneficial for circulation, weight loss, prostate health, and hypertension. While other employees struggle to create a balance between work life and personal life, Gibran has managed to master that task, all while drinking tea. ■