National Aeronautics and Space Administration

Goddard View

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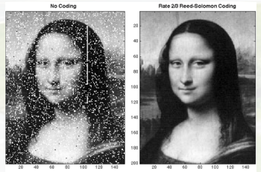
THE WEEKLY

Visitor Center Hosts Lecture: Our Eruptive Sun
On Feb. 13 at 7:00 p.m., experience "Our Eruptive Sun: The Causes and Consequences of Space Weather," with Dr. Phillip Chamberlin, research astrophysicist in the Solar Physics Laboratory. New movies of the sun at 10 times better resolution than HDTV will be presented. Click on the image to learn more and to register.

New Video Brings Webb Telescope's Third Mirror to Light
There are four types of mirrors that on the Webb Telescope: the primary, secondary, tertiary and fine steering mirrors. Although the 18 primary mirror make the biggest splash, the other mirrors are equally as important. A new video takes viewers behind the scenes for a special look at the tertiary mirror.



See the Story Everyone is Talking About
As part of the first demonstration of laser communication with a satellite at the moon, LRO scientists beamed an image of the Mona Lisa to the spacecraft from Earth. The accompanying video has passed 100,000 plays on YouTube and the story was picked up in the Feb. 4 issue of *Time* magazine.

VISIONS: Seeing the Aurora in a New Light
VISIONS (VISualizing Ion Outflow via Neutral atom imaging during a Substorm), a Goddard-build instrument on a Wallops sounding rocket will fly through the Northern Lights to study the auroral wind and how oxygen atoms leave Earth's atmosphere under the influence of the aurora. Learn more by clicking on the picture.

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On the cover: A United Launch Alliance Atlas V rocket blasts off from Space Launch Complex-41 with NASA's Tracking and Data Relay Satellite (TDRS-K) payload.

Photo credit: United Launch Alliance

GoddardView

Goddard View is an official publication of NASA's Goddard Space Flight Center. *Goddard View* showcases people and achievements in the Goddard community that support Goddard's mission to explore, discover, and understand our dynamic universe. *Goddard View* is published weekly by the Office of Communications.

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News items for publication in *Goddard View* must be received by noon Wednesday of each week. You may submit contributions to the editor via e-mail at john.m.putman@nasa.gov. Ideas for new stories are welcome but will be published as space allows. All submissions are subject to editing.

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NASA LAUNCHES NEXT-GENERATION COMMUNICATIONS SATELLITE

By: Dewayne Washington, George Diller and Rachel Kraft

The first of NASA's three next-generation Tracking and Data Relay Satellites (TDRS), known as TDRS-K, launched at 8:48 p.m. EST Wednesday from Cape Canaveral Air Force Station in Florida.

"TDRS-K bolsters our network of satellites that provides essential communications to support space exploration," said Badri Younes, deputy associate administrator for Space Communications and Navigation at NASA Headquarters in Washington. "It will improve the overall health and longevity of our system."

The TDRS system provides tracking, telemetry, command and high-bandwidth data return services for numerous science and human exploration missions orbiting Earth. These include the International Space Station and NASA's Hubble Space Telescope.

"With this launch, NASA has begun the replenishment of our aging space network," said Jeffrey Gramling, TDRS project manager. "This addition to our current fleet of seven will provide even greater capabilities to a network that has become key to enabling many of NASA's scientific discoveries."

TDRS-K was lifted into orbit aboard a United Launch Alliance Atlas V rocket from Space Launch Complex-41. After a three-month test phase, NASA will accept the spacecraft for additional evaluation before putting the satellite into service.

The TDRS-K spacecraft includes several modifications from older satellites in the TDRS system, including redesigned telecommunications payload electronics and a high-performance solar panel designed for more spacecraft power to meet growing S-band requirements. Another significant design change, the return to ground-based processing of data, will allow the system to service more customers with evolving communication requirements.

The next TDRS spacecraft, TDRS-L, is scheduled for launch in 2014. TDRS-M's manufacturing process will be completed in 2015.

NASA's Space Communications and Navigation Program, part of the Human Exploration and Operations Mission Directorate at the agency's Headquarters in Washington, is responsible for the space network. The TDRS Project Office at NASA's Goddard Space Flight Center in Greenbelt, Md., manages the TDRS development program. Launch services were provided by United Launch Alliance. NASA's Launch Services Program at the Kennedy Space Center was responsible for acquisition of launch services. ■

Above: A United Launch Alliance Atlas V rocket blasts off from Space Launch Complex-41 with NASA's Tracking and Data Relay Satellite (TDRS-K) payload.

Photo credit: United Launch Alliance

> “This is an armored type of dinosaur that had spikes all over their body.”

DINOSAUR FOOTPRINTS AT GODDARD TAKE ANOTHER STEP

By: Karl B. Hille

A grouping of 110 to 112 million-year-old dinosaur footprints pressed into mud from the Cretaceous Period has now been safely moved from their original setting on the grounds of Goddard. Until further scientific study is possible, the footprints, now wrapped in protective material, will be stored on the Goddard campus.

The discovery of dinosaur footprints came to light in August 2012 when well-known Maryland-based dinosaur hunter Ray Stanford brought one track to the center and the public’s attention. Later analysis by emeritus paleontologist Rob Weems, of the U.S. Geological Survey in Reston, Va. and Goddard’s consultant paleontologist Lee Monnens verified the track and discovered additional footprints hiding under a thin layer of topsoil in the same rock layer.

Earlier this year, the footprint-bearing rock was reinforced and removed.

“We successfully made a mold of the upper surface to preserve the dinosaur footprints,” said Stephen Godfrey, Curator of Paleontology at the Calvert Marine Museum. He was contracted by Goddard to preserve and move the preserved footprints for further scientific examination and eventual display.

The original footprint was almost certainly that of a nodosaur, Godfrey confirmed.

“This is an armored type of dinosaur that had spikes all over their body. The spikes consist of bones that were embedded in their skin,” he said. “With the second large print, the orientation was different, and the shape of the print is different as well.”

Godfrey suspects the second creature was a three-toed ornithopod, perhaps from the iguanodontid family of dinosaurs, which were also herbivores much like the nodosaur.

A third, smaller footprint was originally found superimposed over the nodosaur track. Experts say it is likely a juvenile nodosaur meandering behind its parent on a more circuitous route.

After the dinosaurs left the footprints, single-celled organisms feeding on nutrients in the Cretaceous mud precipitated an iron-rich mineral known as hematite that solidified and preserved the tracks until natural processes buried and fossilized them, said Stanford.

Excavation of the stone with the dinosaur footprints had to wait until geologists and paleontologists learned more about the find and its surroundings, in accordance with Bureau of Land Management guidelines.

In December, 2012, Goddard scientists using ground penetrating radar showed that the sedimentary rock layer bearing these prints was preserved in its original location, but that investigation found no additional indications of locations of dinosaur track specimens of scientific value.

Further hands-on exploration by Goddard volunteers, including Godfrey, took place in mid-December 2012. Volunteers dug in several areas around the initial find location, but turned up no additional preserved footprints.

The entire find, containing at least three dinosaur footprints, is approximately seven feet long and three feet across at its widest point. The footprint-bearing layer is bonded to a separate layer of iron-rich sandstone that complicated the efforts to extract and preserve it.

Before removing the rock layer, Godfrey made a silicon-rubber cast of the prints, then jacketed the entire find in multiple layers of plaster-soaked burlap (i.e. just like a cast) to add rigidity and to further ward against breakage during transport. Galvanized steel pipes wrapped into the jacket acted like splints to provide additional structural support.

The combined weight of the footprint, field jacket material and surrounding soil that was removed was estimated at approximately 3,000 pounds, so extra care was taken in moving it to avoid damaging the rather extraordinary find.

The future disposition of the dinosaur-track-bearing rock layer has not yet been determined. Senior management at Goddard will work with government officials and scientists to determine the best course of action.

“One of the amazing aspects of this find is that some of the starlight now seen in the night sky by astronomers was created in far-distant galaxies when these dinosaurs were walking on mud flats in Cretaceous Maryland where Goddard is now located,” said Jim Garvin, Chief Scientist at NASA Goddard. “That starlight (from within the Virgo Supercluster) is only now reaching Earth after having traveled through deep space for 100 million years.”

Center Director Chris Scolese added, “Much of the work at Goddard is focused on Earth and space science. The discovery and follow-on work with the dinosaur footprints created a wonderful blending of sciences. You have astronomy - the study of the Universe, geology - the study of the Earth, and paleontology - the study of the prehistoric life on Earth and they have all come together here at NASA Goddard.” ■

Opposite: Michael Godfrey (left) and Perry Carsley (center) are coating the dinosaur footprints with a silicone rubber molding compound. A mold was made of the prints so that in addition to preserving the original rocky surface, cast replicas of the surface could also be made. To see more pictures, visit the Goddard flickr page.
Photo courtesy Stephen Godfrey

TRIUMPH OVER TRAGEDY: COLUMBIA'S LAST MISSION

By: Claire Saravia

It was the moment the STS-107 mission team thought would never come.

On February 1, 2003, space shuttle Columbia broke apart re-entering Earth's atmosphere, taking the lives of all seven crewmembers and destroying the six experiments from Goddard's payload as well as many others.

As NASA investigated the accident in the following months, team members from FREESTAR—the Goddard payload housing six of the mission's major instruments—searched through debris brought back to Kennedy Space Center, hoping to find clues that could lead to results from the experiments. The scientists spent months piecing together the limited data recovered in the rubble or transmitted before the accident.

This mission could not have been in vain, they told themselves. Not after this.

"There was an incentive to make sure every last bit of data was exploited because of what happened," SOLSE-2 instrument project scientist Scott Janz said. "We wanted to make sure it wasn't wasted."

Although not all of the FREESTAR experiments produced results—the SEM-14 housing multiple student projects was lost—the scientists produced results from the other experiments that helped shape science.

The Mediterranean Israeli Dust Experiment (MEIDEX)—a collaboration between the Israeli Space Agency and Tel Aviv University—discovered how desert dust affects cloud precipitation, how lightning in thunderstorms acts in sync, and proved that smoke from forest fires prevents rain clouds from forming. The results have since been published in multiple scientific papers around the world.

Although only about 20 percent of the total data from SOLSE-2 was recovered, the scientists were able to create a high-resolution profile of ozone in the stratosphere. In addition, Janz said there was enough data to use in developing future instruments.

Another successful experiment from the mission was the Goddard-developed Low-Power Transceiver (LPT/CANDOS), which successfully performed the first flight demo of Internet Protocol ops using the NASA Communications Network.

Although one cataclysmic flaw in the shuttle brought the mission to a premature end, FREESTAR integration and test manager Michael Wright said the team's preparedness before and after the accident allowed it to be an overall success.

"It was a successful mission in our eyes because of the science that came out of it," Wright said. "Although the accident occurred, we had done our job when it came to flight safety, so from NASA lessons learned, it brought out the importance of always being prepared."

The FREESTAR payload was also the last to be part of NASA's Hitchhiker program, which started at Goddard in 1984 to allow experiments from agencies and universities to "hitch a ride" on space missions. After the accident, NASA stopped the program to shift mission focus to the space station instead of scientific experiments.

FREESTAR mission manager Tom Dixon said the mission's diverse experiments and crew—crewmember Ilan Ramon was Israel's first astronaut to launch into space—embodied what the Hitchhiker program was all about. "Suddenly we had instruments from all over the world," Dixon said of the program. "It took on a life of its own."

The scientists credit Goddard's Hitchhiker team for making the mission an overall success. "The Hitchhiker program team's willingness to be flexible with the payload team and their overwhelming commitment absolutely ensured our success," SOLSE-2 project manager Tammy Brown said. "You were not nearly a fish in a sea of scientists and experimenters."

Dixon said the Hitchhiker team's commitment led to an overall successful mission. "When I heard the shuttle had broken up, I asked myself if we did something wrong, but I had so much trust in the people here that I was convinced we did everything right," Dixon said. "As complex as all the coordination and mission control here at Goddard was, we pulled off the perfect mission except for one huge imperfection."

Despite the mission's success, however, the scientists couldn't ignore the sting of loss.

Dixon said the engineers were with the crew in Houston when the September 11 terrorist attacks occurred. That night, Dixon joined a small prayer group in a church and heard a man praying for him who turned out to be pilot Rick Husband. "They reached out to us poor engineers and made us feel like we were part of a team," Dixon said.

Brown remembered Ramon as a "quiet charmer" who liked to make jokes, and how she shared stories with crewmember Laurel Clark about their sons. She has not returned to working on manned space flight missions since the accident.

"Everyone on the crew was so dedicated to the mission, and it went so flawlessly that I kind of got bored in the control center," Brown said to the SOLSE team the day after the accident. "It was a deep personal blow to lose them. I spent a lot of time this weekend remembering the conversations I had with them, and their remarkable commitment, enthusiasm, and bravery. They will continue to inspire me, and I will never forget them."

Although the team looks back on the mission with heavy hearts, Dixon said he and the other members could use the successful results and lessons learned to do what NASA is known for: moving forward.

"We learned a lot and used those skills to further our careers," Dixon said. "I personally use that as a benchmark—that's the worst thing that's ever happened to me, and we're still pushing ahead." ■

Above: The STS-107 crew poses with the FREESTAR payload team during a visit to Goddard, October 2001. Photo credit: NASA/Goddard/Pat Izzo

2012: WEBB TELESCOPE'S BIG YEAR OF PROGRESS

By: Rob Gutro

The James Webb Space Telescope marked another year of significant progress in 2012 as flight instrumentation was completed and delivered to NASA.

On Sept. 17, 2012, two primary mirror segments that will fly aboard the Webb Telescope arrived at Goddard. The flight secondary mirror and a third primary mirror segment arrived at Goddard on Nov. 5 and are currently being stored in the giant clean room. All of the mirrors are made of beryllium, which was selected for its stiffness, light weight and stability at extremely cold cryogenic temperatures. Bare beryllium is not very reflective at Webb's shortest wavelengths, so each mirror is coated with gold. The microscopic gold coating enables the mirrors to efficiently reflect infrared light, which is what the Webb Telescope's cameras see.

The Mid-infrared Instrument (MIRI) flight hardware was delivered to Goddard on May 28 for integration into the ISIM. The MIRI will allow scientists to study cold and distant objects in greater detail than ever before and with unprecedented sensitivity. MIRI will observe light with wavelengths in the mid-infrared range of 5 microns to 28.5 microns, which is longer wavelength than human eyes can detect. Of Webb's four instruments, MIRI is the only one that works at the longest wavelengths. MIRI will be integrated into Webb's science instrument payload known as the Integrated Science Instrument Module (ISIM).

The second of four instruments to fly aboard the Webb Telescope was delivered to Goddard on July 30. The Fine Guidance Sensor (FGS) will enable the telescope to accurately and precisely point at the correct targets. The FGS is packaged together as a single unit with the Near-Infrared Imager and Slitless Spectrograph (NIRISS) science instrument.

The FGS consists of two identical cameras that will allow the telescope to determine its position, locate its celestial targets, and remain pointed to collect high-quality data. The FGS will guide the telescope with an accuracy of one millionth of a degree of angle. NIRISS provides unique capabilities that will aid in finding the earliest and most distant objects in the universe's history. It will also peer through the glare of nearby stars to detect and study planets in other Solar Systems.

The center section of the Webb Telescope's flight backplane structure was completed in April 2012. The structure will support twelve of the eighteen beryllium mirrors, thermal control systems and other elements during ground tests, launch and during science operations. Measuring approximately 24 by 12 feet yet weighing only 500 pounds, the center section of the backplane meets unprecedented thermal stability requirements. The center section is the first of the three sections of the backplane to be completed.

For three years, engineers at Johnson Space Center have been building and remodeling the interior of Chamber A, the largest thermal vacuum chamber in the world, to meet the temperature requirements to test the Webb. They installed a gaseous helium cooling system that brought the interior of the chamber down to 11 degrees Kelvin above absolute zero (-439.9 F). Chamber A testing will confirm that the telescope and science instrument systems will perform properly together in the cold temperatures of space.

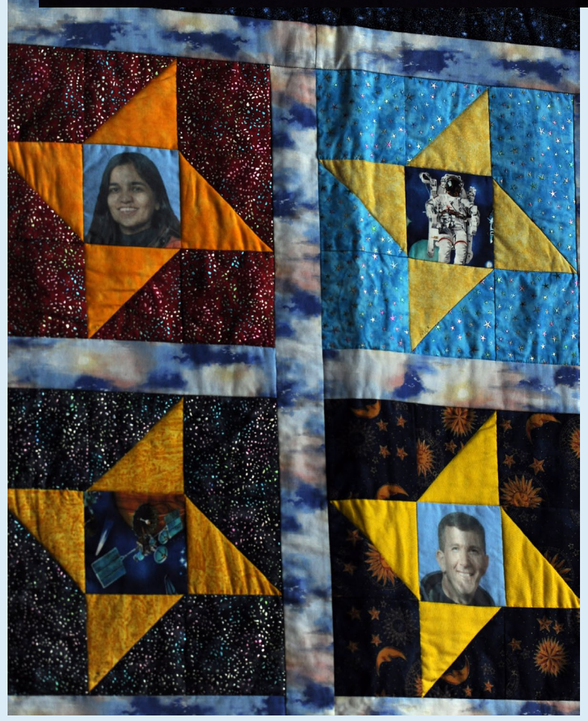
New technologies developed for the Webb Telescope have already been adapted and applied to commercial applications in various industries: optics, aerospace, astronomy, medical and materials. Some of these technologies can be explored for use and licensed through NASA's Office of the Chief Technologist at Goddard.

For example, the optical measuring technology developed for the Webb, called "wavefront sensing" has been applied to eye health and has allowed improvements in measurement of human eyes, diagnosis of ocular diseases and potentially improved surgery. ■

Above: Engineers at ATK work on the center section of the "backplane" support structure that will hold Webb's mirror segments. Photo credit: ATK

GODDARD DAY OF REMEMBRANCE

By: John M. Putman



Goddard employees were invited to join Center Director Chris Scolese on Friday, February 1, 2013 for a Goddard program associated with NASA's 2013 Day of Remembrance. The space agency's day of remembrance is an annual event that permits the NASA family to honor the astronauts, test pilots and others who have lost their lives in the pursuit of NASA missions.

This year's remembrance holds special meaning for the Goddard family as the center had hardware and experiments flying about shuttle Columbia on the STS-107 mission. Columbia and her crew were lost when the orbiter broke apart during entry and landing ten years ago on February 1, 2003.

As part of the program, there was a showing of the powerful documentary, "Space Shuttle Columbia: Mission of Hope." Daniel Cohen, the director, introduced his film and took questions from the audience.

At the Goddard Visitor Center, a handmade memorial quilt donated approximately 10 years ago was displayed with a few photos and labels near it, which turned it into a mini-exhibit of sorts. The quilt was created by Paint Branch Montessori fifth grade students and produced by their teacher and her husband. The quilt was given to the Visitor Center after the teacher and the class left the school.

To see more pictures from Goddard's and the agency's Day of Remembrance activities, visit the Goddard flickr gallery. ■

Photo credit: NASA/Goddard/Debora McCallum

GODDARD HOSTS AEROSPACE@ANNAPOLIS

By: John M. Putman

On Friday, Feb. 1, 2013, NASA Goddard and industry partners came together for Aerospace@Annapolis, an exciting day of interactive exhibits and presentations celebrating Goddard's remarkable achievements and discoveries. The event was held in the Miller Senate Office Building in downtown Annapolis, Md.

Missions and organizations featured at the event included Curiosity and the Sample Analysis at Mars, James Webb Space Telescope, Global Precipitation Measurement (GPM), Landsat, Magnetospheric Multiscale (MMS) mission, Space Weather, Space Systems Design Lab, Wallops Flight Facility, Goddard Office of Communications, Goddard's Innovative Partnerships Program, and the Goddard Office of Education.

At Aerospace@Annapolis, visitors could "land" on the surface of Mars, explore Earth, and learn about missions to the sun. Maryland lawmakers, their staff and constituents discovered educational programs and technologies developed at Goddard that are now making a difference in the lives of everyday Marylanders.

As part of Goddard's presence at Aerospace@Annapolis, Center Director Chris Scolese and Wallops Director Bill Wrobel met with Maryland Governor Martin O'Malley to discuss current programs and missions. The discussion included Goddard's economic impact including current spending in Maryland, employee statistics, STEM education and the FAA UAS test site designation. After the meeting, Scolese and Wrobel presented Governor O'Malley with a plaque recognizing the August 2012 landing of the Mars Science Laboratory aboard the Curiosity rover. ■

Photo credit: NASA/Goddard/Pat Izzo and Bill Hrybyk

OUTSIDE GODDARD

By: Elizabeth M. Jarrell

SCIENCE FICTION NOIR

At the age of ten, TV producer Chris Smith claimed his parents' video camera and used it to make a lot of home movies and even a fake television call-in show. "I recorded callers using fake voices," says Smith. "We also tried blowing stuff up but it wasn't always as successful as we wanted it to be." In high school, he made more video projects. One of which was a parody of "Star Wars" and "Les Miserables," with literary figures thrown in for good measure. "So we had Obi-Wan Emerson fighting Darth Thoreau," says Smith. "I played both parts."

Nonetheless, Smith remained conflicted about a career choice. "My dad was an engineer and I was really good in math so I was going to be a math major and become an actuary. It was solid work. But every time I was asked what I wanted to be I would say 'cinematographer,'" explains Smith. His father is proud—and relieved—that Smith is able to earn a living in film.

Smith earned a film/video degree on a full scholarship from the University of Maryland, Baltimore campus. "Eventually I ended up at NASA. I found my job through Craigslist. I thought it was a joke," says Smith. Although he came here as a videographer, he has become a producer, which is exactly what he loves to do.

From 2006–2009, he wrote, directed, filmed, and edited a science fiction film noir called "For Us." "It is about a couple caught in an infinite time loop. It took 2 ½ years to make an eight-minute film. The need to actually finish something was the only thing that kept it going," says Smith. His film was eventually shown at film festivals in San Francisco, Pasadena, Toronto, New Orleans, and Athens, Greece. He saw Ron Perlman at one of the festivals and heard Richard Dreyfuss give a talk at another.

Smith spent 2010–2011 writing a feature length comedy script called "M1." "It's about an accountant who gets stuck in a top-secret, government-made suit of armor," notes Smith. "He replaces the original secret agent who was supposed to wear the armor and now has to battle monsters who are experimental, government-made creatures that did not work out."

"In a perfect world," says Smith, "I'd get to make this movie. In a miracle world, someone would actually want to buy the script. In the real world, I don't really expect anything to happen with it, but it was a lot of fun to write."

He is currently writing and producing a 16-minute science fiction noir film called In Memory. "It's about four people on a space salvage ship who find an abandoned research ship parked near a strange 'phenomenon.' Somehow the 'phenomenon' can project your memories, emotions, and anxieties. One salvager has recently lost his wife, and the 'phenomenon' helps him let go," explains Smith. "Guy finds peace with a lost loved one through strange circumstances. I guess you could say it's like a sci-fi Hallmark Channel movie. But maybe I have to work on the title," he notes.

"The film is in the style of sci-fi from the 1960s through early 1980s," explains Smith. "There is very little camera movement but each frame is really well-composed." Another fun part is making the costumes. "I am making the astronaut's backpack and helmet, says Smith. "A vacuum cleaner attachment holder and some aluminum water bottles will be the air supply. I buy cheap stuff and then bang it up and write on it. If we have a Halloween party, I will wear it."

He remains philosophical about success. "I really cared that people saw my first movie 'For Us.' I care a lot about my 'M1' script, but if people do not see it I can accept it. The current shoot is all about having fun. I do not want to get wrapped up in wondering who will see it or will it be big. It's a never ending struggle," says Smith.

For Smith, enjoying himself is more important than marketability. "Financial success depends on being good enough and being what people want. My first film was a success because I enjoyed making it, but it just was not marketable. I'd like to finish this film in less than 2 ½ years and see it reach a big audience. Most importantly, I want to have a lot of fun making it," he says.

Smith recently left Goddard for the Bay Area to accept a video position at a software company but his NASA legacy lives on. To see some of Smith's videos, visit here and here. ■

Below: Chris Smith demonstrating the "Glidecam." Photo credit: NASA/Goddard/Bill Hrybyk