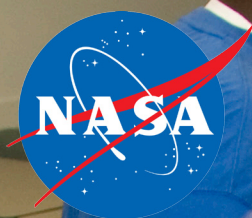


National Aeronautics and Space Administration



goddard view

Volume 6 Issue 12

## Middle School Takeover

Pg 3

## Women of SDO

Pg 6

## MIB Concludes Balloon Mishap Investigation

Pg 10

## Goddard Supports Biggest Science Fair Ever

By John M. Putman

Over 50 Goddard community members volunteered their time and energy to support the inaugural USA Science and Engineering Festival in Washington, D.C. Billed as the the country's first national science festival, the massive event filled the National Mall and Freedom Plaza.

Goddard scientists, engineers, Public Affairs Officers, Educations Specialists, and others manned booths, engaged with students, and shared the NASA mission with thousands of attendees.

The mission of the USA Science and Engineering Festival is, "To re-invigorate the interest of our nation's youth in science, technology, engineering, and math (STEM) by producing and presenting the most compelling, exciting, educational, and entertaining science gatherings in the United States." To learn more, visit: <http://www.usasciencefestival.org/> ■



Photos credit: NASA/Goddard/Bill Hrybyk

## GoddardView

Volume 6 Issue 12

### Table of Contents

#### Goddard Updates

- Goddard Supports Biggest Science Fair Ever – 2
- Middle School Takeover – 3
- Teen Sailor Meets NASA Team That Helped Save Her Life – 4
- NASA Employees Now Have Access to ESRI® ArcGIS – 5
- Women of SDO – Sarah Mitchell – 6
- Goddard Delivers Magnetometers for *Juno* Mission – 7
- MIB Concludes Balloon Mishap Investigation – 8
- Supercomputer Models Yield Sneak Previews of What *James Webb Space Telescope* Will See – 9

#### Goddard Community

- OutsideGoddard:** Stars from NASA to Nashville – 10
- An Interview with Sonya Williams – 12

Cover caption: Marci Delaney from Goddard's Office of Education demonstrates "Crater Creations," an interactive experiment that shows students how craters are made.

Image credit: NASA/Goddard/Bill Hrybyk

### GoddardView Info

Goddard View is an official publication of the Goddard Space Flight Center. It is published bi-weekly 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/home/index.html>.

**Managing Editor:** Trusilla Steele

**Editor:** John M. Putman

**Deadlines:** News items for publication in the Goddard View must be received by noon of the 1<sup>st</sup> and 3<sup>rd</sup> Thursday of the month. You may submit contributions to the editor via e-mail at [john.m.putman@nasa.gov](mailto:john.m.putman@nasa.gov). Ideas for new stories are welcome but will be published as space allows. All submissions are subject to editing.

## Middle School Takeover

By Christina Coleman

Students surrounded a pan layered full of pancake batter, cocoa powder, sand, and detergent, while a facilitator dropped a gray rock in the center.

"More momentum. The faster it goes, the deeper the crater," said one student. "Drop it from a higher point," said another. In an activity meant to create and analyze crater impacts on the surface of the moon and other planets, the students, excited to give their own scientific theories, displayed a wealth of knowledge and eagerness that represent the primary goal of the Summer of Innovation Program.

In October, Goddard was taken over by more than 800 middle school students who participated in the first year of the "Summer of Innovation-Goddard Middle School Week."



*Caption: Students from William Wirt Middle School get ready to learn at the Goddard Visitor Center.*

What started as a call from NASA Administrator Charlie Bolden and President Obama to increase stimulus of science, technology, engineering and mathematics (STEM) career interests has blossomed into various programs over the past few months, one of which being the middle school week held at Goddard. For four days, Goddard welcomed schools from the District of Columbia Public Schools, Prince George's County, Baltimore City Public Schools, Baltimore County Public Schools and District of Columbia Public Charter School Board.

To address the lack of STEM interest the students experienced a wide variety of experiments at learning stations across the center. Each day, students

engaged in different facets of science that was aligned with state science content standards. Hands-on activities ranged from heliophysics, Earth science, planetary science, astrophysics, and the *Hubble Space Telescope*.



*Caption: Students from the Baltimore Leadership School work together on a temperature experiment.*

"These are our primary customers," said Michelle Thaller, Assistant Director of Science for Communications, who also facilitated the electromagnetic spectrum exhibit in the Visitor Center. "It has to be a primary goal to engage the public and there is an obvious need to have a generation of students curious of science," she said on why it was paramount to have programs similar to the middle school week.

Other activities included detecting ultra-violet light, exploring the composition of the universe while getting familiar with NASA's fleet of satellites, and using cell phones as infrared detectors. The Office of Education and a handful of scientists and engineers were on hand to meet and talk to the visitors as well.

In addition, the lucky students had a chance to communicate with astronauts from a variety of science and engineering fields. Astronauts Leland Melvin, Don Thomas, and Paul Richards sat and talked with students about the long hours of training needed for space missions, what it was like to live on a spacecraft and the research and experimentation they did to expand the world's knowledge about space.

The Goddard Middle School Week marked the beginning of a three-year partnership with these school districts to strengthen instructional delivery of STEM content to underperforming and underrepresented middle school students. ■

## Teen Sailor Meets NASA Team That Helped Save Her Life

By Christina Coleman

It has been almost six months since 16-year-old Abby Sunderland's 40-foot vessel, *Wild Eyes*, was damaged in a storm, leaving her stranded in the middle of the Indian Ocean. She finally got a chance to meet the people who developed the technology used to save her life.

Abby visited Goddard on October 25 to meet Search and Rescue Manager Dave Affens and a team of engineers. He and his team developed the Search and Rescue Satellite (SARSAT) technologies that contributed to her rescue. "Without NASA technology, she may have lost her life," Affens said. "This case was more interesting than most because we contributed to every aspect of it.



*Caption: During her visit to NASA's Goddard Space Flight Center on Oct. 25, 2010, Abby Sunderland met with David Affens (left), NASA Search and Rescue mission manager, and NASA systems engineer George Theodorakos.*

Photo credit: NASA/Goddard/Bill Hrybyk

"The system is great, super actually," Sunderland said about the search-and-rescue technology that pinpointed her exact location during the aggressive storm.

After giving a presentation about her extraordinary journey from Marina Del Ray, Calif., to her dismasting 2,000 miles from the nearest land, Sunderland took questions from the engineering team and a group of Congressional staffers regarding the moments that lead up to her rescue and the safety measures and devices she used during her ordeal. In addition, Affens explained in detail to Sunderland and the group how SARSAT technology operates.

"We developed the concept of detecting distress signals by the satellite, relaying it to the ground stations where the locations were calculated," Affens explained. "We then launched the distress-detection device on a NOAA weather satellite, tested the concept, and approved the system for operational use.

The SARSAT system has saved more than 205 lives in the United States this year alone. Affens and his team are developing new technology that will detect distress signals in less than five minutes, a process made possible by placing repeater technology on the Air Force's network of Global Positioning System (GPS) satellites. The current system, which places the technology on the *Geostationary Operational Environmental Satellite*, or GOES (which alerts), and the *Polar Operational Environmental Satellite*, or POES (which provides the location of the distressed), could take up to an hour or more depending on the location of the satellite.

Sunderland's signal reached an Indian satellite (INSAT) and two NOAA weather satellites that were launched by NASA and used NASA technology to pinpoint her location less than an hour later.

"It was a real surprise when the airbus flew over me. I wasn't expecting it, I was expecting it to be weeks," she said about the amount of time it took for her rescue to begin. "When you set off your beacon, you know someone is going to hear you, but I wasn't sure if I was going to be helped. But I don't think it could have been done any faster," she added.

Also critical to her rescue was a small, yellow device that Microwave Monolithics Inc. (MMInc.) in Simi Valley, Calif., had developed under a NASA Small Business Innovation Research (SBIR) program award. The MicroPLB (personal locating beacon) Type GXL handheld device—about the size of a BlackBerry®—emitted an emergency distress signal picked up by a SARSAT satellite orbiting 22,500 miles up in space. The satellite also was equipped with NASA-developed repeater technology that then relayed the signal to the U.S. via the international satellite-aided search and rescue network now comprised of 40 participating nations.

The company's president, Daniel Ch'en, had given Sunderland the beacon before she attempted to sail the world solo and non-stop, a record previously held by her older brother, Zac. "I wasn't expecting her to use it, and I was hoping she wouldn't have to, but I knew this would be the last line of safety [if needed]," he added.

The company originally developed the device for the U.S. Government. It is the only sub-miniature PLB certified by the international satellite-based search and rescue community. It operates for a minimum of 48 hours after the user activates the emergency signal. These extra hours are vital given that most rescue teams cannot reach the individual until after a storm subsides, which can be more than a day or two. In Sunderland's case, the boat sent to rescue her arrived two days after she had activated her device. Most PLBs, in general, are not made for 48-hour operation.

Continued on Page 5

## Teen Sailor Meets Team That Helped Save Her Life

Continued from Page 4

Because Sunderland used the device correctly and made a point to register the beacon with NOAA (adding personal and contact information), the U.S. Coast Guard's Pacific Area Command in Alameda, Calif., was able to contact her parents in less than 10 minutes.

"We couldn't ask for a better scenario," said U.S. Coast Guard's Adolfo Viezca, also in attendance. "When beacons aren't registered and I'm on the receiving end, I don't know who you are, where you are, and I end up with a quagmire."

Sunderland isn't discouraged by her ordeal. She still plans on sailing the world solo, carrying the beacon and relying on NASA technology of course. "Overall, it's the best experience of my life," she said.

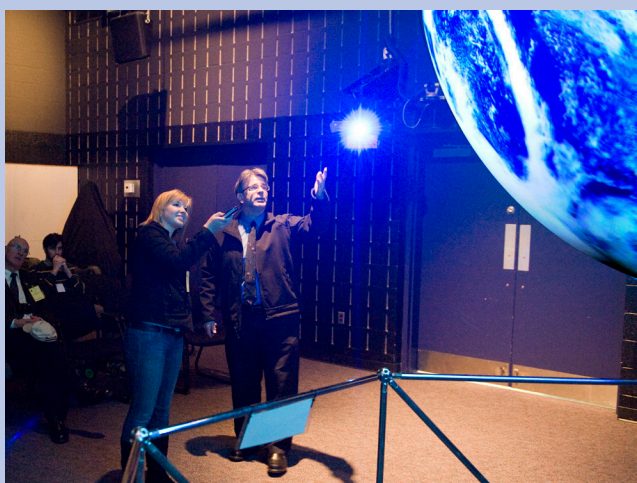


Photo credit: NASA/Goddard/Bill Hrybyk

*Caption: Abby Sunderland lights up Science On a Sphere with Goddard Chief Scientist, Jim Garvin.*

After meeting with Affens and his team, Sunderland was able to enjoy the other revolutionary science and technological developments at Goddard. Center Director Rob Strain presented her with a glass globe with an image of the *Hubble Space Telescope* emblazoned inside as a keepsake. In addition to enjoying the Goddard Visitor Center exhibits, including the Science On a Sphere globe, Sunderland visited the Earth Science and *Lunar Reconnaissance Orbiter* control centers, and the Spacecraft Test and Integration Facilities. ■

## NASA Employees Now Have Access to ESRI® ArcGIS

NASA's latest Enterprise License Service Agreement is making an array of ESRI®'s most prevalent ArcGIS software tools available to authorized NASA employees and contractors for unlimited deployment. Desktop users will also have unlimited use of Bing Maps (formerly Virtual Earth) and ESRI® Virtual Campus training courses. With ESRI® ArcGIS, users can easily author data, maps, globes, and models on the desktop and use them on a desktop, in a browser, or in mobile devices, making them readily accessible for work done in the field.

The popular Geographic Information Systems (GIS) software tool is currently in use by more than 25 Federal Agencies and many in private industry companies as well. The software's ability to create the most accurate and comprehensive product with less need for duplication drives its popularity. ArcGIS users enjoy access to its online capabilities of collaboration, and can share results with colleagues, stakeholders, or the public.

Kelly Boyd, Lead Environmental GIS Analyst at Stennis Space Center explains why this collaboration functionality is important, "GIS increases our understanding of the world around us through the visualization of information. ESRI®'s ArcGIS platform provides the tools to leverage this understanding each day to inform decisions in our work."

Due to the versatility and usability of the software, ESRI® customers are integrating it into various types of work, including digitizing cultural resource data and updating flood insurance rate maps. At NASA, GIS plays an obvious and important role in Earth science initiatives, involving the global effort to monitor Earth's climate. ESRI® technology will support this worldwide collaboration by providing a strong platform for sharing and analyzing geospatial data.

There are other areas of NASA business that benefit from GIS knowledge that may seem less apparent. In fact, there are already over 175 known GIS software users across the Agency using these tools to perform some pretty unique tasks. For example, Langley Research Center recently pioneered the successful use of GIS in facilities management reorganization.

GIS software can be a great benefit in any project that involves planning and analysis, situational awareness, business operations, or asset/data management. If you think that the new ESRI® ArcGIS software might be useful to you in your daily work activities, please submit a request to receive authorization to use the software via the NASA Account Management System (NAMS) at <https://idmax.nasa.gov/idm/user/login.jsp>. ■



## Women of SDO – Sarah Mitchell

By Karen C. Fox

Launched on February 11, 2010, NASA's *Solar Dynamics Observatory* (SDO) is already making history transmitting nearly continuous high-resolution images and science data of our nearest star, the Sun.

SDO, the first mission in NASA's *Living With a Star* program, is designed to understand the causes of solar variability and how space weather results from this unpredictable environment.

Encouraging women to pursue careers in science, technology, engineering, and math is a high priority for NASA. This is the first in a series of interviews with some of the women of SDO as they share their individual journey to becoming part of this exciting mission.

Sarah Mitchell is the Flight Operations Lead for SDO's Atmospheric Imaging Assembly/Heliioseismic and Magnetic Imager (AIA/HMI). She is from Paw Paw, Mich. and currently lives in San Francisco, Calif. Sarah received her B.S.E in aerospace engineering from the University of Michigan. She earned a dual MBA/MSE in Engineering Management from the San Jose State University Colleges of Business and Engineering in 2008.

Sarah's career highlights include being a research programmer for the *Cassini-Huygens* program, systems and test engineer for GOES-NOP Solar X-ray Imager (SXI) programs, lead systems engineer for *Solar-B* Focal Plane Package (FPP) and SDO AIA programs, lead flight operations engineer for SDO AIA/HMI, and successful launches and on-orbit operations for SXI, FPP, and AIA/HMI.



Photo credit: NASA

*Caption: Sarah D. Mitchell poses with SDO mascot Camilla Corona in front of a composite image of the Sun taken by SDO.*

### What first sparked your interest in science or engineering?

When I was a kid growing up on our small horse farm in Michigan, I used to stand in the horse's pasture with my mom and look up at the stars in wonderment. I could easily see the Milky Way and often saw the Northern Lights dancing in the night sky. Space intrigued and boggled my mind.

I studied astronomy in high school and realized I had a natural ability in math and science. I was also a part of the Science Olympiad team in high school which encouraged both the engineering and science minds. I loved to learn and create and the opportunities to facilitate these traits were endless in these two fields.

### What do you enjoy most about your job?

I enjoy three specific things about my job, which highly motivate me and are the reasons why I continue to do what I am doing with my life. In no particular order, these things are: the people I work with, the content (solar science and engineering), and the constant challenge and opportunity to learn and grow.

### What advice would you give to students who would like to work on a project such as SDO?

I truly believe that you can achieve most anything you desire in this world by hard work, faith, and dedication. I also believe that having a good education is a keystone to success.

### What do you do on an average day?

As a systems engineer and as a flight operations lead, I do a lot of running around, believe it or not! Depending on what phase of a program we are in, you might find me doing any of the following on an average day (though I'd hardly call any day "average"): leading planning meetings, writing requirements verification reports, operating the instruments on-orbit, supporting Integration and Test efforts (in a bunny suit sometimes!), or presenting at reviews. I enjoy the variety of my job—it is always interesting and never boring.

### What are the greatest challenges of your job?

I'd say the greatest challenge of my job is maintaining balance. Evenly meeting the demands of cost, schedule and technical excellence can be extremely challenging, as well as meeting the needs of individuals. Technical anomalies are always difficult but I dare say they may be one of the favorite parts of an engineer's job—solving a complex problem without an obvious solution—I think we love the challenge!

### What do you like to do outside of work?

Having a life/work balance is very important to me. My favorite hobbies outside of work are yoga and photography. I was recently certified as a yoga instructor and I am active in a local photo club. I also enjoy hiking, running, knitting, reading, and sailboat racing. ■

## Goddard Delivers Magnetometers for *Juno* Mission

By Elizabeth Zubritsky

The magnetometers developed at Goddard for the *Juno* mission to Jupiter were delivered recently to Lockheed Martin in Denver, Colo. Designed and built by an in-house team of Goddard scientists, engineers, and technicians, this instrument will map the planet's magnetic field with great accuracy and observe its variations over time. Each of the two vector magnetometers carries with it a pair of non-magnetic star cameras to determine its orientation in space with commensurate accuracy. These were designed and built by a team led by John Jorgensen at the Danish Technical University in Copenhagen, Denmark.

"*Juno's* magnetometers will measure Jupiter's magnetic field with extraordinary precision and give us a detailed picture of what the field looks like both around the planet and deep within," says Goddard's Jack Connerney, the mission's Deputy Principal Investigator and head of the magnetometer team. "This will be the first time we've mapped the magnetic field all around Jupiter—it will be the most complete map of its kind ever obtained about any planet with an active dynamo, except, of course, our Earth."

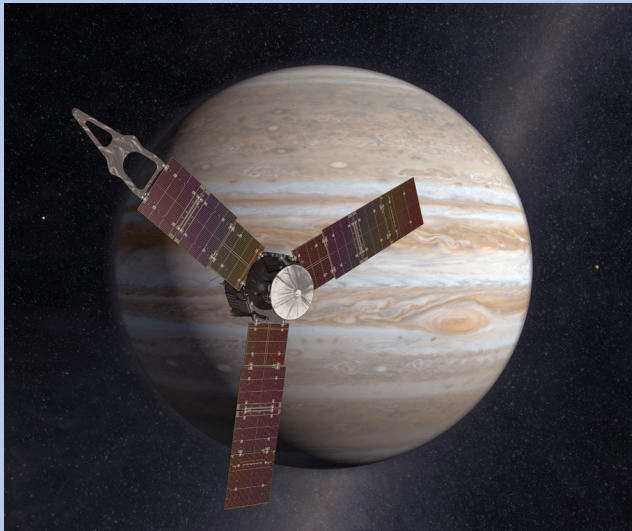


Image credit: NASA/JPL-Caltech

*Caption: The Juno spacecraft passes in front of Jupiter in this artist's depiction. Juno, the second mission in NASA's New Frontiers program, will improve our understanding of the solar system by advancing studies of the origin and evolution of Jupiter. The spacecraft will carry eight instruments to investigate the existence of a solid planetary core, map Jupiter's intense magnetic field, measure the amount of water and ammonia in the deep atmosphere, and observe the planet's auroras.*

Scheduled for launch in 2011, *Juno* is the second mission in NASA's New Frontiers program. The mission will improve our understanding of the solar system by advancing studies of the origin and evolution of Jupiter. The spacecraft will carry eight instruments to investigate the existence of a solid planetary core, map Jupiter's intense magnetic field, measure the amount of water and ammonia in the deep atmosphere, and observe the planet's auroras.

"The magnetometers play a unique and important role in *Juno's* investigation of the formation and evolution of Jupiter," says *Juno's* Principal Investigator, Scott Bolton of the Southwest Research Institute in San Antonio, Texas. "They provide one of the ways that *Juno* will see deep inside the giant planet, and this will help us understand how and where Jupiter's powerful magnetic field is generated."

The *Juno* magnetometers will study Jupiter's powerful magnetic field, which is nearly 20,000 times as strong as Earth's. The field is generated deep within the planet's atmosphere, where the intense pressure compresses hydrogen gas into an electrically conductive fluid. Fluid motion within the planet drives electric currents in this liquid hydrogen, and these currents generate the magnetic field. If a map were drawn of the magnetic field lines running between Jupiter's north and south poles, the region of space filled by the lines (called the magnetosphere) would be enormous. Jupiter's magnetosphere extends up to 2 million miles (nearly 3 million kilometers) toward the Sun and as far as Saturn's orbit in the other direction.

"From a distance, Jupiter's magnetic field has two poles, north and south, like Earth's. But looking closer, below Jupiter's surface, the magnetic field is thought to be quite complex and tangled," says Connerney. "*Juno* will give us a detailed picture of the magnetic field extending down to the surface of the dynamo, or engine, that generates it."

Jupiter's powerful magnetic environment also creates the brightest auroras in the solar system, as charged particles get trapped by the field and rain down into the atmosphere. *Juno* will directly sample the charged particles and magnetic fields near Jupiter's poles for the first time, while simultaneously observing the auroras at ultraviolet wavelengths of light. These investigations will greatly improve the understanding of this remarkable phenomenon and of similar magnetic objects, such as young stars that have their own planetary systems.

"With *Juno*, we will learn much more about the structure and evolution of Jupiter, and this will help us understand our own solar system," says Connerney. "But astronomers have now found many other giant planets outside our solar system. What we learn about Jupiter also will help us understand the planets orbiting other stars."

NASA's Jet Propulsion Laboratory in Pasadena, Calif., manages the *Juno* mission. Lockheed Martin Space Systems, Denver, Colo., is building the spacecraft. The Italian Space Agency in Rome is contributing an infrared spectrometer instrument and a portion of the radio science experiment.

For information about the *Juno* mission, visit: <http://www.nasa.gov/juno>. ■

## MIB Concludes Balloon Mishap Investigation

By Christina Coleman

It's been half a year since a dramatic video recording of a NASA scientific balloon crashing in Australia caught the public's attention around the world. The baffling accident set off a storm of speculation about why the balloon, which carried the \$2 million Nuclear Compton Telescope (NCT), failed to launch. Goddard Center Director Robert Strain immediately commissioned a Mishap Investigation Board (MIB), chaired by Goddard's Mike Weiss, to investigate the accident, determine its causes, and recommend corrective actions to prevent similar failures.

The board and its advisors traveled to Alice Springs, Northern Territory just days after the crash. After a long, exhausting series of commercial airline flights, the group arrived at the balloon launch facility at Alice Springs Airport to collect evidence, conduct witness interviews, and examine documentation related to the accident. They spent a week in Australia and then returned to Goddard to begin the investigation process.



*Caption: The NCT Balloon launch configuration in Alice Springs, Australia.*

In October, NASA released the MIB's report, comprised of pictures, test reports, procedures, and other evidence that concluded the four-month-long investigation.

On launch day, the gamma ray NCT payload did not release from the mobile crane launch vehicle as expected. When the launch team attempted to abort the launch attempt, the payload inadvertently separated from the crane and hit the ground. The payload was dragged downwind by the airborne balloon. It breached a security fence and struck an unoccupied vehicle. Several spectators were watching the separation event and had to run for safety.

NASA classified the accident as a "Type B High Visibility mishap" because of the estimated damage costs and because of media coverage on TV networks and YouTube. It may have appeared that a gust of wind was to blame, but Weiss stressed that there was more to the accident than what met the eye.

"The report contains the complete traceability of what you were left with and why," he explained. The process can be grueling, but Weiss added that the purpose of a mishap team is "not to place liability, but to determine what caused the accident and what can be done to prevent the same thing from happening again."



*Caption: The NCT Balloon being set up for launch in Alice Springs, Australia.*

"The most important thing was to get to the mishap site immediately," Weiss said. Upon arrival, the team started collecting records of weather data from previous balloon launches, names of personnel at the scene, photographic evidence (including very important aerial photographs), NCT payload GPS tracking, logs and permits, balloon and payload hardware, and other evidence that would help them create a timeline of the event. In all, 15 witness interviews were taken for evidence. The team even conducted performance tests of the launch mechanism. "Fortunately, the site had not been compromised by the weather," Weiss said.

Back at Goddard, the team continued the investigation, cataloging and filing the evidence in a crime scene-like treatment. "We created a timeline of events and assembled all of our video and photo evidence," Weiss said. "We had an abundance of photo and video evidence, so we took it all and time-synchronized it."

In order to compile the information and evidence in that way, Weiss called in many people from different fields. Graphics, animation, mechanical, and transcription support was needed to complete the picture. The team then constructed a fault tree using the Root Cause Analysis (RCA) software tool, which is a way to consider every possible reason the balloon launch failed in a cause-and-effect manner.

"We start with the undesired event. Then we consider all possibilities that cause the problem. We eliminate those using evidence and data we collected and create the event and causal factor tree. By using the RCA tool, the MIB is led to the final answer in the form of direct, intermediate, and root causes," Weiss said.

That final answer was 3 proximate causes, 15 key intermediate causes, and 6 root causes. The MIB determined that weather, as originally speculated by public spectators, was not the cause. In fact, there were very few technical problems. Almost all causes were organizational in nature. After completing their report, the appointing official, Center Director Rob Strain, was provided a briefing where the board presented their findings and recommendations.

Continued on Page 11



# Supercomputer Models Yield Sneak Previews of What *James Webb Space Telescope* Will See

By Francis Reddy

As scientists and engineers work to make NASA's *James Webb Space Telescope* a reality, they find themselves wondering what new sights the largest space-based observatory ever constructed will reveal. With *Webb*, astronomers aim to catch planets in the making and identify the universe's first stars and galaxies, yet these are things no telescope—not even *Hubble*—has ever shown them before.

"It's an interesting problem," said Jonathan Gardner, the project's Deputy Senior Project Scientist at Goddard. "How do we communicate the great scientific promise of the *James Webb Space Telescope* when we've never seen what it can show us?"

So the project turned to Donna Cox, who directs the Advanced Visualization Laboratory (AVL) at the National Center for Supercomputing Applications (NCSA). Located at the University of Illinois in Urbana-Champaign, NCSA provides enormous computing resources to researchers trying to simulate natural processes at the largest and smallest scales, from the evolution of the entire universe to the movement of protein molecules through cell walls.

Cox and her AVL team developed custom tools that can transform a model's vast collection of ones and zeroes into an incredible journey of exploration. "We take the actual data scientists have computed for their research and translate them into state-of-the-art cinematic experiences," she said.

Armed with an ultra-high-resolution 3D display and custom software, the AVL team choreographs complex real-time flights through hundreds of gigabytes of data. The results of this work have been featured in planetariums, IMAX theaters, and TV documentaries. "Theorists are the only scientists who have ventured where *Webb* plans to go, and they did it through complex computer models that use the best understanding of the underlying physics we have today," Cox said. "Our challenge is to make these data visually understandable—and reveal their inherent beauty."

The new visualizations reflect the broad science themes astronomers will address with *Webb*. Among them: How did the earliest galaxies interact and evolve to create the present-day universe? How do stars and planets form?

"When we look at the largest scales, we see galaxies packed into clusters and clusters of galaxies packed into superclusters, but we know the universe didn't start out this way," Gardner said. Studies of the cosmic microwave background—the remnants of light emitted when the universe was just 380,000 years old—show that the clumpy cosmic structure we see developed much later on. Yet the farthest galaxies studied are already more than 500 million years old.

"*Webb* will show us what happened in between," Gardner added.

Cox and her AVL team visualized this epoch of cosmic construction from a simulation developed by Renyue Cen and Jeremiah Ostriker at Princeton University in New Jersey. It opens when the universe was 20 million years old and continues to the present-day, when the universe is 13.7 billion years old.

AVL team members Robert Patterson, Stuart Levy, Matthew Hall, Alex Betts, and A. J. Christensen visualized how stars, gas, dark matter, and colliding galaxies created clusters and superclusters of galaxies. Driven by the gravitational effect of dark matter, these structures connect into enormous crisscrossing filaments that extend over vast distances, forming what astronomers call the "cosmic web."

"We worked with nine scientists at five universities to visualize terabytes of computed data in order to take the viewer on a visual tour from the cosmic web, to smaller scales of colliding galaxies, to deep inside a turbulent nebula where stars and disks form solar systems like our own," Cox said. "These visuals represent current theories that scientists will soon re-examine through the eyes of *Webb*."

Closer to home, *Webb* will peer more deeply than ever before into the dense, cold, dusty clouds where stars and planets are born. Using data from models created by Aaron Boley at the University of Florida in Gainesville, and Alexei Kritsuk and Michael Norman at the University of California, San Diego, the AVL team visualized the evolution of protoplanetary disks over tens of thousands of years.

Dense clumps develop far out in a disk's fringes, and if these clumps survive, they may become gas giant planets or substellar objects called brown dwarfs. The precise outcome depends on the detailed makeup of the disk. "Dr. Boley was interested in what happened in the disk and did not include the central star," Cox said, "so to produce a realistic view we worked with him to add a young star."

This is astrophysics with a pinch of Hollywood sensibility, work at the crossroads of science and art. "The theoretical digital studies that form the basis of our work are so advanced that cinematic visualization is the most effective way to share them with the public," Cox said. "It's the art of visualizing science."

"What AVL has done for the *Webb* project is truly amazing and inspiring," Gardner noted. "It really whets our appetites for the science we'll be doing when the Telescope begins work a few years from now."

To see some of the AVL visualizations, visit the *James Webb* site at: <http://www.jwst.nasa.gov>. ■

## OutsideGoddard: Stars from NASA to Nashville

By Elizabeth M. Jarrell

Goddard astrophysicist Dr. Marc J. Kuchner doesn't really sing, and doesn't seriously play any musical instruments. He does, however, write award-winning country songs, both lyrics and music.

When he was in high school, Kuchner attended The Julliard School's pre-college program in music composition on weekends. He then did his undergraduate work at Harvard in physics and, at the same time, took music classes and played drums in a rock band. He began studying for a Ph.D. in astronomy at The California Institute of Technology (Caltech), but decided to take a year off to be an unpaid intern at a recording studio in Burbank, California, after answering an ad he stumbled across in the paper. "I spent a lot of time making coffee, tweaking recording machines, and organizing the microphone closet," said Kuchner. "My mother was extremely upset."

The studio was the Mad Dog recording studio, home of country music icon Dwight Yoakam. His experience in that studio was Kuchner's first real exposure to country music. At the end of the year, Kuchner returned to Caltech to finish his Ph.D., which involved spending many nights at the telescope. Whenever it was too cloudy or too rainy to observe, he would write country songs.

Kuchner's first national recognition occurred in 2000 when his song "I Can Break My Own Heart" won fifth place in John Lennon's annual songwriting contest sponsored by Yoko Ono. "There were 3,000 entries. All of a sudden, I realized that there might be something to this songwriting thing," says Kuchner. He returned to Harvard for a post-doctoral fellowship but continued writing and winning even more contests. Kuchner explains, "I won a guitar, a trip to Vegas, some cash, and lots and lots of BluBlocker® sunglasses. But then I stopped entering contests. I found that Nashville people were not impressed by songwriting contest winners. That's how everyone down there got their start."

He began a second post-doctoral fellowship, this time at Princeton on NASA's Hubble Fellowship, and also began making trips to Nashville once or twice a year. Kuchner says, "During those trips to Nashville, I met music publishers, who connect writers to the recording artists, and pitched them my songs. They all helped me in some way." Soon he was selling his songs in Nashville.

Kuchner notes, "The first royalty check I ever got was in 2005 for a song I wrote called 'Start Now.'" "Start Now" was later named 2008 Demo of the Year from Music Connection magazine, the Los Angeles, Calif. music trade journal. Explains Kuchner, "The chorus is a list of things I learned from my grandmother. Country music today isn't about cowboys. It's about regular folk."

Ever the astute businessman, Kuchner delineates the currency of success in Nashville. "A cut means an artist has recorded your song and you'll get royalties when it is played. A placement means your recording ends up on TV in a show, movie, or commercial. These are the magic words, the measure of success." Kuchner's first cut was in 2006 for "I Can Break My Own Heart." Since then he has had about 20–25 more cuts. His first placement was in 2009 for "True Love," which was played on MTV2's and BET's "Making the Band." "I get a lot of checks, but they are always small," jokes Kuchner.

In explaining his writing process, Kuchner says, "I try to get a melody that works in my head, without an instrument. Beginning songwriters write using an instrument, but once you get good at it, you don't use an instrument so much. I now do a lot of my writing at a laptop. I type the lyrics, but I remember the music. And if I can't remember it, then it wouldn't be a good song anyway."

After writing a song, he then makes a work tape, which is a recording of himself singing his song while playing the guitar. He uses the Garage Band program on his old Macintosh laptop to make the recording. Once in Nashville, he finds up and coming singers to professionally play and sing his songs on a demo tape. He then emails the demo tapes to targeted publishers. A publisher in the musical world pitches songs to recording artists in exchange for a percentage of each cut or placement.



*Caption: Country music superstar Marc Kuchner.*

Photo credit: NASA/Goddard/David Friedlander

## OutsideGoddard: Stars from NASA to Nashville

Continued from Page 10

A unique aspect of Kuchner's songwriting is his analytical approach to the lyrics. Kuchner has analyzed country music songs by archetypes or characters based on Carl Jung's theory of archetypes. As explained on his Web site,

Kuchner has identified seven archetypes commonly used in country music: hero/warrior, everyman/regular guy/gal, lover, innocent, caretaker, joker, and outlaw. In describing his analysis, Kuchner says, "I find that it helps a song to have a primary archetype, but you need a secondary archetype as a foil. You need tension between these archetypes to tell the story."

Like many songwriters before him, Kuchner hopes to eventually become more successful as a music publisher. To further his publishing ambitions, Kuchner sends out a monthly newsletter containing marketing tips. Recent topics have included changes in how advances are structured; the new "entertainment group" trend which involves production, management, and promotion from a single independent label; interviewing basics; Web sites looking for music to post; and labels looking for country music artists.

Ever the businessman, Kuchner also has a Facebook group called "Marketing for Scientists," which discusses these same marketing techniques as applied to science. According to Kuchner, "The music business is a business. Science is really a kind of business too. The same principles apply." In fact, he is working on a book called "Marketing for Scientists" and already has a literary agent working with him to find a publisher. The funny thing is that although Kuchner has graduated from some of the most prestigious educational institutions in the world, he does not have a degree in marketing. He does not need to; in between writing award-winning country songs, he is already writing the book.

Check out Kuchner's Web site at: <http://www.marckuchner.com>. ■

## MIB Concludes Balloon Mishap Investigation

Continued from Page 8

"Through our analysis and timeline construction regarding the mishap, the board has determined the root causes," Weiss said. The MIB also presented 44 recommendations regarding the need for better communication, more robust range and ground safety plans and procedures, and better understanding of potentially unsafe conditions that can lead to accidents.

NASA encounters hundreds of mishaps every year. Rarely are they stunning, like the balloon crash. Most are mundane. Regardless of their visibility, NASA assigns a MIB to each one in an effort to prevent future mishaps. "We have an incredible talent pool and resources to use in NASA's safety and mission assurance organization," Weiss said.

Weiss, who has been dealing with safety and field investigations for 33 years, said he wants to make sure people know that NASA's Office of Safety and Mission Assurance, in conjunction with the MIB process, is there to keep the Agency safe. "We learn from our mistakes and get better, continuing to work as a NASA team."

The Board's report has been officially endorsed by NASA and has been publically released. It can be accessed at: [http://www.nasa.gov/centers/goddard/business/foia/balloon\\_mishap.html](http://www.nasa.gov/centers/goddard/business/foia/balloon_mishap.html). ■

## An Interview with Sonya Williams

By Rob Gutro

November is National Native American Heritage Month. NASA is recognizing Native Americans and their many accomplishments, contributions, and sacrifices, and pays tribute to their participation in all aspects of American society. In honor of this special month, *Goddard View* is spotlighting NASA employee Sonya Williams in this Q&A Feature.



Caption: Sonya Williams.

### What kind of work do you do for NASA?

I am an Education Specialist. I conduct professional development workshops for Science, Technology, Engineering, and Mathematics (STEM) educators in K-12, college pre-service teachers, and informal educators. I work in Code 160 in Building 28. I encourage anyone who's interested in assisting with this monumental task to contact us in Education. We are encouraging people of diverse backgrounds on Center to make their knowledge and experience available to teachers and students.

### What got you interested in this kind of work?

When I was 8 years old, my parents took me to NASA's Kennedy Space Center for a tour. As a result, my life was forever changed and science became my favorite subject. I went on to attend college where I majored in secondary education. I taught Earth science, oceanography, and astronomy in Newport News, Va. and in Virginia Beach for 13 years.

When a position at NASA Langley came available in the education office, I was given the opportunity to share with other educators the vast amount of education resources NASA has to offer. This was like a dream come true for me and I am very fortunate to have this amazing opportunity.

### Can you give me some background about your heritage?

I am a descendent of the Meherrin and Nottoway tribes of North Eastern North Carolina and the border of Virginia. They are both small tribes that have managed to hold on to their culture and customs. The Meherrin's hold state recognition in North Carolina and the Nottoway hold state recognition in Virginia.

### What are your feelings about Native American Month?

It's a time to celebrate the culture of the first people of North America. This gives all an opportunity to be educated about the many different Native American tribes here in the United States. I encourage everyone to attend the films being shown on Center this month by the Native American Advisory Board. They are informative as well as entertaining. The Museum of the Native American in Washington, D.C. is hosting several events in honor of Native American Month. Check out their listings to learn more about the many tribes in the U.S.

### What are your hobbies and interests?

I have always had a great interest in nature and my place within it. I spend as much time as possible enjoying the outdoors. I am an artist and I work in many different media; however, I think that my talents lie most in my silversmith work and oil painting. This past October, I had the opportunity to show off my skills at the GEWA craft fair here at Goddard.

### Any parting thoughts?

Yes. Stop and think about who you are, where you come from, and how unique you are. We all have cultural history to be proud of and I encourage each of you to explore and share yours with others. ■

Photo provided by Sonya Williams