A Flight Projects Directorate Publication
A Newsletter Published for Code 400 Employees

Volume 15 number 2
2007 Summer/Fall

INSIDE THIS ISSUE:

GLAST: NASA's Next Major Space Observatory

It's the boon and bane of a space scientist's existence. As soon as they successfully build and launch one mission, they're already thinking about the next.

In 1991 NASA had just deployed the second of its four Great Observatories, the Compton Gamma-Ray Observatory. As data started pouring in, instrument team member Peter Michelson of Stanford University started to envision the ideal follow-up mission. Teaming up with Bill Atwood of the Stanford Linear Accelerator Center (SLAC), and several others, they published a concept paper in 1993. They named their mission GLAST, short for Gamma Large Area Silicon Telescope.

Fast forward 14 years. A spacecraft similar to the original GLAST proposal, and with the same acronym, is now undergoing final environmental testing at General Dynamics Advanced Information Systems, near Phoenix, Arizona. If all goes according to schedule, GLAST — since renamed the Gamma-ray Large Area Space Telescope — will blast off from Cape Canaveral aboard a Delta 2 Heavy in early 2008.

As anyone who has ever been involved in a space mission knows, it's a long, strange trip from a scientist's brain wave to an actual working craft. GLAST survived open competition, nu-

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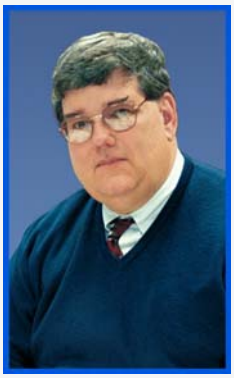
Message from the Director Of

Greetings:



It doesn't seem possible that I have served as the Director of Flight Projects for three years. Over this brief period we have evaluated the processes and procedures by which we manage our organization, and we reorganized to more closely align with our Headquarters customers. We have continued our string of consecutive successful missions, and maintained our focus on meeting our commitments to those projects currently in implementation and operations. We have initiated new approaches to enhance communication and information flow/feedback. We continue to expand the opportunities for the GSFC cadre of technical and resource specialists to compete for a majority of the FPD job openings. But, perhaps most importantly, we validated our fundamental promise: the FPD – and Goddard, and NASA – can only be successful if our people are trained and empowered to be their very best. Whether through diverse work opportunities, specialized training or mentoring/guiding, if we do not nurture our workforce all of our past successes are meaningless. We are most fortunate to have within the FPD a group of individuals who not only challenge us to be our best but question us aggressively when performance improvements are not forthcoming. Only through constant assessment of achieved performance can we guarantee progress.

Three years is a remarkably short period, but it will be the measure of my tenure as the Director of Flight Projects. I have enjoyed these past few years, and wish each of you continued success as you lead the FPD to even higher levels of performance. I will shortly be leaving the FPD to assume a different opportunity, one that was created by the continued success of Goddard managers. Continuing a scenario that began in 2000, when Brian Keegan was selected to be the NASA Chief Engineer, and continued two years ago with Chris Scolese moving to Headquarters to assume the Chief Engineer duties, Mike Griffin has asked Mike Ryschkewitsch to become the next NASA Chief Engineer. (The position became available when Chris was selected as the NASA Associate Administrator.) I will be moving to Code 100 as the next Deputy Center Director. (This choice of a replacement for Mike R. may well be due to a belief that one way to stop the flow of Center Deputies to Headquarters is to select a candidate that Headquarters would surely not covet.)

I am very much looking forward to my new assignment, and will continue to explore all opportunities for increasing the amount of exciting work available at the GSFC. I will also continue my focus on effectively developing our workforce, while ensuring that all employees have an opportunity to grow professionally and fully utilize their potential.

Rick

PERSONALITY TINTYPE

Mark Allen

Editor's Note: For the first time The Critical Path is featuring a contoractor employee as a TinType. It is a practice we intend to follow from time to time in the future.

Mark serves as a Resource Analyst on SGT's Program Analysis and Control (PAAC) Contract. With 22 years at Goddard in technical and management capacities, Mark has progressed from a business management background, via writing and editing positions, to a senior contract administrative position reporting to the PAAC II Program Director. He enjoys his work on the PAAC II management team that supports a 350+ person contract.

Born: Takoma Park, MD

Education: Frostburg State University graduate work for M.A. in Modern Humanities (1987) along with B.A. in English, minor in Spanish, and concentration in Public Relations (1984).

Life on PAAC: Mark was released from Coast Guard active duty in 1985 and began work for EER as a writer/editor on the Goddard documentation contract. He followed his Goddard documentation work in 1989 to McDonnell Douglas, where he added duties as an Engineering Administrator on the FPDMSS Contract. McDonnell Douglas later merged with Boeing, and Mark added duties as a documentation group supervisor and Quality Systems manager for what became the SEIMSS Contract. Continuing to follow the same contract since he arrived at GSFC, Mark added duties of a Resource Analyst when QSS won the PAAC I contract in 2000.

SGT won the PAAC II Contract in 2003 and Mark assumed collateral duties as PAAC Resource Analyst, Health and Safety Officer; Government Property Custodian; Quality Systems / Performance Assurance Manager; Security Officer, EEO Coordinator, GSFC LISTS Monitor, and Website curator. Mark ensures compliance with contract deliverable requirements; researches Federal Acquisition Regulations, NASA, and GSFC require-

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Kimberly Wiggins

Kimberly serves as the Information Technology Manager for the Earth Science Projects Division (ESPD) and the Information System Security Official (ISSO) for the NPP, GPM, LDCM and GLORY Projects.

Born: Washington, D.C.

Education: Kimberly earned an Associate Degree of Applied Science (A.A.S) in Computer Information Systems from Prince George's Community College and a Bachelor of Science degree in Information Systems Management from the University of Maryland University College.

Family: Kimberly and her four-legged child, Domino, reside in Upper Marlboro. Kimberly has family in the Maryland area, but most of her family resides in North Carolina.

Life at Goddard: Kimberly began her career at GSFC as a Cooperative Office Experience (COE) student, working in 600, in 1993. Upon graduation from Eleanor Roosevelt Senior High School and successfully completing the COE internship, Kimberly was offered a full-time, permanent position in the 200 directorate office as an Office Automation Clerk. While completing her college course-work, Kimberly continued to move up the career ladder, transitioning from the clerical series to the professional administrative series, through the Upward Mobility Program. Through this program, Kimberly transitioned into the professional series as a Contract Specialist for Simplified Acquisitions, in 1997. She spent 5 years in Procurement, holding various positions.

Upon completion of her B.S. in Information Technology Management, Kimberly was anxious to transition over to the I.T. field. After completing a couple of "Detail" positions in the former 290 Technology Directorate, Kimberly was able to transition into the former 297/Enterprise I.T. Security Branch, as an Information Technology Security Specialist, in 2003. It was a challenging transition from "Procurement" to "I.T. Security", but Kimberly was up for it! Kimberly feels that the knowledge, experience and skills that she gained, while working in 297, have proven to be invaluable. Not to mention…all of the great people she worked with.

A couple of years later, an opportunity presented itself for

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merous peer reviews, management shakeups, and a host of technical difficulties and budgetary pressures. Project Manager Kevin Grady and his team in Goddard Code 446 successfully navigated around these trouble spots and coordinated the activities of 18 institutional partners in the United States, Europe, and Japan, while also providing much of the systems engineering and mission support.

But the result will be well worth the trials and tribulations. The 4,303-kilogram spacecraft, which will consume only 1,500 watts of electrical power on average during its 90-minute low-Earth orbit, promises to revolutionize human understanding of the gamma-ray sky, where the most extreme and highest-energy phenomena rock the Universe. With a 5-year primary mission and a 10-year goal, GLAST will clear up mysteries about cosmic exotica such as black holes and gamma-ray bursts. And if Mother Nature is generous, it might even provide glimpses of new physics.

Bullets of Energy

GLAST is a joint NASA/Department of Energy mission built to detect gamma rays — the highest-energy form of "light" in the electromagnetic spectrum. Gamma-ray photons are usually produced by powerful gravitational or electromagnetic fields that accelerate charged particles to near light speed, or by particles of matter annihilating one another with their antimatter counterparts. As GLAST Project Scientist Steve Ritz of Goddard explains, "Gamma rays tell us about physics we can't explore on Earth." The observatory will detect gamma-ray photons several billion times more energetic than the photons you see with your eyes. No wonder gamma rays transformed the mild-mannered Bruce Banner into the Incredible Hulk of science fiction!

Individual gamma rays pack so powerful a punch that scientists find it easier to describe them according to their energy rather than by frequency or wavelength. After all, who wants to refer to a "wavelength" of only 10^{-12} meter, the size of an atomic nucleus? Instead, scientists refer to gamma rays in units of electronvolts. Whereas a typical visible-light photon has an energy of 1 eV, gamma rays range from about 100,000 eV (100 KeV) to an observed upper limit of tens of trillions of electronvolts (tens of TeV).

Packing even more energy than X rays, gamma rays can easily destroy cellular and genetic material. We can thank Earth's atmosphere for blocking them out, because otherwise nobody would be here to study them. The flip side is that scientists must launch observatories into space to make direct detections.

Gamma-rays are so energetic that $E=mc^2$ comes

GLAST is a NASA/Department of Energy cooperative effort, with substantial contributions from international partners. The spacecraft itself weighs 4,303 kilograms. Instrument components were built at institutions in France, Germany, Italy, Japan, Sweden, and the U.S. General Dynamics assembled the spacecraft and integrated the components. The spacecraft will consume only 1,500 watts of electrical power on average during its 90-minute low-Earth orbit. The U.S. components of the mission cost about $600 million, and the international partners contributions cost about $90 million.

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into play. In this famous equation from special relativity, Albert Einstein showed that mass can be converted into energy, and vice-versa. Gamma rays have energies greater than the rest mass of electrons, and they behave like particles. This unruly behavior makes them difficult to study, since they punch right through a conventional telescope mirror just as a bullet easily passes through tissue paper. When a gamma ray interacts with material in a particle detector, its energy can be converted into an electron and its antimatter counterpart, a positron, in a process known as pair production.

GLAST brings together particle physicists and astrophysicists, a relationship that evolved into one of mutual respect. Ritz encourages science team members to think of themselves not as astrophysicists or particle physicists, but as “GLAST scientists.” One of these team members, David Thompson of `Goddard, emphasizes that the mission required the expertise of both branches of science: “The particle physicists bring tremendous expertise in building sophisticated detectors, while the astrophysicists offer strong experience in operating telescopes in a space environment to address well-defined questions about the Universe.”

The Instruments

GLAST will carry two state-of-the-art instruments. The primary instrument, the Large Area Telescope (LAT), was assembled at SLAC, with substantial hardware contributions from partners in France, Italy, Japan, Sweden, and the U.S. SLAC also manages the collaboration, which includes 230 scientists from around the world. The Principal Investigator of the LAT Instrument is Peter Michelson, who is related to Albert A. Michelson (1852–1931), America’s first science Nobel laureate.

The LAT is the prominent box in any GLAST photo or illustration. Since gamma rays cannot be brought to a focus using mirrors or lenses, the LAT operates as a particle detector rather than a conventional telescope. It features 880,000 channels of electronics and over 70 square meters of silicon-strip tracking detectors, which measure the paths of electrons and positrons created when gamma rays interact in thin tungsten sheets. A calorimeter produces flashes of light whose intensity is proportional to the energy of the original gamma ray. The LAT will pick up gamma rays between 20 million electronvolts (MeV) to greater than 300 billion electronvolts (GeV).

In orbit, this 2,789-kg instrument will see one-fifth of the sky at any given moment, a wide view that is ideal for catching sources that flare up and then fade away. Such transients are common in gamma-ray astronomy. In sky-survey mode, the LAT will continually slew so that it covers the entire sky every three hours, meaning that very few sources will escape its ever-watchful eye. With a sensitivity greatly exceeding any previous mission, the LAT will harvest enough photons during GLAST’s five-year primary mission to locate thousands of sources. The previous best comparable detector, the EGRET instrument on Compton, detected only 271.

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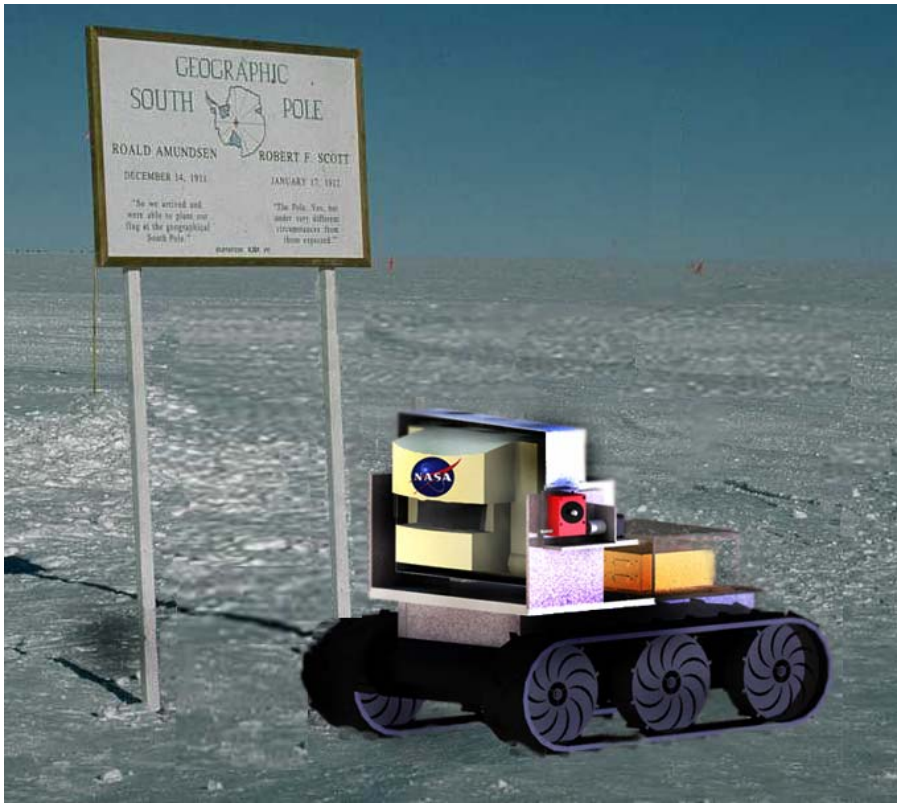
GREAT – Goddard Robotics for Exploration and Avionics Testing

Code 400.0 is building a second semi-autonomous mobile robotic vehicle as a platform on which to integrate flight-like avionics systems and to demonstrate them in remote and hazardous environments akin to space exploration. This program has been cooperating with engineering colleges since CY 2003 whereby teams of graduating seniors work on NASA projects for academic credits towards their degree. The original NASAbot-1 is commanded via a wireless link from a nearby laptop. It drives to the location commanded and scans the field using a LASER imaging device and a scanning platform. 3D images are produced and translated to a top-down view and then stitched together to form a composite map of the local area around the vehicle. The operator can then plan a path around the obstacles to a specific destination and command a worker robot to follow that path and do a specific job when it arrives. Now, a team of 6 college engineering seniors and graduates is working at GSFC to design and build a larger, improved version (NASAbot-2) and to cold-rate it for operations in Antarctica and Alaska.



"It's pretty ambitious," says Steve Strasburg, a senior in Electrical Engineering at George Mason University in Virginia charged with the overall integration and testing effort, "to produce a complete robotic track-vehicle with a customized scanning LADAR, motor controllers, various sensors, thermal controls, and a flight-like onboard processing system in one summer." Nevertheless this team of students and a few GSFC engineers, who mentor, them is confident they can be demonstrating their creation on Center in August. In parallel Goddard Code 561 has been developing a flight version of their Space Cube Processing system, which intends to fly on the next HST mission. As soon as that design has passed

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its critical design reviews a non-flight version of the key processor board will be assembled for NASAbot-2. Meanwhile a development CPU that is equivalent to the Space Cube's 4 Power PC architecture, is being used to develop the application software.

An exciting demonstration is being planned for January, 2008, where the semi-autonomous robotic vehicle will be roaming around the Geographic South Pole taking laser scans on command via TDRS from GSFC. The imagery will be sent back to GSFC. The field activities will demonstrate the versatility of the GSFC Space Cube Processing system in a Mars-like environment and the ability to conduct advanced science over a Delay-Tolerant Network protocol that Code 567 is helping to develop.

NASAbot has been developing for several years as a credited capstone design project for college seniors, along with other robotic projects all sponsored and mentored by Code 400.0. Mike Comberiate, who heads this effort says that about 100 seniors have gotten five academic credits each since CY 2003 working on his projects. This summer there is a new twist, which should have long-term benefits to Goddard. "The idea", says Mike, "has always been to accomplish some really significant results, which could be useful to Goddard, by breaking them down into small steps that can be accomplished in a series of semesters by these teams of college seniors." This summer six interns, some having already graduated, are using all the lessons learned to date to build a new robotic vehicle that will demonstrate Goddard's emerging Space Cube Processor technology in Antarctica in January, 2008. This is a very advanced processing system using four Power PCs, which in spite of being commercial grade, can handle the hazardous radiation environment of Space with only error correction techniques. With a Space Cube onboard, the robotic vehicle will be able to demonstrate the versatility of this adaptable processor in situations and environments analogous to those encountered in space exploration. This 3-month effort is being done in cooperation with Codes 561 and 592, using funding from IRAD and from flight projects, which might ultimately use this flight processing technology. The primary workforce is college engineering seniors and graduates from several universities, under the supervision of volunteering GSFC engineers/mentors.

NASAbot 2 like its predecessor carries a LADAR imaging scanner that produces 3D images of the field around it, which a computer can decipher. It is controlled by a remote operator via a wireless link. The operator's laptop shows the composite image as the robot takes successive scans from different locations, stitching each image together until a complete top-down view of the target area is produced. Stitching all these successive images together is computationally intensive, but an easy task for the flight-like Space Cube. Then the operator can direct a second robot to follow a specific path around the objects to any desired location where it can execute its primary function.

NASAbot 2 is being cold-rated to operate under extreme environmental conditions at the Geographic South Pole (90S), Antarctica in January, 2008. John Nappi, is a mechani-

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The biggest hurdle facing any gamma-ray observatory is the relentless bombardment of cosmic rays, ultrafast charged particles (mostly protons) that resemble the particles produced by gamma rays. For every gamma ray that hits the LAT, it will have to filter out 100,000 to one million cosmic rays. GLAST has several systems that work together to solve this problem. The first line of defense is an anticoincidence detector (ACD), which was designed, built, and tested by Code 500 at Goddard. The ACD is sensitive to particles but not gamma rays. It will weed out 99.97% of signals from cosmic rays. The silicon-strip detectors can distinguish an electron-positron pair produced by a gamma ray from a single cosmic-ray particle. The calorimeter helps discriminate electrons from protons. A data-acquisition system is the on-board "brain" that makes the distinction between cosmic-ray signals and gamma rays, and decides which signals should be relayed to Earth.

Whereas the LAT is a general-purpose instrument ideal for studying a variety of cosmic exotica, the secondary instrument, the GLAST Burst Monitor (GBM), was built with one target in mind: gamma-ray bursts (GRBs).

GRBs have remained one of the greatest enigmas in astronomy ever since their discovery in the late 1960s. Roughly once per day, a short-lived but powerful blast of gamma rays strikes Earth's atmosphere from a random direction. Only in the past decade have astronomers made significant progress in understanding the origin of GRBs. Thanks to the Italian-Dutch BeppoSAX satellite and Goddard's Swift satellite, evidence is mounting that most GRBs are triggered by exploding massive stars in distant galaxies. But a significant fraction probably comes from other cosmic cataclysms, such as the collision of two neutron stars.

To answer some of the unresolved questions, such as what kind of stars die as GRBs, how much total energy they emit, and how their central engines work, GLAST carries the GBM, which are fire-extinguisher-size detectors mounted on the sides of the spacecraft. The GBM consists of twelve Sodium Iodide (NaI) detectors for catching X-rays and lower-energy (soft) gamma rays, and two Bismuth Germanate (BGO) detectors for "harder" gamma rays. Together, the detectors cover the energy range of 8 KeV to 30 MeV and weigh only 99 kg.

The GBM watches the entire sky not occulted by Earth, and according to Principal Investigator Charles "Chip" Meegan of NASA's Marshall Space Flight Center (MSFC), it should pick up about 200 bursts per year. Given that GLAST can slew quickly in the direction of a GRB, the LAT will be able to provide almost immediate follow-up for particularly interesting GRBs. The two instruments combined will cover seven orders of magnitude in energy, by far the widest span of coverage of any mission. The LAT will pick up extremely energetic gamma rays from GRBs, which have fallen outside the detection capabilities of previous missions.

The Max Planck Institute for Extraterrestrial Physics in Germany built the GBM detectors in collaboration with the National Space Science and Technology Center in Huntsville, Alabama, and

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the instrument is managed at MSFC.

Other Science Objectives

Peter Michelson emphasizes that GLAST is not just a GRB mission. “GLAST promises to greatly extend our knowledge of these powerful explosions,” he says, “but it’s a multipurpose observatory designed to study many other phenomena as well.”

According to Ritz, GLAST’s “bread and butter” will be the study of active galactic nuclei (AGN). These are galaxies with extraordinarily luminous cores powered by material spiraling into black holes containing millions or even billions of times the mass of our Sun. Some AGN accelerate jets of particles to speeds approaching that of light. Amazingly, the jets often remain tightly collimated for hundreds of thousands of light-years. In particular, GLAST will study blazars — AGN that point their jets directly at Earth.

By measuring the specific energies of gamma-ray photons coming from AGN, the LAT may answer the long-standing mysteries of jet composition and acceleration mechanism. And since gamma rays from some AGN originate near the monster black hole, the LAT’s observations may reveal precious insight into the central engines that drive AGN. The LAT will also increase

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Social News

Congratulations:

Beverly Townsend (446) has a lot to be proud of these days. Her youngest son, Michael, was chosen Teen of the Week by the Capital Newspaper. Michael will be a senior at South River High School, in Edgewater, MD, this coming school year. Michael is on the high school wrestling team, and is one of the team captains. Many of his teachers and peers look up to him because of his strong work ethic and his commitment to wrestling. For the past two summers, Michael has attended one of the most intensive wrestling camps that's offered and has successfully completed the camp both times. Michael also attends tournaments year round in Maryland, Virginia, DC and Pennsylvania, winning numerous trophies and medals. He plans to go to college when he graduates, to carry on with his wrestling ambition. Apart from his busy wrestling schedule, Michael works part-time at Nationwide Insurance in Crofton, MD, updating policy holder information.

Births

Congratulations to Preston Burch (440), and his wife, Martha, on the birth of their newest grandchild. Preston’s oldest daughter, Katherine, who lives on the island of Maui in Hawaii, gave birth to her first baby, Pressly, at 11:44am Hawaiian Standard Time (5:44 pm EDT) on Sunday, June 24, 2007. This also happened to be Pressly's father, Wade Brady’s birthday. Pressly is 19 inches long, and weighs 6 lbs 15 ounces. This makes grandchild number 14 for Martha and Preston.

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the sheer number of known gamma-ray-emitting blazars from 66 to perhaps several thousand.

In our Milky Way Galaxy, GLAST will reveal new information about one of nature's most wondrous creations: neutron stars. Matter in these cinders — the collapsed cores of massive stars that exploded as supernovae — cram roughly one to two solar masses into a city-sized sphere perhaps 20 kilometers across. Matter is packed so tightly that a sugar-cube-sized amount of material would weigh more than Mount Everest!

"With neutron stars, we're seeing a combination of strong gravity, powerful magnetic and electric fields, and high velocities. They are laboratories for extreme physics and conditions that we cannot reproduce here on Earth," says Thompson. GLAST will help physicists better understand how particles are accelerated in neutron-star magnetospheres, which are trillions of times stronger than Earth's wimpy field. LAT will find dozens of new neutron stars, and it might answer critical questions about how a subset of neutron stars, known as pulsars, emit pulsed emission in lighthouse-like fashion.

GLAST observations will almost certainly resolve a century-old mystery about the origin of cosmic rays. Theory and observation have converged on a likely culprit: shock waves that form in supernova remnants. If the LAT sees a telltale spike in gamma rays with energies around 67 MeV in these remnants, that would clinch the case that theorists are correct. Protons accelerated in supernova remnants would collide with interstellar gas, producing secondary particles known as pions that quickly decay into 67-MeV gamma rays.

Closer to home, GLAST should provide new insight into how the Sun's magnetic field accelerates charged particles to produce solar flares. Powerful flares will trigger the GBM, and the LAT can catch high-energy gamma-ray emission. Working in conjunction with Goddard's RHESSI satellite, which works in a lower bandpass, the LAT should fill in some of the crucial missing data that is needed to understand particle acceleration and the total energy of solar flares. Improved understanding of flares will, in turn, make human missions to the Moon and Mars much safer.

GLAST is not just of interest to astrophysicists. The mission will test some of the fundamental tenets of physics. But Deputy Project Scientist Julie McEnery of Goddard cautions, "This is not guaranteed science; this is somewhat speculative."

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For example, GLAST can test the principle that all photons travel at the same velocity regardless of wavelength. Some theories that attempt to unite the twin pillars of twentieth-century physics, general relativity and quantum mechanics, predict that very-high-energy gamma rays might travel at slightly different speeds. According to quantum mechanics, space-time becomes turbulent at tiny scales. Very-high-energy gamma rays have such short wavelengths that they might actually "feel" this quantum turbulence, which could slightly boost or retard their velocity. If very-high-energy gamma rays from distant GRBs preferentially arrive at Earth slightly before or after low-energy gamma rays, this finding could revolutionize physics.

GLAST may also see compelling evidence for dark matter: hypothesized particles that neither radiate nor absorb light, but whose combined gravitational influence "outweighs" that of familiar matter by approximately five-to-one. According to a theory known as supersymmetry, the types of particles we know about, such as protons and electrons, have counterparts that are too heavy to be detected in current laboratory experiments. These particles could comprise most of the dark matter. Supersymmetry predicts that these particles annihilate each other when they collide, producing a cascade of secondary particles and radiation that includes gamma rays. If the LAT see gamma rays from these annihilations, one or more team members might enjoy an all-expenses-paid trip to Stockholm.

Voyage into the Unknown

Expectations are justifiably high that GLAST will shed light on the known unknowns. But perhaps the most exciting results will come from the unknown unknowns. As Thompson explains, "This is a relatively unexplored field, so the potential for major discoveries is very high." For example, the LAT will offer unprecedented sensitivity between 10 and 100 GeV, where virtually nothing is known. Nearly two-thirds of EGRET's 271 gamma-ray sources remain unidentified. With the LAT's ability to pinpoint the location of sources, follow-up observations will be able to characterize their nature. "We're going to find things that we don't understand, then we'll have to figure out how to deal with them," says LAT science team member Alice Harding of Goddard. "It will be fun to study the sources we know about, but it'll be even more fun to solve the mysteries of the sources we can't explain."

Solving these mysteries might require a next-generation observatory that improves on GLAST, just as GLAST represents a giant leap over previous gamma-ray missions. You can bet your house that at least some GLAST scientists are already envisioning that next mission.

Robert Naeye
Senior Science Writer
Code 660.1/Office of General Investigative Programs
Astrophysics Science Division

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cal/aeronautical engineering senior only one semester from graduating at **Rensselaer Polytechnic Institute,** Troy, NY. "This summer has been an incredible learning experience for me," says John. "It's probably equivalent to a year or more of actual working in the field as an engineer." John is being mentored by one of Goddard's long-standing hands-on experts, Jack Lorenz.

Matthew Bolitho, a PhD candidate in Computer Graphics at Johns Hopkins University (JHU), heads the software developments for the project. "The tall pole in this summer's effort is the delivery of a Space Cube Processor board, given the high demand for these very promising processors. Meanwhile we're using alternate CPUs which are similar enough for software-compatible developments. The big difference is in the footprint of the actual Space Cube, which is only 4" x 4". My personal goal is to apply the work I'm doing here towards my PhD thesis and to operate the vehicle from JHU or GSFC when it is in Antarctica."

This upgraded Robotic Explorer Vehicle will be tested at GSFC on the Mars terrain in bldg 23 and at the CSTL in bldg 25 prior to going to the Ice. Other team members including Danny Meekins/Maryland co-op in Computer Engineering (CE), and Anthony Comberiate (post graduate GUI developer) are local and will probably be on-hand during the upcoming months to complete the final details and support field tests. However, the main task of electrically integrating the Space Cube is falling on Elie Bergsman a CE graduate from Maryland. "This has been a major opportunity for me to pull together much of what I studied in school and to get some very practical hands-on experience. I'm doing circuit design and programming for the project and will be an expert of sorts on that Space Cube when we're done here. I hope to continue this kind of work in a

The Robotic Track - Vehicle Team

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full-time position at Goddard if at all possible."

Jaime Esper, Code 592 fits this effort into the Big Picture where GSFC is aggressively pursuing recognition in the avionics area within the Agency and outside. Jaime points out that, "Code 500/AETD has been studying the need to integrate the development of avionics components within GSFC under a single "roof". The Mission Integration and Demonstration Facility (MIDF) has been proposed as a means to accomplish this integration. It is composed of three major parts: The Communications, Standards and Technology Laboratory (CSTL), The Goddard Mission Systems Evolution Center (GMSEC), and the Vehicle Avionics Integration Laboratory (VAIL). In the South Pole Demo, the NASAbot-2 would be commanded using the GMSEC framework, through the lines and interfaces of the CSTL. The mobility of this robotic vehicle in realistic scenarios on which to test mission-level systems, serves as an operational demonstration that is in-line with the MIDF approach." Jaime intends to extend the Space Cube architecture to include a firewire 1394 A & B interface and to promote it to the IPO for future missions in the NPOESS series.

This unusual cooperative program with college and graduate engineering students is something unique to Code 400, but it has already produced a number of new hires for GSFC. If this NASABot-2 project succeeds as planned, it will be the source of another wave of cooperative projects with universities, where students do relevant work for NASA while earning academic credits. It's a Win-Win situation.

Mike Comberiate
Code 400.0

"Cultural Tidbits"

Did you know … that the Sanskrit word "Karma" means action? When people say "it is my karma", they are talking about the consequences of their actions. Hinduism believes that good actions result in good consequences or "good karma" and bad actions result in bad consequences or "bad karma". According to Hinduism, there is no escape from this either in this life or in the next. Also, the Sanskrit word "Guru" means teacher, though it is often used by Americans to mean expert. A teacher should indeed be an expert in the field he/she is teaching, but an expert is not necessarily capable of teaching.

Mohan Murthy
Code 429

2007 NASA Honor Awards Code 400 Recipients
May 14, 2007

Exceptional Achievement Medal

Candace Carlisle/422
For your exceptional technical and management expertise involving the Space Technology 5 mission.

Debra Dodson/460
For your sustained high level of performance in managing program and project budgets and your expertise and excellence in supporting NASA business initiatives.

Mary Esfandiari/423
For your exceptional performance in the conceptualization, development, early delivery, and execution of the EOSDIS Step 1 Evolution Plan.

Robin Pfister/417
For your vision, initiative, and technical leadership in the successful development and reuse of Earth Science data and information management capabilities.

Dale Schulz/400
For your exceptional achievement in leading the joint LaRC/GSFC team in successfully completing the assembly, integration, and test of CALIPSO.

Barbara Scott/441
For your outstanding leadership and achievements in the development of HST flight software.

Sheila Stanford/442
For sacrificing many extra hours, including long nights and weekends, to complete technical evaluations, enabling the smooth functioning of the Hubble Space Telescope Program.

Exceptional Service Medal

John Fiorello/424
For dedication and commitment in contributing to the success of the GOES-N mission.

Linda Price/450
For outstanding leadership in managing resources for the Center's space communications programs.

Exceptional Public Service Medal

Dr. Babak Saif/443
For remarkable inventions which have contributed significantly to the James Webb Space Telescope's development and pre-launch test programs.

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(Awards Continued from page 14)

Leonard Switalski/452.N
For over thirty-nine years of dedication and commitment to Goddard Space Flight Center's support of NASA's scientific and human space flight programs.

Public Service Group Achievement Award

HST GYROS WHEEL CLEARANCE TEST TEAM
For preventing an early Hubble Space Telescope gyro failure by developing a new wheel health assessment test.

Outstanding Leadership Medal

George Barth/400
For consistently strong leadership in the Goddard Flight Projects Directorate.

Bryant Cramer/400 (now at HQ)
For outstanding leadership that enabled the success of ST-5 and CALIPSO, the efficient development of GLAST, and the effective formulation of LISA and CON-X.

Douglas Mc Lennan/431
For outstanding leadership of the Space Technology 5 Project, leading to successful technology development and validation and benefiting future NASA missions.

Ardeshir Azarbarzin/422
For outstanding leadership contribution to Space Technology 5, resulting in a motivated team and successful launch and mission operations.

Jill Holz-McGuire/442
For outstanding leadership in the advancement of NASA's robotic-servicing technology in realizing NASA's Vision for Exploration.

Gilberto Colon/460
For outstanding leadership in the implementation of Heliophysics Programs and the development of future leaders for NASA.

Group Achievement Award

GOES-N Series Team
For providing the next generation of advanced weather satellites, a service essential to the Nation.

Space Technology-5 Team
For outstanding accomplishment in building, testing, launching, and operating the Space Technology 5 mission, enabling future NASA science missions.

Fifth Annual NASA Project Management and Challenge Conference

"REACH HIGHER"

The Hilton Daytona Beach Oceanfront Resort will host the Fifth Annual Project Management Challenge Conference on February 26 and 27, 2008. Attended by more than 1,000 individuals in 2007, registration for the 2008 conference is $375 and begins on November 14, 2007 through January 31, 2008. Speaker abstracts and Biographies are due September 14 and presentations by December 21, 2007.

PM Challenge is sponsored by the NASA Office of the Chief Engineer, the NASA Academy of Program/Project & Engineering Leadership (APPEL), and the NASA Office of Safety & Mission Assurance.

Conference Co-Chairs, both from Goddard, are Dorothy.J.Tiffany@nasa.gov and Walter.Majerowicz.1@gsfc.nasa.gov.

To join the conference mailing list contact Lesley.L.Paul.1@gsfc.nasa.gov.

Her Majesty Visits Goddard

Over the years, Goddard Space Flight Center has been visited by Presidents, Senators, Congressmen, foreign and domestic dignitaries, and now by Her Majesty Queen Elizabeth of the United Kingdom - to you, me and most Americans, that translates into the Queen of England.

Accompanied by her husband, the Duke of Edinburgh, the Queen and Duke spent several hours this past May 8 visiting, seeing demonstrations, planting a tree at the Visitor Center and graciously greeting Goddard employees while here on a glorious Maryland spring day.

Just prior to entering the auditorium in Building 8 to address Goddard employees, Her Majesty used the Code 403 room of Nancy White and Katy Boone as a special powder room. She even sat at Nancy's desk as she adjusted her bonnet.

Project Management Development Emprise Program (PMDE)

Code 400 Director Of, Rick Obenschain presented graduation plaques to Tracy Parlate (Code 461) and Leigh Gatto (Code 180) at a brief graduation ceremony in the Flight Projects Directorate suite at noon, June 12, 2007. Tracy's mentor in the program was Rick King (Code 420), while Leigh's mentors were Tony Comberiate (before he transferred to NOAA) and then George Morrow (Code 400).

The 2007 PMDE class is currently in the process of being selected. A new class is generally started every 2 years. For more information, contact Howard.K.Ottenstein@nasa.gov, or call him on x6-8583.

From L to R George Morrow, Leigh Gatto, Rick Obenschain, Tracy Parlate, and George Barth

“Property Custodian of the Year Award”

This year, Code 273, the Supply and Equipment Branch initiated an award for "Property Custodian of the Year" for contractors and civil servants. We were very proud that Loretta Cale an SGT employee working in Code 443 was selected for this years' award. She is pictured with Ms. Gail Regan, the Property Survey Lead for Code 400 and Mr. Rick Obenschain, the Director of Flight Projects. Congratulations Loretta!!!

Code 400 Peer Award Picnic

Code 400 is all set for the 2007 Peer Award Picnic. The Date is Wednesday, September 19 at the Rec Center from 11:30 A.M. to 2:00 P.M. Tickets for all you can eat hamburgers, chicken, hot dogs and all the trimmings are (once again) just $5.00, and can be purchased in the Code 400 suite.

Come on out and find out who all the 2007 winners are. The committee, made up of the 2006 winning candidates has been hard at work setting up this year's festivities. **See you there.**

Melwood Goddard Award Winner: "I Don't Let Anything Stop Me"

Editor's Note - The following article is published in its entirety as it appeared in the Spring 2007 edition of: Around Melwood. Georgia has been a custodian for several years in Building 8 and regularly takes care of the Code 400 facilities on the 2nd floor of the building.

When Melwood's Georgia Chung-Blake was a four-year-old with polio in Jamaica, few there envisioned the life she would one day build for herself in the United States.

In April, Georgia was awarded the prestigious NISH William M. Usdane East Region Award, presented each year to an individual with severe disabilities who has exhibited outstanding achievement and exceptional character as an employee in the Javits-Wagner-O'Day (JWOD) Program.

She came to the U.S. with her family at the age of 17 determined to live a full life. In 1999, Ms. Chung-Blake started as a Goddard custodian, and has seen her dreams fulfilled. She's now married and raising three children.

"I like where I work at Goddard. I really know how to get along with people," she said. "I have a severe disability, but I don't let anything stop me."

The award is named for the late William Usdane, former Assistant Commissioner of the Rehabilitation Services Administration (RSA), who worked tirelessly on behalf of people with disabilities.

(Wiggins Continued from page 3)

Kimberly to work in the "Projects", which was a totally new experience for her. Excited for the opportunity, Kimberly transitioned over to 420/Earth Science Projects Division, as their I.T. Manager. Kimberly quickly learned that what everyone would say, "The Projects are totally different…like a different world…" wasn't far from the truth. Kimberly embraced the change and challenges that came with it. It has proven to be a tremendous growth opportunity for her and she feels that she has gained a wealth of knowledge and experience.

Kimberly has also participated in numerous committees and initiatives, throughout her career, including the GSFC Mentoring Program, African-American Advisory Committee, and the Diversity Dialogue Project.

Hobbies: In her spare time, Kimberly enjoys cooking, planning social events for her family and friends and traveling. Her latest interest is Pilates.

(Allen Tintype Continued from page 3)

ments; and satisfies or verifies satisfaction of requirements. Mark supports contract deliverables such as 533, Monthly Technical Progress Report, Self Evaluation, EEO reports, Government Property reports, and Health and Safety reports. Mark jointly performs PAAC Orientation for new PAAC employees, and serves as postmaster for e-mail comms from PAAC management to all PAAC employees and other internal and external customers. Mark loves to run (especially as team co-captain of the SGT and Friends Walking and Running Team in the GSFC Fun Runs).

Family: Mark and Colleen have lived for most of their 26 years together in Fort Washington, MD, where they have raised sheep, peafowl, Toulouse geese, fantail pigeons, and cats. They enjoy gardening, aerobics, and walks together. They regularly enjoy Mark's parents and other family who live nearby.

Life outside PAAC: Master Chief Petty Officer Mark Allen has enjoyed every day of his 30 years in U.S. Coast Guard Reserve. He is currently serving at Coast Guard Headquarters as Reserve Chief Petty Officer Academy Liaison in the Office of Leadership and Professional Development. Mark has been recalled to active duty in response to contingencies such as the Mariel Boat Lift, Air Florida Flight 90 crash, El Toro II sinking, and 9/11 terrorist attacks. A member of The Coast Guard Reservist magazine Editorial Board, he has served as Staff Assistant in the Coast Guard Reserve Communications Division at Coast Guard Headquarters, Washington, DC.

Mark also serves on the Coast Guard Mutual Assistance Board of Control and as a member of the Recruit Company Mentor Program. He serves on the Coast Guard Chief Petty Officers Association National Board of Directors, and has been elected to six terms as Washington, DC Chapter President, during which time he assisted the DC Chapter in earning its first and second President's Outstanding Chapter Awards. He is a graduate of the Coast Guard Chief Petty Officer Academy; is the second Coast Guard Reservist ever to graduate from the Navy Senior Enlisted Academy; and is a graduate of the Coast Guard Senior Enlisted Command Master Chief Course.

Mark's personal awards include the Coast Guard Commendation Medal; Coast Guard Achievement Medal with Operational Distinguishing Device, and Coast Guard Commandant's Letter of Commendation (three awards).

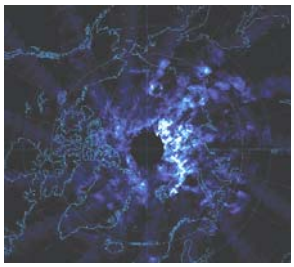
Editor's Note: After preparing this tintype, Mark was presented the MORE (Matt Opeka Recognition of Excellence) Award for his contributions on the PAAC 2 Contract in support of Code 400.

Moving Ahead

The staff of The Critical Path joins everyone in Flight Projects in wishing Director Of Rick Obenschain good luck and smooth sailing in his new position as Center Deputy Director. Equal good wishes to George Morrow in his move from Deputy to Director of Flight Projects. The Center and Flight Projects continue to be in Good Hands.

Good luck as well to Mike Ryschkewitsch in his move to NASA Headquarters as NASA Chief Engineer. There, he replaces Chris Scolese, another former Goddard Center Deputy Director, who moves on to become NASA Associate Administrator.

AIM Satellite



Noctilucent, or 'night-shining', clouds glow in shades of white and blue in this new image from the Aeronomy of Ice in the Mesosphere (AIM) satellite. Launched on 25 April, the mission snapped this picture on 11 June, as the season for seeing such clouds got underway in the Northern Hemisphere.

The clouds form in the mesosphere, about 85 kilometres up, and thus reflect sunlight long after the Sun has set — hence their name. They have been appearing more frequently and at lower latitudes in recent years, and some researchers suspect that may be due to climate change: as surface temperatures rise, those in the mesosphere drop, enhancing the cold conditions needed for noctilucent clouds to form.

AIM, the first mission to study these clouds, will spend the next two years looking at them above both the Northern and Southern Hemispheres.

Comings:

Laurey Adkison detailed to 454/TDRS Project
Diane Yun to 443/JWST Project
John Wolfgang to 400/Flight Projects Directorate
Matt Mazur to 442/HST Development Project
Matt Ritsko to 454/TDRS Project
Jamie Dunn to 443/JWST
Jeffrey Hein to 426/Glory Project
David Long to 407/ESTO Project
Shaida Johnston to 420.1/NPOESS IPO Support Office
Jahi Wartts to 401/Advanced Concepts & Formulation Office
Tina Woods to 410/Explorers Division
Deanna Adamczyk to 451/LRO Project
Richard Burns to 444/SSMO Project

Goings:

Jan Kalshoven retired from408/Advanced Concepts & Technology Office
Mike Kelly retired from 450/Exploration and Space Communications Projects Division
Nannette Rhoads to 150/Chief Financial Office
Jonathan Root to Code 305/Resource Analyst Office
Russ Werneth retired from 442/HST Development Office
David Funkhouser to Internal Revenue Service
Gail McCaskill to 300.1/Directorate Resources Management Office
Bob Savage to 300/Office of Systems Safety and Mission assurance
Paul Garza retired for 454/Ground Network Office
Eric Grob to 545/Thermal Engineering Branch
Mark Fontaine retired form 443/JWST Project
John Thurber retired for 410/Explorers Division
Bernie Klein detailed to 301/Systems Review Office

Sad News

Robert S. Cooper

Former Goddard Center Director Robert S. Cooper (1975-1979) passed away in July at age 75. Dr. Cooper was also an Assistant Secretary of Defense for Research & Technology while serving as Director of the Defense Advanced Research Projects Agency (DARPA). He was founder and president of Atlantic Aerospace Electronics Corporation. Dr. Cooper also served in the Air Force and held a Ph. D. in electrical engineering from MIT.

Barbara Blom

Flight Projects Directorate employees also mourn the loss of Barbara Blum long term Code 400 employee who for the past several years served as a Secretary to the Center Deputy Director.

Quotes To Think About

Luck is what happens when preparation meets opportunity.
- Seneca -

Good judgment comes from experience, and a lot of that comes from bad judgment. -- Will Rogers -

Behold the height of the stars, how high they are!
- The Bible -

I don't pretend to understand the Universe-it's a great deal bigger than I am
-Thomas Carlyle -

There was a young lady named Bright
Whose speed was far faster than light;
She set out one day
In a relative way,
And returned home the previous night.
- Arthur Buller -

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Summer 2007 at Goddard
Photo by Nancy White, SGT/403

FUTURE LAUNCHES CALENDAR YEAR 2007/2008	
GLAST	JAN
GOES-O	APR
CINDI	JUN
IBEX (SMEX-10)	JUN
HST SM4	AUG
LRO	OCT
GLORY	DEC

ATTENTION INTERNET BROWSERS:

We're on the WEB
http://fpd.gsfc.nasa.gov/news.html
Or via the New "Code 400" Homepage
http://fpd.gsfc.nasa.gov

The Critical Path

Published by the Flight Projects Directorate

— In April, August, and December —

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If you have a story idea, news item, or letter for The Critical Path, please let us know about it. Send your note to Howard Ottenstein via Email: hottenst@pop400.gsfc.nasa.gov, Mail: Code 403, or Phone: 6-8583. Don't forget to include your name and telephone number. Deadline for the next issue is November 16, 2007.