
**A FLIGHT PROGRAMS AND PROJECTS DIRECTORATE QUARTERLY PUBLICATION**

***A Newsletter Published for Code 400 Employees***

## INSIDE THIS ISSUE:



# Robotic Lunar Exploration Program Well Underway

***Introduction***

In February 2004, Goddard Space Flight Center (GSFC) was assigned management responsibility for the Robotic Lunar Exploration Program (RLEP) – containing the first flight mission of the President's new Exploration initiative. With that assignment, GSFC was thrust into what promises to be a broad new arena of work for the Center. Despite the fact that GSFC has provided more planetary instruments than any institution in the world, it has not had significant mission, system, or program responsibility for planetary-type missions – until now. It promises to be an exciting and invigorating new role for the Center.

***Program***

The Exploration Systems Mission Directorate (ESMD) is the RLEP customer – providing the requirements and objectives that form the basis of the mission set. NASA's Science Mission Directorate (SMD), through the

*(Robotic Continued on page 6)*

# Format in Transition

NASA Headquarters is initiating a new Communications Material System throughout the Agency, beginning in February 2005. In order to meet our regular quarterly February deadline, it was decided to duplicate the Winter 2005 issue in the Goddard print shop, so that our readers could receive the issue in a timely manner. The alternative would have been a delay of an unknown length of time. Thanks for your understanding.

-Editor

## Message from the Director Of

Greetings:

2005 is rapidly developing into a year of exceptional challenge and opportunity for all of NASA, with the Flight Programs and Projects Directorate assuming a major leadership role in many important development activities. We are scheduled to support the launch checkout and initial operations of seven missions by the end of July. We are focused on completing a series of Preliminary Design Reviews for the Hubble Robotic Repair missions which will clearly demonstrate the viability of both the selected hardware/software configurations as well as the proposed implementation strategy. Our leadership of the Agency's Robotic Lunar Exploration Program (RLEP) and our management of the Lunar Reconnaissance Orbiter (LRO) – the first mission to be accomplished within the RLEP – present incredible opportunities for us to expand our mission management responsibilities across the solar system. Our continuing efforts on missions that range from the JWST to Explorer missions, coupled with the multitude of spacecraft and instrumentation efforts that are in pre-formulation and formulation phases, are stretching our management capabilities. The extraordinary ability of the FPPD to continually meet the most challenging assignments, our agility and resourcefulness in accomplishing missions with state-of-the-art technical requirements and run-of-the-mill schedules and budgets, and our continuing adherence to those proven management practices that maximize our ability to succeed have paid dividends in 2004. We will need these hard-earned skills as we face 2005.

I spoke to the challenges of 2005. In addition to the now typical required stretching of our resources to meet our on-going and identified new requirements, we enter the year with perhaps greater than normal uncertainty on the specific mission implementation strategies. The President's budget for FY2006 will be released in a few weeks. Our efforts on many of our most demanding missions – including the Hubble Robotic Repair and LRO – could be significantly refocused; we are exposed almost daily to some "expert's"

***(Message from the Director Of Continued on page 12)***

## "Cultural Tidbits"

***Did you know … that there are many foreign words and phrases for which there are no English equivalents and vice versa? In many cases, the difficulty in translating arises because our cultures simply don't share the same experiences. To recognize what a language can and cannot express provides insight into the culture and the mindset of the people who speak that language. This understanding can be invaluable when communicating with people from other cultures-especially when negotiating and solving problems jointly.***

**Do you have a cultural tidbit to share? Send it to the Code 400 Diversity Council c/o Andrea Razzaghi @ andrea.i.razzaghi@nasa.gov and we'll publish it in a future issue.**
**Andrea Razzaghi/Code 424**

# PERSONALITY TINTYPES

## Jonathan Bryson

Jonathan has served as the James Webb Space Telescope (JWST) Deputy Project Manager-Resources (Code 443) for the past five years.

Born: Albany, NY.

Education: B.A. Political Science, SUNY Binghamton; MPA, Syracuse University; MS Computer Systems UM-University College

Life at Goddard: Jonathan arrived at GSFC as a Presidential Management Intern in 1984. After five years in the Engineering Directorate and Office of the Comptroller, he became the HST Financial Manager in 1990 where he helped divide resources for the single HST project into its Servicing and Operations sides and supported SM-1 preparations. In 1991, he joined John Hrastar to complete a very challenged Geospace Science Mission program. He is proud that WIND and POLAR made it and are still flying and producing science. Next he served as the Terra DPM/R through launch and set up the current EOS Program Office. Looking for a startup opportunity, he joined the Next Generation Space Telescope (now JWST) team where he built up the resources systems and team. Along the way, he and others have worked to drive the development of the Next Generation Integrated Network (NGIN) suite of tools. Overall, he is proud of how FPPD missions continually rewrite the science textbooks with discoveries and what his business folks have done to help make this happen.

Family: Jonathan and his wife Joanne are busy raising their three children in Silver Spring, MD. Matthew (10), Andrew (8), and Linda (6) are in full swing with respective baseball, soccer, and basketball teams as well as Cub and Girl Scouts. Linda is in her second year of ballet and tap dance. When the calendars align for some downtime, the family travels to a vacation home in the Poconos in eastern PA. Most recently, they trekked to Orlando for Thanksgiv-

*(Bryson Tintype Continued on page 11)*

## Mary DiJoseph

Mary joined NASA in 1990 as an instrument manager for the EOS Program. She previously worked at General Electric Astro Space in Valley Forge, PA. Since joining GSFC, she has worked on numerous projects including TRMM as the Deputy Spacecraft Manager, GLAST as the Formulation Manager, and MMS, GEC and Mag-Con as the Formulation Manager. She led the GSFC proposal office in 1996 and 1997. In 2001, Mary had a detail at NASA HQ as the co-chair for the Decadal Planning Team that led the initial strategic planning on what has become the Exploration Vision.

Mary returned to GSFC to work on the Living With a Star (LWS) Program and is now the LWS Deputy Program Manager. LWS and the first mission in the LWS line, Solar Dynamics Observatory (SDO), were confirmed for implementation in June 2004. The LWS program is designed to determine the causes of solar variability and its effects on society, with a goal of enabling space weather prediction.

Born: Wayne, PA

Education: Bachelor degree in Mechanical Engineering from the Massachusetts Institute of Technology

Family: Mary and her husband Greg reside in Mount Airy, MD, where they have a small horse farm. Greg is a former NASA engineer who currently works at Thompson Financial as a senior software developer.

Life outside of work:

Mary breeds, trains, shows and sells Holsteiner horses at Foals Grove Farm. She currently has five horses including her stallion Rocky that she shows at Federation Equestrian International (FEI) levels in dressage. The first Foals Grove foal arrived last spring a month before the LWS Confirmation Review – named, appropriately, Countdown.

# FEEDBACK

**GSFC Resident Office at KSC**

- The aft skirt and lower segment of the Solid Rocket Booster (SRB) is being prepared for stacking at the Vehicle Assembly Building (VAB). They are being prepared for "Return To Flight" mission STS-114. The new External Tank with a redesigned fuel tank to prevent foam shedding has arrived at Kennedy Space Center (KSC) and is being readied for Shuttle Discovery launch scheduled May, 2005.
- On November 20, 2004 we had a magnificent SWIFT payload launch. SWIFT was launched aboard a Boeing DELTA II rocket from Launch PAD 17 at Cape Canaveral Air Force Station (CCAFS). This payload is an international mission in the NASA Explorer Program to study the mystery of the origin of gamma-ray bursts.
- 2005 is getting off to a busy start with the Hubble Space Telescope, Get-Away-Special (GAS) and LMC Carrier groups coming to KSC and CCAFS to attend meetings, participate in walk downs of CCAFS facilities, receive special training and certifications, and attend Safety Training classes.
- Hurricane recovery is still going on at KSC. Roofs, shutters, ceiling tile, carpet, and the like are still being repaired or replaced throughout the Center.
- The National Space Club Florida Committee is honoring KSC Public Information Officer George Diller with the Harry Kolcum Memorial News and Communication Award for his excellence in communicating the space story along Florida's Space Coast and throughout the world. Diller has served at KSC in the Office of Public Affairs for 24 years. He has interfaced extensively with GSFC projects at

*(FeedBack Continued on page 11)*

# SWIFT LAUNCHED

*"Show me someone who has done something worthwhile, and I'll show you someone who has overcome adversity."*
*Lou Holtz*

After seven years, a couple hundred million dollars and the sweat of a few hundred people, Swift is finally on orbit and performing magnificently. Swift was launched into orbit atop a Boeing Delta 7320-10 on a dazzling clear and beautiful Florida November afternoon. The Delta placed Swift in a near perfect orbit after an eighty minute ride. Once separated, NASA's newest multi-wavelength observatory, started flying on its own, spreading its wings of solar cells and taking its first steps by pointing them at the sun and all along streaming real time data via TDRSS to the Mission Operations Center at Penn State University. The Swift is free now to explore and study the most violent explosions in the universe.

But what is a Swift? It is, of course, a common name for over 90 varieties of birds among them the fastest flyers known, but it is also the name of a bird that is made of aluminum and electronics and flies at heights feathered birds can only dream about. NASA's Swift was designed to autonomously detect the death of stars and with unprecedented speed reposition an x-ray and UV and optical telescopes onto the newly discovered cosmic happening. When the stars explode, large amounts of energy flood the universe in the form of gamma rays. But the gamma ray burst only lasts from less than a second to a couple minutes. The challenge of Swift is to detect the burst and re-point the Observatory while the burst is still occurring. Historically, maneuvering a spacecraft on orbit is planned well in advance by a team of flight controllers on the ground and then takes hours to perform the actual maneuver. Swift, on the other hand, must safely move at a moment's notice, and do it in tens of seconds to study this cosmic phenomena.

The three instruments on board Swift are the Burst Alert Telescope (BAT) which detects and loosely positions the Gamma Ray burst (GRB). An X-Ray Telescope (XRT) which localizes the burst to 5 arc seconds, measures fluxes, spectra and light curves. The final instrument is the UV/optical Telescope (UVOT) which improves the BAT and XRT localizations giving a position to 0.3 arc second accuracy.

The commissioning phase will take more than 4 months to complete. During this phase, the spacecraft and instruments are turned on and fully calibrated. During the first 30 days after launch (L+30), the spacecraft, built by General Dynamics was made operational. Working 24/7 for those 4 weeks with the relatively small team at the Penn State Ops Center, the spacecraft team affirmed and learned about the spacecraft they designed and built over the last several years. The Swift spacecraft bus is now ready to chase and catch Gamma Ray bursts on the fly.

During the L+30 time, the XRT and BAT were turned on. The UVOT turn on is in process. In a cautious and deliberate manner each part of the instruments were brought on line. On XRT, the electronics and the detector system are first turned on and verified. The thermal control systems which regulate the temperature of the 3.5 meter long telescope tube is powered. The opening of the outer and internal doors of the telescope at L+21 days finally allows the XRT to begin the job it was designed to do. Unfortunately, the Thermal Electric Cooler (TEC) which keeps the detector cold stopped working. Fortunately the thermal design of the radiator and heat pipe assembly is robust enough to keep the detector cold enough to do the science it was built to do.

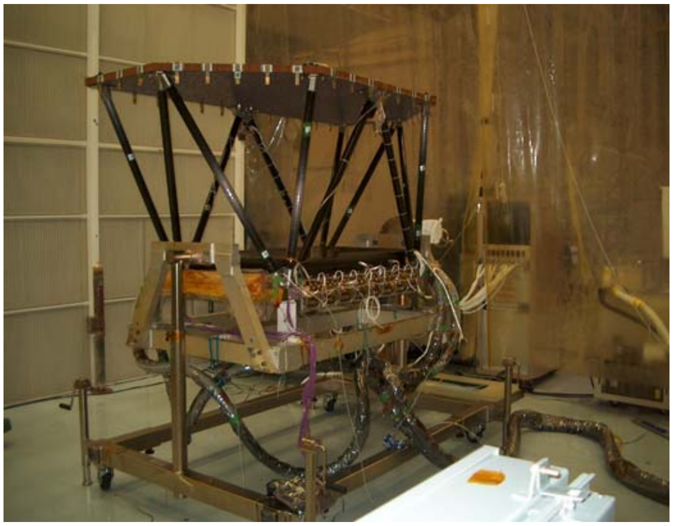
***(SWIFT Continued on page 5)***

*(SWIFT Continued from page 4)*

The BAT instrument, designed built and tested in-house at the Goddard Space Flight Center (GSFC) is "wowing" the high energy astrophysical world. In the couple weeks since the instrument was turned on, and while the BAT was being calibrated, BAT hit the GRB jackpot.

On December 17, BAT detected its first burst, proving the concept and design worked. But the best was yet to come. Two days later, BAT detected three bursts in one day! The first of the three bursts was an exceptionally large explosion which is labeled as a BBOY (Brightest Burst of the Year). Not only was it a BBOY, which the science team expected only to see a few in the lifetime of the mission, but the BAT detected that the burst was going to happen 5 minutes before the actual main eruption by detecting a smaller event within the dying star.

In the first 2 weeks that BAT was turned on, it has seen three BBOYs and a total of nine bursts. The pre-launch prediction was to see about one burst every 3 days on average. Were the predictions wrong or were the Swift scientists lucky? It is, of course, too soon to tell, but since seeing the last burst at the end of December, as of mid January BAT has not detected any new events. Exploring the unknown is what we at NASA do and Swift will expand mankind's knowledge of the most violent explosions in the universe for years to come.



***BAT instrument without the radiation shield and insulation***

*"The winds of change are always blowing*
*And every time I try to stay*
*The winds of change continue blowing*
*And they just carry me away."*
*Willie Nelson*

When Swift left GSFC for KSC in July 2004, no one knew what lay ahead for the spacecraft and the team in sunny Florida over the next 4 months. But within a week of arrival at the Cape, nature's fury was unleashed in the form of a tornado and a "take cover" order was given to the Swift team in the AE processing facility. Fortunately, no one was injured and the tornado did no damage. But the challenges lay ahead and their names were Charley, Frances, Jeanne and Ivan.

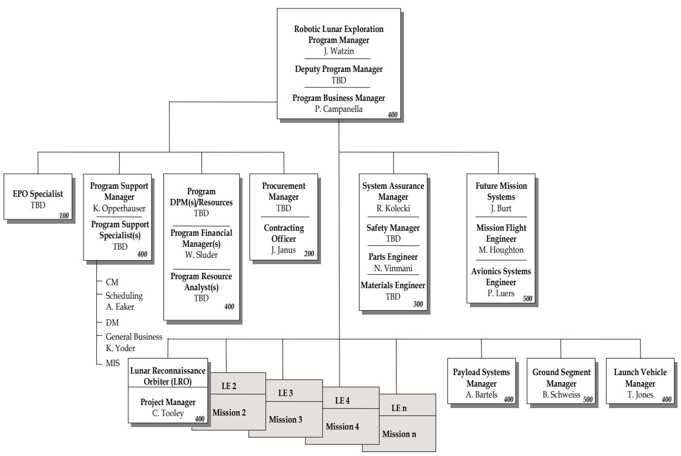
The deadly 2004 hurricane season in Florida touched, it seems, every Floridian in varying degrees. The NASA KSC employees and contractors who supported Swift were not different. Many of our fellow KSC associates dedication was amazing as they stayed until the evacuation order was given and helped us save Swift and the AE facility as the howling winds and rain pounded them relentlessly. Our appreciation and thanks to the many KSC and Air Force personnel who supported and advised the Swift team members before and after the tumult of the storms. Thankfully, Swift personnel and the Observatory rode through the hurricanes without harm.

Ironically, on November 20, 2004, at 12:15pm EST when the Delta with Swift atop thundered off the pad into the vacuum of space, the weather was perfect. Blue sky with a few clouds, mid 70's and a light breeze made for one of the best viewing launches in recent memory.

Tim Gehringer, Code 410

*(Robotic Continued from page 1)*

Solar System Exploration Division RLEP Program Director, Tom Jasin, is responsible for the management of RLEP. The RLEP Program Office, managed by James Watzin at GSFC, is responsible for implementation. All missions (projects) of the RLEP will be managed by this office. In order to promote synergy and efficiency, the RLEP office provides shared business, administrative, and systems engineering services to all of the mission projects. Craig Tooley is the Project Manager for the Lunar Reconnaissance Orbiter (LRO) mission.




***Robotic Lunar Exploration Program Organization Chart***

## *Program Overview*

The RLEP is expected to execute a series of robotic missions to the Moon, starting in 2008, in order to pave the way for human exploration missions to the Moon, and ultimately, to Mars and beyond. The role of the RLEP is to ensure that all lunar flight missions are integrated into a program in a manner that allows them to achieve mission success, and support the larger goal of integrated human and robotic exploration. The primary purpose of the lunar robotic preparation step is to reduce risk, enhance mission success, and reduce the cost of future human missions, as well as to enable the scientific activities human explorers will undertake on the Moon. These objectives will be accomplished by designing and implementing a program of robotic lunar missions to collect critical measurements, demonstrate key technologies, and emplace essential infrastructure, while also seeking to make discoveries about what the Moon can offer as a scientific stepping-stone to Mars and beyond.

For planning purposes, each mission is envisioned to be within the NASA Discovery-class scope (~$400M full cost, full lifecycle, including instruments, spacecraft, launch vehicle, ground systems, and mission operations – phases A-E inclusive), and to be developed in four years or less. While the first flight mission will be purely orbital, subsequent missions will undoubtedly include surface elements (landed, or impacted), as required to best provide the necessary measurements, validation of technologies, and risk mitigation for follow-on human missions. However, given the unique characteristics of lunar flight, it is possible that each mission will include an orbital element, if for no other reason than to provide a platform for payload delivery and/or communications back to Earth.

The RLEP embraces a broad range of mission content, ranging from quantitative remote sensing of the lunar surface, assessment of the lunar environment on human adaptation to space, prospecting for in-situ resources, supporting technology maturation for human-tended Exploration systems, to the emplacement of infrastructure for human in situ activities. The series of robotic missions will progress from precursor mission activities for extended duration operations, to long duration operations, and ultimately to a sustained presence on the Moon.

One goal of the RLEP is to provide an early assessment of candidate human exploration sites on the Moon, followed by a risk mitigation strategy for both the technology developments needed for human exploration and the emplacement of supporting infrastructure. This will require a comprehensive, quantitative assessment of the character of the

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lunar surface (and shallow subsurface) environment in all regions deemed relevant to human exploration activities. Although much is known from the Apollo missions (and their robotic predecessors), many factors still remain unanswered in terms of human health, safety, and performance, particularly for longer lunar surface stays and in association with the largely unexplored lunar polar regions, where the potential for discovering and then using accessible water/ice as a resource is a possibility.

RLEP will provide observational data in the form of fully calibrated and validated measurements to help address these questions. It will also assist in meeting the challenges posed by human exploration technology maturation, as well as emplacement of the operations support infrastructure, both Moon- and Earth-based. RLEP will also provide critical elements in support of all phases of the planned human exploration program for the Moon, as a key step toward conducting human activities on Mars.

The first mission defined within the RLEP is the Lunar Reconnaissance Orbiter (LRO). This mission is to fly to lunar orbit before the end of 2008. The second project, still under definition, is ideally to be flown by the end of 2009. Subsequent missions will be developed in conjunction with and in response to requirements still being formulated by the (ESMD) at NASA Headquarters, in concert with inputs from the SMD.

In order to keep pace with the evolving nature of the Exploration Program, a mixed mode of flight missions is envisioned for the RLEP. While LRO is planned for a Delta-class launch vehicle and its associated performance capabilities, this is not necessarily the case for all the follow-on flight missions. Follow-on missions may include landers, both soft and hard, utilizing impactors and surface probes, and possibly systems with limited surface and subsurface mobility, as well as robotic sample/experiment "return" missions. Other missions may include communications, ranging, and navigation satellites, as well as lunar surface and Earth ground assets that help achieve these capabilities. Also under consideration are small sub-satellites that could better define the gravitational field of the Moon, particularly on the far side. Some flight missions may be launched on a smaller Expendable Launch Vehicle (ELV) if their total mass is less than 400 kg. Such missions may support options for smaller probes, impactors, bio-sentinels, sub-satellites, and other technology demonstrators.

Larger scale missions (i.e. Discovery-class or larger) may support risk mitigation or infrastructure requirements originating from other elements of the Exploration Vision. Some infrastructure may be developed externally to the RLEP program as a directed payload. The Exploration Program can utilize the quick response and relatively low cost of the RLEP to mitigate developmental risk on key manned flight system functions, such as automated rendezvous and docking, precision landing, or engine performance and control.

RLEP is unique in that as a program of multiple mission classes it can provide flexibility in both capability and response time that can be tailored to the individual Exploration Vision needs, be they for specific measurements, technology demonstration/maturation efforts, or infrastructure emplacement. It is a program that will constantly be evolving, and unquestionably have a broad range of content. RLEP is intended to be an adaptable enabler of human exploration of the Moon and beyond.

***Program Objectives/Themes***

The President's Vision for U.S. Space Exploration laid out the following objectives relative to "Space Exploration Beyond Low Earth Orbit," and specifically to the lunar program:

- Undertake lunar exploration activities to enable sustained human and robotic exploration of Mars and more distant destinations in the solar

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*(Robotic Continued from page 7)*

system.

- Starting no later than 2008, initiate a series of robotic missions to the Moon to prepare for and support future human exploration activities.
- Conduct the first extended human expedition to the lunar surface as early as 2015, but no later than 2020.
- Use lunar exploration activities to further science and to develop and test new approaches, technologies and systems, including use of lunar and other space resources, ultimately to enable sustained human and robotic exploration of Mars as well as more distant destinations in the solar system.

From these, the Exploration Strategy-to-Task-to-Technology (STT) process identified five primary objective themes for the RLEP program. These objectives are:

**A. Preparing for Safe Landing and Selecting Exploration-relevant Sites**

Any human-based extended-duration mission to the surface of the Moon will require (for navigation purposes) knowledge of global geodetic topography and detailed hazard-scale mapping for site selection and safe landing. Key environmental characteristics must be understood for risk reduction to human missions as well as robotic and human vehicle design. The radiation, thermal, and lighting environments are items of primary interest in preparation for a short stay on the Moon. Lunar polar regions are of particular interest for mapping and environmental characterization since there is the potential for locating water ice resources. As precursor robotic missions prepare for potentially longer duration human missions to other sites on the lunar surface, additional topographic and resource-relevant mapping will be required for site selection and landing safety.

**B. Emplacing Infrastructure Support**

Providing support for the human missions with preparatory and/or coincident placement of communications/navigation, power, and other necessary infrastructure is also a fundamental objective of the precursors. If it is eventually determined that humans must stay for a long time on the surface of the Moon to enable future human exploration of Mars, it is possible that infrastructure for resource extraction and generation would also be required.

**C. Preparing for and Assessing the Possibility of Resource Utilization**

Currently, the in situ resource of most interest is the potential for substantial deposits of water ice in the lunar polar regions. Lunar robotic precursors will acquire both orbital and *in-situ* ground truth data to determine whether the putative water ice actually exists, its accessibility, and abundance. If found, technology demonstrations would be required to validate techniques for energy-efficient extraction of water ice from the lunar surface materials. Oxygen in the lunar regolith and surface rocks is also of interest and robotic missions may undertake technology demonstrations for small-scale extraction of $O_2$. Additional surveying for resources and resource extraction (such as drilling) may be undertaken as part of the human missions. Longer duration stays on the surface will possibly lead to requirements for larger scale resource extraction and processing if it is determined that this is beneficial on the basis of cost/benefit analysis.

**D. Maturing Technologies**

Through the STT process, a set of critical technologies can be prioritized for investment and when available, can be demonstrated as part of the lunar robotic precursor program. Early technology demonstrations in RLEP include radiation and micrometeorite shielding assessment of materials with low mass atomic constituents that may be used for future missions. Critical components of human environmental monitoring systems can also be tested as a greater understanding of the lunar environment is acquired. It is expected that precision-landing tech-

*(Robotic Continued on page 9)*

*(Robotic Continued from page 8)*

nologies will be required for safe landings of the precursor robotic missions in the desired locations. Additional technology demonstrations such as dust mitigation will aid in Extravehicular Activity (EVA) suit design for humans and demonstration of thermal systems will aid in vehicle design for extreme thermal environments.

**E. Preparing for Human-based *In-Situ* Science Activities**

Supporting the highest priority research to be performed by the human missions on the Moon will involve cooperative work between humans and robots during the landed missions to perform key research activities such as life science experiments, highly informed sample selections (including subsurface), and other detailed investigations of the surface and interior of the Moon.

***Program Architecture***

The RLEP architecture is being crafted to be responsive to the evolving needs of Exploration. It is intended to address key questions faced in the development of the Exploration missions and their necessary systems as framed in the five primary objective themes. As the questions change on the basis of discoveries and new capabilities, so will the solutions. Consequently, the RLEP architecture development is, and will continue to be, highly iterative in its implementation, preserving an option-based template at each step.

Like the NASA Mars Exploration Program, which has been designed to be responsive to discoveries, the RLEP is designed to be responsive to the evolution of Exploration needs. We recognize that the specific character of Exploration needs will progress through the five broadly defined objectives previously outlined, but those needs best served by robotics beyond LRO are not yet clear. As a result, the RLEP is working with the leaders of Exploration to articulate the critical questions that must be addressed, with the corresponding time relevant reference frame, and then developing candidate strawman mission profiles that could be used to address these issues. This process is being used to define the potential pathways that RLEP may take in its future missions.

Key to this activity is recognition that LRO will generate specific testable hypotheses that must be addressed either via follow-on orbital remote sensing missions or via a variety of surface-based missions. Programmatic constraints as well as solid systems-engineering practices will dictate the directions to be taken, as pathways are developed. Not knowing the actual mission requirements at this time, the RLEP Future Missions Office has focused on identifying elements that are common to all lunar missions, starting with the transportation options from Earth to the Moon. Ideally, RLEP would develop the building blocks necessary to enable sustained and affordable robotic access to the Moon – thereby facilitating human system Exploration.

***Implementation Strategy***

The RLEP plans to have between one-half and two-thirds of the activities within its work content open to competition. A broad range of procurement approaches is anticipated to optimally address the large range of potential mission content. Broadly announced competitive procurements and partnerships will be used to the greatest extent possible. Participation by universities, industry, other government agencies, and small, disadvantaged businesses will be promoted and encouraged in all procurements.

NASA Headquarters will procure scientific investigations through the Announcement of Opportunity (AO) process, managed with support from the RLEP Program Office. Headquarters will issue an AO to solicit payloads for a mission prior to the start of mission formulation. The announcement of the awards from the peer-reviewed proposals coincides with the start of the mission formulation.

*(Robotic Continued on page 17)*

# NASA's SCIENCE DATA COULD FILL LIBRARY OF CONGRESS 300 TIMES

The largest scientific data system on the planet, the Earth Observing System Data and Information System (EOSDIS), is providing users around the world with unprecedented access to huge amounts of important information about the Earth's environment. Five years after the launch of the flagship satellite, Terra, the current volume of available data is 4 petabytes (4 followed by 15 zeros), the equivalent of a DVD movie with a running time of more than 160 years or the equivalent of enough information to fill the Library of Congress 300 times.

The EOSDIS supports a diverse customer base of over 17,000 users, including researchers, federal, state, and local governments, the commercial remote sensing community, teachers, museums, and the general public. The EOSDIS stores environmental measurements collected from over 30 satellites, including NASA's EOS satellites (e.g., Terra, Aqua, Aura, ICESat, all managed within Code 400).

These satellites provide images of the entire surface of the Earth every day as well as three-dimensional information about the atmosphere up through the stratosphere. They are capturing amazing geological events, as well as building a long-term database to provide scientists with important information needed to understand how our planet's environment may be changing, including:

- one complete 11-year solar cycle
- extended ozone-hole information
- El Nino and La Nina observations
- volcanic eruption aerosol and ash data

Each day, the equivalent of roughly 44 days of the above referenced DVD movie (3 terabytes) are distributed to users, and 66 days (4.5 terabytes) of new data are added to the archives.

"The EOSDIS has been a boon to the Earth science research community", said Dr. Carl A. Reber (423/900) the EOSDIS Project Scientist. "The availability of, and relatively easy access to, all these data are facilitating unprecedented studies into land and ice cover, the oceans and the atmosphere, as well as encouraging steps toward multi-discipline investigations utilizing information from all the above disciplines."

The EOSDIS is managed by FPPD's ESDIS Project (423) at Goddard Space Flight Center. For more information on EOSDIS, visit: http://romulus.gsfc.nasa.gov/eosinfo/EOSDIS_Site/index.html

Lynn Chandler/ Code 130 (as appearing in the Goddard News)

# THE CRITICAL PATH SOCIAL NEWS

## Congratulations:

Best wishes to Roseline Ude/460 and her husband Henry, on the birth of twin daughters on January 12, 2005. Jessica Aisha weighed in at 6.14 lbs., and Justina Nina was 6.6 lbs. Mom, dad, and big brother Justin are all doing well.

HST Operations Project (Code 441) has three new "engineers-in-training", all of whom arrived on Monday, December 27, 2004:

- Luka Ruitberg (grandson of Project Manager Ed Ruitberg/440)
- Evelyn Noelle and Rebecca Joy Walyus (twin daughters of Operations Servicing Manager Keith Walyus/441)

Excellent timing for tax purposes!

Susan Sparacino/441 is extremely proud to report the December 2004 graduation of her daughter, Rita Sparacino, from the University of Maryland, with a bachelor's degree in civil engineering. Rita begins her engineering career in January, with Wiss, Janney, Elstner Associates, structural engineers, architects and materials scientists, in Fairfax, Virginia.

*(FeedBack Continued from page 3)*

news conferences and in providing launch commentary.

- Badging is constantly changing at KSC. All Safety Training information in the PM50 data base has been forwarded to the VRC to be verified before issuing Temporary Area Access (TAA) badges. If the training is up to date and the VRC receives an authorized request for an Unescorted TAA for specific requested areas, these TAA badges can be picked up at the VRC during office hours.
- Security procedures, too, are constantly changing at KSC and CCAFS. The latest change underway at CCAFS is with the badging procedure relating to Foreign Nationals. They must be escorted at all times while at CCAFS and escorts must attend a security required class designed for escorts. No caravans will be allowed with one escort. Each escort must ride in the same vehicle with the Foreign Nationals being escorted while they are at CCAFS. While working on CCAFS or just passing through to KSC, Foreign Nationals will be accompanied by an escort that has attended the newly required CCAFS Security "Foreign National Escort" class.
- NOAA activity and status is being monitored closely by this office and significant meetings/reviews will be supported.

Mary Halverstadt

*(Bryson TinType from page 3)*

ing week, where they rarely left the roller coasters. It was the trip of a lifetime for his family.

Personal Hobbies: When not working or chauffeuring, Jonathan is a Cub Scout leader and enjoys digital photography and video. He also participates in skiing and snow tubing with the family.

New Job: Jonathan recently accepted a position to be the Chief of a newly formed Policy and Standards Office within Code 150. He has some mixed emotions about leaving FPPD but has faith that he will be able to continue having a positive impact for GSFC missions and personnel. His parting words: "Thanks to all for many great years in Flight Projects. Be safe, be well, be happy."

*(Message from the Director Of continued from page 2)*

supposed inside information about the future direction of every NASA initiative. I believe that we are now seasoned enough to recognize that, while some portion of every rumor may be factual, our job is to aggressively implement the stated mission requirements. Remember that our efforts on Hubble are required both for a specific mission and to enable the successful accomplishment of the President's Exploration Initiative. Goddard is creating the capabilities that are essential if the country is to succeed in space; your contributions enable the pursuit of the most demanding science initiatives. As the opportunities for NASA, GSFC and the FPPD continue to expand, our job is to fully utilize our management and leadership abilities to accomplish our mission in the most effective manner.

It's always easy to comment why something can't be accomplished; our focus on simply getting the job done enables the decision makers to create the path forward based on achieved performance rather than nay-sayers cries of despair.

Rick

## Happy Valentine's Day

With hopes that you are enjoying life
And are happy when each day ends.

# A Home of Their Own

The all-volunteer organization I work with picks up stray cats, gets them a clean bill of health from a veterinarian and fosters them in their home until they are adopted. Over the past year, this small rescue group has saved and adopted out approximately 140 cats/kittens. There are currently 25-30 still in foster homes and more coming every day. Due to the very mild winter we are having, (that just changed) cats who ordinarily would not have survived are in fact living and still producing kittens.

A big part of what our organization does involves fostering stray cats until permanent homes can be found for them. A cat can be in foster care for as little as a few days or as long as a year. We are always in need of reliable foster homes. If you're thinking of adopting a cat, fostering is a great way to find out if a cat is indeed the right companion animal for you.

If you have no previous cat experience, we will match you with a very friendly low maintenance cat and provide you with all the information you will need to care for it. If you have cat experience, you might consider taking a "special needs" cat or kitten. These are animals that need short-term medication or who need to be socialized or re-socialized (We always need people with experience taming feral kittens or semi-feral cats).

Remember that you can get VERY attached to your foster cats or kittens, and letting them go can be difficult. In fact, many fosters end up adopting their foster cats! But there is enormous satisfaction in the job as well, especially with cats that arrive sick and/or feral (and who would have died or been euthanized by a shelter) and leave healthy and tame to go to a loving home.

We will continue to devote our lives to this mission until there are no homeless cats in this world.

If you can provide a loving, safe home for these cats while they await adoption, please contact Mindy Deyarmin/440 at 301-262-2014 or Jean Radaeckar at 410-326-1616.

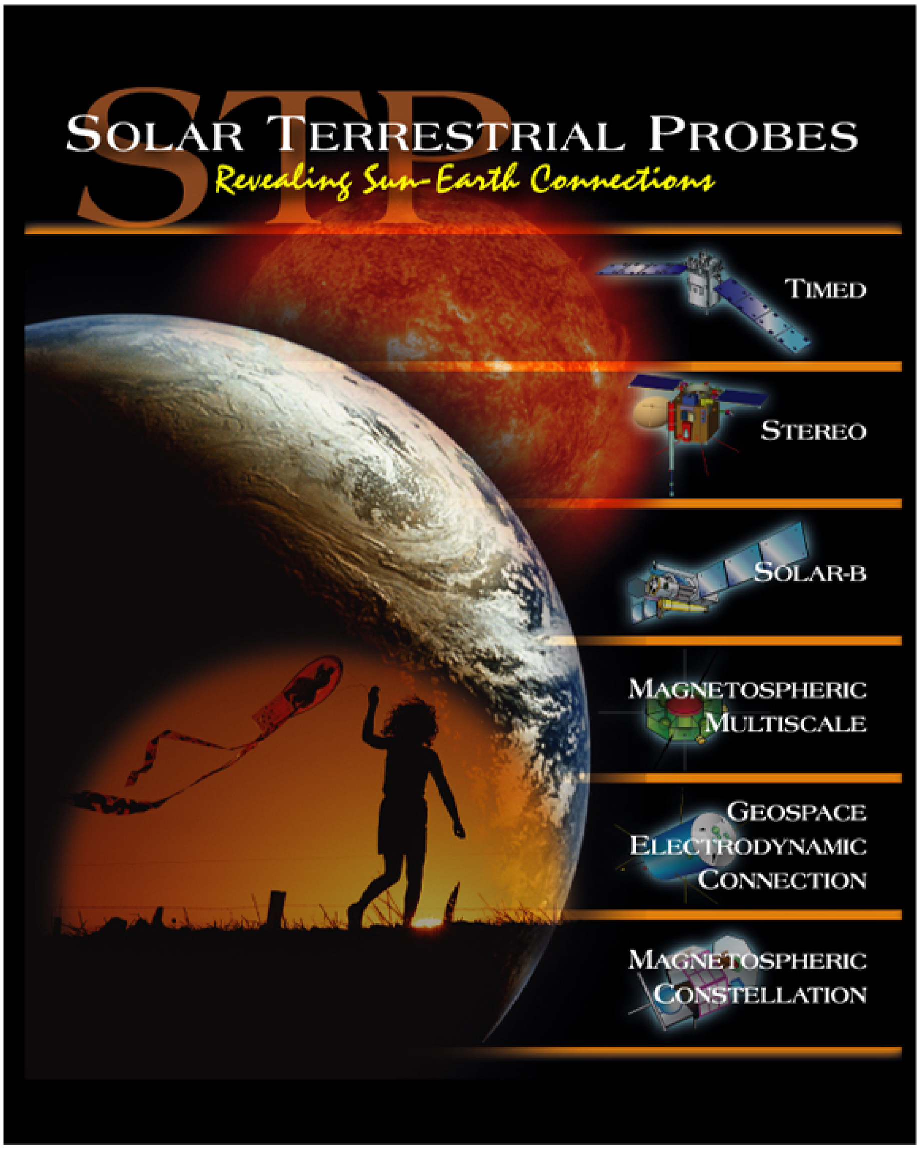
Mindy Deyarmin/440

***Good Luck Cats***

***Looking to add to the family? or be a foster parent? :) Cats available for adoption, rescued in the vicinity of Goddard & Good Luck Road. Vetted, tested, known personalities. Foster homes also needed. Call Elise at 301-526-6899 or go to GoodLuckCats.org.***

# Solar Terrestrial Probes (STP) Not Really a Quirky Mission

"Make it quirky and interesting" that's the message that (the editor) left on my voicemail, so out the window went my plan of writing an article about Solar Terrestrial Probes (STP) that described each of the STP missions and mass, power and other technical details that would probably only be of interest to other systems engineers. So instead I'm going to write a personal account of the early days of the STP program and some items from each of the missions.




I had spent most of my career working integration and test (I&T) or designing electronic hardware. When Abby Harper asked me if I'd be interested in working on a start up program and supporting phase A studies I thought it would be a great change. One of my favorite systems engineering sayings is that "the important mistakes are inherent in the design by the first design review", so this was my chance to do it right and not leave it up to the I&T folks to "test quality into the system". When I joined STP it was about nine months old and still didn't have an official code number or a place to call home. Gil Colón was the Program Manager, Abby Harper was the Deputy and Project Manager for STEREO, Jan Gervin was the Project Formulation Manager (PFM) for Magnetospheric Multiscale (MMS) & Global Electro-Dynamics (GED) (later to change its name to Geospace Electrodynamic Connections GEC), and Peter Panetta was the PFM for nano-sats (later to change its name to Magnetic Constellation). The idea for Solar Terrestrial Probes (STP) came from George Withbroe, then the Associate Administrator for Space Science, who felt the individual missions needed a collective identity to help them survive. Since the missions covered the

*(STP Continued on page 15)*

*(STP Continued from page 14)*

range from solar to magnetosphere and Earth environment the name Solar Terrestrial Probes was chosen.

STEREO already had a science and technology definition team working with engineering support from Jim Watzin. The idea for the Magnetospheric Multi-Scale mission had been floating about for almost ten years being then called Grand Tour lite and was ready for a serious review from the science and technology definition team (STDT) and engineering studies. The Global Electro-Dynamics STDT was a little behind MMS in planning & I remember at one of the first meetings of the science teams that they changed the name to Geospace Electrodynamics Connection so that it would sound similar to Sun Earth Connection!

In the 1998 and the 1999 timeframe there was a push for new technology so the next STP mission planned was to be 100 satellites each weighing 5kg. There was a $4M per year budget for new technology that was split among the missions although Nanosats got the bulk of the money because nobody really knew how to make a scientifically viable satellite for the mass or cost. Nanosats was later named Magnetospheric Constellation to emphasize the science of the mission rather than the engineering.

It was very disappointing that the new technology budget was zeroed out a few years later. The original plan was that each of the STP missions would cost ~$250M (in '97 dollars) and the missions would be launched 18 months apart. STEREO was already above this price and within a short time it became obvious that none of the other missions could be completed at this funding level. The budget would not support the launch rate either. The exception to a fully funded spacecraft mission was Solar-B, which called for three instruments to be supplied by the U.S. for a Japanese spacecraft. Even though the project office for the instruments was at Marshall Space Flight Center, Solar-B was still considered an STP mission.

There are some hurdles to overcome with managing a mission from MSFC out of GSFC. Monthly status still has to be presented to GSPMC and one month Ken Ford was describing how the MSFC Project Manager would be taking another job but would still be involved. Bill Townsend asked Ken if the Project Manager would be "committed" to Solar-B or "involved" in Solar-B. Ken said he wasn't sure of the distinction and Bill said that it's like the difference between ham and eggs. The chicken is "involved" but the pig is "committed". Bill then asked Ken which the MSFC Project Manager was, and Ken immediately replied "he was definitely a ___" (that is—committed).

By 1998 the STEREO science and engineering teams had finished their reports and were proceeding. The price that the engineering team had estimated for the two STEREO spacecraft was $60M. When the 1999 budget came out there was an earmark for APL but it was only later in the fiscal year when APL asked for their $3M worth of work that it became apparent that the STEREO mission was headed for APL. There then ensued a tussle between APL and GSFC & HQ over what this meant. In the end GSFC retained overall responsibility and would provide the instruments; APL would design the spacecraft, provide mission operations and be the mission integrator. Many of the future conflicts and frustrations concerning STEREO would deal with the meaning of the term "mission integrator".

The STEREO project office was initially modeled after the Explorer's project office but it become increas-

*(STP Continued on page 16)*

*(STP Continued from page 15)*

ingly apparent that it would have to be staffed up to accommodate the increasing number of items that APL didn't feel were part of the mission integrator function. At the beginning the STEREO project office staff consisted of Abby Harper (PM), Haydee Maldonado (Systems Engineer) and Randy Pensabene (Instrument Manager – for 13 instruments!) and me part-time. Independent review teams were just coming into vogue and the first independent review of STEREO was in phase A. Over thirty people came to review a project office of three people!! It was not an auspicious start to the independent review process.

Conflicts with APL were common early in the project because it was obvious that our management styles were very different. APL would have preferred that they report directly to HQ for STEREO but failing that, they wanted to use TIMED as the management model. TIMED was the big project at APL at the time (not a pun) but was nominally managed by GSFC; the entire GSFC management team consisted of three people. TIMED was moved into the STP program office since it was a code S mission and it needed a program home. TIMED became the first STP mission and was launched around 18 months late, attributable to a foreign mission that was flying on the same Delta rocket. TIMED had three mishaps immediately after launch. A review panel was convened and subsequent major debates between APL and GSFC took place. Although none of the three reviews (TIMED Mishap Investigation Board (MIB) , CONTOUR MIB and a Code-Q audit) dealt directly with STEREO, they significantly impacted the interpersonal relationships. To APL's credit though they have taken these reviews to heart and have significantly upgraded their internal systems.

From an engineering perspective, each of the three STP missions I've worked on have been wonderfully different: STEREO is a two 3-axis stabilized spacecraft with very tight pointing and thirteen instruments, MMS was originally 5 spinning spacecraft but was reduced to 4 spacecraft when some engineering common sense set in, and GEC is four spacecraft that dip down to 130km altitude. The area that GEC explores is known in the science community as the "ignorosphere" because there is so little known about it: it's too high for planes or balloons and too low for spacecraft. The challenge is to design a mission orbit & spacecraft that has low drag and the spacecraft is perfectly balanced while at the same time accommodating the instruments, other spacecraft components, and the programmatic constraints.

It's ironic that with the latest budget cuts the coherence of the STP missions may be lost. Because of the increase in cost of the missions and the reductions in the latest budget the GEC and MC missions have stretched out to the point where HQ is looking at less costly alternatives to these missions. So while STP has successfully launched it's first mission, it is about a year away from launching its second and MMS is ready to choose instruments. The future direction of the STP will depend on budget constraints and how well we as engineers can meet the science goals with affordable & reliable hardware designs.

Shane Hynes
Code 463

*(Robotic Continued from page 9)*

## *Lunar Reconnaissance Orbiter (LRO)*

LRO is the first of the RLEP missions to the Moon. The four primary measurement objectives of the LRO mission were defined by the Orbiter Requirements Definition Team (ORDT), approved jointly by the Associate Administrators for Exploration Systems, Space Science, Biological and Physical Research, and Space Flight on May 24, 2004. These objectives are summarized below:

1. Characterization of the lunar radiation environment, biological impacts, and potential mitigation. Key aspects of this objective include determining the global radiation environment, investigating the capabilities of potential shielding materials, and validating deep space radiation prototype hardware and software.
2. Develop a high resolution global, three dimensional geodetic grid of the Moon and provide the topography necessary for selecting future landing sites.
3. Assess in detail the resources and environments of the Moon's polar regions.
4. High spatial resolution assessment of the Moon's surface addressing elemental composition, mineralogy, and Regolith characteristics.

Through an Announcement of Opportunity for the LRO, NASA selected six proposals to provide instrumentation and associated exploration/science measurement investigations for the LRO. These measurements will characterize future robotic and human landing sites. It also will identify potential lunar resources and document aspects of the lunar radiation environment relevant to human biological responses. The measurements are critical to the key decisions that must be made before the end of this decade for the ESMD. The six selected investigations and principal investigators are:

***Lunar Orbiter Laser Altimeter (LOLA) Measurement Investigation*** – Principal Investigator Dr. David E. Smith, NASA GSFC. LOLA will determine the global topography of the lunar surface at high resolution, measure landing site slopes and search for polar ices in shadowed regions.

***Lunar Reconnaissance Orbiter Camera (LROC)*** – Principal Investigator Dr. Mark Robinson, Northwestern University, Evanston, IL. LROC will acquire targeted images of the lunar surface capable of resolving small-scale features that could be landing site hazards, as well as wide-angle images at multiple wavelengths of the lunar poles to document changing illumination conditions and potential resources.

***Lunar Exploration Neutron Detector (LEND)*** – Principal Investigator Dr. Igor Mitrofanov, Institute for Space Research, and Federal Space Agency, Moscow, Russia. LEND will map the flux of neutrons from the lunar surface to search for evidence of water ice and provide measurements of the space radiation environment which can be useful for future human exploration.

***Diviner Lunar Radiometer Experiment*** –
Principal Investigator Professor David Paige, UCLA, Los Angeles, CA. Diviner will map the temperature of the entire lunar surface at 300 meter horizontal scales to identify cold-traps and potential ice deposits.

**Lyman-Alpha Mapping Project (LAMP) –** Principal Investigator Dr. Alan Stern, Southwest Research Institute, Boulder, CO. LAMP will observe the entire lunar surface in the far ultraviolet. LAMP will search for surface ices and frosts in the polar regions and provide images of permanently shadowed regions illuminated only by starlight.

***Cosmic Ray Telescope for the Effects of Radiation (CRaTER)*** – Principal Investigator Professor Harlan Spence, Boston University, Boston, MA. CRaTER will investigate the effect of galactic cosmic rays on tissue-equivalent plastics as a constraint on models of biological response to background

*(Robotic Continued on page 18)*

*(Robotic Continued from page 17)*

space radiation.

LRO is a one year duration reconnaissance mission to be flown in a low (50 km) lunar polar orbit. It will be launched on a Delta II class launch vehicle in late 2008 and fly a direct insertion trajectory to the Moon. The observatory is a 3-axis stabilized nadir pointing platform with a total mass, including fuel, of approximately 1000 kg. The preliminary design for LRO orbiter is shown in Fig. 1 and key attributes of the spacecraft are given in Table 1.

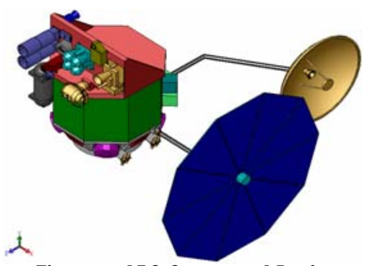


**Figure 1. LRO Conceptual Design**

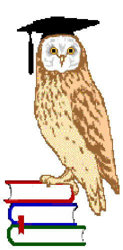
| LRO Flight Segment Mass & Power Estimates | | |
|---|---|---|
| *Range of on-going design trades* | | |
| **Subsystem** | **Mass (kg)** | **Orbit Average Power (W)** |
| Instrument Payload | 100 | 100 |
| Spacecraft Bus (Dry) | 454 - 484 | 300 - 355 |
| Propellant | 396 - 583 | |
| **Total:** | 980 - 1137 | 400 - 455 |
| Launch Vehicle Capability (C3 = -2.0) | 1285 - 1485 | |

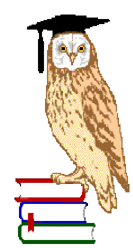
**Table 1. Key Spacecraft Attributes**

In addition to the one year primary mission, LRO is being designed to be potentially flown for up to four additional years in an extended mission. Possible objectives for an extended LRO mission include functioning as a communication relay asset for subsequent missions and performing additional target observations in support of exploration planning.

Jim Watzin, Code 430/Program Manager

# Quotes of the Quarter





*"I have the two greatest stimulants in the world to action; youth and debt."*
*- Benjamin Disraeli (1804—1881) -*

*"There are no such things as incurables. There are only such things for which man has not found a cure."*
*- Bernard Baruch (1870—1965) -*

*"If you find yourself in a hole, stop digging."*
*- Will Rogers (1870—1965) -*

*"If you torture data sufficiently, it will confess to almost anything."*

## *Project Management Conference – 2005*

The Program for "Project Management Challenge 2005", the Second Annual NASA-wide Conference on Project Management, is now posted on our web site. The program currently includes:

- 70 Different Track Topics
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If you visit our web site at http://pmchallenge.gsfc.nasa.gov/>http:/ pmchallenge.gsfc.nasa.gov you can find abstracts of the program topics and bios of the speakers, to help you plan your time at the conference. You can also find out more about the many exhibitors who will be displaying their products and services at the conference.

If you have not yet registered, please go to: <http://pmchallenge.gsfc.nasa.gov/>http://pmchallenge.gsfc.nasa.gov and click on "Registration". Space is still available. Also, if you registered but have not yet paid, please make payment ASAP. Your seat is not confirmed until payment is made.

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Dates - March 22 & 23, 2005

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Should you have any questions about the registration process, please feel free to contact Sandra Adorney at 301-286-3413.

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| ASTRO-E2 | MAY |
| GOES N | MAY |
| CINDI | JULY |
| CALIPSO | JULY |
| CLOUDSAT | JULY |
| TWINS-A | JULY |

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