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A Newsletter Published for Code 400 Employees

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Hubble Upgrades Usher in A New Era in Astronomy

Sporting a tenfold increase in optical capability, the newly refurbished Hubble Space Telescope (HST) is now delivering unparalleled and breathtakingly clear pictures of the Universe. On April 30, 2002, as NASA released the first four images from Hubble's new main camera, astronomers promised that this is just the beginning of a new era in discovery.

Jubilant scientists unveiled the first images taken by Hubble since STS-109, the March upgrade mission to the modular HST. During the 10-day mission, astronauts from the Space Shuttle Columbia installed the new Advanced Camera for Surveys (ACS) and made other important improvements to the orbiting observatory.

The new, test photos unveil thousands of previously overlooked features, including stellar nurseries, extremely faint and distant galaxies, and cataclysmic collisions between galactic neighbors. Dr. David Leckrone, Hubble's Senior Scientist, called the new pictures "remarkable, breathtaking. They're everything we expected and more!"

With more sensitivity than the largest ground-based telescope, ACS is expected to see the very faintest objects ever. Its camera delivers a panoramic crispness comparable to that of a wide-screen IMAX movie, a staggering 16 megapixels per snapshot (a megapixel equals a million picture elements). Typical consumer cameras are 2 to 4 megapixels.

"We have a great camera!" declared Dr. Holland Ford, ACS Principal Inves-

(HST Continued on page 10)

**Grace Doing Great
See Page 4**

**Aqua Lifts Off In Flawless Fashion
See Page 8**

Message from the (New) Director Of

To all of Code 400: I'm delighted to be here as Director of Code 400. My arrival has been paved by the good wishes and welcome that so many of you have offered, and punctuated by one of our major events of the year - the successful launch of Aqua. My congratulations go out to all of you who have worked so hard for many years to bring us this key milestone in the life of Aqua. I wish you all continuing success as we activate the spacecraft and bring it to a nominal operational state. I am eager to share in the scientific understanding and new discoveries that Aqua will bring us in the years to come.

We have many more events, large and small, to fill out our year. I look forward to being part of them, to learning about the myriad programs and projects of Code 400, and to working with all of you in the course of the daily happenings that are the building blocks of our projects.

Dolly

SOHO Discovers Comet #420

Who would have thought when the Solar and Heliospheric Observatory (SOHO) was launched on December 2, 1995, that it would become the most prolific comet discoverer in the history of astronomy.

When launched from Cape Canaveral Air Force Station (CCAFS), objectives of the NASA/Goddard Project, in association with the European Space Agency, were to use the Sun-pointing observatory to investigate the interior structure and dynamics that regulate energy flow and produce magnetic field structures at the base of the solar corona. Key goals were to study the interior structure of the Sun; perform solar atmospheric remote sensing to study heating and acceleration mechanisms of the solar wind; obtain measurable parameters in the outer solar wind; and perform in-situ measurement of energy distribution and composition of the solar wind.

(SOHO Continued on page 8)

PERSONALITY TINTYPES

Kevin Grady

Kevin Grady is the Project Manager for the NPOESS Preparatory Project (NPP), Code 429. Kevin has been at Goddard since 1978, the last 14 years in the Flight Programs and Projects Directorate. His entire career at Goddard has been directed toward supporting flight programs, with the exception of a 4 year tour on one of the Center's greatest "experiments", the Space Station.



Born: Riverside, New Jersey

Education: Bachelor's degrees in physics and engineering from Drexel University in Philadelphia, Pennsylvania and a Masters degree in electrical engineering from Johns Hopkins University.

On Family: Kevin and his wife Jean (also a Goddard veteran) live in Columbia, Maryland with their two sons, Patrick, age 5, and Brendan, age 3. Prior to doubling the size of the family, Kevin and Jean enjoyed skiing, golfing, camping, running, theater and dining out. More recently they have refined their tastes to include tee-ball, miniature golf, hanging out at playgrounds, digging forts at the beach, kids videos, and Flumpa. Hope is in sight, as well as their completed foursome, as both Patrick and Brendan love to play golf. Kevin's hope is that one or both of them will do good enough to keep Kevin from having to double-dip to pay their college tuition.

Life on NPP:

Kevin joined the NPP Project in the fall of 2001. NPP is often referred to as the bridge mission between the initial series of EOS satellites (Terra and Aqua) and the NPOESS era that will begin at the start of the next decade. For NASA it represents continuity of critical climate change measurements started on Terra and Aqua; for the NPOESS Program it is a risk reduction activity of three of the four critical new development sensors for the Program.

The attractiveness of the NPP Project lies in the strength and abilities of the personnel that the Project is fortunate to have as part of the Team.

(Tintype Continued on page 16)

Cheryl Powell

Cheryl joined the IFMP Project in February 1998 as a secretary. She was selected for the Resources Analyst position in

March 1999 and since that time has spent her days monitoring and accessing costs for various contracts.

Born: Cheverly, Maryland

Education: High school graduate and some college at UMD and PGCC. Still working on pursuing a degree in Business Management.

On Family:

Cheryl's parents passed away in the last couple of years. She is so grateful to have had such wonderful parents. Her brother Gary lives in Georgia and her sister Elaine lives close by in Laurel, MD. She also is very close to her Aunt Mary Rose and Uncle Elmer who also live in Maryland. Cheryl resides in Seabrook with her dog Jack.

Life before IFMP:

Cheryl worked the summer of 1974 with the Department of Agriculture. She then started work at NASA/GSFC in August and was a secretary for 24 years with Personnel, Infrared and Radio Astronomy Branch, Flight Projects Directorate and as of February 1998, the IFMP Project.

Life on IFMP:

Cheryl loves it! She feels that God has blessed her with so many wonderful co-workers and friends. The work on IFMP involves funding different contracts and tracking costs. Since becoming a Resources Analyst it has been extremely interesting and challenging. She feels IFMP has provided her with an abundance of resources experience. She feels incredibly fortunate to have been chosen for the Resources Analyst position after being a secretary for so many

(Tintype Continued on page 16)

FEEDBACK

GSFC Resident Office at KSC

- Security policy (currently, the Security Classification is Bravo) is in place and will most likely continue throughout 2002 at Cape Canaveral Air Force Station (CCAFS) and Kennedy Space Center (KSC). "Gate Badges" will be re-instated beginning May 2002 and "Mission Badges" will be discontinued. Once the Resident Office requests the "Gate Badges" for processing team members, they can be issued at Gate 1 or Gate 3, the same as they were before September 11, 2001. Security requirements change frequently, so GSFC Projects must check with the Resident Office before traveling to KSC/CCAFS to avoid delays.
- Two GSFC payloads were launched in March 2002, Hubble Space Telescope Service Mission (HST SM 3B) and TDRS-I. HST SM 3B was successfully launched on board the Columbia Shuttle (STS-109) March 1, and TDRS-I was successfully launched on an ATLAS rocket March 8, 2002. Both missions required extra badging and safety training. Both teams required "Mission Badges" and the TDRS-I team also required Air Force Badges. "Mission Badges", Air Force Badges, and Personnel Access Control Accountability System (PACAS) badges must be returned to the Resident Office after each mission is complete. Attention Project Managers: these badges are the property of the U. S. Government and must be returned for accountability. If these badges are not returned it could limit or jeopardize access.
- Teams for the Fast Reaction Experiments Enabling Science Technology Applications and Research (FREESTAR) payload are processing in the Multi-Payload Processing Facility (MPPF). FREESTAR is composed of the following six separate experiments: MEIDEX, SOLCON-3, SOLSE-2, CVX-2,

(FeedBack Continued on page 16)

AMAZING GRACE!

On March 17, 2002, the twin Gravity Recovery and Climate Experiment (GRACE) satellites launched successfully from the Plesetsk Cosmodrome in Russia aboard the Eurockot GmbH ROCKOT launch vehicle. The GRACE satellites are now orbiting the Earth at an 89 degree inclination and 500 km altitude.

The purpose of the 5-year GRACE mission is to measure the Earth's gravitational field to an accuracy better than 20 times our current knowledge. GRACE will be able to map the Earth's gravity field by making measurements of the distance between the two satellites, using a microwave ranging system. With this system, the relative distance of the two satellites separated along track by 220 km can be measured to an accuracy of less than the thickness of a sheet of paper. This is important as the twin GRACE satellites orbit the Earth gravity field variations cause small changes in the distance between the two. Results from this mission will yield crucial information about the distribution and flow of mass within the Earth and its surroundings. Gravity variations that GRACE will study include: changes due to surface and deep currents in the ocean; runoff and ground water storage on land masses; exchanges between ice sheets or glaciers and the oceans; and variations of mass within the Earth.

In addition to the primary gravity measurement, GRACE also carries a limb sounder that will obtain measurements intended to determine how much error is introduced into measurements made by Global Positioning Satellites (GPS) as the signal passes through the ionosphere and atmosphere. These will be obtained using a technique known as occultation, where the GPS receivers on the GRACE satellite track refracted signals from the GPS satellites as they rise or set through the Earth's atmosphere and compare

them to a non-occluding GPS satellite. This measurement also reveals information about ionospheric pressure, important to weather prediction.

GRACE was one of the first two ESSP missions selected in March 1997, in response to the program's first Announcement of Opportunity as part of NASA's Earth Science Enterprise. In March of this year, just 5 years after selection, GRACE became the first ESSP mission to launch. With a total NASA mission cost of \$96.8M, GRACE is a legacy of NASA's faster, better, cheaper philosophy, to provide significant science for small cost. As such, the GRACE project office relied upon a small, but very talented and motivated team to design, build and fly the mission. The complex international organizational structure was managed efficiently at JPL, with the help of a multi-organization Steering Group, chaired by Principal Investigator (PI) Dr. Byron Tapley from the University of Texas at Austin and co-chaired by the Co-PI, Dr. Christoph Reigber of the GeoForschungs Zentrum in Potsdam, Germany.

GRACE is a partnership between NASA and the German space agency known as the Deutsches Zentrum für Luft und Raumfahrt (DLR), where NASA provides the two GRACE satellites and science data processing, while the DLR provides the launch service and mission operations for 5 years.

Within NASA, GRACE is known as a "Principal Investigator mode" mission, where the PI leads the mission team and reports to the Earth Explorers Office at GSFC, which is the Lead Center. As noted earlier Dr. Tapley, is the GRACE PI. Project management is provided by Mr. Ab Davis and his team at the Jet Propulsion Laboratory

(GRACE Continued on page 5)

(GRACE Continued from page 4)

(JPL). This team works with Rick Fitzgerald, the GRACE Mission Manager for the ESSP Office of Earth Explorers at GSFC.

Prime GRACE contractors for JPL include Astrium GmbH in Friedrichshafen Germany for the satellite buses, Space Systems Loral in Palo Alto for the attitude control system design and mission planning, ONERA in Paris, France for the SuperSTAR accelerometers, the Danish Technical University in Copenhagen, Denmark for the star camera, and JPL -the K-band ranging instrument and GPS receivers.

The GRACE mission is operated at DLR's German Space Operation Center (GSOC) in Oberpfaffenhofen, Germany, with support from NASA's Polar Ground Network (PGN). Science data processing is performed at the University of Texas and at JPL.

For more information on GRACE, visit <http://www.csr.utexas.edu/grace/>



Off We Go!



***The GRACE twins at Astrium GmbH
Photo courtesy of Astrium***

Rick Fitzgerald
GRACE Mission Manager/ESSP Project Code (471)

Whoops!

In a letter printed in the last issue of The Critical Path I noted that the writer, Mitch Hobish was retired. Well, in fact, I made an (incorrect) assumption that since he left the area and moved to a new home in the mountains of Montana, that he had left behind his excellent scientific and technical research and writing skills and retired. It didn't take long to hear from Mitch, who advised me, in no uncertain terms, that he is still hard at work serving clients back east as well as elsewhere. Although it is a vain resolution, I promise never to make another assumption. Perhaps it will last for at least one issue of The Critical Path.

The Editor

FUSE Science Operations Start-Up Once Again

After science operations with the Far Ultraviolet Spectroscopic Explorer (FUSE) were suspended in December 2001 due to problems with two of the four reaction wheels on-board, the FUSE Project is happy to report that new procedures and software have been developed that allow FUSE to resume science operations.

It was November 25, 2001, just as FUSE was finishing its second year of science operations, that one of the reaction wheels (also known as momentum wheels) experienced a friction event and stopped turning. The

FUSE History

On June 24, 1999, the Far Ultraviolet Spectroscopic Explorer (FUSE) satellite was successfully launched from Cape Canaveral FL aboard a Delta II 7320 Expendable Launch Vehicle.

FUSE is a NASA mission developed and managed by the Johns Hopkins University in collaboration with other universities, contractors and international partners. FUSE performs high-resolution spectroscopy in the far ultraviolet spectral region to probe the chemical composition and evolution of the universe. The on-orbit operations are managed from the satellite control center located on the Johns Hopkins Homewood campus in Baltimore MD.

wheels are needed for positioning and stabilizing the satellite thereby permitting science observations. By design, full control of the satellite's pointing can be maintained with any three of the four wheels operating. Unfortunately, on December 10, 2001, a second wheel shut down, leaving only two operational wheels. This meant that control could be maintained in only two axes

of motion, not the three axes required. FUSE automatically went into its safe hold mode in which the solar panels always face the sun and three axis pointing control is not required.

FUSE could remain in this attitude indefinitely, which gave the FUSE team time to troubleshoot the problem and come up with a solution without worrying about losing the spacecraft. On December 20, a software patch provided by the spacecraft vendor, Orbital Sciences Corporation, was uploaded to the spacecraft. This patch brought the magnetic torquer bars (MTBs) into the attitude control loop and provided modest stability in the otherwise uncontrolled "yaw" axis of motion. When running electrical power through the MTBs, local magnetic fields are generated. Changing the direction of the current flow flips the polarity of the magnetic fields. The torquer bar magnetic fields "push" and "pull" against the Earth's magnetic field to control the satellite's motion and pointing in the uncontrolled axis. Additional procedures and software were developed and checked out, so that now FUSE can perform science observations. In this new configuration, FUSE has demonstrated about 0.6 to 0.7 arc seconds of pointing stability which is within a factor of 2 of what it was previously.

The only limitation is that the control ability on the magnetically controlled axis is not as powerful as provided by the reaction wheels. It is like having a strong muscle in two directions and a weak one in the third direction. In addition, the strength and direction of the Earth's field varies as FUSE goes around the orbit, so the strength of the weak muscle varies with time and with the satellite's pointing direction. This makes the ability to hold steady for science operations a complicated function of time and the observing direction in the sky. Despite these limitations, FUSE has been able to resume its science program.

Congratulations to all the FUSE scientists and engineers from Orbital Sciences Corporation, the Johns Hopkins University and the supporting staff at NASA/GSFC for their efforts in the FUSE recovery. Also, a thank you goes to Bill Blair, Chief of Observatory Operations, Johns Hopkins for his inputs to this article.

Dave Mengers, Code 410/FUSE Mission Manager



Things You Should Know About

Upcoming Events

The 2002 Peer Awards

Just a heads-up to let you know that this year's Code 400 Peer Awards ceremony is scheduled for September 18, 2002. The Critical Path August issue will have full details.

The FPPD Peer Awards are morale boosters that say my co-workers (civil servants and contractors alike) value me and my work. It is a process that recognizes that we are all peers, a Code 400 value added process for identifying nominees for Agency and Center Awards. The FPPD Peer Awards promotes and recognizes innovation, teamwork, respect, diligence and efforts to improve. It recognizes all who contribute to the success of the Directorate (both Code 400 and matrixed personnel) and provides illumination of the breadth and depth of the Directorate's Mission and its People. It gives us the opportunity to say – Thank You!

This year's Peer Award Committee will be sending out a call for nominations on May 31. It will include a guideline for the types of awards and write-ups required. Be on the lookout!

New FPPD Logo

The Logo Selection Committee met again to recommend a logo from among several submissions. One last meeting has been scheduled. The Director of will make a final selection shortly thereafter. Look for more information from the 400 suite in the ensuing weeks. Of course, the new logo will appear in the next issue of The Critical Path along with the name of the winner.

Public Service Recognition Week

Many public employees at all levels of government took a few hours between May 6 and 12, 2002 to observe "Public Service Recognition Week". Events recognizing Federal employees and the work Federal agencies perform to serve America were held throughout the nation. An expo of Federal agency exhibits took place on the National Mall in Washington from May 9 through May 12. NASA presented a Space Flight exhibit highlighting the Space Shuttle/International Space Station Program.

Congress had earlier resolved to observe Public Service Recognition Week. Resolutions were introduced in the House of Representatives and the Senate recognizing public servants and members of the military for their dedicated service.

Quann Update

For those of you who knew former Deputy Center Director, John Quann, you will likely recall that he suffered a massive stroke 5 years ago. His recovery from the brain hemorrhage has been miraculous. Since the attack, John has regained nearly all physical function and continues to work on his speech and memory. Now fully retired, John is enjoying life with his wife Eileen and can drive himself around town to perform errands. Eileen has documented the remarkable story of John's life-changing events in the book, 'By His Side: Life and Love After Stroke'. Incidentally, the book is available at the GEWA Store

Aqua Spacecraft Launched

On Saturday morning, May 4, the Aqua spacecraft was successfully launched from the Western Test Range at Vandenberg AFB. Following the Terra liftoff late in 1999, this latest Earth observing satellite will advance our understanding of Earth's water cycle and our environment.

A joint project of the United States, Japan and Brazil, the project was managed at GSFC, which provided the spacecraft and 2 of the 6 scientific instruments aboard. Within NASA, other instruments were provided by Langley Research Center and the Jet Propulsion Laboratory. The instruments will collect data on global precipitation, evaporation, and the cycling of water.

Aqua will cross the equator daily at 1:30 p.m. as it heads north. The early afternoon observation time contrasts with the Terra satellite, which crosses the equator between 10:30 and 10:45 a.m. daily. Aqua's afternoon observations combined with Terra's morning observations will provide important insights into the daily cycling of key scientific parameters such as precipitation and ocean circulation.

Aqua is part of NASA's Earth Science Enterprise, a long-term research effort dedicated to understanding and protecting our home planet. Through the study of Earth, NASA will help to provide sound science to policy and economic decision makers so as to better life here, while developing the technologies needed to explore the universe and search for life beyond our home planet.

(SOHO Continued from page 2)

As an incredible long lasting bonus, on April 12, a Chinese amateur astronomer discovered the latest comet over the internet while visiting the website for SOHO. These comets, (more than 400 discovered since SOHO was launched) are very close to the Sun and are very small and faint. They can only be seen through a space-based coronagraph like that on the SOHO. The new comet was discovered while the astronomer was watching SOHO real-time images of the Sun on the internet.

Meanwhile, NASA's tour of the Comets Program is well underway. The \$60M CONTOUR (Comet Nucleus Tour) is scheduled for a July launch from CCAFS in July, on a 6-year mission to fly by and photograph the nuclei of 3 comets. The NASA/JHU-APL/Cornell spacecraft has just completed extensive testing at GSFC and has been shipped to CCAFS.

"Cultural Tidbits"

Did you know ...

...that laugh clubs are being organized in Germany to combat the trend toward seriousness. Statistics show that on average Germans only laugh six minutes daily. As of the year 2000, there were 22 laughing clubs around the country with about 350 members.

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

Andrea Razzaghi/Code 424

PMDE Graduates Four

At a brief ceremony on April 25, Dolly Perkins, Director of FPPD, presented graduation plaques to 4 PMDE mentees (see pictures below). PMDE, established in 1990, is currently advertising for a 2002 class. Since inception, 49 Goddard (including Wallops) civil service employees have been brought in to the program. Thirteen active mentees remain in PMDE, each one matched with a mentor. Project Management Development Emprise is a developmental program that provides participants with a variety of work experiences, training and instruction that will prepare them to assume program/project management positions anywhere on the Center.



From left to right, Code 400 Director Of Dolly Perkins and graduates Kevin Miller (490), Rich Ryan (405), and Jim Smith III (410)



Director Of Dolly Perkins awards plague to new graduate Candace Carlisle (533) in a separate meet-

THE CRITICAL PATH SOCIAL NEWS

Births

Best wishes to Dena Butler (Coder 403), and husband, Terrence. Dena gave birth to a darling baby boy on April 5, 2002, at 8:47 a.m. Terrance Xavier weighed in at 6 lbs., 13.3 oz.



Late Breaking News!! - Gretchen Burton (403) and her husband Tom became grandparents for the first time on Friday, May 10, 2002. A grandson Jack Burton Pinkerton was born in Boulder, CO, at 6:04 a.m. He weighed 6lbs. 13 oz. Gettchen, Tom, their daughter and son-in-law, and grandson are all doing fine!!

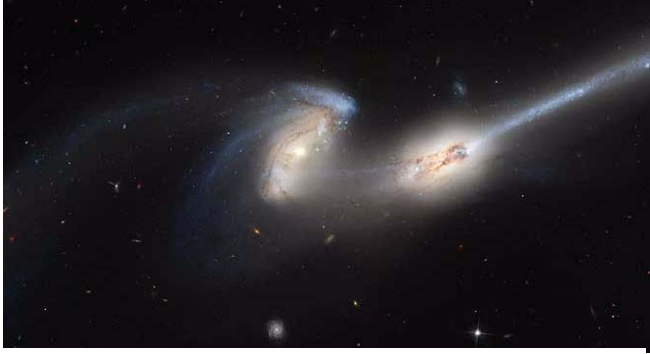
Weddings

Congratulations to Carol Dibble (Code 410). She and Rick Wooten were married on May 4, 2002 in Temple Hills, MD.

Justin Se- kula, son of Jeaneene Grisham (Code 495), recently won first place in the science fair for his 4th grade class in his school, and also took home one Of the first place awards in the Prince George's County "Kids for Science" Science Fair. Way to go, Justin!

(HST Continued from page 1)

tigator. He marveled that these test pictures of the distant universe were the best humans had ever



The Mice—Resembling a pair of dancing mice, these spectacular colliding galaxies are located 300 million

seen. "ACS will allow us to push back the frontier of the early universe," Ford said. We will be able to enter the 'twilight zone' period when galaxies were just beginning to form out of the blackness following the cooling of the universe from the Big Bang." Installed on March 7, 2002, ACS is Hubble's first new visible-light camera in nine years. Compared with the telescope's former workhorse, the Wide Field and Planetary Camera 2, the ACS covers more than twice as much sky with sharper resolution and higher sensitivity. Its detector array records a patch of sky 3.4 arcminutes square, or about one-ninth the apparent diameter of the Moon.

Hubble's breathtaking portraits include a dusty, volcano-like area of star formation, an ethereal, rainbow-colored nebula that serves as a stellar nursery, a disturbed, cannibal galaxy that looks like a tadpole, and a pair of colliding, spiral galaxies that resemble dancing mice. This last image, informally dubbed The Mice, could offer a glimpse of the future of our own Milky Way, which astronomers predict will collide the neighboring Andromeda galaxy in several billion years.

The Long Road to Here

The jubilation of April and May was a long time in coming. Even before the tension and adrenaline of the March mission, the heady excitement of mating the Hubble payload to Columbia, and the long

months of diligent integration and testing at Goddard and Kennedy, the Hubble team spent years preparing for this launch. In addition to designing and developing the new Hubble equipment, the team trained the STS-109 astronauts—particularly the four spacewalkers—for more than two years.

"If it were not for the fact that mission preparations take two years to complete," joked astronaut, astrophysicist and payload commander John Grunsfeld, "One might be tempted to think that working in space is a piece of cake!"

Actually, Grunsfeld's training started back in 1997 when he was selected as a spacewalker for the original HST Servicing Mission 3. Back then, the plan was to replace the solar arrays, install ACS, the new cooling system for NICMOS, a Fine Guidance Sensor (FGS), and some small electronics boxes to improve the Hubble systems. A failure of the telescope's gyros, which allow Hubble to point precisely, would change that plan and require an urgent call-up mission to launch as soon as possible.

Thus, SM3 was split into two parts: SM3A and SM3B. In December 1999, the Space Shuttle Discovery flew to Hubble on SM3A. Astronauts—including Grunsfeld—installed a fresh complement of gyroscopes, a refurbished fine guidance sensor, an advanced main computer, and other new electronics.

After SM3A, Grunsfeld stayed on with the Hubble team to provide continuity for SM3B. He joined a new crew, including mission commander Scott Altman, a Commander in the U.S. Navy, and an aeronautical engineer on his third space mission. Columbia's pilot, U.S. Air Force Lieutenant Colonel Duane Carey, was an aeronautical engineer flying his first space mission. John's spacewalking partner was veterinarian Rick Linnehan on this his third ride to orbit.

Physicist Jim Newman, on his fourth space mission, led the team performing the second and fourth spacewalks. His partner, Mike Massimino, was a mechanical engineer on his first flight. Rounding out the team was flight engineer and robotic arm operator Nancy Currie, a Colonel in the U.S. Army

(HST Continued on page 11)

(HST Continued from page 10)

and an industrial engineer, on her fourth flight. For astronomers, the climax of this fourth Hubble house call would be the installation of ACS, a state-of-the-art imager with twice the field of view and five times higher sensitivity than any of the telescope's earlier instruments. For the average person following along at home, the most photogenic and noticeable difference would be the replacement of Hubble's wing-like solar arrays. But for the Hubble team, the hands-down heartstopper would be the changeout of the Power Control Unit (PCU), which distributes electricity throughout Hubble's systems. The scary part of this task was that it required the telescope to be shut off completely—something that hadn't been done since Hubble's deployment in April 1990.

In the end, the hard work, training and obsessively diligent testing paid off. After lying lifeless while as-

tronauts replaced the PCU, Hubble pulsed back to life when commanded to do so. The telescope's new solar arrays and electronics now provide it with about 30 percent more power than before—enough to operate several scientific instruments at once. And Hubble now has at least ten times more discovery power than at any time since its launch 12 years ago.

That's the condensed version of the SM3B story. What follows is a first-hand, personal and more detailed account of those wonderful, agonizing days in March.

"A Thing of Beauty!"

At 6:21 a.m. on March 1, the first moments of dawn broke across the eastern sky in green and peach and federal blue. From the still-dark west, a small, bright light appeared, moving high and fast

(HST Continued on page 14)



Lift Off—HST Service Mission 3B Aboard Columbia



GSFC 2001 Annual Honor Awards Program (March 8, 2002) Code 400 Recipients



INSTITUTIONAL SUPPORT - INFRASTRUCTURE

Ms. Valerie L. Potter/442 “In recognition of your dedication, hard work, and great attitude to bring about process improvements in the Hubble Space Telescope (HST) resource office.”

GROUP - Building 32 Critical Power Reconfigurations Tiger Team/423* “In recognition of your ability to rapidly mitigate serious risks to Earth Science Enterprise flight missions operated from GSFC/Building 32 involving the critical power infrastructure.”

INSTITUTIONAL SUPPORT - PROGRAMMATIC

Mr. Raynor L. Taylor/429 “In recognition of your exemplary performance and accomplishments in the establishment and operation of the interagency National Polar Orbiting Environmental Satellite System (NPOESS) Preparatory Project (NPP) Project.”

OUTSTANDING TEAMWORK

GROUP - POES METOP Team/480 “In recognition of the dedicated teamwork that successfully integrated United States instruments to the European METOP spacecraft.”

SECRETARIAL AND CLERICAL EXCELLENCE

Ms. Jennifer Baldwin/402 “In recognition of your exceptional performance in facilitating high level interagency interactions and filling in as lead secretary for the Tri-Agency National Polar Orbiting Environmental Satellite System (NPOESS) Integrated Program Office.”

SAFETY AWARD OF HONOR

Mr. Robert J. Menrad/423 “In recognition of your leadership in configuring Building 32 facilities for operational robustness, thereby assuring essential support for Earth Science Enterprise missions.”

EXCELLENCE IN OUTREACH

Mr. David K. Martin/415 “In recognition of your enthusiasm in spreading excitement of NASA’s work through outreach to schools and professional groups.”

NATIONAL RESOURCE

ISTP Ground System Staff “In recognition of the substantial contributions made by the International Solar-Terrestrial Physics (ISTP) Ground System staff enabling Sun-Earth Connections science.”

CENTER OF EXCELLENCE

Ms. Heather L. Keller/410 “In recognition of your outstanding performance and dedication as the Business Man-

*Several group awards include employees from a number of directorates.



GSFC 2001 Annual Honor Awards Program (March 8, 2002) Code 400 Recipients



(Continued from page 12)

ager for the Microwave Anisotropy Probe (MAP) mission.”

GROUP – Microwave Anisotropy Probe (MAP) Team/410 “In recognition of your outstanding performance and dedication in the successful development and operation of the Microwave Anisotropy Probe (MAP) mission.”

GROUP – Resume Management Project Team/405 “In recognition of your outstanding achievement in implementing NASA’s new Staffing and Recruitment System (STARS) which significantly contributes to NASA’s business drivers and the President’s Initiatives.”

GROUP – Space Telescope Imaging Spectrograph Recovery Team/440 “In recognition of your outstanding performance in the recovery of the STIS instrument operation and resumption of the STIS science program.”

GROUP – Triana Project/474

In recognition of your extraordinary efforts, unfailing spirit, and endless creativity in developing and preparing for this challenging mission.

OUTSTANDING LEADERSHIP

Ms. Elizabeth A. Citrin/410 “In recognition of your outstanding leadership of the Microwave Anisotropy Probe (MAP) as Mission Systems Engineer and Project Manager.”

Dr. Bryant Cramer/490 “In recognition of your outstanding programmatic leadership for the EO-1 Project.”

CONTRACTOR EXCELLENCE

Mr. John W. Allen/422 (DSC) “In recognition of your extraordinary efforts in reviewing and solving critical flight code problems that have made a substantial and direct contribution to the success of the Aqua Mission.”

Ms. Leslie M. Cusick/420.2 (QSS) “In recognition of your outstanding effort in the execution of Global Precipitation Measurement (GPM) advanced study and the establishment of the GPM Formulation office.”

Dr. George F. Hartig/441 (STS) “In recognition of outstanding contributions to the successful development of three generations of Hubble Space Telescope science instruments.”

GROUP – Radiation Protection Team/423 “In recognition of your outstanding contributions in implementing Goddard’s Radiation Protection Program.

(HST Continued from page 11)



Working In Space

to greet the breaking day. This was Hubble, streaking overhead as the Space Station readied to leave the launch pad. Columbia's main engines roared to life and at 6:22 a.m., lit up the sky with a brilliant glow. As Columbia rushed heavenward, Hubble appeared to meet the Shuttle high above the launch pad. No one had planned this breathtaking spectacle, but those who saw it will never forget. The actual rendezvous of Hubble and Columbia would take place about a day-and-a-half later. Payload commander John Grunsfeld describes the hours leading up to the handshake in space: "Early in the day, as we slowly advanced on HST, the orbiter crew continued the task of preparing Columbia for our rendezvous and grapple. Of course slowly is a relative term, as both the Hubble and

Columbia are orbiting the earth at about 17,500 miles per hour. As we approached the telescope, Scott Altman fired reaction control jets to slow our rate of closure. Each time one of the jets in the nose of the orbiter fires, it sounds like a cannon blast, and everything in the cabin shakes and vibrates. With a 100-plus-ton spaceship it takes a lot of punch to move it around, even in free fall."

"I truly felt like I was close to visiting an old friend again," continued Grunsfeld. "Scott slowly brought the shuttle in close, with Duane Carey backing him up. Jim Newman was on the laptop computer providing situational awareness calls from a program that displays our trajectory on the computer screen. Rick manned the hand-held laser, as used by police to catch speeders, to monitor the distance to Hubble. Nancy Currie and Mike Massimino prepared the robotic arm to reach out and grab HST. My job was to work the Hubble communication procedures, which also allowed me to take pictures of HST on approach."

"Once Scott had flown the HST into range of the shuttle's robotic arm, Nancy, an Army helicopter pilot, flew the end of the arm on to a special grapple fixture on HST and captured the Hubble," Grunsfeld recalled. "It was a thing of beauty to watch. ... The telescope is still a beautiful sight after nearly 12 years on orbit."

”

Hubble Gets a Brand New Look

With Hubble firmly locked in the berthing ring of Columbia's payload bay, the process of charging up the telescope's batteries began. After that, commands were given to roll up Hubble's solar arrays. Thoughts of Servicing Mission 1 filled the air as veterans recalled the original array that failed to roll up and had to be jettisoned during a spacewalk. Fortunately, both of these arrays rolled up smoothly and without incident.

The new, smaller arrays are more stable and efficient, and they will give Hubble a sleek and updated look. John Grunsfeld and Rick Linnehan took the first night's spacewalk, replacing one of Hubble's flexible arrays with a new, rigid array. Jim

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Newman and Mike Massimino teamed up for the second excursion and replacing the other array. They also replaced a reaction wheel assembly, and repaired some torn insulation and a door hinge on the aft shroud.

The Night We Stopped Hubble's Heart

The third spacewalk was the one that gave the Hubble team nightmares: the changeout of the PCU. The PCU is the main power relay box for the whole HST. When a problem with the old unit threatened to end the telescope's life early, NASA decided to replace it. However, this box is not designed for changeout by spacewalkers.

Rick Linnehan and John Grunsfeld crawled into their spacesuits to prepare for this difficult spacewalk. When John's space suit was turned on, it began to leak water out of the cooling water tank. The crew quickly assisted in changing out the upper part of Grunfeld's suit with one of the other team's suits, and the spacewalk began about two hours late.

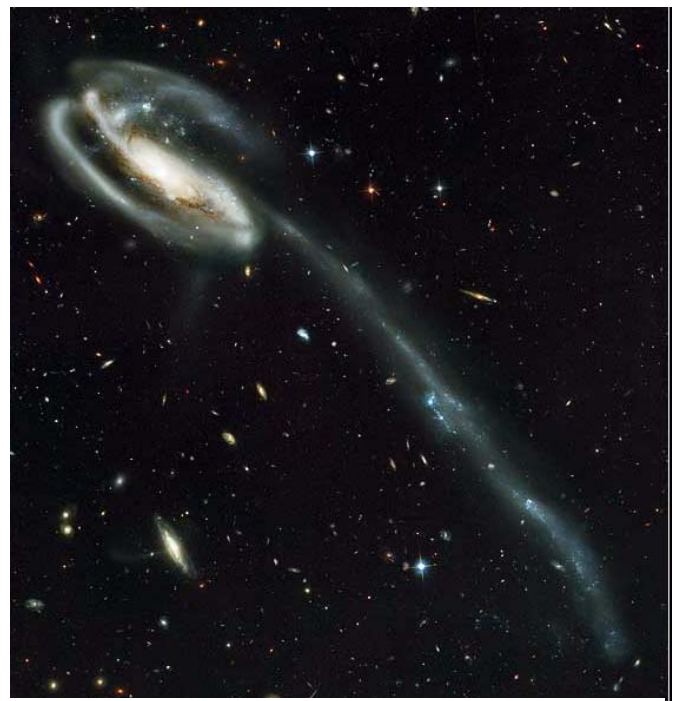
Grunsfeld and Linnehan went to work preparing the telescope for its first complete power-down in 12 years on orbit! Grunsfeld put thermal covers on some of the temperature-sensitive bays to protect them from the cold of space. Linnehan began disconnecting batteries, and Grunsfeld lowered light covers over the star-tracker cameras.

The PCU has 36 circular connectors along the left side of its large black box. Inside are electronics and relays to power the telescope. The astronauts' job was to disconnect all of the connections, then swap the old PCU for a new one, and then reconnect all the wires. This sounds a lot easier than it is when wearing very bulky, stiff space suits. To make matters more interesting, the connectors are too close together for the astronauts to use their hands. The Hubble team developed a special wrench/connector tool for this task. One after another, Linnehan disconnected the wires. With just a few to go, he swapped positions with Grunsfeld on the shuttle's robotic arm, and Grunsfeld finished the

last few. After driving the bolts to remove the old PCU from Hubble, Grunsfeld met Linnehan in the payload bay and picked up the new PCU. Riding on the robot arm driven by Nancy Currie, Grunsfeld fitted Hubble with the new PCU.

For the next two hours, Grunsfeld attached one connector after another. Because of their location on the side of the box, he often only had a view of the interface with only his left eye. During training, Grunsfeld joked that the PCU task was "Zen and the art of connectors." He meant that to perform this task, he and Linnehan needed "extreme concentration, patience, and a little bit of skill."

At one point, Grunsfeld thought he had met his match. "I looked at one particular connector and started laughing, thinking, 'This is it, the PCU task ends here.' I didn't think I could get access and align and mate the connector with my big gloves on



The Tadpole Galaxy—Located about 420 million light-years away in Draco, the Tadpole is a gravitationally disrupted spiral galaxy. Its debris tail, stretches out

it. After trying a couple of different approaches I finally used my connector tool, and zip, it went on. Seven more connections and I was all done."

Meanwhile, on the ground, the team held their
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(TinType Kevin Continued from page 3)

An exceptionally talented group of personnel have put together a mission that provides climate data continuity at a fraction of the price of previous missions. While programmatic and technical challenges abound every day, and cultural differences are the norm, there is a unique opportunity on NPP to give the taxpayer two Programs for the price of one. Here's hoping that the next couple of years brings continued success.

Life before NPP:

Prior to his present position on NPP, Kevin managed the EOS Terra mission. After 2 years on orbit, Terra continues to perform extraordinary science for the remote sensing community. Making measurements of the Earth on a global scale, and at a near daily update rate is a mind-boggling accomplishment. Looking back, it is hard to believe the enormity of the task that was undertaken to develop the Terra mission. New developments were the norm in almost every segment of the mission, and it was only through the efforts of an exceptional group of contractors and civil servants that the mission was accomplished. The magnitude of the new developments that were taken on in the Terra flight segment, provided a once in a career opportunity to push the state-of-the-art, across the entire instrument and spacecraft development. Memories of the individuals who hung in until the end, in spite of some difficult external circumstances and often at great personnel sacrifice, will always be especially meaningful.

Prior to EOS Terra, Kevin worked for 4 years on the Space Station. While enormously disappointing, Kevin still views them as quite possibly the most memorable 4 years of his career. He was involved with a group of people who set their sights extremely high, and in the process expended extraordinary amounts of effort, to achieve a goal that seemed of paramount importance. All in all there may have been a lesson here, but for the time being, Kevin is going to give it another decade to figure it out. Space Station was also Kevin's first opportunity to see how NASA operated at higher management and programmatic levels, and that in itself was enlightening.

Prior to his Space Station years, Kevin worked on a series of missions that utilized the Multi-Mission Modular spacecraft bus. This series of missions included the Solar Maximum Mission (SMM) and Landsat 4 and 5. Kevin also had the opportunity to be involved with Goddard's first venture into on-orbit satellite servicing, with the Solar Maximum Repair Mission (SMRM). By their nature, these missions relied on government furnished equipment, for a large portion of the flight segment. No single experience in his 24 years in the aerospace business has made a more lasting impression, than the experience he acquired during those years. And that is, that mission success is best served when the contributions of contractors and government personnel are accepted readily and willingly, and the mentality of a single Team envelops the mission. Almost invariably, when talking to people working on missions that are experiencing significant problems or delays, you will find that communications issues of this type abound.

Hobbies:

In recent years, managing a Project the size of Terra or NPP, and

(TinTypes Cheryl Continued from page 3)

years.

Hobbies/Interests: Cheryl loves sports! Volleyball is her favorite, which she plays year round in different leagues in the area and on a USAV team. She also plays softball with a coed team and women's team. She's an avid Redskins, Capitals, and Maryland fan. She enjoys singing with a Gospel band and the church choir. Cheryl loves getting dirty in the garden and can be found out in the yard on most nice days. She loves gourmet cooking and is just about out of the "how to cook an egg" stage. Cheryl is looking into remodeling her kitchen and hopes to have it finished in about 6 months. Her best times are with her dog, Jack.

keeping up with two young boys, has left little time to Kevin for personal hobbies. In his earlier days, he enjoyed playing golf and ice hockey, skiing, exercising, traveling and generally being outdoors as much as possible. These activities have been replaced by family oriented expeditions in recent years, such as trips to the beach or zoo, in lieu of exploring new cities, golf courses, national parks or ski slopes. However as mentioned earlier, hope is on the way, and the opportunity is rapidly approaching to do all of the above, at double the cost. Kevin can hardly wait.

(Feed Back Continued from page 3)

LPT, and SEM. MEIDEX is a Mediterranean Israeli Dust Experiment; SOLCON-3, the Solar Constant will measure the solar cycle to understand global climate changes on Earth; SOLSE-2 will demonstrate using light scattered from Earth's atmosphere to measure ozone; CVX-2 will rapidly stir xenon, one of nature's simplest fluids to aid predictions of the flow of new plastics; LPT is a low power, lightweight, low cost, software programmable, navigation and communication transceiver prototype; and SEM is an educational initiative with up to ten small enclosed modules, each containing a separate, passive experiment designed and constructed by students. FREESTAR is scheduled for launch July 11, 2002 on board STS-107. This effort speaks highly of the "GSFC Small Payload Team".

- KSC's planned International Space Research Park is being created through a partnership between NASA and the State of Florida. The Space Experiment Research and Processing Laboratory (SERPL) is part of this park and is currently under construction. The SERPL is a custom designed facility for life sciences payload processing and research. The planned building completion date is August 2003. A new road called Space Commerce Parkway will border the park

(HST Continued from page 15)

breath throughout the spacewalk. Everyone knew the astronauts were well trained, but also understood the gravity of the situation. Hubble was completely turned off. What if it couldn't wake it up from this suspended animation? Finally, hours later, aliveness and functional tests showed a healthy, working telescope.

A New Era Begins

For astronomers, the climax of this fourth Hubble house call was the fourth spacewalk, with the installation of the Advanced Camera for Surveys (ACS). This state-of-the-art imager has twice the wider field of view and five times more sensitivity than Wide Field and Planetary Camera 2, the instrument it replaced. It is Hubble's most powerful instrument yet.

To make room for ACS, spacewalkers Newman and Massimino first removed the Faint Object Camera (FOC), the last component of Hubble's original scientific arsenal. Now Hubble is very different—and far more capable—than it was the day it launched in 1990. That's the beauty of Hubble's modular design: the telescope can evolve right along with advancing technology.

A Cool Idea Becomes Reality

On the mission's fifth and final space walk, Grunsfeld and Linnehan restored the Near Infrared Camera and Multi-Object Spectrometer (NICMOS) to operation by hooking up a new cooling system. Inside the cooler is the neon cooling system driven by a small turbine. The supercooled neon is used to cool the detectors on NICMOS to near 70 degrees above absolute zero.

Installed during the second servicing mission in 1997 and intended to last at least five years, NICMOS ran into problems and depleted its original supply of cryogenics in less than half that time. With the new cooler, the instrument should once again be able to make observations of high-redshift galaxies, cool stars, and dusty nebulae.

Describing the moment he and Linnehan opened

the aft shroud door to get access to NICMOS, Grunsfeld remarked, "I felt like we were opening the doors to a sacred shrine, going inside the area where the scientific instruments on Hubble live. In our training we were taught to have the utmost respect for the delicacy of the instruments, and to treat them with kid gloves, giving some support to the idea of the inside of Hubble as a shrine." Inside the aft shroud, Grunsfeld tried to move as carefully as he could, even though he was in a clumsy, bulky space suit. He commented that the interior of the telescope is as clean and pristine as it was when launched, maybe more so after years of outgassing in the vacuum of space.

After removing a serpentine vent hose that was originally used for venting gas from the old solid nitrogen cooler on NICMOS, the astronauts in-



The Cone Nebula - Located in a turbulent star-forming region about 2,500 light-years away, the Cone Nebula is reminiscent of Hubble's famous "Pillars of Creation" in the Ea-

stalled the cryogenic cooler itself. This box, filled with electronics, plumbing, and a tiny turbine that spins at 450,000 rpm, went in smoothly. Installing the 3-foot by 12-foot radiator turned out not to be

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as easy. “We pushed and pushed,” said Grunsfeld, “but try as we could, it didn't seem to line up.” Only after significant effort and realignment did the team have some success.

The team then threaded cables and cooling lines. Then they began the process of hooking up the electronics connectors and the ammonia cooling line to the cryogenic cooler. Once Grunsfeld and Linnehan were safely back inside Columbia, commander Scott Altman and pilot Duane Carey raised Columbia's—and the telescope's—orbit by about 6 kilometers (3.7 miles).

Grunsfeld reminisced about saying goodbye to an old friend, “At the end of five space walks to improve the telescope, I gave Hubble a final small tap goodbye, and wished it well on its journey of discovery. It is likely I will never see the Hubble again, but I have been touched by its magic and changed forever.”

“Awesome! ...As In ‘Totally Awesome, Dude!’”

Those were the words that Preston Burch, HST Program Manager, used in a JSC press briefing to describe Spacewalk #5. He went on to say much more, but that was the phrase that best summarized his feelings on how the astronauts performed on their fifth and final spacewalk—and throughout the mission.

When asked to compare the newly refurbished Hubble with the original telescope, Burch didn't hesitate for a moment. “A far better machine than when it was first launched.” Dr. Ed Cheng, who headed the NICMOS Cryocooler effort, added, “The miracle of servicing makes this possible.”

Free At Last

On Saturday, March 9th, the crew of Columbia deployed Hubble back into Earth orbit. While watching the telescope drift away, Grunsfeld took time to admire its beauty. “The look of the telescope has been forever changed,” he said. “Stout and strong-looking panels have replaced the bird-like solar array wings. The new solar arrays have deep blue gal-

lium arsenate solar cells, replacing the silicon cells. On the other side of the arrays are white reflective panels, and so the telescope will no longer emit the golden glow so characteristic of the first 12 years of Hubble's life on orbit.”

“On the aft bulkhead of Hubble, Grunsfeld continued, “is a conduit leading to a large white radiator mounted to handrails on the side of the telescope. Along handrails all around the telescope are hung new cable harnesses to transfer power and signals to new systems on the telescope.”

From the ground, Hubble looks as beautiful as ever. Shortly after release, a large group from JSC's Mission Control ducked outside to watch Hubble and the shuttle fly overhead. Although we theoretically had visible passes over Houston every night of the mission, the cloudy, light-filled Texas sky prevented us from actually seeing Columbia and Hubble. But now, finally, they both graced the sky overhead, flying in tandem and giving us chills. “Like a religious experience” is how one of the senior managers described it. In any case, it was a beautiful way to end the mission.

Stay Tuned

Already, the first ACS releases from the newly refurbished Hubble have fascinated the scientific and popular press alike. The NICMOS cryocooler is working fine, and all can look forward shortly to images from the newly revived instrument. With Hubble now more powerful than at any other time in its history, expect that the best is yet to come!

Ann Jenkins, Principal Technical Writer, Code 442/QSS

Going and Coming

It's not like saying goodbye, or even "see yuh", as Diane Williams has moved all of one flight in building 8 to the first floor.

As you all know by now, Diane has left her Deputy position in Code 400 to assume the Director Of position of Code 200.

All FPPD personnel join us, we know, in wishing Diane the best in her new role and in giving her any assistance she might request while settling into her new position. Diane provided great leadership to the Directorate's business planning and management activities during her 7-year tenure in Code 400, and her savoir faire and upbeat personality will be sorely missed.

Replacing Diane as Deputy Director for Planning and Business Management is Krista Paquin, who rejoins Goddard after a stint in the private sector. Just before she left the Center, Krista served as Deputy Director for Planning and Development for the Applied Engineering and Technology Directorate. Earlier, Krista was Assistant to the Director of the Management Operations Directorate. Welcome aboard, Krista!

The Editor and TCP Staff

Quotes of the Quarter

"Keep your eyes on the stars and your feet on the ground"

— Theodore Roosevelt —



"The chess-board is the world, the pieces are the phenomena of the universe, the rules of the game are what we call the laws of Nature. The Player on the other side is hidden from us."

— Thomas H. Huxley —



"You see, wire telegraph is a kind of a very long cat. You pull his tail in New York and his head is meowing in Los Angeles. Do you understand this? And radio operates exactly the same way; you send signals here, they receive them there. The only difference is that there is no cat."

— Albert Einstein —



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