Space Telescope Science Institute

ANNUAL REPORT 2007

Table of Contents

The SM4 astronauts, (l-r): Johnson, McArthur, Grunsfeld, Altman, Massimino, Good and Feustel

Introduction

The Space Telescope Science Institute (STScI) implements the science program for the Hubble Space Telescope (HST) and will be the Science and Operations Center for the upcoming James Webb Space Telescope (JWST) and the Data Management Center for Kepler.

Several important milestones were completed during 2007. A new contract for HST was signed in March. STScI has a contract to manage the science operations of HST until 2016. The impact of the catastrophic loss of the Advanced Camera for Surveys (ACS) was mitigated by the pre-planning for such an event after Side 1 failed, and the outstanding performance of the policy, planning, scheduling, and instrument support staff brought the observatory efficiency up to 40% just one month after the event.

JWST's mirrors were cast and are being polished, the observatory successfully passed the Technical Non-Advocate Review, all its technologies were demonstrated, and flight hardware is being built.

The long awaited Servicing Mission 4 (SM4) to HST is on its way for the Fall of 2008. The related visit of the SM4 astronauts on May 9, 2007 for a briefing on the Institute's plans and preparations for this mission was just one reminder that the Institute's work is out of this world. The crew addressed the Institute staff and their families in an overflowing auditorium and answered all their questions, including those from the staff's children.

With the ramping up of the JWST operations and the stabilization of the HST budget, the Institute was able to hire

SM4 astronaut Megan McArthur with children who attended the astronauts' May presentation.

ANNUAL REPORT COVER (by Mike Hauser): Scott Altman addresses the crowd during the May presentation.

for many new positions. This situation helped to address the diversity issues highlighted by several committees, something that had been very difficult to accomplish due to previous hiring freezes and budget decreases.

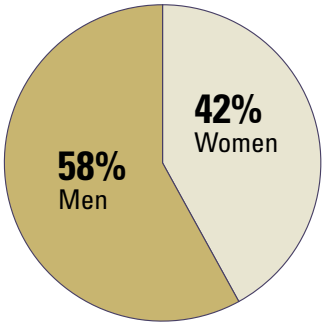
Women currently represent over 40% of STScI's workforce and are found in positions at all levels of the organization, including key scientific, technical and managerial roles. Overall representation of minority groups in all areas and positions is keeping pace as our staff size increases. Trends in staffing show a broadening of our age demographics, with the largest percentage of our employees ranging in age from 35 to 44. The Institute enjoys a rich, international heritage with over 25% of its employees listing over 20 countries other than the US as their country of origin.

As described in the following pages, STScI accomplished all its goals and is very well positioned for the challenges and opportunities that the next years will bring. Letters from committees that assess different aspects of STScI's operations, climate, and diversity agree that the work is progressing at an excellent place and that management changes at the Institute are making STScI an even better place to work.

SM4 astronaut Michael Massimino with children who attended the astronauts' May presentation.

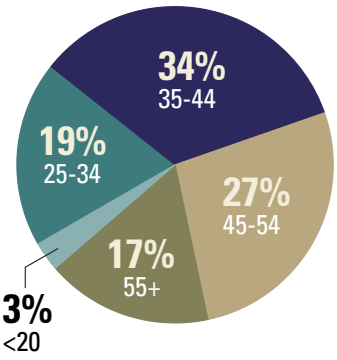
STScI staff gender

As of 1/1/2008



STScI staff age

As of 1/1/2008



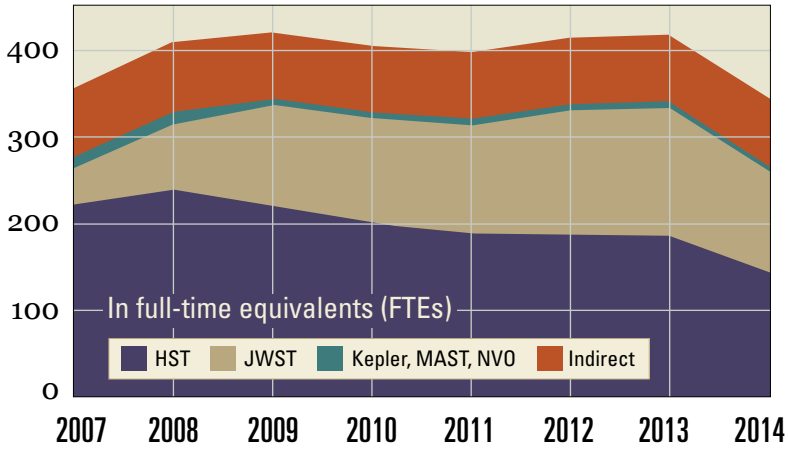
Institute Financial and Staff Resources

On April 30, 2007, the original AURA contract to operate HST expired. A new contract was negotiated with NASA and started on May 1, 2007. This three-year initial contract with two additional three-year extensions allows STScI to be the science operations center for HST until 2016 — enabling an overlap of the operations of the Institute's two major missions.

During 2007, STScI grew as more resources were required and dedicated to work on HST's Servicing Mission 4 and the development of JWST. The HST budget is expected to stay relatively flat for a period after the servicing mission, while JWST's budget is expected to expand over the next few years while the telescope's flight hardware is being built and the Science and Operations Center comes to life.

The chart at top, right, presents the current staffing plans for STScI until the Fiscal Year 2014. The chart reflects the stable environment entered in FY 2007 and the growth in JWST and other missions supported by STScI. These staffing levels do not include post-doctoral, graduate student, or intern positions.

Projected STScI staffing profile



Total cost of STScI operations

Mission	2006	2007	2008
HST	$42.6M	$44.5M	$42.6M
JWST	$8.4M	$8.5M	$15.4M
Other	$3.0M	$3.0M	$2.9M
TOTAL	**$54M**	**$56M**	**$60.9M**

The cost of all operations at STScI is covered in the table, above. HST's 2007 budget includes special funds for network upgrades, centralized storage and improved data backup for the desktop environment. This table does not include the grant funding STScI disburses to the astronomical community through General Observer, Archival and Theoretical Research, and Education and Public Outreach programs.

Staff Awards

AAS Education Prize	Hubble Heritage Project (Keith Noll, PI)
NASA/GSFC Excellence in Technical Leadership	Babak Saif
NASA Exceptional Service Medal	Babak Saif
Gruber Foundation 2007 Cosmology Prize	Andy Fruchter, Ron Gilliland, Nino Panagia, and Adam Riess
Webby Award	HubbleSite
Webby: People's Voice Award	HubbleSite
AUI/NRAO Image Contest, First Prize	Rick White, Robert Becker (UC Davis) and David Helfand (Columbia)
27th Annual Executive Stampede	1st Prize, Non-profit Division 4th Prize, Overall
STScI Group Achievement Awards	
• Recovery of Cycle 15 HST Science Operations	Dave Adler, Elizabeth Barker, Ray Beaser, Eddie Bergeron, John Biretta, Brett Blacker, Ralph Bohlin, Howard Bond, Tom Brown, Stefano Casertano, Marco Chiaberge, Colin Cox, Tomas Dahlen, Roelof de Jong, Rodger Doxsey, Harry Ferguson, Andy Fruchter, Ron Gilliland, David Golimowski, Shireen Gonzaga, Dana Hairsine, William Januszewski, Ian Jordan, Diane Karakla, Anton Koekemoer, Martin Kuemmel, Harald Kuntschner, Claus Leitherer, Knox Long, Duccio Macchetto,Jennifer Mack, Andre Martel, Helene McLaughlin, Shelley Meyett, Max Mutchler, Beth Perriello, Nor Pirzkal, Neill Reid, Massimo Robberto, Tony Roman, Kailash Sahu, Ken Sembach, Paula Sessa, Marco Sirianni, Linda Smith, Ed Smith, Dave Soderblom, Galina Soutchkova, Bill Sparks, Darlene Spencer, Massimo Stiavelli, Denise Taylor, Roeland van der Marel, Alison Vick, Eva Villaver, Elyse Wagner, Nolan Walborn, Jeremy Walsh, Tom Wheeler, Mike Wiggs, Tommy Wiklind, Bob Williams, Bill Workman
• Recovery of Gyro Malfunction	Dave Adler Don Chance, Suzy Crabb, George Chapman, Andy Groebner, Bill Hathaway, Jack MacConnell, Jinger Mo, Alan Paterson, Merle Reinhart, Alan Welty, Tom Wheeler, Bill Workman

Continued …

Staff Awards (cont'd ...)

STScI Group Achievement Awards (cont'd)

• Hubble Legacy Archive Early Data Release	Carol Christian, Niall Gaffney, Michele Gleason, Gretchen Greene, Bob Hanisch, Steve Hulbert, Anton Koekemoer, Kevin Lindsay, Steve Lubow, Brian McLean, Warren Miller, Lee Quick, Fred Romelfanger, Ron Russell, John Schulz, Matt Stankiewicz, Tom Walker, Rick White, Brad Whitmore
• Characterization of JWST Detectors	Eddie Bergeron, Kevin Lindsay, Peter McCullough, Mike Regan
• Archive Problem Report Clean-up	Faith Abney, Dorothy Fraquelly, Lisa Gardner

STScI Individual Achievement Awards

Sylvia Baggett, Joy Hale, Jessica Kim, Shelley Marshall, Vera Platais, Darlene Spencer, Todd Miller, Steve Hulbert, Charles Proffitt

AURA Awards

• Science	Andy Fruchter
• Service	Judy Ashwell
• Technology & Innovation	Perry Greenfield, Warren Hack and Ivo Busko

People and Change

OUR GOALS

Attract and retain the most outstanding administrative, technical and scientific staff.

Provide an invigorating and exciting working environment.

Develop a more inclusive workplace.

Align strategy and operations with goals and values.

STScI Organization

The STScI Directorate

The STScI Directorate is responsible for the strategic and operational management of the Institute. It is the principal interface to the external stakeholders: AURA, NASA/GSFC, ESA, and NASA/HQ.

The members of the Directorate are the Director; Deputy Director; Associate Director for Administration; Associate Director for Organizational Change; Associate Director for International Policy; Center, Offices, Divisions and Missions Heads; the head of Human Resources, the head of the Science Planning Division and the Chief of Staff. The Chair of the Senior Science Staff attends the Directorate meetings but is not a member.

The Associate Director of Organizational Change is responsible for defining action plans and coordinating activities to achieve the STScI strategic goals and objectives.

The Associate Director for International Policy is responsible for the continued support of ESA for the HST and JWST programs. In particular, the Associate Director works to ensure that these programs are visible and well understood in Europe.

The Chief of Staff is the management arm of the Directorate and is responsible for the implementation of Directorate actions and oversight of Directorate activities. The Chief of Staff also facilitates communication between the Directorate organization and the Institute at large.

The Resource Management Office (RMO) has the responsibility, authority and accountability for the successful performance of the organization's projects and missions. RMO is responsible for the overall STScI operating budget, and determines and controls the business model for the organization.

The Divisions are responsible for the operational delivery of the STScI Mission, in concert with the Mission Heads.

Continued …

STScI Organization, continued …

Continued …

STScI Organization, continued …

HSTMO Hubble Space Telescope Mission Office

The HSTMO is responsible for maximizing the science return from the mission by managing the Institute activities specific to the conduct of the Hubble Space Telescope program. It develops the overall Institute plans for HST science operations and system enhancements, working with the team leads in the operating divisions and centers. It is responsible for establishing effective scientific, technical, and operational interfaces with the HST Project at Goddard Space Flight Center and associated contractors.

JWSTMO James Webb Space Telescope Mission Office

The JWSTMO collaborates with NASA to develop the scientific, technical, and operational vision for the James Webb Space Telescope. It manages the development of the JWST Science and Operations Center. It works with the community to ensure the best JWST observatory possible within the cost constraints of this challenging program. It works with the Institute divisions to ensure proper support to NASA, the science instrument teams, and other JWST partners, including the prime contractor, Northrop Grumman Space Technologies.

CMO Community Missions Office

CMO manages the Institute's involvement in missions and projects other than HST and JWST by facilitating new initiatives and coordinating their internal reviews. For missions arising in the community, CMO promotes new applications for Institute products, services, and operational abilities customized to meet specific mission needs, striving to maximize the scientific return of the Institute's involvements by engaging scientific and technical staff members directly in the support of community missions.

SMO Science Mission Office

The Science Mission Office (SMO) is responsible for interfacing with the external HST user community and for maintaining infrastructure to support the STScI research staff. SMO works with the Instruments Division in optimizing the functional assignments of the research staff, and assesses their scientific activities through annual science evaluations. SMO manages the HST time allocation process, which includes updating the appropriate policies, as necessary, issuing the annual Call for Proposals, organizing the proposal review and distributing the results to the community. In addition, SMO handles proposals submitted throughout the year for Director's Discretionary time. The Science Mission Office is also responsible for maintaining communication with the broader astronomical community via the semi-annual meetings of the Space Telescope User's Committee.

SMO oversees the John Bahcall Lectureship, the Caroline Herschel Program and the Distinguished Visitor Program, which support extended visits by internationally respected researchers from other institutions. The Science Mission Office also supervises several journal clubs and the weekly colloquium, which bring in researchers on shorter timescales. SMO

Continued …

STScI Organization, continued …

manages the Director's Discretionary Research Fund and the JWST Discretionary Fund, which support staff research projects and investments in the Institute's research infrastructure. Each year, SMO conducts a spring symposium on a major area of astronomy, as well as smaller-scale workshops on specific scientific topics. Finally, SMO manages both the Hubble Fellowship Program and the Giacconi Fellowship Program.

INS Instruments Division

INS supports HST observers in the use of the science instruments with maximum effectiveness, providing scientific and technical advice in developing observing programs and interpreting data. It calibrates and characterizes the science instruments. It facilitates the use of new science instruments in HST, JWST and other space science missions by participating in their development, by capturing and transferring information about instrument operation and calibration to the Institute, and by coordinating the commissioning of all the instruments following a servicing mission. A small engineering team maintains engineering knowledge of the HST instruments and spacecraft, monitors health and performance of the instruments, and tracks the status of their limited-life items.

OED Operations and Engineering Division

OED processes and schedules the selected HST observing programs, and processes HST data in the pipeline and distributes data products to the community. It maintains the operational state of the Guide Star Catalog. OED staff works with HST users to ensure the optimal translation of their scientific requirements into the technical instructions necessary to execute the observing programs and prepares the multi-year science-observing plan, which reconciles HST science program requirements and operational constraints at a high level. It then fits candidate observations into optimal weekly observing schedules with instrument calibration and engineering activities, and creates the detailed command loads that are executed by the telescope. OED is also responsible for pipeline processing of all HST data. It provides data archiving and delivery services to users. OED operates the Multi-Mission Archive at STScI (MAST) and is an active participant in the National Virtual Observatory (NVO) program, bringing the latest in archive and data distribution expertise to the HST program.

OED is responsible for systems engineering, commanding, and software development at STScI. Specifically, OED staff maintain and enhance the software and database systems used for science mission planning, science operations, the data processing pipeline and the archive. OED develops and maintains commanding software for the HST science instruments; the calibration software and tools used to reduce, analyze and archive HST data; and the systems used by astronomers to interface with the HST systems. It also maintains the Grants Management System software.

ITSD Information Technology Services Division

ITSD is responsible for the Institute's computing and communications infrastructure. It develops technology-based solutions, and ensures the security of and supports information systems

Continued …

STScI Organization, continued …

for HST science operations, scientific research, and business functions. ITSD provides system management and user support services. ITSD is responsible for the production of instrument and data handbooks, Web pages, information management for engineering and business systems, and visual communications technology (Web casting and videoconferencing).

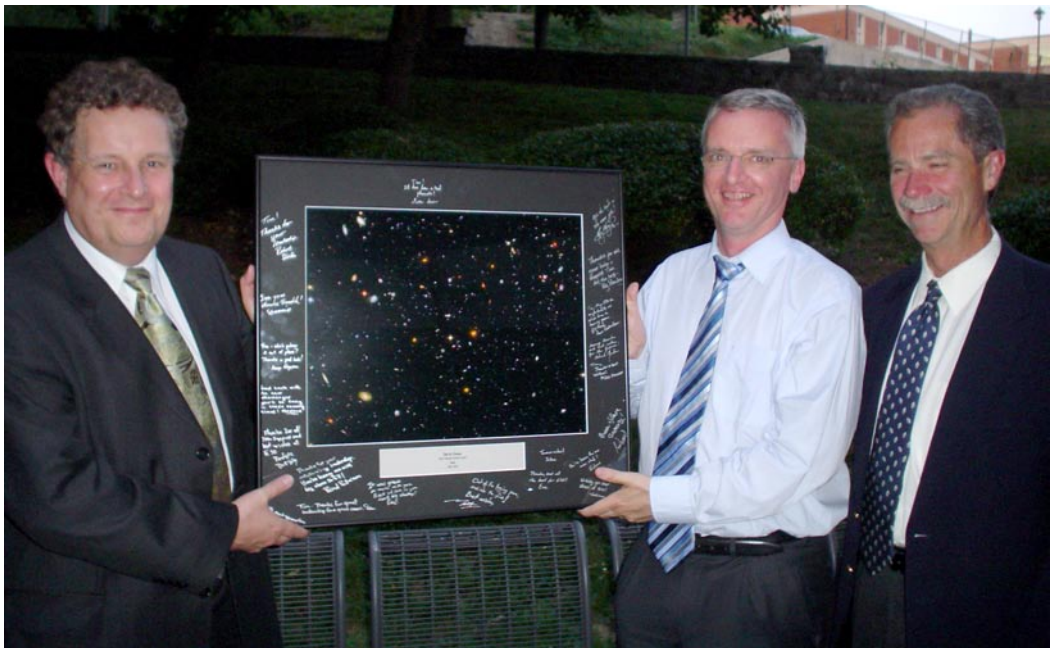
OPO Office of Public Outreach

OPO is responsible for the public outreach and education activities of the STScI. OPO provides a national resource for coordination of astronomy and astrophysics content for journalists, other media professionals, the education community and the informal science community. OPO also supports news, information and exhibit products for other NASA Origins missions as well as for JWST.

OPO develops educational materials that address national education standards and are relevant to K–14 curricula. It also provides pre-service and in-service teacher training on the use of space science educational materials in the classroom. OPO develops and hosts a variety of Internet sites that provide first-hand information about HST and its discoveries to the general public and news media. The Office brings the excitement of scientific discovery and technological accomplishment to a wide audience through science museums, planetariums, libraries, and the Internet. It develops press releases, photo releases, and Space Science Updates to disseminate HST discoveries via print, electronic, and broadcast media.

BRC Business Resource Center

BRC provides business and administrative services to STScI in the areas of finance, human resources, accounting, contracts, grant administration, procurement, facilities management, property administration, administrative support, and staff support services. The BRC administers all HST-funded grants.



Director Matt Mountain (left) and Bill Smith, AURA President (right) present Tim de Zeeuw with a framed HST image to commemorate the end of his tenure as STIC chair.

STIC and AURA

The Association of Universities for Research in Astronomy (AURA) is an international consortium of universities, educational and other non-profit institutions that operates world-class astronomical centers. One of them is STScI. AURA acts on behalf of the science communities that are served by its centers, and as trustees and advocates for the centers' missions.

AURA Board of Directors

The AURA Board establishes the policies of AURA, approves its budget, elects members of the Management Councils, and appoints the president, the center directors, and other officers. The Board of Directors is responsible to the member representatives for the effective management of AURA and the achievement of its purposes.

Space Telescope Institute Council

The Space Telescope Institute Council (STIC) provides oversight and advocacy for the Space Telescope Science Institute. In that role, STIC recommends to the AURA Board tenure promotions, financial commitments and the recruitment and renewal of STScI's director and deputy director.

Children learn about a solar telescope during the 2007 Women Science Forum.

Diversity Initiatives

Future of the Workplace Committee

The Space Telescope Science Institute is committing itself to lead in addressing issues of diversity and equity for our staff and the astronomy community. The Committee on the Future of the Workplace, chartered by the STScI director, is a standing committee to assess and track progress on diversity and climate issues at the Institute. The group meets annually and consults by email or teleconference between meetings. The committee is chaired by Meg Urry (Yale University), and its members are: Sheryl Bruff (STScI), Bernice Durand (University of Wisconsin), Jay Gallagher (University of Wisconsin), Cheryl Gundy (STScI), Richard Kilburg (JHU), Antonella Nota (STScI) and Neill Reid (STScI).

The committee is responsible for assessing progress in all aspects of STScI diversity, including gender, racial, religious, age, and accessibility issues. During the first meeting on June 3-5, 2007, the committee heard from several focus groups on topics that included hiring and retention, equal treatment within STScI, and the overall climate toward the diverse population within STScI.

The committee made a set of recommendations that included, among others, the reestablishment of the ombuds office, reinforcement of the STScI and AURA policies on harassment, provision of management training to new managers and supervisors, and equalization of the treatment of the staff regarding office space and computer and office equipment. The Director accepted all the recommendations. Their implementation started immediately and is ongoing. The committee will conduct their second site visit in early 2008.

Instruments Division's Diversity, Culture and Respect Working Group

The Instruments Division's Diversity, Culture and Respect Working Group was established in June 2007. The primary objective of this committee is to develop solutions to diversity, culture, and respect issues currently observed within STScI's Instruments Division. The implementation of the recommendations of the committee will improve the ability of division personnel to work harmoniously and maintain a high level of morale and job satisfaction. It is expected that these solutions will also improve the work environment and interaction of staff throughout the Institute. The membership of the committee spans all areas of the division, from instrument scientists to data analysts to administrative support. It also includes the head of Human Resources.

Although the committee's work is ongoing, a set of initial recommendations was delivered to the division management on Nov. 30, 2007. The recommendations include the institution of a training program for new managers and supervisors, the creation of a division-wide mentoring program, the implementation of 360-degree reviews, the review of the data analysts' career path, and more rigorous management of projects.

Youth for Astronomy and Engineering

The Youth for Astronomy and Engineering (YAE) program at STScI engages children and teens interested in astronomy and engineering as a career. The YAE exposes participants to activities and experiences representative of the work done by astronomers and engineers. It also provides a supportive environment that encourages diversity in the astronomical and engineering community by increasing awareness of opportunities in the field to young women, minorities, and those with special needs. This year, YAE conducted a "Parent and Daughter Evening Under the Stars" and "Parent and Son Evening Under the Stars" Around 160 middle and high school children and their parents attended a telescope-aided skywatching session and an interactive lecture from STScI staff and special guests, including Derrick Pitts, the Franklin Institute's chief astronomer and planetarium director.

Derrick Pitts, Chief Astronomer and Planetarium Director, Franklin Institute

In May 2007, approximately 50 middle and high school girls participated in the Women Science Forum, where they learned about science careers from astronaut Mary Cleave and several STScI staff members. The activities this year, geared toward encouraging engineering skills, included designing a bridge on a computer and making solar observations.

2007 Women Science Forum participants learn about the work done at STScI.

Hard Science/Soft Skills: Fostering Civility in the Scientific Workplace

"Hard Science/Soft Skills: Fostering Civility in the Scientific Workplace," an innovative speaker series focused on examining relational competence, ethics, quality of life and productivity in the scientific workplace, continued this year.

"Hard-discipline" organizations, such as science, medicine, technology and engineering, present culture-specific challenges and needs when it comes to everyday workplace interaction. In 2007 the series speakers were:

- Richard Kilburg, from John Hopkins University: "Reverence and Temperance: Ancient Foundations of the Modern Workplace"
- Thomas Meylan, developer of Evolving Success: "Applying Technical Skills to Managerial Responsibilities"
- Tim Wise, former associate director of the Louisiana Coalition Against Racism and Nazism: "Race is Not a Card: Confronting Racism, Privilege and Inequality in the 21st Century"

Top to bottom: Kilburg, Meylan, Wise

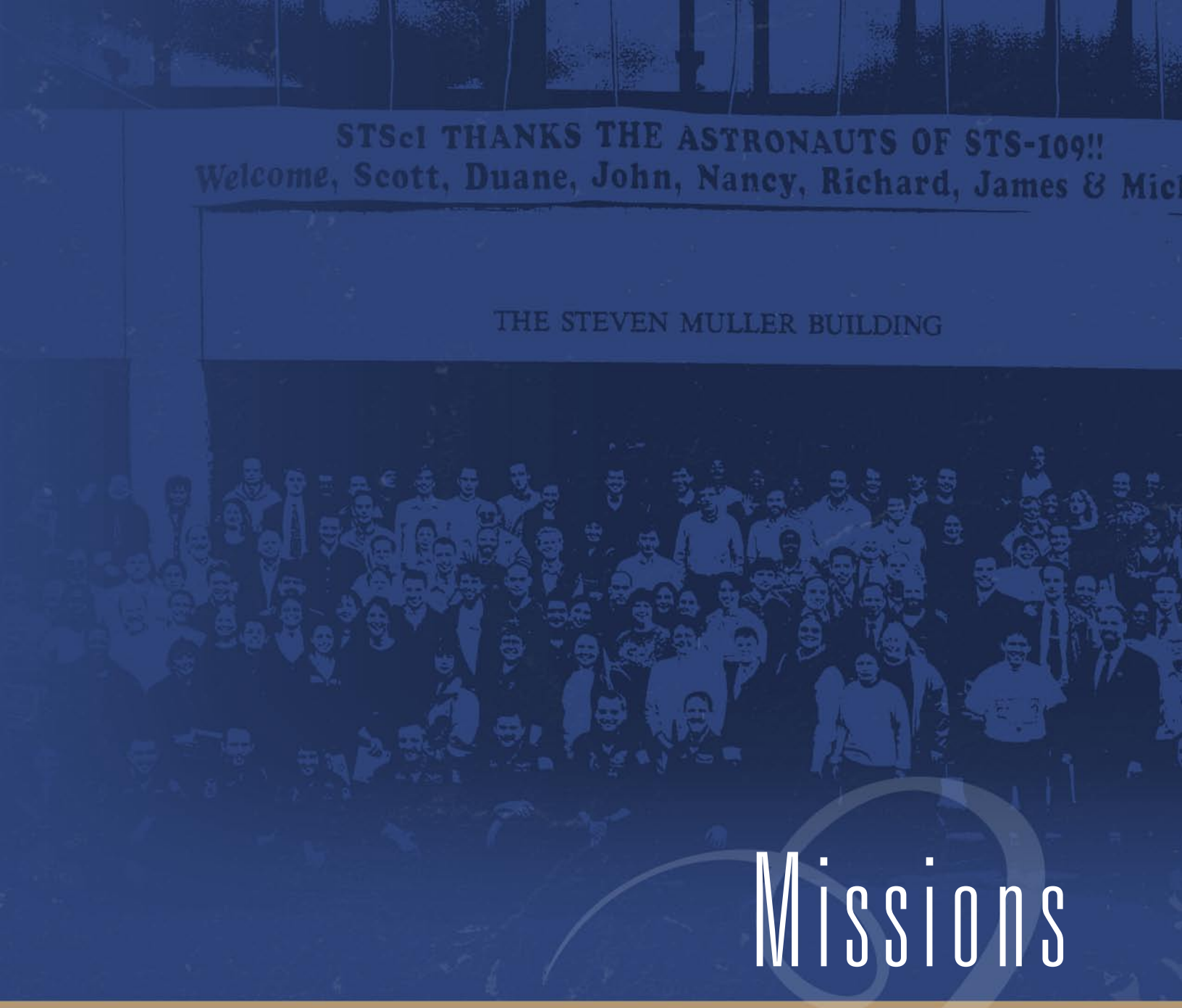
Caroline Herschel Distinguished Visitor Program

The Caroline Herschel Visitor Program to enhance women and minority representation at STScI brings distinguished scientists from around the world to the Institute for one- to three-month visits. The program provides a stimulating and productive environment for colleagues in the community to work and lecture on their scientific projects at STScI, and offers mentoring for STScI scientists, especially women and other underrepresented groups. Visitors meet regularly with the STScI science staff, women and minority scientists, and function as members of selected short term committees.

The Herschel visitors typically gave both a formal colloquium and an informal talk. The rest of their time was spent interacting with the staff, particularly the non-tenured scientists and postdoctoral fellows.

2007 Caroline Herschel Distinguished Visitors:

- Jay Gallagher, University of Wisconsin, 7/23 to 8/1/07
- Neta Bahcall, Princeton University, 5/7 to 5/15/07
- Harriet Dinerstein, University of Texas, 4/4 to 5/4/07
- Linda Sparke, University of Wisconsin, 4/9 to 4/20/07



Missions

OUR GOALS

Maximize the science program of HST.

Develop and operate the best JWST possible.

Operate a world-class archive.

Stimulate education and public outreach.

Maximize the science return of community-based astronomy projects.

Hubble Space Telescope

As the science mission operations center for the Hubble Space Telescope (HST), STScI's responsibility is to maximize the science output of the observatory. HST is not only NASA's most productive astronomical observatory, its images inspire the imagination of the public at large.

During the past year, the observatory continued to operate in Two-Gyro Science Mode (TGS), and work was completed on the development, testing and implementation of a One-Gyro Science Mode (OGS). A failure of the most-requested mode of operation of the Advanced Camera for Surveys in January 2007 required a major revision of the science program. Despite the failure of the ACS CCD channels, the science productivity of the observatory remains high and Cycle 16 was as competitive as the previous ones.

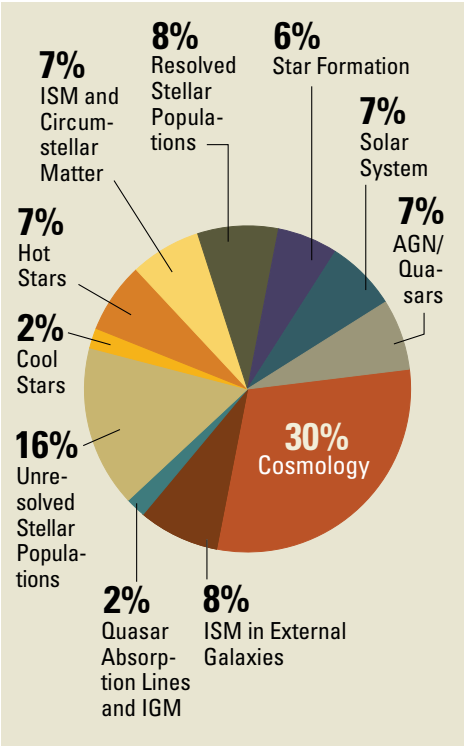
In response to NASA's announcement of Servicing Mission 4 to HST, STScI resumed work on the development and ground-based testing for the two new instruments to be installed in the spacecraft: the Cosmic Origins Spectrograph (COS) and the Wide Field Camera 3 (WFC3); and supported the preparations for the scheduled repairs of ACS and STIS.

Proposal selection

Observing time on HST continues to be in strong demand from the community. The over-subscription rate for General Observer (GO) programs in Cycle 16 was 4.5:1 in terms of

Continued …

HST: Cycle 16 approved orbits, by science category



proposals, and 5.6:1 in orbits. There is also substantial over-subscription of requests for funding of HST archival research. The increasing size and breadth of the HST archive is progressively attracting more attention to its value, such that the over-subscription of Archival Research projects is 3.4:1, comparable with GO programs.

The ACS failure occurred less than 12 hours after the submission deadline for Cycle 16, rendering moot a significant fraction of the submitted proposals. A total of 747 proposals were received by the original deadline. Of these, 102 were withdrawn and 176 new proposals were submitted. By the revised deadline, 821 proposals had been submitted.

The distribution of proposals among disciplines (seen in chart at left) is similar to that of previous cycles, with a substantial fraction of Cycle 16 observations devoted to extragalactic astronomy.

As in previous years, the Cycle 16 science program spans the gamut of astrophysical research, from investigations of planetary neighbors in the solar system to observations of galaxy evolution in the high-redshift universe. The lack of availability of the ACS Wide-Field Channel (WFC) and High-Resolution Channel (HRC) made wide-field survey programs much more expensive in telescope time, resulting in a change in tactics in some fields.

During 2006, ACS suffered two electronic failures, temporarily removing it from service and reducing electronic redundancy. ACS observations accounted for approximately 75% of the Cycle 15 program (with nominal execution from July 1, 2006 to June 30, 2007). Consequently, the Science Policies Division (SPD) at STScI worked with the Space Telescope Users Committee (STUC) to devise a process for selecting backup programs that would be activated in the event of a catastrophic ACS failure. A Call for Contingency Proposals was issued in September 2006. The Cycle 15 Time Allocation Committee (TAC) was reconstituted to review those proposals, and six were selected for potential activation. The Principal Investigators (PI) were asked to submit Phase II proposals by mid-February 2007. Those proposals were activated immediately following the ACS failure on Jan. 27, 2007.

The failure of the Wide-Field Channel (WFC) and the High-Resolution Channel (HRC) of ACS in January 2007 also left incomplete 121 GO and 20 SNAP Cycle 14 and 15 science programs. Working with the HST Mission Office and the Instruments Division, the Science Policy Division developed and implemented a process for assessing which of those programs could be

Continued …

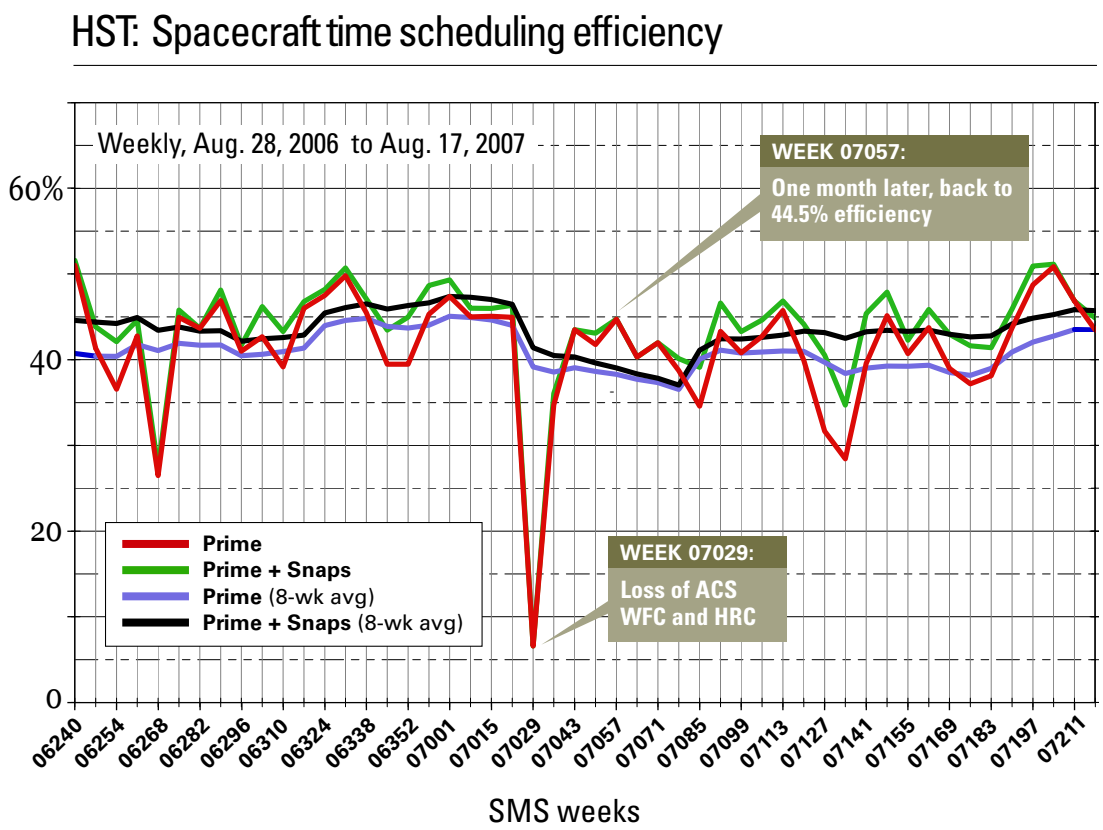
switched to other HST instruments and achieve the science goals approved by the Cycle 15 TAC. All proposals received two independent technical reviews and a Feasibility Assessment Panel determined whether each proposal was feasible for transfer. Principal Investigators of proposals were given the opportunity to appeal any adverse decision. Unsuccessful PIs were given the option to submit a revised version of their proposals as a Director's Discretionary (DD) Time request to be reviewed by the Cycle 16 TAC.

Scheduling

The average scheduling efficiency for "prime (GO) plus SNAP" observations (i.e. those that define pointings to produce science data) was 44.8% for the period from Aug. 13, 2006 to Aug. 20, 2007. HST operated in two-gyro mode for this entire interval. This efficiency result is an increase of approximately 2.7% over the previous reporting period, in which HST also operated in two-gyro mode.

This period has also shown the effect that spacecraft and instrument events have on the execution of the prime and SNAP programs over the course of an observing cycle. Notable is the fact that the eight-week efficiency average remained very stable despite these disruptive instrument events. This was accomplished through the combination of STScI's contingency planning for a potential ACS failure and the notable efforts of STScI staff in the weeks during and immediately following the events to expedite the implementation of that contingency plan.

Continued …



Likewise, when the ACS failed completely in January 2007, STScI immediately responded to minimize the impact of losing the primary imaging instrument. Science planners and schedulers reworked the long-range observing plan and short-term schedules to accelerate scheduling of non-ACS observations. In addition, six contingency programs that had been selected for such a situation were incorporated to the schedule.

The implementation of a new check in the operations process and the switch to the next generation of the Guide Star Catalog, GSC II, avoided a significant loss in scheduling efficiency during this reporting period.

HST Instruments

STScI staff continued in 2007 to support the development and testing of WFC3 in multiple areas, including detectors, optics, filters, test planning and execution. They also resumed ground system testing and preparations for supporting observers. Major accomplishments during the past year include writing the WFC3 Instrument Handbook and broadly supporting the second round of systems-level thermal vacuum (TV) testing and science ground calibration.

A number of key items required for the Cycle 17 Call for Proposals and the future scientific operation of WFC3 were developed this year, particularly the draft of the WFC3 Instrument Handbook and the Exposure Time Calculators for all the modes of the instrument.

The STScI COS team commenced preparations for GO user support activities. The first COS Instrument Handbook was written in preparation for distribution with the Cycle 17 Call for Proposals.

Two brochures detailing the capabilities of these two new instruments were created and distributed at the American Astronomical Association meetings. They are also available to be downloaded or read online in the instrument Web pages.

The STIS team updated requirements necessary for the definition of the STIS Servicing Mission Orbital Verification (SMOV) observing program, which will be conducted immediately after SM4 in order to prepare STIS for GO use in Cycle 17. These requirements were approved by the HST Project in March.

STScI staff conducted a study of the relative performance of the Fine Guidance Sensors (FGS) to determine whether there was a scientific basis for preferring replacement of FGS2 or FGS. As there was no appreciable difference, the choice will be made based on the servicing mission constraints.

Instrument Calibration and Characterization

The active program of calibration and characterization of the observatory with an on-orbit program that uses approximately 5 percent of the spacecraft observing time continued this year. All active instruments, (ACS, NICMOS, WFPC2 and FGS) have participated in the ongoing program. STIS continues to improve its calibration through the STIS data enhancement

Continued …

program, which is now largely complete. A calibration outsourcing program continues as a small but relevant item in the calibration planning.

Several efforts have been devoted to improving the geometric distortion solution for the Wide Field Channel (WFC) and to implement the new solution in the ACS pipeline. Also, the ACS team has characterized the impact of the charge transfer efficiency degradation in astrometry. Another major initiative includes substantial efforts aimed at improving the calibration of the Solar Blind Channel, as it is now in much higher demand following the failure of the CCD channels of ACS. The ACS team worked with an external team of GOs to characterize an optical ghost in SBC, probably due to internal reflections between the back and front side of the filter.

Production of routine reference files for WFPC2 was resumed after several months of interruption, during which the camera was hardly used for science observations. Reference files needed for processing all WFPC2 datasets from February 2006 up to SM4 have been prepared, and are now in the calibration database and available for use in the pipeline.

The WFPC2 team has completed an on-line WFPC2 Drizzle Cookbook to aid observers in combining their WFPC2 images.

A detailed closeout plan for WFPC2 has been prepared, and calibration proposals have been implemented to acquire all the necessary data.

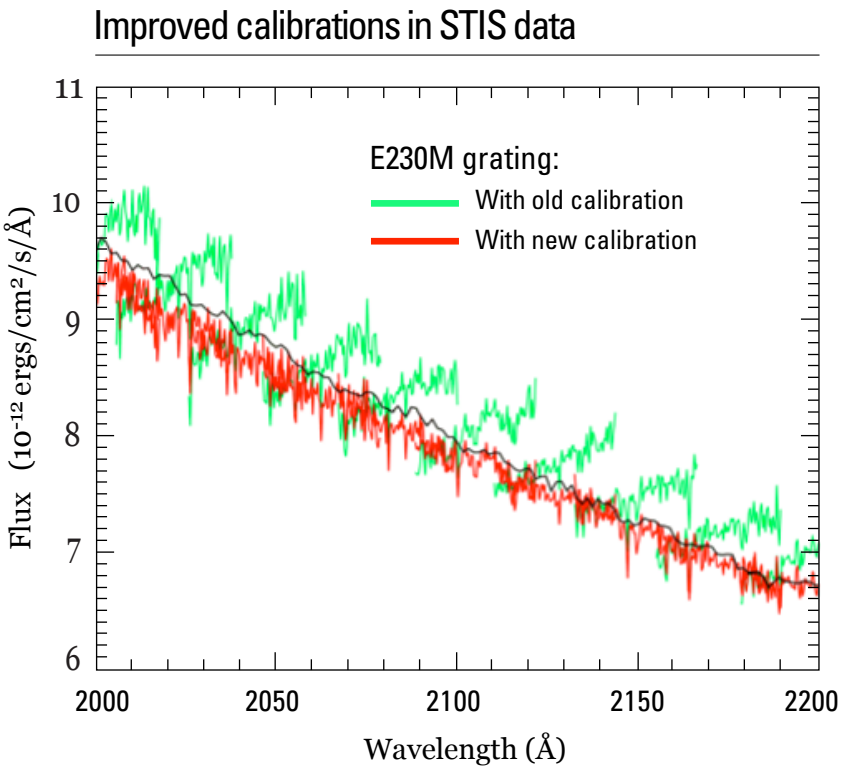
The NICMOS team made several significant advances in calibrating and characterizing the NICMOS instrument during this period, in which NICMOS accounted for around 40% of all the science observing time awarded in Cycle 16. A significant program to improve the NICMOS flat fields showed that the flat-field sensitivity of all three cameras varies with time, and for the first time provided direct time-dependence for all the filters in NICMOS. As a result, “epoch-dependent” flat-field reference files have now been created for all the filters in all three NICMOS cameras, covering a total of five epochs to date. The NICMOS team also completed the software that corrects for the count-rate non-linearity effect in the NICMOS detectors, without which photometry of faint sources could be severely impacted. The bulk of the work associated with the STIS data enhancement program has now been completed. Changes to the CALSTIS software have been finalized, and with one exception described below, final calibration reference files were delivered.

The reprocessing of the entire STIS data archive began in November 2006, and over the subsequent months the entire collection of about 127,000 STIS data sets were reprocessed using better aperture flux and dispersion corrections (see chart, next page).

Synphot tables for STIS modes were updated to reflect the revised throughputs and time-dependent sensitivity corrections developed for the STIS data improvement program. Synphot throughputs for the echelle modes now properly include the effects of the echelle blaze as well as vignetting that depends on the central wavelength setting.

A new and extensively revised version of the STIS Data Handbook that describes the calibration improvements and the new STSDAS tasks was published this year.

Continued …



During 2007, the telescope team conceived and implemented a calibration program that produces a much better characterized HST Field of View. From this program, the relative alignment of the FGSs and the science instruments was obtained to accuracies under 50 milliarcseconds. For the first time in HST operations, the 1 arcsecond 1 sigma error in pointing and absolute astrometry will be significantly reduced. Values of less than 0.25" 1 sigma error (absolute) are expected. HST focus this year continued to be maintained within the observatory's science requirements.

The telescope and ACS teams performed a novel single-orbit calibration that established the ACS/WFC absolute scale to better than 5 x 10-5 fractional accuracy in 2007. This establishes HST as a calibration link, allowing certain stringent JWST requirements to be met. The calibration was possible only through the existence of a special set of stars in M35 with sub-milliarcsecond relative positions (from numerous FGS calibration observations over the HST mission life) and absolute position knowledge. Thus HST's FGS has calibrated ACS, which will then be used to calibrate JWST.

Continued …

Hubble Fellows, 2007: The Hubble Fellowship Program supports outstanding postdoctoral scientists whose research is broadly related to the scientific mission of HST.

Grants Awarded through 9/30/07 (with obligations through FY07)	
1989	$1,038,133
1990	$144,801
1991	$3,313,374
1992	$11,377,362
1993	$15,545,673
1994	$16,906,230
1995	$10,601,449
1996	$19,788,368
1997	$17,955,274
1998	$21,240,639
1999	$18,943,201
2000	$18,685,619
2001	$21,108,402
2002	$21,099,550
2003	$22,369,517
2004	$25,421,259
2005	$24,670,412
2006	$19,590,494
2007	$28,649,028
TOTAL:	**$318,448,785**

Grants

Each year, STScI receives funding from NASA to award grants to support General Observing Programs, Archival Research and the Hubble Fellowship Program. Budgets submitted for approved programs are peer reviewed by a Financial Review Committee (FRC), and funding recommendations are provided to the STScI Director who makes the final funding decisions.

STScI is responsible for the administration of the entire grant process. The in-house development of the Space Telescope Grants Management System (STGMS) has been a critical tool over the past seven years for assisting the Grants Administration Team and institutions with managing their grants. Continued development of the STGMS is maintained to provide user-friendly software, and will be used to manage grants awarded for the James Webb Space Telescope (JWST).

The table at left lists the total amount of grant funding distributed for each fiscal year of the program.

Photo by Scott Speck

James Webb Space Telescope

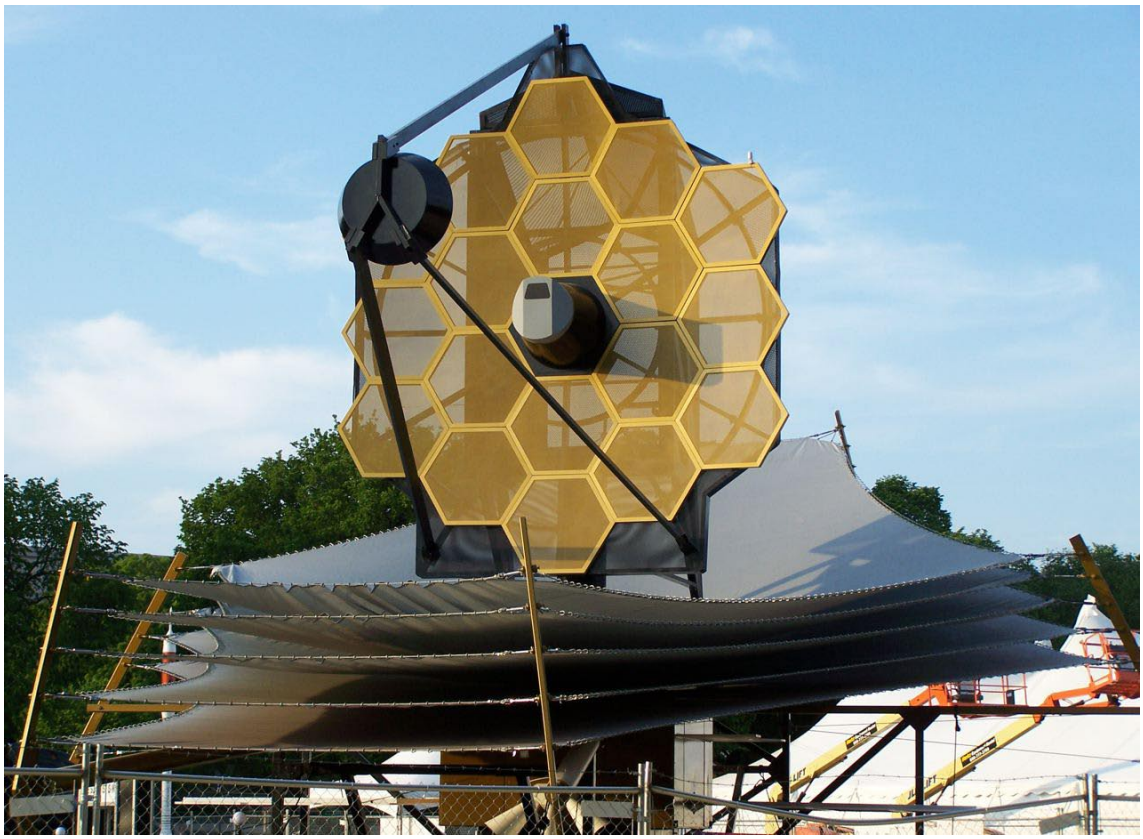
Since NASA revised the project plan almost three years ago, JWST has remained on schedule for a launch in June 2013. The manufacturing and testing of the 18 primary mirror segments are critical parts of the plan and the segments are currently being ground and polished. In preparation for the important Preliminary Design Review and Non-Advocate Review to be held in March/April 2008, most systems of the observatory have passed their individual reviews. For the science instruments and other long lead items such as telescope optics, the corresponding development teams have completed Critical Design Reviews and initiated construction of the flight hardware. In February 2007, the JWST project completed a major milestone -- the review and acceptance of all new technology developments. The success of this Preliminary Non-Advocate Review enables the mission design to progress with confidence in the performance of these enabling technologies. Only one technology, the MIRI cryo-cooler, required additional verification and analysis. The review team forwarded its acceptance of the revised cryo-cooler design to NASA in March 2007.

As was the case with HST, NASA is partnering with the European Space Agency (ESA) in the development and construction of JWST. This partnership and that with the Canadian Space Agency (CSA) will extend into the area of science operations, with both agencies contributing

expert technical and scientific staff at STScI. Currently, two CSA-supported scientists work as part of the STScI Webb team. NASA, ESA, and CSA signed their respective Memoranda of Understanding (MOU) in 2007, committing their agencies to supporting the development and operations of Webb.

As the observatory design becomes firmly established in preparation for the mission PDR, STScI staff works with the observatory contractor, Northrop Grumman Space Technology (NGST), to analyze operations scenarios and ensure that the JWST requirements are complete. Following the sunshield baseline design and PDR, STScI staff developed an operations concept that assigns the management of angular momentum between the S&OC, the spacecraft software, and the on-board management of the observing program. STScI staff also worked with the JWST Project at GSFC to measure the thermal stability of the Integrated Science Instrument Module (ISIM) structure. Using the same techniques that were used for the mirror backplane testing, the Institute team tracked the deformations of the ISIM structure through five cryogenic cycles at the Marshall Space Flight Center testing facility in the summer of 2007.

Although the JWST launch is still planned for June 2013, NASA directed STScI in the fall of 2007 to delay some of the development of the Science and Operations Center while still maintaining the capability to support launch and commissioning. This was done to free additional resources for observatory development in the tight budget years of 2008-2010. The development of the Flight Operations Subsystem, used for real time operations; and most of the Data Management Subsystem, used for data calibration, archive and distribution, have in consequence been delayed. To support the initial Call for Proposals in 2012, the development of the Proposal and



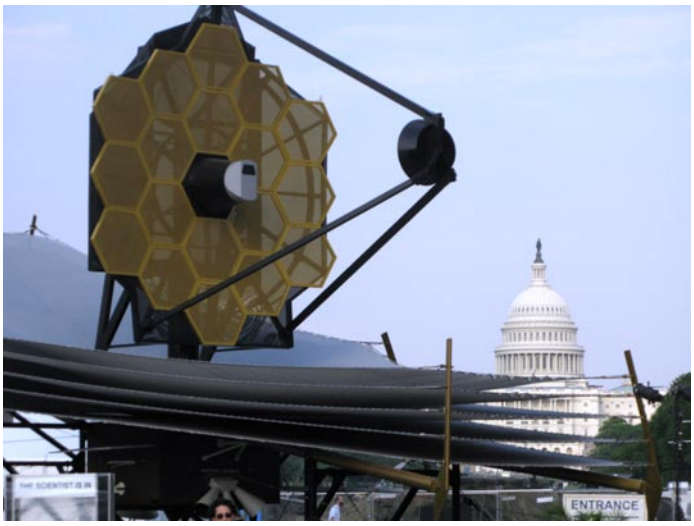
JWST model on the Mall, Washington, D.C. Photo by Pam Bresnahan.

Planning Subsystem, including guide star selection and the interface to the grants management software, was started in 2007. With this work, a major development phase, utilizing the depth and experience of the Hubble software groups, has begun. Prototypes of the proposal entry system were developed and demonstrated in preparation for the subsystem PDR in late 2008.

STScI staff have engaged with each of the Science Instrument developer teams directly and by establishing operations working groups. These groups define how the instruments are commanded and operate. One of the groups' goals is commonality across the various instruments. The Institute's commanding team has made considerable progress in creating the on-board scripts and the Operations Plan Executive. The on-board scripts convert high-level instructions for the science observations into detailed commands for the instruments and spacecraft. They embody the knowledge of how the instruments operate and manage the intricate interactions between the flight systems to perform the observations. The Operations Plan Executive runs the scripts and orchestrates the event-driven operations paradigm for the observatory. In 2007, STScI delivered the second and third script builds to three of the JWST science instruments: NIRCam, NIRSpec and MIRI, and the first two builds for the Tunable Filter Imager (TFI). The team developing the scripts and executive passed PDR in January 2008. Additional deliveries will be made over the next two years to provide the teams with a full complement of scripts, enabling them to test the science instruments in the same way as they will be operated in orbit.

JWST senior project scientist and Nobel Laureate John Mather spoke at a December 2007 STScI colloquium.

The JWST Wave-front Sensing and Control System (WFS&C) analyzes images of stars and computes corrective motions for the actuators on the primary mirror segments to maintain the correct optical alignment. The portion of this system that does the analysis will reside at STScI and will be developed by Ball Aerospace & Technologies Corporation and the STScI. This team passed its first major review, the System Requirements Review, in fall 2007.



JWST model on the Mall, Washington, D.C.
Photo by Laura Burns.

Multimission Archive at STScI

The Multimission Archive at STScI (MAST) holds the science data products of the following missions or projects: HST, FUSE, GALEX, IUE, Copernicus, EUVE, HUT, UIT, WUPPE, HPOL, IMAPS, BEFS, TUES, VLA-FIRST, and XMM-OM.

Over a decade now in age, MAST has seen an explosion over the years in the number of products and data it makes available. Correspondingly, the number of users has increased significantly.

The Hubble Data Archive

The Hubble Data Archive continues to be one of the most-used resources in the astronomy community. During the past year, the Hubble Legacy Archive began to make available enhanced HST data.

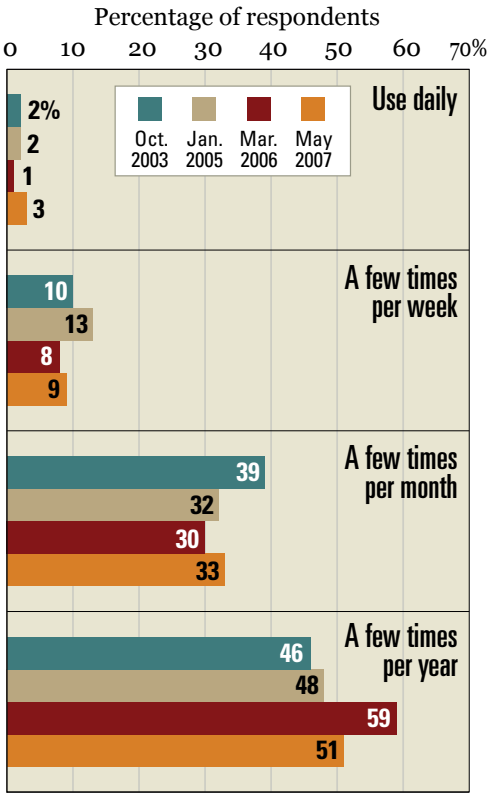
Since the observatory's launch, more than 6,000 HST-related papers have been published in refereed journals.

During the past year, 45,804 observations were processed through the STScI data pipeline and into the Hubble Data Archive. This number is comparable to the 43,122 reported last year, despite the ACS loss in January. Users were able to access their science data from the Archive, on average, within 14.4 hours after the observations executed. This includes the time the data spent on the spacecraft. Fully 98.9% of all observations were processed and archived within 48 hours of their receipt.

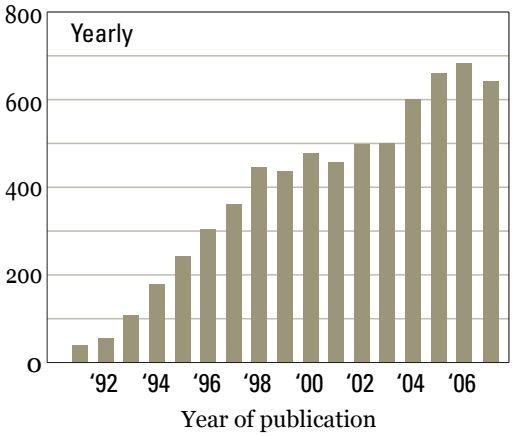
The HST Archive ingested 2.56 terabytes of data between August 2006 and July 2007, bringing the total size of the archive to 31.4 terabytes. The amount ingested is down 36% from last year, due to the loss of the ACS CCD channels.

This year's distribution of 28.9 terabytes of archive data is 22% more than our previous record, bringing our total volume of data distributed since launch to more than 149 terabytes. In March 2007, we distributed 4.21 terabytes, a new one-month record.

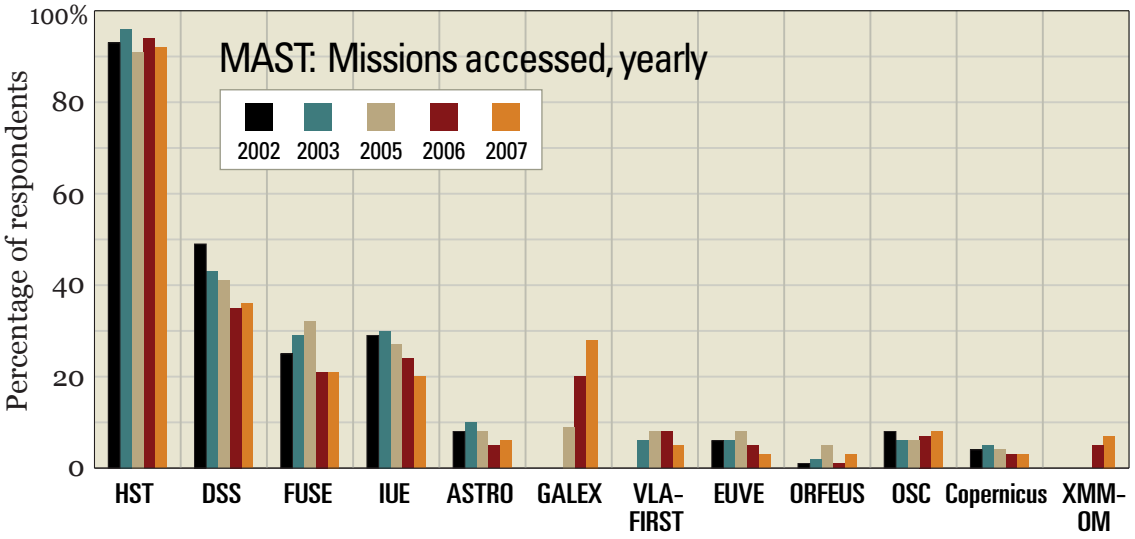
MAST: Frequency of use



Refereed papers based on HST data



Continued …

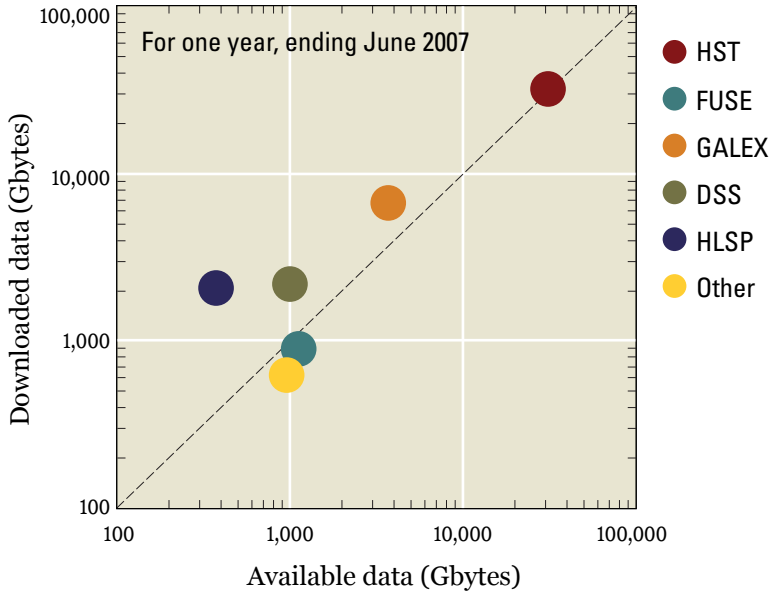


Major new data releases included additional products from large Hubble Treasury Programs (e.g., COSMOS, GOODS, and the Hubble Ultra-Deep Field), Hubble Heritage programs (e.g., NGC 2440, M82, observations of Jupiter to support the New Horizons flyby), and archival research projects involving the analysis of large numbers of HST images (e.g., WFPC2 observations of spiral galaxies, the Archive Pure Parallels Project).

The Hubble Legacy Archive

The Hubble Legacy Archive (HLA) is an augmentation of the Hubble Space Telescope (HST) data archive service. The goal is to optimize the science coming from the telescope by providing better browsing capabilities and easy access to enhanced products. The project is a collaboration between STScI, the Space Telescope European Coordinating Facility (ST-ECF) and the Canadian Astronomy Data Centre (CADC).

Data volume downloaded, by MAST mission



The Hubble data (red dot, in chart above) represent by far the largest volume. The High-Level Science Products (HLSP, blue dot) are very heavily utilized, with a total download volume almost 10 times larger than the data volume.

Some of the primary enhancements for image data include:

- Putting the data online for immediate access (see page 36)
- Adding a footprint service to make it easier to browse and download images
- Providing more extensive "composite images" (e.g., stacked, color, mosaics)
- Improving absolute astrometry (i.e., from ~ 1-2" to ~ 0.3") when there is sufficient overlap with the Guide Star Catalog 2 (GSC2)
- Developing generic source lists

Continued …

HLA's First Data release included all the publicly available data from six instruments: ACS, WFPC2, NICMOS, STIS, FOS, and GHRS (see table, next page). The data can be broken into two groups; enhanced HLA data (i.e., ACS combined images and NICMOS grism extractions; some WFPC2 Beta prototype images) and standard products already available from MAST (i.e., WFPC2, STIS, NICMOS images, FOS, GHRS).

HLA images have improved absolute astrometry as they are cross-correlated with the GSC2. Two general-use source lists are provided for many images: one made with DAOPHOT (better for point-line sources) and another one produced by SEXTRACTOR (for extended sources).

FOC and GHRS data were reprocessed and made available. On The Fly Reprocessing (OTFR) was never available for these instruments' data, so the files in the Archive were static and did not get reprocessed as better reference files appeared later in the mission. CADC, ST-ECF and MAST decided on a collaborative effort to process the entire GHRS and FOC holding with a consistent set of reference files representing the best current calibration. After thorough testing of the calibration software and databases, we used the OTFC pipelines at the ST-ECF to produce the final calibrated files for both instruments.

GALEX

GALEX Data Release 3 occurred in January and Data Release 4 in late December. DR3 included new tiles and Guest Investigator data, now public. DR4 included the Medium Imaging Survey (MIS); the Deep, Nearby Galaxy survey; and calibration surveys. As is the case with other MAST holdings, the GALEX data can be viewed through Sky in Google Earth.

In October 2007, MAST released the "GALEX Map." The Map allows users to browse across visible tiles and sky Images, and to assess at a glance which data are available in the General Release archives at MAST.

High Level Science Products

The community continues to provide the results of their research in the form of High Level Science Products. Archive retrieval statistics over the past year reveal that the HLSPs get downloaded approximately 10 times more often than the average HST pipeline processed dataset.

This year, this important archival collection was enhanced by the addition of the following sets:

- Catalogs of B-, V- and i-band dropout sources for the GOODS North and South fields and the HUDF (PI: Beckwith)
- GALEX Atlas of Nearby Galaxies (PI: Gil de Paz)
- WFPC2 spiral galaxies (PI: Holwerda)
- ACS mosaic images of M82 (PI: Mountain)
- Jupiter images in support of New Horizons fly-by
- FUSE Magellanic clouds Legacy Project
- Galaxy Halos, Outer disks, Substructure, Thick disks and Star clusters Survey (GHOSTS)
- HST snapshots of 3CR radiogalaxies

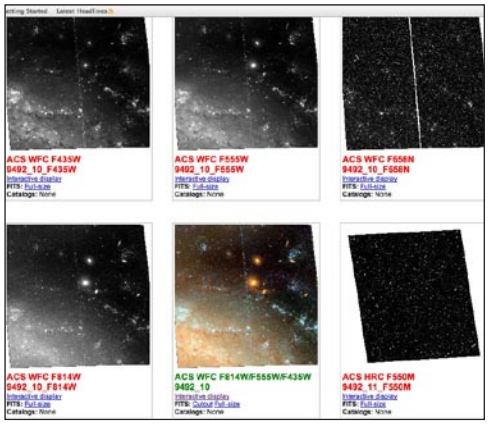
HLA's 'First Data' release

HLA-enhanced products Standard products

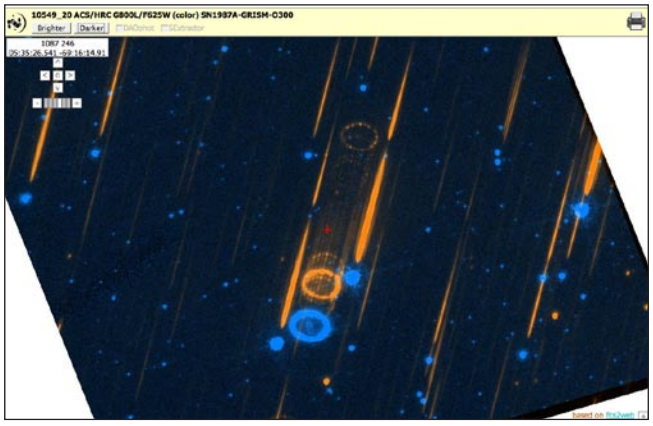
Instrument	Product	Source	% data HLA-enhanced	Download	Interactive display?
ACS	Combined images	STScI	~90%	FITS	yes
ACS	DAOPHOT source lists	STScI	~50%, <~2004	ASCII	yes
ACS	Extractor source lists	STScI	~10%, beta product	ASCII	yes
WFPC2	Combined images	CADC	Beta product coming soon	FITS	yes
NICMOS	GRISM extractions	ST-ECF	~80%, 1-D and 2-D spectra	FITS	
WFPC2	Single exposures	STScI		DADS[2]	
NICMOS	Images	STScI		DADS[2]	
STIS	Images and spectra	STScI		FITS	yes
FOS	Spectra	STScI		tar	
GHRS	Spectra	STScI		tar	

NOTES:
1. Beta products are being validated and are not currently recommended for scientific analysis.
2. DADS downloads require a request to the DADS system.

Screenshots: The HLA interface



Display view of some M101 images. Note that color previews are also produced.



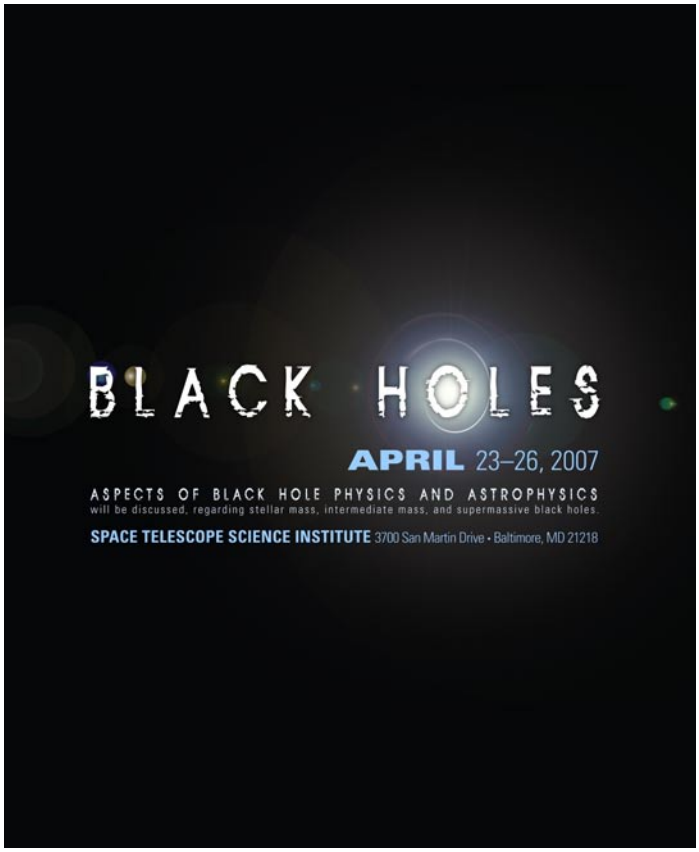
Interactive display of combined color image of SN 1987A (ACS, G800L + F625W)

Science Mission

OUR GOAL IS TO DEFINE
A DIVERSE SET OF PROGRAMS TO FOSTER
A VIBRANT SCIENTIFIC ATMOSPHERE

May Symposium

STScI presented its 2007 Spring Symposium, titled "Black Holes," from April 23-26. About 100 astronomers and astrophysicists from around the world attended the symposium to discuss all aspects of black hole physics and astrophysics, including black hole formation and evolution, characteristics of intermediate and supermassive black holes, gas dynamics, astrophysical jets, active galactic nuclei and more.



Neta Bahcall and Robert Williams, former STScI Director, unveil the auditorium's new formal name, honoring John Bahcall.

John Bahcall Lectureship

STScI and NASA's Hubble Space Telescope Project established the annual John Bahcall Lectureship to honor the late astrophysicist, John Bahcall, for the fundamental role he played over three decades in championing Hubble Space Telescope. He frequently advocated for Hubble, tirelessly explaining the important ways the observatory was changing our understanding of the universe and the significant impact it had in reaching every level of society. Best known for his work on solar neutrinos, Bahcall served as president of the American Astronomical Society and president-elect of the American Physical Society.

Geoff Marcy, professor of astronomy at the University of California, Berkeley, gave the second annual John Bahcall lecture. In his lecture, Marcy described the excitement and challenge of finding planets outside of our solar system.

Prior to the lecture, STScI dedicated its auditorium in honor of John Bahcall. Neta Bahcall and her daughter Orli Bahcall presided over the dedication.

Giacconi Fellowship

The Giacconi Fellowship Program, named in honor of STScI's first Director and Nobel Laureate Riccardo Giacconi, brings outstanding young researchers to STScI. Giacconi founded the Institute Fellowship in 1984, and the fellowship was renamed in his honor in 2006.

The Giacconi Fellowship is similar in its level of competition and prestige to the prize fellowships at other leading astrophysics institutions. It is for research only, on topics of the holder's choice, and carries no other duties. The research may be theoretical, observational, or instrumental. The Fellowship has a generous salary and research grant.

The current Giacconi Fellows are:

- Katherine Brand
- Asaf Pe'er
- Michael Santos

Summer Students

STScI runs a Summer Student Program for highly motivated college undergraduates. The 10-week program selected 18 participants in 2007 for immersion in a true research environment. Students have one-on-one interaction with an Institute scientist and participate directly in research, including data acquisition, reduction, and interpretation. At the end of the program, students present their summer's work at an informal symposium of their peers and mentors. Students also have an opportunity to participate in a program that shows the research done by the scientific staff of STScI, the ways in which modern research is supported and conducted, issues related to research careers, and the many and diverse activities that support the operations of HST and preparations for the launch of the James Webb Space Telescope.

STScI was also accepted as a Mentoring Organization in the 2007 Google "Summer of Code." This program offers student developers a stipend to write code for open source projects. Over the summer of 2007, STScI hosted two students who worked on HST calibration software and on Sky in Google Earth.

Summer students, 2007, left to right: William Schoenell, Kari Reitan, Josh Perlow, Elizabeth Keil, Alex Viana, Julie Taylor, Jessica Kellar, Radek Poleski, Eliceth Rojas, Dave Soderblom, Adrian Albert, Swarnima Manohar, Jonathan Sick, Ayesha Mahmud, Nicola Da Rio, Andrea Cardullo, Morgan Dwyer, Jose Hernandez, Viviana Rosero

Summer students' countries of origin

for all years of the program, from 1997 to 2004

National Virtual Observatory

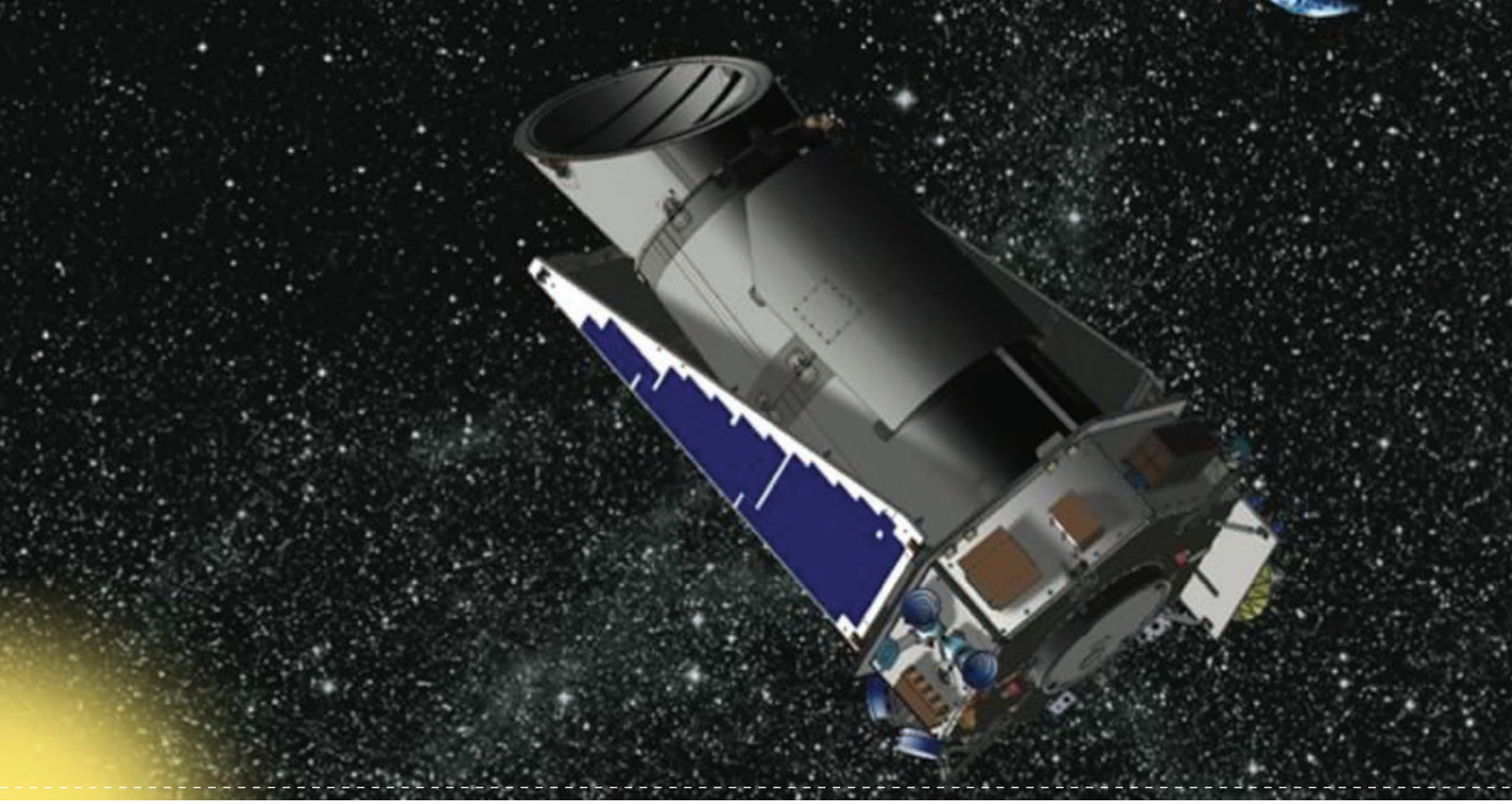
STScI is a key player in the development of the U.S. National Virtual Observatory (NVO).

NVO will link all the world's astronomy data together via online tools, giving people worldwide easy access to data from many different instruments at all wavelengths of the electromagnetic spectrum.

The Virtual Astronomical Observatory accomplishes this goal by linking a multitude of astronomical data sets into an integrated system that allows automated search and analysis among all cataloged objects. The Virtual Observatory will provide access to data sets, create and maintain data protocols and standards, and provide analysis tools and services to the astronomical research and educational community.

STScI is responsible for overall project management and for coordinating the NVO education and public outreach program. STScI staff are also major contributors to software development, particularly in the area of tools used to determine sky coverage and overlapping survey regions, and tools to locate data. STScI provides data standardized for the NVO, including all MAST data collections and many high-level Hubble science products.

A request for proposals for the Management and Operation of the Virtual Astronomical Observatory was issued jointly by NASA and the National Science Foundation (NSF) in early January 2008. AURA is teaming with Associated Universities, Inc. to submit a joint consortium proposal.



Kepler Data Management Center

STScI is partnering with the Kepler Project to serve as the mission's Data Management Center (DMC). The primary goal of the Kepler mission is to determine he frequency of terrestrial and large planets in or near the habitable zones around a wide range of star systems. The Kepler spacecraft will do this by detecting and characterizing photometric transit events for around 100,000 stars near the Galactic plane. Kepler launch is scheduled in November 2008.

At STScI, the Kepler DMC will be responsible for scientific data processing, and for populating and managing the Kepler data archive, including the storage and dissemination of the light curve data.

The Kepler Ground System and Mission Operations (of which the DMC is a critical portion) Critical Design Review (CDR) was successfully passed at the end of January of 2007. In April 2007, STScI built the third version of the Data Management Center.

Office of Public Outreach

STScI's Office of Public Outreach engages the public in Hubble discoveries on a multitude of fronts, using the news media, museums, classrooms and more to disseminate a steady stream of knowledge-broadening discoveries and images.

This was an exceptionally successful year for the Office of Public Outreach, even with the background of many years of accomplishments in engaging the public in Hubble discoveries.

News

By design, the News Team continued to lead the way with press releases, NASA Science Updates and media teleconferences, Science Writers' Workshops, and a variety of activities in support of other missions and organizations.

On Sept. 18, 2007, the News Office organized a special Science Writers' Workshop on "Dark Energy." The two lead authors on the discovery papers of dark energy and a Nobel Laureate in Physics made the presentations and answered questions. The workshop resulted in full-page articles in USA Today and Newsweek — unusual coverage for a science event that was not based on breaking news.

Formal Education

The Formal Education team continued its extensive program of curriculum development and support, evaluation projects, and E/PO grants administration. In recognition of the team's experience with the immersion of astronomical discoveries into standard education curriculum activities and the success of the Amazing Space formal education program, NASA's Office of Education asked STScI staff to implement an educational workshop for Queen Elizabeth of England's visit to the Goddard Space Flight Center. The activities were centered around images of the Hubble Deep Field.

Online Outreach

HubbleSite.org is OPO's entrance door, providing Web audiences with firsthand knowledge about the Hubble mission, including access to news releases and detailed information about the observatory. During 2007, 24 million users viewed more than 102 million Web pages on HubbleSite, generating 1.4 billion Web "hits."

A new section on Dark Energy went live in November 2007. The section, which provides a detailed explanation of the discovery, interviews with key astronomers, and interactive elements, is the first of a series that will place the scientific and cultural accomplishments of the Hubble mission in the context of the greater search for knowledge.

Online Outreach developed an off-line version of HubbleSite to accompany the Hubble traveling exhibit. The version does not need an Internet connection, thus allowing a larger number of venues to use it.

HubbleSite added a new section, Hubble Essentials, where an encyclopedia-style overview of the mission is available. It also expanded its "make-your-own model" section, "Hand-Held Hubble," with new paper models the public can assemble.

Informal Education

The Informal Education Team continued to produce its extraordinarily successful product, ViewSpace. During 2007, no fewer than 44 new partners signed on to integrate ViewSpace into their shows. ViewSpace is thus becoming one of the most popular "entry points" for audiences interested in learning about NASA science. To enable museum visitors to further explore topics that intrigue them, the Informal Education Team developed special Web portal pages that contain links to other NASA educational programs. It is worth noting that the Informal Education efforts this year have put special emphasis on small and underserved communities, providing them with ViewSpace systems on loan.

JWST Outreach

In 2007, OPO and NASA agreed to begin to expand OPO's outreach to the public regarding the James Webb Space Telescope (JWST). In response, OPO produced a short video that would serve as a basic introduction to the mission, the first of a number of new tools to explain and build support for JWST.

JWST outreach efforts to the astronomical community continued with new displays at the 2007 winter and summer meetings of the American Astronomical Society (AAS). STScI is prepared to support similar updated displays in 2008 and will assist the JWST Science Working Group in organizing a Town Hall event at the winter AAS meeting in Long Beach, CA.

Origins Education Forum

The Origins Education Forum continued to coordinate E/PO endeavors across missions and partner with a variety of groups involved in the dissemination of Origins materials. The Forum has taken the lead in coordinating with NASA and the AAS the activities associated with the International Year of Astronomy (IYA). The Forum has identified networks that provide connections to large audiences, including the Jet Propulsion Laboratory (JPL) Museum Alliance, The JPL Solar System Ambassadors, and the Astronomical Society of the Pacific's Night Sky Network. All of these networks have agreed to participate in NASA's IYA activities, like providing plenary speakers for major education conferences, observing experiences for students and educators, and support for public unveilings of large images.

Innovation

OUR GOALS

Optimize the science from state-of-the-art astronomical instruments.

Promote new applications for STScI products.

Foster new missions and mission concepts.

Sky in Google Earth

"The Sky in Google Earth," the astronomical equivalent of Google Earth resulting from a partnership between STScI, the University of Pittsburgh and Google, launched on Aug. 22, 2007.

The Sky in Google Earth allows users to roam through the celestial sphere mapped by the Sloan Digital Sky Survey, looking at the constellations and zooming further to objects of interest, whose images are provided by HST or GALEX. This interface connects to astronomical databases served by the Multimission Archive at STScI and HST press releases, and offers hyperlinks to larger collections, such as the National Virtual Observatory. Images from the Chandra X-ray Observatory and Spitzer Space Telescope are available as well as the all-sky surveys made by the Infrared Astronomical Satellite (IRAS) and the Wilkinson Microwave Anisotropy Probe (WMAP). As a result, the Sky in Google Earth contains images in all wavelengths, from X-rays to infrared radiation.

The interactive and engaging interface, which features a map of the constellations drawn by Giovanni Cassini in the 18th century, is an ideal outreach and educational tool, but is also intended to flourish into a research and discovery tool.

Astrophysics in the Next Decade

Astrophysics in the Next Decade, a meeting hosted by STScI and NASA/GSFC and sponsored by Northrop Grumman, engaged the broad science community in a discussion of science enabled by JWST and concurrent orbital and ground-based facilities. It described and stimulated work on the theoretical foundations for astrophysics in the next decade. The topics included the reionization history of cosmic hydrogen, the large scale structure of the universe, clusters and superclusters of galaxies, the interstellar medium, accretion disks, extra-terrestrial planets, and more. Speakers included Alice Shapely of Princeton University, Mark Dickinson of the National Optical Astronomy Observatory, and Ewine Van Dishoeck of the Leiden Observatory. Over 200 people from universities, observatories and the aerospace industry attended the meeting on Sept. 24-27, 2007.

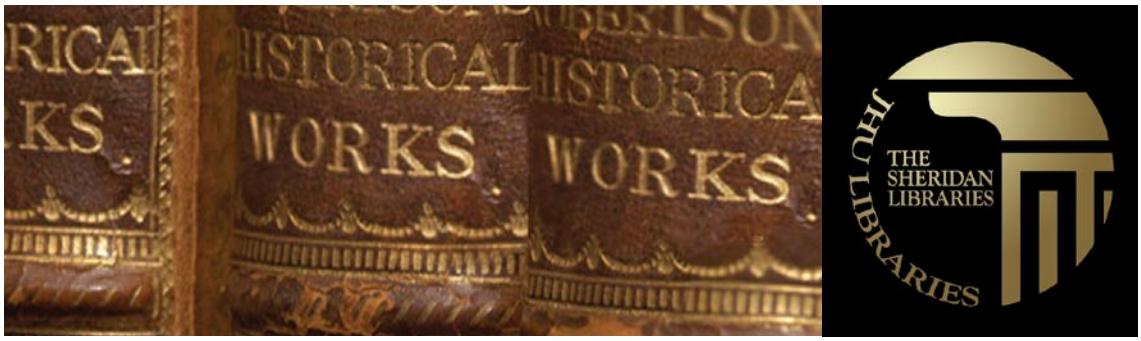
Astrophysics 2020

The Space Telescope Science Institute sponsored a three-day science workshop, "Astrophysics 2020: Large Space Missions beyond the Next Decade," in November 2007.

About 200 people from universities, national and international space agencies, and observatories attended this workshop, which focused on envisioning the astrophysics that could be accomplished from space in the 2020 era and beyond. Astrophysics in the 2020's will build upon the results obtained by the James Webb Space Telescope, the Atacama Large Millimeter Array, the Large Synoptic Survey Telescope, the Giant Magellan Telescope, the Thirty Meter Telescope, the Extremely Large Telescope and other remarkable facilities now being planned for the coming decade.

While predicting the precise areas in astronomy and astrophysics that will be most important in 15 to 25 years is difficult at best, the research topics that will be ripe for investigation will most likely be those that require sensitivities, discovery efficiencies, and/or spatial resolutions that significantly exceed what the above facilities will routinely provide. Also discussed were critical pathfinder missions and technological innovations that need to be accomplished in the coming decade in order to enable innovative astronomy beyond the next decade.

Speakers included Ron Allen of STScI, Webster Cash of the University of Colorado, and Dennis Ebbets of Ball Aerospace.



Institutional Archive at MSEL

In 2007, STScI entered into an agreement with the Milton S. Eisenhower Library (MSEL) at the Johns Hopkins University for the collection, cataloguing, curating and archiving of all the non-financial institutional documentation generated by STScI. MSEL will store all the material and will make it available to scholars upon request. The STScI Library is coordinating this effort. To initiate the project, a proposal was submitted to the American Institute of Physics to provide matching funds and allow for the hiring of an archivist. The proposal was accepted, and an archivist was hired to create a preliminary catalog of the available documents and write a guide informing STScI on which documents to keep and send to MSEL.

Network Upgrade and Central Storage

During the past year, a multi-organizational team from the Information Technology Services, Operations and Engineering, and Instruments divisions developed and executed a major upgrade of the network and data storage infrastructure at STScI. The primary goal of this upgrade is to provide a reliable and secure data storage environment for HST Mission Critical information. This environment increases the overall bandwidth within STScI's internal network, including 1Gb/s to the desktop, and provides a centralized data storage system. The storage system contains 50TB of network-attached storage (NAS/SAN), 10TB of content-addressable storage (CAS), as well as a disk library for backup staging and a tape library for creating backups stored offsite. The content-addressable storage device enables duplicate copies of files to be stored only once, increasing the overall storage capacity of the system.

The centralized storage solution was created and sized to support the data needs of other non-HST work within the Institute. In this way, staff can leverage the storage infrastructure to archive research data. It also provides a scalable solution that can be extended as needed to other areas and projects.

Community Involvement

OUR GOALS

Be a good community partner.

Develop community partnerships to expand our programs in the greater Baltimore area.

Engage young people to encourage their interest in science, technology, engineering and mathematics.

Public Lecture Series

STScI conducts the Public Lecture Series program. The lectures are a well-attended series of public talks hosted in the Institute's auditorium. Each month a noted expert from the astronomical community is invited to conduct a presentation on a topic of interest to the public. The lectures start with an overview of recent HST discoveries or other science-related items of interest to the public.

The first section of the lecture, dealing with the latest Hubble news, is now taped and distributed as a video podcast through HubbleSite and Apple's iTunes. The lecture series podcasts began in April 2007, and joined the already-popular audio podcasting of the Skywatch radio series.

Frank Summers (STScI) presents the Public Lecture Series.

Walters Art Museum

Throughout 2007, STScI cooperated in creating an exhibit for the Walters Art Museum that will open in 2008. "Mapping the Cosmos: Images from the Hubble Space Telescope," is part of the exhibit, "Maps: Finding Our Place in the World." This is the first collection of Hubble images presented as part of a major art exhibit in a prominent art museum.

The exhibit was created through a unique collaboration between the Walters, STScI, and Professor Elizabeth Rodini and her students in the "Behind the Scenes at the Walters Art Museum" class at Johns Hopkins University.

Seven undergraduate students and Professor Rodini worked with STScI professionals to choose the images and design a two-room exhibit that was scientifically accurate and also appropriate for an art museum.

STScI staff gave presentations to the students on the science and production of Hubble images. The students then presented their image selections and exhibit design to their colleagues and to their STScI counterparts. STScI staff created a three-dimensional computer model that showed the students how their exhibit would look when installed.

The Hubble images were chosen primarily for their visual impact. By revealing the natural beauty of the universe, the exhibit explores the relationship between aesthetics and science.

Meridian Speeches

STScI staff, along with JHU staff, students and faculty, are invited to attend the Meridian Speaker events at the institute. Meridian speakers discuss scientific topics on a less technical level than they would in a scientific colloquium. Topics and speakers in 2007 included "Star in a Jar," by Lawrence Crum, "The Jasons," by Ann Finkbinder, and "True Success: A New Philosophy of Excellence," by Tom Morris.

Speakers Bureau

STScI conducts the Speaker's Bureau program. The Speaker's Bureau coordinates lecture requests from educational and civic organizations interested in learning about astronomy or the Hubble mission. The speakers are all volunteers; STScI provides them with resources and programmatic support.

Employee Recreation Committee

STScI's Employee Recreation Committee is a self-sustaining, voluntary organization that coordinates social events and charity fundraising at the Institute. The ERC raises money for local charities through the sale of STScI- and Hubble-related merchandise. In 2007, the ERC hosted a craft sale, the traditional STScI Halloween party and costume parade, an ice cream social, and a winter holiday party. The ERC also promoted the yearly Toys for Tots campaign and a fundraising program for the Maryland Food Bank.

The ERC provides STScI staff with an number of additional benefits: discount tickets to the Maryland Science Center and other local attractions, information on discounted cellular phone plans, and a free book exchange located in the STScI Café.

2007 Assessments

HST

From the HST Project's Performance Assessment Committee (PAC) FY07 letter:

The [HST Project Assessment] Committee assigned an overall rating of 95 percent, directly recognizing the STScI's excellent performance over the period.

The loss of the ACS wide field and high resolution channels came without warning and was a serious detriment to the science capabilities of the Hubble Space Telescope (HST). However exemplary preplanning by the STScI paid off [...and] kept the overall level of spacecraft efficiency over 40 percent.

During the spring and summer of 2007, the HST program undertook a complete bottoms-up reassessment of the HST SM4 manifest and priorities. STScI management also provided key insights that [... were] used as the guiding principle for SM4 manifest and priority decisions.

The Institute received outstanding ratings for all of its outreach goals. Initial implementation of the diversity plan showed excellent progress in serving the underserved and underrepresented portions of the nation's population in an organized and strategic manner.

The Institute ended its fiscal year within 0.1 percent of the budget guideline for the entire contract. It is noteworthy that this outstanding result marks the best fiscal planning and implementation performance by the Institute in the last decade.

The initial Bahcall lectureship by Dr. Richard Ellis was a great success and set a high standard for the future of the program. The Caroline Herschel Program was tremendously successful this year, bringing a wide variety of people particularly appropriate to addressing the goal of the program.

Significant improvement in the diversity and the working environment at the Institute was noted over the last year. A reversal in the trend of severe under-representation of women and minorities – particularly in high positions within STScI – has begun.

The STScI was again ineffective in holding schedule on deliverables [of the Hubble Science year in Review book]. Though very late, and produced with great difficulty, the resulting book was of outstanding quality and a credit to the Hubble program.

JWST

From the JWST Project's Performance Evaluation Committee (PEC) letter, May 2007:

[For this eighth evaluation period, Oct. 1, 2006 to March 31, 2007], AURA's overall performance was evaluated as "Excellent" with a score of 95.

Continued ...

The overall score for the period reflects several events deserving of special recognition for the excellent support received from AURA. We commend AURA on the continued excellent support for the Electronic Speckle Pattern Interferometer (ESPI). As noted previously, the ESPI work is highly praised as a significant contribution to achieving TRL-6 schedules.

The Performance Evaluation Committee (PEC) rated AURA's overall Technical/Schedule performance with a score of 95 or "Excellent," [...], overall Business/Cost Management performance with a score of 95 or "Excellent, [...and] overall Science Program Implementation performance with a score of 94 or "Excellent." Support for Science Outreach was excellent.

From the JWST Project's Performance Evaluation Committee letter, November 2007:

For this [ninth] period [April 1 to Sept. 30, 2007], AURA's overall performance was evaluated as "Excellent."

We also commend AURA for the major update of the JWST website.

The Performance Evaluation Committee (PEC) rated AURA's overall Technical/Schedule performance with a score of 92 or "Excellent." During this period, AURA successfully met all key events on or ahead of schedule with high quality products.

AURA continued efforts in defining JWST Ground Segment test program has included excellent input and justification for the test hours required for Ground Segment Verification. During this period, AURA also provided an excellent technical report for the Moving Target study.

The PEC rated AURA's overall Business/Cost Management performance with a score of 92 or "Excellent." AURA continues to be very responsive to request from the JWST business and contract management team. In the area of Equal Employment Opportunity (EEO), AURA has improved in the representation of women and minorities. We request that AURA continue to pursue actions to reach parity in all EEO statistical areas.

The PEC rated AURA's overall Science Program Implementation Performance with a score of 97 or "Excellent." Support for Science Outreach was excellent. As noted earlier, we commend AURA on the leadership provided for the "Astrophysics in the Next Decade; JWST and Concurrent Facilities" conference.

Institute Visiting Committee (IVC)

From the IVC 2007 Report:

The 2007 IVC is delighted to report that the general situation of the Institute improved with regard to the concerns raised in the 2006 report and that the Institute's traditional strengths in carrying out its core mission re: HST and JWST are still in evidence.

The IVC finds that the Director has been effective in moving the Institute's internal organization and management style towards a more efficient horizontal form, as planned, and encourages him to continue this process.

Continued ...

The IVC finds that the changes in organizational structure and management style were much more apparent to staff members relatively high in the Institute's organizational structure. Those working "in the trenches," far from senior management, reported much less, if any, change in their organizational work environment and in their interactions with their direct managers.

Space Telescope Users Committee (STUC)

From the Space Telescope Users Committee 2007 Report:

The STUC wishes to commend the Institute and the Project for their timely and adept handling of the Cycle-15 observing program and Cycle-16 proposal process in light of the anomaly with ACS. This was a unique challenge and the Hubble team rose to the occasion with prompt planning and careful follow-through.

The committee has some concerns that the Institute may not have the required personnel to support HST instruments post-SM4. We encourage the Project and Institute management to examine the size of the instrument support teams from the perspective of the most optimistic outcome of SM4. We suspect that additional staff may be required.

The committee is impressed with the work being done on the Hubble Legacy Archive and believes that this activity should continue to receive ample support. We believe that the HLA can become a valuable and important tool for research for years to come.

Future of the Workplace

From the Future of the Workplace 2007 Report:

The STScI has one of the most exciting missions in science. You properly perceive that coupled to your mission are responsibilities to become more diverse, provide outreach, and raise awareness of the necessity for a workplace as fair, respectful, and supportive as the mission is exciting. We commend your efforts and are pleased to support them.

Lawrence Hall of Science

From Steven M. Dunphy, Great Expectations in Math & Science Marketing and Operations Director:

I am writing to acknowledge the outstanding contributions of the HST formal education team to the development of two Curriculum Sequences for Space Science by Lawrence Hall of Science's Great Explorations in Math and Science (GEMS) program. It is hard to imagine how we could have completed these projects on schedule and at the quality level we achieved, without the support of Bonnie Eisenhamer and the HST education team. On a project with many talented contributors the HST team stands out as a key collaborator.

The SM4 astronauts, from left to right: Gregory C. Johnson, Megan McArthur, John Grunsfeld, Scott Altman, Michael Massimino, Michael Good and Andrew Feustel

SM4: Perspectives of an astronaut

by John M. Grunsfeld

For astronauts, and for me on a personal level, the opportunity to leave planet Earth and fly in the space shuttle on any mission is an incredible privilege. It is nevertheless important to remember that this activity carries with it more than a significant risk, as the tragic loss of the Columbia and the STS-107 crew patently demonstrated. As a crew, we go forward with the Hubble Servicing Mission 4 with the knowledge that we are participating in an activity that is much bigger than all of us and worth the risk to ourselves and our families. We recognize that this mission reaches beyond the teams of astronomers who will directly benefit from the new and exciting observations enabled by the Wide Field Camera 3 or the Cosmic Origins Spectrograph, and beyond the extended Hubble lifetime on orbit.

Continued …

The work that we do on orbit — with the efforts of the big team including Goddard Space Flight Center, the Institute, scientists around the world, and many others — has become an integral part of our culture. When we go to Hubble in 2008, we will not just write another chapter in the Hubble story, but will extend a work that is already a major mark in human history.

The day-to-day efforts to train and prepare for the flight have already started, with training in the Neutral Buoyancy Laboratory (big swimming pool), robotic-arm training, and long planning meetings. Our commander Scott Altman, and space-walkers Mike Massimino and I are certified "Hubble Huggers," and we know how special it is to be part of the Hubble team. The new space flyers on this flight — pilot Greg (Ray J) Johnson, flight engineer Megan McArthur, space-walkers Drew Feustel and Mike Good — regard their assignment as being incredibly special, and they're right! There is an enormous amount of hard work for all us to do, but in the background is the thought that the greatest discovery from Hubble may well be enabled by our labors on Servicing Mission 4.