

## **Report of the Hubble Space Telescope Users Committee November 13-14, 2008**

**Attending:** M. Barstow, P. Garnavich, J. Green, L. Lubin, J.-P. Kneib, D. Koo, M. Mateo, P. McCarthy (Chair), P. Nicholson, R. O'Connell, A. Saha, T. Treu, M. Vestergaard

**Unable to attend:** A. Renzini

### **Summary and Top Level Recommendation and Observations**

The Space Telescope Users Committee met at STScI on November 13 & 14, 2008. The committee was apprised of the current status of the observatory, plans for the upcoming servicing mission, results from the recent time allocation process and plans for the next proposal cycles. The committee believes that the observatory remains a vital and productive facility despite recent short-term problems and delays in the servicing mission. The STUC supports the plans by the Institute to bridge the gap in the observing program via a supplemental call for proposals. The committee made the following top-level observations and recommendations:

- The STUC commends the Project and the Institute for their continued focus on SM4 while dealing effectively with issues requiring immediate attention.
- The STUC is very concerned that budget projections beyond 2012 call for a significant reduction in support for HST. We urge NASA to allocate funding at the level needed to maximize the scientific return from HST in its most capable configuration.
- The committee understands that the delay in the scheduled servicing mission entails unforeseen expenses to the program, but feels strongly that funding for science support and data analysis should remain top budget priorities.
- The committee does not recommend revisiting the relative prioritization of repairs to STIS and ACS; both are vital to HST science.
- The STUC is not convinced that the case for ranking the FGS replacement above the second instrument repair is compelling, but does not feel that a strong case can be made for a different prioritization.
- The STUC commends the Institute for its rapid, but deliberate, response to the delay in SM4 and supports a timely call for supplemental proposals and has offered some suggestions to improve the draft call for proposals.
- The committee was pleased with the outcome of the Cycle 17 TAC process, but is concerned with the lower than average success rate for medium sized proposals.

The STUC requests a discussion of possible approaches to ameliorating this problem in future cycles at the time of its next meeting.

- The plan for the cycle-18 proposal process is sound. The STUC believes that coordination and transfer of knowledge between the cycle 18 and multi-cycle treasury time allocation committees is essential to a successful outcome for both.
- NICMOS should be brought back on-line without undue delay as its value has a timeliness associated with it.
- The Institute has developed a good plan for instrument and user support post SM4. We thank the Institute staff for responding to our requests for reporting on this issue.
- The committee was pleased to hear of the progress in renewing the MOU with ESA and reaffirmed its belief that continued ESA involvement in Hubble operations and user support is vital to the success of the program.
- The committee laments the upcoming closure of the ST/ECF facility in Garching, and is particularly distressed at the potential loss of their excellent outreach program. We hope that ESO or ESA will find some means to continue the outreach activities currently led by the ECF.
- We support the broad aim of fostering the use of common software languages, and environments, and the development of general-use tools across broad areas of astronomy. The committee would look favorably on the allocation of additional resources in this area, provided that they do not come at the cost of support for HST users, instruments, and data products.
- The STUC continues to be impressed with the excellent progress on the final reprocessing and archiving of data from NICMOS and WFPC2, the continued enhancements of the Hubble Legacy Archive, and the development of multi-drizzle and supports the basic plans for these areas as presented to the committee.

## Minutes of the Meeting

*November 13, 2008*

**STScI Outlook (Mountain):** The STScI Director reported that the Hubble is back on line after a series of problems, the most serious of which is the failure of side A of the data handling unit. WFPC2 is back in operation and producing good data. NASA will shortly release direct images of an extrasolar planet. Mountain noted the rather urgent need for NICMOS to be brought back into operation and cited this exoplanet system as a science opportunity that should not be missed. He reviewed the enormous gains in sensitivity offered by Hubble compared to ground-based telescopes.

ESA held a senior review of support for ongoing missions. HST was ranked first and ESA will thus continue its support providing 15 scientists to STScI, approximately to one-third of Institute astronomical research staff. In preparation for the Decadal survey, AURA and STScI will prepare a document discussing options for future space-based UV to near-R mission, entitled "Next steps in UV/optical/NIR Space astronomy". David Spergel has agreed to Chair this group. A workshop will be held at STScI March 26-27, 2009 on this topic, and the report should be ready by the fall of 2009.

**HST Project and Program Status (Burch & Leckrone):** The STUC heard from Preston Burch regarding some of the challenges that have arisen in recent months and led to the disappointing delay of SM4. Part of the disappointment arises from the fact that all support and hardware elements required for SM4 were on track for a mid-October, 2008 launch at the time of the serial failures on HST in Sept and Oct 2008. The most significant of these failures, that of the side-A electronics of the SI/C&DH 1 unit (the 'data handler'), was handled by the Project carefully, expeditiously, and, ultimately, successfully by changing to the side-B electronics. Burch reviewed the efforts to assess the suitability of finding a flight spare for the on-orbit SI/C&DH unit. The spare clearly cannot be ready in time to meet the February 2009 launch window. A complete schedule--including review, testing, and flight readiness--has been developed to assure that this component is ready for the current SM4 alternate launch date of May 2009. Some of the flight tool designs and mockups needed to support the SI/C&DH change out in SM4 are under development. Finally, the STUC heard of the staged process of bringing the HST instruments back on-line after the recent failure. This process has brought nearly all the instruments back up, with the exception of NICMOS. This instrument may have additional problems; efforts to bring NICMOS back will begin the week of Nov 17.

The budget impact of the SM4 delay was described in detail. The additional costs are substantial and the Hubble Project has been challenged to provide some of the needed funds from its budget. Burch reported that the current plan is that some of the funds will come from science operations and data analysis budget lines. There should be no immediate impact on current or Cycle 17 research funding. The Project believes that

reprogramming of the cash flow can mitigate the impact on science support in the out years. The STUC intends to remain vigilant on this issue.

Burch believes that, in many ways, the last few months have been among the most challenging in the history of the project. The STUC offers its sincere congratulations and appreciation to the Hubble Program for its rapid and effective response to the various challenges.

These developments leave SM4 on-track to bring HST to its most scientifically powerful state ever. The disappointment that SM4 has been delayed is palpable in the HST Program. But the Program has exhibited remarkable skill and dedication to get HST through these recent ills, diagnose the problems, and prepare a modified SM4 in response to the events of the past two months. The strong support for Hubble at NASA headquarters is appreciated and the users look forward to a successful servicing mission in the spring of 2009.

Leckrone reported on the status of the HST project. The delay of SM4 to April/May 2009 is a disappointment, but morale remains good and the project is energetically addressing preparations for the reconfigured mission. The timing of the SI CDH failure was, in fact, fortuitous because SM4 can now incorporate replacement of this unit with one that will have redundant capability. Without that, HST would have been in a "zero-fault tolerance" condition. With the SI CDH replacement, there is good confidence that operations can continue at least to 2014. Support from NASA Headquarters, Congress, and the general public for SM4 has been unwavering, and the project is well positioned for a highly successful servicing mission.

Leckrone reviewed some metrics of HST's prominence as a "public observatory," which serves the interests of both professional astronomers and the general public. HST completed its 100,000<sup>th</sup> orbit in August 2008, nearly a record for a functional spacecraft. Over its lifetime, 4300 astronomers have participated directly in 27,000 observations, and 7700 authors have contributed to journal articles. The publication rate for HST-related science is now about 14 articles per week. Observing time on HST remains in great demand, with the oversubscription ratio being 5.6:1. The just-completed selection of Cycle 17 scientific proposals includes many innovative and important projects and exploits the full "tool box" of post-SM4 capabilities of HST, new and old instruments alike. Educators throughout the world use HST images and public outreach materials. Its scientific productivity is as high as ever, even after 18 years of operations.

Final evaluations of the two new instruments to be installed during SM4 are now available. Both perform superbly. The WFC3 point spread function meets or exceeds all specifications except for a small departure at 1.6 microns. Its limiting magnitude in long exposures exceeds all earlier HST instruments except for ACS/WFC at 7000-9000 Å. COS sensitivity exceeds all specifications except for the two longest wavelength channels, which have been affected by the growth of an oxide layer on the bare aluminum gratings (resulting in a 30% decrease in reflectivity).

Great effort has been invested in developing and practicing the STIS and ACS repairs, and there is every expectation that these will succeed. The ACS repair procedure will bypass all the known failed segments in the electronics strings.

The restart of NICMOS after the recent safing events has been delayed because of technical uncertainties with the cryocooler. A new attempt at restart will be made in the week of Nov 17. The STUC recommends that every effort be made to have NICMOS available for science observations in the January-April 2009 period because WFC3/IR will supercede some of its capabilities after SM4.

**NASA Headquarters Perspective (Smith):** Eric Smith presented the view from NASA HQ. NASA has found funding to support the cost of a 7-month slip in launch for SM4. A review of the list and status of other programs managed by the Astrophysics Division was shown. The STUC finds the balance reasonable but is concerned about the projected sharp decline in support for Hubble in 2012 and beyond. We urge NASA to recognize the unprecedented power of the post-SM4 Hubble when revisiting long-range plans for mission support.

There are plans to have a senior review of Hubble, post SM4. This will also serve as input to the Decadal Survey. The launch slip causes some concern about the usefulness of a review in the spring/summer 2009 time frame. There is some question as to whether a comprehensive enough assessment can be made in time for the Decadal Survey to assess by the Decadal Review how HST should be operated following the SM4 enhancements.

The STUC is satisfied that HST is high in HQ's priority, and that the SM4 mission and its implications are getting adequate attention, and recognizes that HQ is managing the budgetary fallout from the launch slip as constructively as possible.

**HST Mission Report (Doxsey & Sembach):** In preparation for SM4 NSSC-1 flight software, needed to command and monitor science instruments post-SM4, was installed in early September. This required the safing of all instruments and the NICMOS cryocooler. During the subsequent recovery of the instruments several problems and anomalies occurred that caused first WFPC2 and later the NICMOS cryocooler (NCS) to go into safe mode. The WFPC2 problems were not related to hardware and are well understood. NCS could not be recovered during several attempts due to different issues related to the coolant circulator. It was suspected that water ice, deposited on or near the circulator during the initial safing, was interfering with circulator operation. With the hopes that this water ice would sublime during a warm-up of NICMOS it was decided to leave the NCS off until after SM4 which was just a few weeks away at that time. The NCS went into another safe mode during the hardware failure of the SI/CDH on September 27th. On October 15 HST was switched to the redundant side B electronics, which experienced a glitch the next day. Side B was restarted on Oct 23 and has worked fine since. WFPC2 and ACS/SBC have since been recovered and are working fine. On November 18 STScI will attempt to restart the NCS. If the issue repeats the problem may not be water ice and alternative explanations and solutions must be sought. NICMOS is

expected to be operational at the end of 2008 since it takes four weeks to cool and subsequent tests (focus, tilt, and filter wheel) will take another week.

Since recovery, the ACS/SBC performance has been normal. CCD 4 of WFPC2 continues to have low gain and bias sensitive to the circuit board temperature but is expected to perform through a May 2009 SM4 launch date with no blank images; however there is limited room for further temperature reduction to keep CCD4 operational.

HST has been kept productive during the anomaly period by changing the observing program to focus first on WFPC2 SNAP programs and later Fine Guidance Sensor (FGS) programs, supplemented by FGS community solicited programs (as Directors Discretionary programs). If NICMOS is recovered, the schedule will be weighted toward NICMOS programs. A supplementary call for proposals is aimed at keeping HST productive until the servicing mission.

The STUC strongly commends STScI and GSFC for their efforts and success in quickly addressing and solving the many operational and technical issues that have come up in the wake of the NCCS-1 software installation in early September.

**Cycle 16 and 17 Update (Reid):** The delay of SM4 and the recent events with NICMOS impose a substantial reorganization of the science program for HST in the current cycle 16 and the schedules for cycles 17 and 18. The Institute has been working to reconfigure the science program under the guiding principle of maximum scientific output. Even if NICMOS is successfully restarted, the pool of approved programs with the current instrument suite is not sufficient to fill the schedule until the planned date for SM4 (April/May 2009). If NICMOS is not returned to science operation, the shortfall of targets could begin as early as January 2009. The STUC strongly supports the current plan to return NICMOS to standard operations as soon as possible. As demonstrated by the number and quality of approved and pending programs, NICMOS is still capable of highly competitive science.

In any event, a supplemental call for proposal is a clear necessity. The Institute plans to release a supplemental call for proposals as soon as possible, aiming for approval of new programs by early January at the latest so that they are ready to execute by February 2009. Important features of the proposed call include: i) limited sky visibility; ii) restriction to large or innovative/risky proposals; iii) no duplication of cycle 17 programs. A time allocation committee will be formed including panel/TAC members from Cycle 16 and 17 and STUC members.

The STUC commends the Institute for its rapid response and for producing a clear plan to overcome this emergency. The STUC recommends setting the minimal threshold to approximately 75 orbits, which seems to be a good compromise between the needs of having a small enough pool of proposals to evaluate and schedule and that of soliciting a broad range of programs containing the best ideas. The STUC recommends that the definition of innovative/risky proposals be clarified both in the call for proposals and in

instructions to the TAC. We agree with the no-duplication policy as defined by "same target, equivalent science (depth/wavelength)". However, the STUC suggests that proposers be required to address specifically in their proposal not only possible duplications but also scientific overlap with cycle-17 approved programs. The full list of cycle-17 approved programs should be made available on the web, linked to the call for proposal and also to the TAC members, to help them evaluate scientific merit of overlapping programs. In addition the STUC recommends that both the call for proposals and instructions to the TAC members should encourage proposals that contribute to the lasting legacy of HST in addition to their immediate scientific output. Finally, the STUC notes that the Institute should consider evaluating WFPC2 proposals before NICMOS proposals, to identify at least a few highly ranked programs to fill the immediate gaps in the schedule. The STUC notes that the visibility plots linked to the call for proposal could be improved in presentation (particularly color scale).

The STUC is pleased with the outcome of the Cycle 17 Time allocation process overall. However, the STUC concurs with the Institute that the low acceptance rate of medium proposals (50-100 orbits) appears to be an artifact of the structure of the allocation process, which should be addressed in Cycle 18. Lowering the threshold for large programs to 75 orbits appears to offer one sensible strategy to rebalance large and medium proposals. This could also help balance medium and small proposals if the partition of time between panels and TAC is suitably adjusted. The committee would like a more detailed discussion of this issue and possible approaches to dealing with it at the time of the next meeting.

The STUC also notes that the Institute is planning to increase the number of panels, increasing the degree of specialization of each. Although the STUC understands the practical motivations, it is concerned that the balance of the scientific portfolio may suffer if available orbits are allocated to relatively small subtopics on the basis of pressure only. The Institute could perhaps consider broader panels, with a higher pool of orbits per panel. This could mitigate the adverse selection against the largest proposals in each panel as well as allow for a competition of science programs across broader areas of science.

The schedule for Cycle 18 and for the Multi-Cycle Treasury Program has been delayed. The STUC supports the revised schedule and encourages scientific communication between the MCTP TAC and Cycle 18 TAC.

**NICMOS & WFPC2 Reprocessing (Jenkner):** STUC was pleased to hear, from Helmut Jenkner, of the significant progress to date and expected completion by early to mid 2009, of the reprocessing of all the data from WFPC2 and NICMOS as part of efforts for their decommissioning. For each instrument, upgraded pipeline software has been developed that incorporates the best corrections for the many, diverse, and sometimes subtle, but now characterized, detector effects and years of astrometric and photometric calibrations. Besides using the new pipelines to generate the final, static, fully recalibrated archive for all exposures from WFPC2 and NICMOS, the two instrument teams are providing validation of the data, updated documentation via handbooks and

web (MAST), and higher level combined 4-chip images for WFPC2 and, by using the Hubble Legacy Archive (HLA) system, multi-drizzled combinations of NICMOS images. The full program has been the result of over ten person-years of careful and thorough efforts by many within the institute. On behalf of the community, STUC commends and thanks them for giving us such high quality archives as legacies of WFPC2 and NICMOS.

**HLA (White):** Rick White reported recent progress on the Hubble Legacy Archive and gave the committee a real-time demonstration of its use. The committee was very impressed with the progress. We applaud the team for their success and look forward to further capabilities and data as the program continues.

*November 14, 2008*

**Science Data Reduction and Analysis (Greenfield & Ferguson):** Software is a critical component of astrophysics research and often under-resourced in mission planning. IRAF/STSDAS has been a tremendous resource for data reduction and analysis for HST and as a flexible tool for a wide range of astronomical data. It is clear that IRAF needs to be replaced to keep current with the evolution of computing, lower-level software and new missions and projects. Python/PyRAF appears to be the framework for the next generation of astrophysics reduction/analysis software.

Given the new, complex instruments to be added to HST and the approach of JWST, it is clear that STScI should take the lead in developing a user-friendly platform for reducing data from these projects. It is important that this software platform be useful for general astrophysics data reduction as IRAF/STSDAS has been, and be compatible with software that will be written for Gemini, VAO, LSST and other major facilities.

The STUC recommends that STScI commit resources to the development of PyRAF as an astrophysical data reduction tool and cooperate with long-term planning of software with other missions/projects. It is also important that students and young astronomers be introduced and trained to use these new tools.

**ESA Update (Nota):** As the ESA-NASA MOU is expiring 2010, the European contribution to the Hubble project has gone through a senior review, which is conducted by three advisory committees of ESA (namely AWG, SSAC and SPC). Hubble has increased public awareness of astronomy worldwide, and ESA has been a major contributor to this success. After SM4, Hubble will be at the peak of its scientific capabilities and will make key contributions to the ESA Cosmic Vision themes. As a consequence, the European access to Hubble after 2010 has been requested through the continuation of ESA contribution to the Hubble mission at the same level as of today.

The AWG met in October 15-16, 2008 and ranked Hubble as the 1<sup>st</sup> astronomy mission for ESA. The SSAC met on October 28, 2008 and proposed to continue ESA support to Hubble. David Southwood wrote a letter to STUC confirming the continuation of ESA support to Hubble beyond 2010, however stated that the extension of the MOU will only

be made after SM4. Antonella Nota thanked STUC for its support in helping out with the proposal for the extension of ESA support in the Hubble project.

**ST-ECF update (Walsh):** Despite the closeout of ECF planned for 2010, ST-ECF members are working hard in completing their planned tasks. The current activities are focused on the slitless spectroscopy capabilities of Hubble. Nearly 2500 NICMOS slitless spectra have been released through the HLA, and 30,000 ACS slitless spectra are planned for a release in 2009. Work on WFC3 slitless spectroscopy is continuing and will be handed over to STScI post 2010. Slitless simulations are being done for the future EUCLID and JDEM mission concepts. The ECF HST archive is moving from a dynamic to a static state to ease its maintenance in the future.

Lars Christensen who was the ST-ECF head of communication has a new position as head of the ESO Public Outreach Office, and there are possibilities that the Hubble outreach continues as part of the ESO outreach effort.

The meeting was adjourned at 11:45 EST, Nov 14.