Report of the Space Telescope Users' Committee (STUC) Meeting, April 2004

The Space Telescope Users Committee (STUC) met on April 22 and 23, 2004 at the Space Telescope Science Institute.

Attended: David Axon, Debra Elmegreen (Chair), Martin Elvis, Eric Emsellem, Karen Meech, Peter Nugent, Bob O'Dell, Regina Schulte-Ladbeck, Lisa Storrie-Lombardi, Monica Tosi, Don York

The Space Telescope Users Committee (STUC) was interested to receive reports on the state of the Hubble Space Telescope and the Institute from the STScI Director Steven Beckwith, NASA HST Project Scientist Dave Leckrone, NASA HST Program Manager Preston Burch, STScI HST Head Rodger Doxsey, NASA engineer Jill Holz, and STScI Science Policies Head Duccio Macchetto, with comments from NASA Headquarters HST Program Scientist, Jennifer Wiseman.

1. UDF update

The STUC congratulates the Director and members of STScI and NASA for the successful completion of the Hubble Ultra Deep Field, in which images totaling 400 orbits in 4 pass-bands were acquired by January and released to the public in March. The 10s sensitivity in z band achieves 28.2 mag, with the faintest object so far at 31.1 mag. An object at z=6.7 has been reported as confirmed with grism measurements. There is already a wealth of extremely red objects (EROs), high z galaxies in assembly, and quasars. The online "Skywalker" visualizer is a nice aid for quick views of the field.

2. Hardware and Software updates

The UDF release was facilitated by a total change in the architecture of the computing system, with new hardware in place by October 2003 and new software (DADS 10.2) installed in December 2003 that reduced the average wait time for data retrieval to less than an hour (from a peak of 200 hours). The VMS system was eliminated, and more user and operator flexibility was achieved. New mirror sites also help during busy access periods. Data access, via secure ftp, is also a welcome addition, and so far is used for 18% of requests. The STUC is impressed with the work done to complete the new system. We recognize the difficulty and complexity of completing this process, and compliment STScI on its success. The impact on scholarly research should be widespread, as a large number of scientists will use the new capability in support of numerous projects. It is important that the Institute maintain DADS as a state-of-the-art system in the future.

3. Instrument status

All instruments on HST are performing well, with minor glitches corrected in the ACS filter wheel and a NICMOS calibration lamp. A new ACS data handbook was released. Multi-drizzle development is in progress for ACS pipeline implementation. Initial pipeline deployment is targeted for summer 2004. We are glad to hear that COS has been delivered and that its data processing system is nearly finished; that thermal vacuum testing of WFC3 is imminent (Summer 2004), with a successful first system level test last December/January; and that all possible STScI work on these instruments has been completed. It is imperative to have both instruments ready to go and to have STScI staff available to respond to final testing and integration consistent with the timing of whatever servicing mission is developed.

4. Performance metrics

The publication rate of results from the HST indicates that it continues to be the most productive of all NASA missions. Furthermore, NASA leads worldwide productivity in science, with its space science missions (led by HST) accounting for most of the publications. The publications of refereed HST-related papers reached an all-time high of over 500 last year. In the Science News metric developed by G. Davidson, HST accounts for 35% of all NASA discoveries over the last 30 years, making it not only the single most productive NASA mission under this metric but the leader among all missions/facilities across all of science. The importance of HST science is obviously underscored by these measures of productivity.

It is interesting to note that the productivity slope increases whenever a new servicing mission for HST has been executed, indicating that periodic renewal of the system is worthwhile.

5. Power system

HST batteries are 14 years old, and are losing their ability to hold charge. The charge capacity is measured by taking a battery off-line for several days and performing a deep discharge, and much work has gone into such measurements. The initial (1990) charge of the batteries was over 500 Ampere-hours. Now, their level is at about 300 Amp-hrs, and expected to decrease to about 100 Amp-hrs in 2009 if the current rate of charge capacity loss continues. Most likely the gyros will fail before the batteries, forcing an entry into zero-gyro safemode until any servicing could accomplish the replacement or augmentation of both the gyros and batteries. In zero-gyro safemode, HST requires a minimum capacity of 40 Amp-hrs just to survive the battery drain during orbit night; but the minimum level to ensure spacecraft survival in science mode is 115 Amp-hrs unless Software Safemodes are abandoned. (The Project would not likely give up this safety net if servicing preparations are underway.) Dropping below this level could mean loss of the observatory in the event of a demanding safemode entry (from science mode) if HST is in a power-negative attitude or is experiencing an electrical power system problem. Rather than take this risk, the spacecraft would be preferentially dropped into zero-gyro safemode if it isn't already in that state due to gyro loss.

HST Project is exploring ways to optimize the battery charging scheme to reverse or at least slow the current rate of battery capacity loss, and HSTP and the STScI are considering strategies for load reduction to preserve battery margin against safemode entries which are keyed to pre-set "trigger levels" of total system charge. Although the NICMOS cryocooler is a logical candidate for load reduction based on its 400W load, it is realized that NICMOS accounts for 20% of the science program and that other steps need to be considered first, including a lowering of the conservative "trigger levels." The STUC expects that the Institute and the Program will present results and alternatives for discussion at a later meeting.

6. Two-Gyro Science mode

Expectations from reliability studies are that there will be at least three operating gyros until early-2006. The two-gyro science mode currently under development as a 12-18 month life extension measure will primarily affect programs requiring the highest resolution (imaging and spectroscopic), telescope stability, and specific orientations. We applaud the progress the Institute has made in planning for the support of a two-gyro science mode. The pointing control system (PCS) and flight software development are going well. The first flight software update was up-linked last week, with no effect on current operations. Several technical issues have been resolved and the short-term scheduling development and ongoing scheduling studies are going well. There will be a better characterization of the expected jitter from the PCS from simulations planned this summer, the current expectation being that the rms jitter pattern under two-gyro science will be an ellipse with

semi-major axis in the 20-30 mas range. Detailed specifications for software changes required in the long term will be developed, and a full flight test is planned for early 2005.

A two-gyro mode all-sky scheduling study to assess the availability of targets indicates that the number of orbits will be decreased to about 2500 orbits with two gyros instead of the present 3000 orbits using three gyros, and that the usable sun angle would decrease from 50-180 degrees to 60-172 degrees, restricting the number of targets available at any one time. Guide star acquisition time would also increase, reducing the amount of target time per orbit. It is possible that Cycle 14 may be 70% three-gyro mode and 30% two-gyro mode, with Cycle 15 expected to be 100% two-gyro mode. The STUC looks forward to models for the aforementioned, as well as for moving targets. Some programs requiring a periodic cadence with set orientations, as well as target of opportunity programs (TOO) may become physically impossible in the two-gyro mode.

A two-gyro handbook is being developed, which will cover scheduling impacts and instrument/mode specific effects to inform the community. A website will include a handbook, tools for determining schedulability, ETCs, and PSFs for users. A portion of the website will be in place over the summer, with continued update on developments through next December to keep proposers informed. However, some tests will not be completed until January 2005.

We encourage the Institute to continue with their plan of providing as much information as possible with the proposal call regarding the impact of two-gyro observations and then providing web updates for any new information. We feel that it is important that the TAC evaluate the proposals based on the final information provided to the community unless some new major event has occurred, such as entering the two-gyro science mode between the proposal call and the TAC meeting.

7. Servicing missions

As noted, HST is by far the most scientifically productive program for NASA, both in the present and cumulatively since the beginning of the space program. Given the outstanding performance of the observatory, the STUC strongly endorses a servicing mission to HST that will maintain and enhance the full science capabilities in an expeditious manner, including replacement of the batteries and gyros and installation of the WFC3 and COS instruments. Because of the known decay of capacity of the batteries, and the expectation that the observatory will reach critical power levels for survival in the 2007-2009 timeframe, we strongly urge that HST servicing occur at the earliest possible time.

The STUC is pleased to see that an innovative robotics servicing mission is being considered, which, if successful, will allow continuity of the science from the observatory. Because of the wide applications of a robotics servicing mission, we believe that funding support for the mission would reasonably be shared among NASA enterprises.

The National Academy of Science has formed a panel to assess the viability of space shuttle or robotics servicing options as well as benefit and risk assessments, and we hope that plans will proceed expeditiously to save our premier scientific mission. We look forward to the report of the panel. We feel it is very important to maintain the momentum of the drive to service HST, and are pleased that many staff members at NASA are working diligently on servicing issues. We did not receive a report on how NASA is making contingency plans for SM4 in the event that the decision to rescind cancellation of SM4 is made.

8. Scheduling

Cycle 12 is being executed at a nominal rate. The spacecraft scheduling efficiency is 45-50%, as is typical. Previous cycles are complete or nearly complete. The schedule was particularly difficult this cycle due to several large programs competing for the same piece of sky, but good progress is being

made in completing these programs. Cycle 13 requested proposers of large programs to give more scheduling details, which was helpful for assessing needs and conflicts at an early stage.

The SSA transmitters, which are needed to dump data to the ground, have uncertain lifetimes. One has failed and was replaced in servicing mission SM3A. The returned unit showed poor workmanship, which raised some concerns about one unit still functioning. Pure parallel observations accounted for 1/3 of the total data transfer. In order to reduce the number of on/off cycles on transmitters, pure parallels in Cycle 13 were limited to 300 orbits. The STUC supports this position. There was no change in policy for coordinated parallel proposals.

9. Cycle 13 results and Cycle 14 plans

The Cycle 13 proposal selection was completed smoothly. The acceptance rate for the 949 proposals requesting a total of 17257 orbits was 1/5 for GO proposals, 1/4 for SNAPs, and 1/3 for Archival proposals; Large and Treasury proposals accounted for 34% of awarded orbits. It turns out that proposals requesting 30 to 50 orbits had slightly lower acceptance rates than those asking for fewer or more orbits; this anomaly will try to be corrected next year. The TAC was instructed to be cautious about allocation of orbits in future cycles, and very few were awarded. The STUC was asked whether there should be further emphasis on submission of multi-wavelength HST/MAST proposals in the future, but we felt that archival proposals will automatically and necessarily increase in the future and involve multi-wavelength datasets, so that no special emphasis or change in the current archival program is necessary.

Panels were set up to review broad areas of science, and mirror panels helped minimize conflicts. Specialists were spread across multiple panels. Some members of the STUC who served on this year's panels felt this had the result that there was not an adequate breadth of representation in the discussions. We hope that the Cycle 14 panels will have a greater - but not exclusive - concentration of specialists, thus enhancing the quality of reviews and permitting more well-informed reviewers to be part of the important triage process. The CP needs to stress the importance of proposers presenting their ideas in a way that is understandable to the general astronomical community and not just to specialists. We strongly encourage all panelists to read all of the proposals, and suggest which ones ought to be triaged, in advance of the panel meetings. We also recommend enlargement of the solar system panel because it does not have a mirror panel.

Improvements to APT were well received by the community, and reviewers appreciated page limit changes. The distribution of proposals via CDs instead of paper resulted in savings of thousands of pages and hours of preparation, and the STUC congratulates the Institute for this change. Comments for accepted and rejected proposals are being sent out in a timely manner.

There will be an International Symposium at STScI in May to highlight science to be done with HST in the next few years and to discuss community priorities and issues. We note that the Spitzer review panels will take place at the same time as the STScI meeting, but were assured that the website will provide venues for further communication with the community. The STUC was asked whether there should be a follow-up ad hoc committee to decide science priorities for the remaining HST mission. We agree that it is not necessary or desirable to form an ad hoc advisory committee, and that the regular proposal and peer review method will lead to the most appropriate programs in Cycle 14. We expect that the Call for Proposals (CP) will include the latest updates. The STUC recommends that the CP include a clear statement of the expected instrument status as a function of time prior to servicing so that proposers and TAC have the same information.

Proposers in Cycle 14 will be asked to describe how their science will be executed in regular three-gyro mode and also asked to explain whether and how it can be done in two-gyro mode, and to show the impact on the key science affected by reduced S/N or reduced number of targets. The TAC and panels will be asked to rank proposals based on three-gyro mode operation, and then also rank

the top proposals separately in the event that a two-gyro mode is required. Selected programs will be asked to submit Phase 2 proposals for three-gyro mode operations and later for two-gyro mode also. The STUC supports these plans, and also recommends that large program proposals contain a discussion of the viability of the program if it is only partially executed before a two-gyro mode is necessary, so that TAC can develop a scheme to help with prioritizing.

10. Summary

The STUC thanks the Institute for its hospitality and congratulates the Director, the members of the STScI, and the GSFC/HST Project for presenting optimistic reports during what had been anticipated to be a difficult meeting following the HST events of the past few months. In particular, we acknowledge and commend:

- continued scientific achievements of HST, especially with recent ACS UDF images
- continued development of two-gyro mode
- rapid development of possible servicing plans
- investigation of battery capacity-saving operations
- near completion of COS and WFC3 instruments
- use of CDs for panelists
- prudent conservation of transmitter use by the limitation of pure parallel orbits
- substantial improvements to the archive system

The STUC also encourages and recommends:

- a servicing mission to maintain and enhance science on HST expeditiously, including the replacement of batteries and gyros and the installation of both WFC3 and COS
- further analysis of battery drain, and ways to extend battery life
- continued selection of the best science by the existing TAC process
- development of clear-cut guidelines in the next CP regarding two-gyro mode so that proposers can assess productivity of their planned proposal in that mode, as well as a clear best estimate prediction for HST degradation
- prioritization of two-gyro proposals by the TAC in Cycle 14
- enlargement of the solar system panel in Cycle 14
- evaluation of metrics relating to the use of archival data

11. Next meeting

The next meeting of STUC will take place November 18 and 19, 2004 at the Institute. Items for the agenda include, in addition to responses to the above concerns:

- discussion of NAS report
- update on servicing mission development
- update on gyros and battery life expectancies and the impact on science
- update on instrument functionality
- discussion of calibration prioritizations
- discussion of the future of archival research
- discussion of instructions to, and structure of, the TAC

The STUC strongly requests that presentations made during the meeting be available via the web, either before or during the meeting, so that paper copies of presentations are not necessary.

12. Portfolio assignments

Portfolios indicate the areas of primary responsibility for each STUC member. The portfolios were reviewed, and assignments were unchanged:

- ACS/ WFPC2: Elmegreen, Tosi, O'Dell
- COS/ STIS: Axon, York, Schulte-Ladbeck
- NICMOS/ WFC3: Storrie-Lombardi, Emsellem
- Proposal Handling and Scheduling: Axon, Storrie-Lombardi
- Software Analysis Tools: Elvis, Emsellem, Schulte-Ladbeck
- Targets of Opportunity: Meech, Nugent
- Solar System Issues: Meech
- Archive: Elvis, Tosi
- TAC: O'Dell, York
- GO Funding: Elmegreen, Nugent