

ACTIVITY TITLE: Load and Dump On-Board Memory

ID: ACS01

APPLICABLE SMOV REQUIREMENTS:

DESCRIPTION: This activity is a test and verification of the ACS dump of CS memory capability. Areas to dump include: EEPROM, PROM, EDAC RAM, and Buffer RAM with the CS in OPERATE mode. With the MAMA Interface Electronics (MIE) and CS both in OPERATE, perform a full dump of the Control Section's (CS) EEPROM, PROM, and EDAC RAM. Then copy MIE data from MIE RAM and MIE PROM to CS Buffer RAM. Next, copy the ASIC program space to CS Buffer RAM. Finally, dump the portion of the CS Buffer RAM containing the MIE and ASIC data as normal science images. (Note: The remainder of CS Buffer RAM is checked in another proposal.)

IMPLEMENTATION METHOD: Special commanding

DEPENDENCIES: N/A

DURATION: 20 min

DATA REQUIREMENTS: 8 MB

ANALYSES & EXPECTED RESULTS: Analysis of the CS, MIE and ASIC memory data dump images produced in this visit will have to be coordinated with Beverly Serrano at GSFC Code 582 who will have the necessary ground images for comparison with the memory dump images.

COMMENTS: This proposal requires special commanding to execute. When executed, Beverly Serrano at GSFC Code 582 should be contacted to analyze the dump data.

AUTHOR/telephone/email: Alan Welty 410 338-4948 welty@stsci.edu

DATE: 27 September 2007

ACTIVITY TITLE: Science Data Buffer Check

ID: ACS03

APPLICABLE SMOV REQUIREMENTS:

DESCRIPTION: The ACS Science Buffer RAM is checked for bit flips during SAA passages. This is followed by a Control Section (CS) self-test consisting of writing/reading a specified bit pattern from each memory location in Buffer RAM and a similar test for MIE RAM. The MIE must be placed in BOOT mode for its self-test. The CS Buffer RAM self-test and the bit flip tests are all done with the CS in Operate.

Using the set buffer memory macro, write zeros into CS Buffer RAM prior to passage into the SAA and then dump buffer memory to SSR after exit from the SAA to check for bit flips. This Buffer RAM check should be executed only once. (This is different than for SMOV3B, when this test was executed several times, and revealed no significant issues.) Then use the CS self test macro to conduct a pattern test of CS Buffer RAM and check the memory fail counter after the test has completed. Repeat for a similar MIE self test. The MIE will need to be in its BOOT mode for its self-test.

IMPLEMENTATION METHOD: Special commanding

DEPENDENCIES: ACS01

DURATION: 2 orbits, none of which are pointed (always internal darks)

DATA REQUIREMENTS: 34 MB

ANALYSES & EXPECTED RESULTS: If at the end of the CS buffer test, any of the Results Tables are non-zero entries, a status buffer message (931) with the number of errors generated will be issued by the FSW. If this occurs, contact Beverly Serrano at GSFC/Code 582 for further analysis.

COMMENTS: This proposal requires Special Commanding to execute and the MIE to be in BOOT mode for the MIE self-test. For both the CS and MIE self-tests, a memory monitor must be set to check the results of the tests. The CS tests are done in OPERATE so that CS paging is enabled and all 34 megabytes of memory are available for testing.

AUTHOR/telephone/email: Alan Welty 410 338-4948 welty@stsci.edu

DATE: 27 September 2007

ACTIVITY TITLE: CCD hot pixel annealing

ID: ACS04

APPLICABLE SMOV REQUIREMENTS L10.4.3.1.1

DESCRIPTION: This will be similar to the monthly annealing process that was carried out before the ACS CCDs failed except that we will revert to a 12-hour annealing period instead of the recently implemented 6 hours. During this time the TECs are turned off and heaters turned on to bring the CCDs to about 20C. To assess the annealing effectiveness, a bias frame and four 1000-second darks for both WFC and HRC are taken before and after. WFC and HRC will be in separate proposals so that if one is not functioning the tests for the other are not impacted.

IMPLEMENTATION METHOD: Stored commanding.

DEPENDENCIES: CCD temperature set point (ACS05) completed.

DURATION: The dark images require four internal orbits and the anneal itself takes 12 hours to which must be added 3 hours for the WFC to be cooled down again. The total time is 14 internal orbits.

DATA REQUIREMENTS: 10 32MB WFC and 10 2MB HRC images. Total 340 MB

ANALYSES & EXPECTED RESULTS: The dark image and hot pixel analyses will be carried out in the routine way using existing software and compared with the accumulated history.

COMMENTS:

AUTHOR/telephone/email: Colin Cox 410 338-4792 cox@stsci.edu
Ray Lucas 410 338-4716 lucas@stsci.edu

DATE: 13 September 2007

ACTIVITY TITLE: CCD Temperature set point determination

ID: ACS05

APPLICABLE SMOV REQUIREMENTS: L.10.4.3.2

DESCRIPTION: Establish that the planned CCD temperatures can be achieved. Command the CCD temperature set point to the previously used temperatures, -81C for WFC and -80C for HRC . Monitor engineering telemetry of CCD temperature diode reading for 24 hours. Assess the stability of that temperature over the 24 hour period, looking for orbital or longer-term variations. This is not expected to fail, but if a slow thermal runaway should occur, repeat at 1 degree higher.

IMPLEMENTATION METHOD: The initial set point will be adjusted via "engineering only" commanding. In the event that a higher set point has to be tried this will be activated via an Operations Request

DEPENDENCIES: CCD turn on (ACS02) completed.

DURATION: 24 hours

DATA REQUIREMENTS: None.

ANALYSES AND RESULTS: Plot engineering telemetry readings of CCD temperature sense diode and assess the stability of the temperature control.

COMMENTS:

AUTHOR/telephone/email: Colin Cox / 410 338-4792 / cox@stsci.edu

DATE: February 1, 2008

ACTIVITY TITLE: ACS CCD functional test for Hubble SM4/SMOV

ID: ACS06

APPLICABLE SMOV REQUIREMENTS: L.10.4.3.1.3

DESCRIPTION:

During the ACS Repair (ACS-R) conducted during Hubble Servicing Mission 4 (SM4), astronauts will install a CCD Electronics Box Replacement (CEB-R) and Low-Voltage Power Supply Replacement (LVPS-R). A rudimentary aliveness/functional test (AT/FT) will be conducted on-orbit during SM4. Shortly after SM4, the comprehensive CCD function test (FT) summarized here will be conducted as part of SMOV. This program is modeled after the original CCD functional test (HST program 9005, PI Mark Clampin) conducted following the initial installation of ACS during Hubble Servicing Mission 3B.

(1) Measure baseline performance and commandability of CCD subsystems using exposures of bias frames, darks, and flat fields with the tungsten lamps. For all gains and readout modes:

- a. HRC: 68 biases, 8 darks, 16 flat fields
- b. WFC: 34 biases, 8 darks, 16 flats (full), 4 flats (sub-array)

(2) Parallel and serial EPER and FPR will be measured in WFC and HRC. EPER and FPR CTE data will be collected at several signal levels. The proposal calls for a sequence of exposures with increasing integration times that will be used to measure CTE as a function of signal level. Crossed filter elements, a configuration prohibited for science observations, are necessary for the WFC exposures at the lowest signal levels. A total of 75 trailing serial overscan pixel and 75 virtual over-scan rows are readout in each EPER exposure. All data are acquired using the internal tungsten calibration lamp(s).

Note: The routine Cycle 17 calibration program, to generate calibration reference files, will be activated within 48-60 hrs of the completion of this program. This program will be executed once a day to monitor the read noise, the development of hot pixels and to test for any level source of noise.

IMPLEMENTATION METHOD: Standard Phase II proposal and commanding.

DEPENDENCIES: CCD hot pixel annealing (ACS04).

DURATION: 20 internal orbits. No external targets are required.

DATA REQUIREMENTS:

(1) 84 full HRC frames (195 MB), 53 full WFC frames (1734 MB) and 4 WFC sub-arrays (8.5 MB) will be downloaded.

(2) 168 full HRC frames (356.1 MB) and 110 full WFC frames (3598.1 MB) will be downloaded.

ANALYSES & EXPECTED RESULTS:

(1) Provide baseline measurements of bias levels and readout noise values for all 4 amplifiers, measurements of average dark rate (e-/pix/sec) and histogram of dark rate values per pixel, gain conversion factors and sub-array readout performance. After cleaning for cosmic rays, average bias frames will be determined for the 4 quadrant mode and for single amp readout. The difference between pairs of bias frames will be used to determine the read noise. The sum of the dark frames will be used to derive the dark image, average rates, dark histograms, and hot pixel position. Relative gain calibration will be derived by comparing signal levels from the flat field images at different gain settings.

(2) Dedicated software is already available to reduce both EPER and FPR data for HRC and WFC CCD. We will determine a baseline for monitoring of the effects of radiation damage. These data will also be used for photon transfer test to infer the total system gain.

COMMENTS:

AUTHOR/telephone/email:

Max Mutchler (410-338-1321, mutchler@stsci.edu)
Marco Sirianni (410-338-4810, sirianni@stsci.edu)

DATE: 20 Sep 2007

ACTIVITY TITLE: SBC turn-on and anomalous recovery test

ID: ACS07

APPLICABLE SMOV REQUIREMENTS: L.10.4.3.1.3

DESCRIPTION: This procedure is used for the initial turn-on of the ACS MAMA detector and for recovery after an anomalous shutdown, as might result from a bright object violation or hardware problem. The test is in four stages with all voltages returned to zero between the first three stages. Beginning with all voltages off, first the low voltage is turned on and the amplifier thresholds set to a lower than normal value of 0.28V which allows noise counts to be measured to prove basic operation of the electronics.

For the second stage, thresholds are set to their normal 0.48V, the low voltage is turned on and the Global Monitor set to turn the MAMA off if the count rate becomes dangerously high. The high voltage is advanced in 50V stages up to 2000V (300V less than the normal operating value), with counts being monitored at each stage. The field voltage is ramped up to 100V and a 720 second MAMA dark image taken.

Stage 3 is a full ramp up to 2300V performed in the same manner, followed by ramping up the field voltage to its normal 1000V. Another 720 second dark image is taken.

Stage 4 is the fold analysis which proceeds immediately while the high voltage stays on. This consists of measuring count rates turning on various combinations of MCP anodes to characterize the size of the electron cloud.

IMPLEMENTATION METHOD: The activity requires real-time commanding and monitoring of count rates. It is a goal to schedule visits while a TDRSS is visible. This activity is part of an already processed proposal, 10735 which only needs to have four on-hold visits released.

DEPENDENCIES: The MAMA will not be operated within 4 days of the servicing mission and not until the pressure in the aft shroud is below $5e-6$ Torr for at least 24 hours (L10.4.3.1.3). The MAMA ACS M3 fold mirror will be in the HRC position during the shutdown. Each stage must await satisfactory analysis of the previous stage before proceeding.

Event flag 2 is used to regulate the commanding. All activities with MAMA high voltage turned on must be scheduled to avoid SAA passages.

We no longer require that we wait for the fold analysis to be complete before scheduling SBC use; only that the first three stages run successfully and the fold analysis data be taken.

DURATION: Stage 1 takes 20 minutes and is followed by a 24 hour waiting period before stage 2. Stage 2 takes 55 minutes and is followed by another 24 hour waiting period before stage 3 which takes 69 minutes. This is followed immediately by stage 4 which takes 64 minutes. The active period is therefore 3.5 hours spread over slightly more than two days.

DATA REQUIREMENTS: Continuous access to the engineering data is required for the first three stages. Five dark images are taken each 2 Megabytes in size

ANALYSES & EXPECTED RESULTS: Data analysis consists of observing the engineering data, checking that voltages proceed as commanded and that currents are within normal ranges. Dark images will be compared with previous examples. The fold analysis takes a few hours using established methods and will be compared with previous results.

COMMENTS:

AUTHOR/telephone/email: Colin Cox 410 338-4792 cox@stsci.edu

DATE: 13 September 2007

ACTIVITY TITLE: WFC CCD Cross-Talk Check

ID: ACS08

APPLICABLE SMOV REQUIREMENTS: L.10.4.3.1.3

DESCRIPTION: The original flight electronics induced a cross talk between the four quadrants of the Wide Field Channel WFC Focal Plane Array. The effect is observed as (mostly) negative ghost images generated by relatively bright sources located in adjacent quadrants. Their position in the quadrant is mirror-symmetric relative to the positions of the generating sources. The test will be conducted by taking short exposures with a bright object in one amplifier quadrant, to check for faint negative “ghost” images mirrored in the other quadrants. Repeat by placing bright isolated stars in each for each amplifier quadrant. The test will be performed at two different gain settings.

IMPLEMENTATION METHOD: Standard phase-II proposal

DEPENDENCIES: ACS06

DURATION: 2 external orbits

DATA REQUIREMENTS: 8 WFC frames (4x33 Mb)

ANALYSES AND RESULTS: The cross-talk will be characterized as function of the source signal, gain and amplifier.

COMMENTS:

AUTHOR/telephone/email: Marco Sirianni / 410 338-4810 / sirianni@stsci.edu

DATE: 13 September 2007

ACTIVITY TITLE: SBC UV Contamination Check.

ID: ACS09

APPLICABLE SMOV REQUIREMENTS: L.10.4.3.1.4

DESCRIPTION: L.10.4.3.1.4 – UV Monitoring. For the SBC BEA targets will be chosen from those observed in ACS/CAL 11322 to obtain images prior to SM4. Two orbits of data covering all of the SBC imaging elements will be obtained as soon as ACS-07 allows, then at +1 week and +3 weeks. An internal orbit is always paired with externals for the SBC to obtain darks.

No suitable targets inside the BEA were identified for ACS/CAL 11322. Thus a waiver for two non-BEA orbits during BEA was granted to observe the standard UV throughput target NGC 6681. For ACS/SBC 11322, observations of NGC 604 were requested if SM4 is delayed to November 2008 when NGC 6681 is no longer visible.

IMPLEMENTATION METHOD: SMS, stored command.

DEPENDENCIES: ACS07

DURATION: 6 External + 6 internal orbits.

DATA REQUIREMENTS: Average of 8 1024x1024 pixel images per orbit: 1 Gbit.

ANALYSES & EXPECTED RESULTS:

These results will be one of the activities determining if the BEA can be ended. Data for UV contamination checks will be analyzed using standard aperture photometry approaches as have been in place for the annual UV monitoring program.

COMMENTS:

This program covers only the SBC portion of L.10.4.3.1.4. The HRC portion of this ACS verification requirement is worded to make use of the standard UV monitoring program, i.e. not in the BEA, and will be covered in ACS-20. BEA targets qualified as part of ACS/CAL 11322 will not have been observed with the HRC.

AUTHOR/telephone/email: Ron Gilliland (STScI)/410 338-4366/gillil@stsci.edu
Jennifer Mack(STScI)/410 [338-4565](tel:338-4565)/mack@stsci.edu
Colin Cox (STScI)/410 [338-4792](tel:338-4792)/cox@stsci.edu

DATE: September 14, 2007

REVISED: February 1, 2008 to take account of target changes and BEA waiver

ACTIVITY TITLE: SBC dark current measurement

ID: ACS10

APPLICABLE SMOV REQUIREMENTS: L.10.4.3.1.3

DESCRIPTION: Measure the SBC dark current over a period of about 6 hours to quantify the known steady increase with time after turn-on. Five 1000-second darks are taken in each of four orbits.

IMPLEMENTATION METHOD: Stored commanding

DEPENDENCIES: ACS07, SBC turn-on activities completed.

DURATION: 4 successive internal orbits, 6 hours continuous.

DATA REQUIREMENTS: 20 2MB images

ANALYSES & EXPECTED RESULTS: Co-add dark images in groups corresponding to time since SBC turn on. Compare with earlier results. The data will ultimately contribute to the SBC dark calibration files but no part of SMOV has to wait for their delivery.

COMMENTS: Duplication of completed proposal 11049

AUTHOR/telephone/email: Colin Cox 410 338-4792 cox@stsci.edu

DATE: 13 September 2007

ACTIVITY TITLE: ACS CCD Sensitivity, Geometric Distortion, and Flatfield Stability

ID: ACS11

APPLICABLE SMOV REQUIREMENTS: L.10.4.3.4.2, L.10.4.3.4.3

DESCRIPTION: The stability of the CCD flat fields will be investigated using the internal tungsten calibration lamps and the standard filter subset (F435W, F625W, F814W, and F850LP). High signal observations will be used to assess the stability of the pixel-to-pixel flat field structure and to verify the position of the dust motes. The stability of the low-frequency flat fields (L-flats) will be assessed by comparing internal exposures obtained just prior to the ACS failure in January 2007 and immediately following the ACS repair in August 2008.

The stability and uniformity of the L-flats will be studied in detail for one filter in the HRC (F475W) and WFC (F606W) using multiple dithered pointings of 47 Tucanae. By moving the same star over different portions of the detector and measuring relative changes in brightness, any spatial variations in the detector response can be measured. To supplement to the usual diagonal dither pattern, steps along the x and y axes will allow a simultaneous evaluation of the detector CTE. One additional short exposure obtained at the beginning of each orbit will give an estimate of the CTE for low sky backgrounds. These external observations will be used to verify the L-flats derived from the internal lamps.

High quality baseline measurements of the cluster provide a catalog which is both astrometrically and photometrically well calibrated, so a full-scale geometric distortion calibration of the CCDs is not necessary. The stability of the distortion will be determined using the dithered 47Tuc L-flat observations. The centroid position of stars, corrected for CTE and proper motions, will be used to verify that the geometric distortion is stable to about 0.2 pixels and to verify the accuracy of the recently computed time-dependent skew correction.

IMPLEMENTATION METHOD: SMS, stored command.

DEPENDENCIES: ACS06 - CCD functional

DURATION: 5 internal + 7 external orbits.

Internals:

HRC LP-flats = 1 orbit (2 exposures * 4 filters 435,625,814,850)
as in program 11052, visit H1

WFC LP-flats = 4 orbits (3 exposures * 4 filters 435,625,814,850)
as in program 11052, visits W1, W7, WB, WC

Externals:

HRC Sensitivity = 1 orbit (1-2 exposures * 13 filters)
as in program 11051, visit H1

HRC Lflat,Distortion = 1 orbit (F475W with 13 dither positions,
plus one short exposure at center)

WFC Sensitivity = 2 orbits (1 exposure * 12 filters)
as in program 11051, visit W1

WFC Lflat,Distortion = 3 orbits (F606W with 13 dither positions,
plus one short exposure at center)

DATA REQUIREMENTS: This activity will produce 38 WFC images (1300 MB) and 40 HRC images (80 MB). Data should be promptly delivered to the archive, since flat fields affect all ACS programs in SMOV, ERO and normal science operations.

ANALYSES & EXPECTED RESULTS: These observations are near the end of SMOV and are not needed for subsequent SMOV activities. Standard IRAF and fortran codes, used within the past year, will be used to analyze the internal flats and quantify changes in the pixel-to-pixel and L-flat structure. Anderson's fortran code will be used to compute aperture photometry and to verify the geometric distortion. Van der Marel's fortran code will be used to verify the L-flat stability from dithered observations. The analyses required for verifying the flat fields and geometric distortion are moderately time consuming.

COMMENTS:

AUTHOR/telephone/email: Jennifer Mack/410-338-4565/mack@stsci.edu
Ron Gilliland/410-338-4366/gillil@stsci.edu

DATE: September 20, 2007

ACTIVITY TITLE: ACS to FGS Alignment

ID: ACS12

APPLICABLE SMOV REQUIREMENTS: L.10.4.3.2.1

DESCRIPTION: Mapping of the ACS detector coordinate frame to the FGS frame will be determined from observations of the cluster NGC 188 with the WFC and HRC. Data obtained in ACS17 will be used to determine the displacement and orientation of the two channels with respect to the OTA's V2 and V3 axes. The maximum uncertainties of the location and rotation of the acquisition apertures (1 arcsec and 10 arcmin, respectively), should be easily satisfied by the astrometric field NGC 188 used in ACS17. These observations will also supplement the investigation of the geometric distortions of the WFC and HRC (program ACS11).

IMPLEMENTATION METHOD: N/A

DEPENDENCIES: ACS17

DURATION: N/A

DATA REQUIREMENTS: The FGS (V2-V3) positions of the astrometric stars in each field will be computed by HST Flight Operations at GSFC and must be delivered promptly.

ANALYSES & EXPECTED RESULTS: Centroid positions of all astrometric stars in each field will be determined to an accuracy of < 0.5 pixel. These centroids will then be related to their FGS frame (V2-V3) positions. Aperture orientations and plate scales will be corroborated with the image position changes between the POS-TARG offsets images. The SIAF aperture descriptions will be updated. Also, the rotation matrix used by the ACS flight software to compute target acquisition slews may be updated. Results pertinent to the revision of the geometric distortion analysis will be communicated to the parties responsible for that activity.

COMMENTS:

AUTHOR/telephone/email: David Golimowski / 410-516-6181 / dag@pha.jhu.edu

DATE: 13 Sep 2007

ACTIVITY TITLE: ACS Coarse Corrector Alignment

ID: ACS13

APPLICABLE SMOV REQUIREMENTS: L.10.4.3.3.2

DESCRIPTION: This activity attempts to nearly optimize the ACS image quality over the fields of both the WFC and HRC channels by adjusting the IM1 and M1 corrector mechanisms in both tip/tilt (cylinder rotation) and focus. These observations of a moderate density star field constitute the "first light" external images for the HST/ACS. High SNR images will be obtained through the F502N narrow band filter to permit accurate phase retrieval estimates of the residual aberrations. Small focus offsets will be performed between the 3 images constituting each set, to remove focus ambiguity. The activity will proceed in three iterations, with pre-planned uplink opportunities for corrector mechanism adjustment after each observation. The recommended target is NGC 188, which (at latitude + 85 deg) is always available and has a suitable density and magnitude distribution.

IMPLEMENTATION METHOD: Proposal, with pre-planned real-time uplink of new corrector mechanism positions.

DEPENDENCIES: This is a contingency proposal only if the PSF quality (ACS 16/17) shows some anomaly. ACS05, CCD Temperature Set Point Determination, must be successfully completed prior to implementation of ACS13.

DURATION: 6 Orbits (external). 2 orbits at each of three epochs, with ~24 hr separation.

DATA REQUIREMENTS: For each of 3 iterations: 6 WFC full frame images (200 MB) and 6 HRC images (14 MB) will be downlinked. The images from each iteration must be available for analysis at least 18 hr before the planned uplink for corrector adjustment.

ANALYSES & EXPECTED RESULTS: Phase retrieval analysis will be performed for selected (isolated, well-exposed) stars throughout the field to determine the coma and focus wavefront error contributions, which will be used to determine the corrector offsets in cylinder rotation and focus travel to optimize the images. The corrective actions will be computed using special IDL software that has been developed and successfully used for the ground alignments. The mechanism offsets will be specified in motor step units, relative to the current positions, at least 12 h prior to the planned uplinks for their implementation.

COMMENTS: This activity will also result in an initial estimate of the ACS aperture positions, orientations and plate scales, in anticipation of activity ACS12 (ACS to FGS

alignment).

AUTHOR/telephone/email: Kailash Sahu, 410-338-4930, ksahu@stsci.edu

DATE: Sep 20, 2007

ACTIVITY TITLE: ACS Fine Corrector Alignment

ID: ACS14

APPLICABLE SMOV REQUIREMENTS: L.10.4.3.3.2

DESCRIPTION: This activity refines the WFC and HRC corrector alignments in order to optimize image quality over their respective fields. Two visits are required, the first to perform a fine focus scan, and the second to perform a tip and tilt scan, after the optimal focus has been set. The same target field, filters and exposure times as in activity ACS13 will be used. The focus scan will comprise 7 positions, with 250 (WFC) or 150 (HRC) step offsets between them, and centered about the best positions found in ACS13. Tip/tilt scans will be in +/- 3 step offsets in a 3x3 grid about the positions resulting from ACS13. Each scan will terminate at the initial position. Image (CRsplit) pairs will be obtained at each scan position.

IMPLEMENTATION METHOD: Proposal, with real-time uplink of optimal focus positions prior to tip/tilt scan and of optimal cylinder positions after the second visit.

DEPENDENCIES: This is a contingency proposal only if the PSF quality (ACS 16/17) shows some anomaly. ACS13, ACS Coarse Corrector Alignment must be successfully completed prior to implementation of ACS14.

DURATION: 14 Orbits (external). 7 orbits at each visit.

DATA REQUIREMENTS: For visit 1, 16 WFC images (530 MB) and 16 HRC images (34 MB) will be downlinked. For visit 2, 20 WFC images (660MB) and 20 HRC images (42 MB) will be downlinked. The complete set of images from each visit must be available 24 h prior to the scheduled uplink for the corrector offsets.

ANALYSES & EXPECTED RESULTS: Encircled energy, peak fraction and FWHM analysis will be performed for a subset of the stars representing the full field of each detector (selected for isolation from nearby stars and high SNR) for each scan position. The optimal focus and tip/tilt (cylinder rotation) of the IM1 and M1 mechanisms will then be determined and provided, in units of motor steps from the current positions, at least 12 h prior to the scheduled uplink.

COMMENTS: Care must be taken when crafting the focus scans to assure that the focus motor temperatures will not reach their red limits. This may require explicit pauses built into the proposal, especially for the HRC; WFC images naturally pad the times between focus motions with their relatively lengthy read and dump times.

AUTHOR/telephone/email: Kailash Sahu, 410-338-4930, ksahu@stsci.edu

DATE: Sep 24, 2007

ACTIVITY TITLE: HRC coronagraphic spot location

ID: ACS15

APPLICABLE SMOV REQUIREMENTS: L.10.4.3.2.2

DESCRIPTION: The position of the 1.8 arcsecond HRC coronagraphic spot is located in the field of view by measurements of earth flats. A clearly delineated image of all coronagraphic features is seen in a 3.2 second earth exposure through the F330W filter. Four images will be taken to quantify the measurement accuracy and to allow for occasional exposures which point at a dark part of the earth. Scheduling to avoid this problem would be too complex and is not necessary.

IMPLEMENTATION METHOD: Stored commanding

DEPENDENCIES: CCD functional tests (ACS06) complete and successful.

DURATION: 1 external orbit

DATA REQUIREMENTS: Four 2MB flat-field images collected

ANALYSES & EXPECTED RESULTS: Analysis will be the application of the routine weekly calculation of the spot location that was done before ACS became disabled. Software is in place for this and the analysis will take less than an hour.

COMMENTS:

AUTHOR/telephone/email: Colin Cox 410 338-4792 cox@stsci.edu

DATE: 13 September 2007

ACTIVITY TITLE: SBC PSF Measurement

ID: ACS16

APPLICABLE SMOV REQUIREMENTS: L.10.4.3.3.1

DESCRIPTION: This activity will obtain a series of images to evaluate the point source image quality over the field of view of the ACS SBC channel. NGC 6681 (18.7 h, -32 deg) will be the target, as this star field has been used extensively for SBC PSF measurement and photometry. High SNR images will be obtained in the F125LP and F150LP filters, with dithers in each axis.

IMPLEMENTATION METHOD: Stored commanding.

DEPENDENCIES: ACS07, after BEA

DURATION: 2 external orbits

DATA REQUIREMENTS: Approx 8 2MB images

ANALYSES & EXPECTED RESULTS: A measurement of encircled energy is relatively straightforward. A more detailed study of the properties of the core of the image (through combination of subsampled images) is slightly more involved, but not greatly demanding.

COMMENTS:

AUTHOR/telephone/email: Andrew Fruchter 410-338-5018 fruchter@stsci.edu

DATE: 20- Sep-2007

ACTIVITY TITLE: Image Quality (CCD) and PSF Measurement

ID: ACS17

APPLICABLE SMOV REQUIREMENTS: L.10.4.3.3.1

DESCRIPTION: This activity will obtain a series of images to evaluate the point source image quality over the fields of view of the ACS HRC and WFC channels in normal imaging (non-coronagraphic) mode. The images obtained will also be used to determine the ACS to FGS alignment (ACS12). The recommended target field is the open cluster NGC 188, which was used successfully in alignment tests for STIS (SMOV2) and ACS WFC and HRC (SMOV3B). This cluster has a suitable star density, contains guide stars with precise (± 50 mas) UCAC2 coordinates, and has an always-available declination of $+85$ deg. Images will be obtained in the F502N and F625W filters, with dithers in each axis of the WFC to improve PSF sampling. Larger (~ 10 arcsec) POS-TARG offsets may be used to improve the sampling over the HRC field, while maintaining mean star separation (>5 arcsec) adequate for PSF evaluation to a reasonable radius.

IMPLEMENTATION METHOD: Stored commanding

DEPENDENCIES: ACS06

DURATION: 4 external orbits (1 per filter for WFC, 1 per filter for HRC)

DATA REQUIREMENTS: 8 WFC images (260 MB) and 24 HRC images (50 MB).

ANALYSES & EXPECTED RESULTS: Encircled energy vs. radius, peak fraction (sharpness), and FWHM statistics will be derived for all stars with adequate isolation and SNR in each field. The direct measurement of the enclosed energy is very straightforward. A more accurate representation of the PSF from dithered data is somewhat more labor intensive but still straightforward.

COMMENTS:

AUTHOR/telephone/email: Andrew Fruchter 410-338-5018 fruchter@stsci.edu

DATE: 20 September 2007

ACTIVITY TITLE: HRC Coronagraph Acquisition

ID: ACS18

APPLICABLE SMOV REQUIREMENTS: L.10.4.3.3.3

DESCRIPTION: This activity tests the abilities of the reactivated flight and ground software to perform isolated point source acquisition onto the coronagraphic occulting spots and bar (also known as the "Fastie Finger"). Successful execution of these acquisitions will also demonstrate the ability of the software to calculate the centroid of the target positions and to perform automated telescope pointing.

A bright star in a sparse field is acquired in the nominal HRC-ACQ aperture using the crossed filters F220W and F550M. The star must not be variable and must have no known companions or circumstellar features. The acquisition procedure automatically places the target at the nominal center of the 1".8 occulting spot (HRC-CORON1.8). The coronagraph will then be deployed and two sets of short, medium, and long exposures will be recorded through F435W and F814W to provide (1) unsaturated images of the residual diffraction peak at the center of the occulting spot, and (2) good S/N images of the inner and outer regions of the coronagraphic PSF. The star will then be reacquired and offset to the nominal position of the occulting bar (HRC-OCCULT0.8). Two sets of short and long exposures will be recorded through F435W and F814W to provide good S/N at the edge of the bar and in the wings of the PSF. The star will again be reacquired and offset to the nominal center of the 3".0 occulting spot (HRC-CORON3.0). The coronagraph will be deployed and exposures through F435W and F814W will again be recorded to provide good S/N images of the coronagraphic PSF.

IMPLEMENTATION METHOD: Stored commanding

DEPENDENCIES: ACS12 (ACS to FGS Alignment) and ACS15 (HRC Coronagraphic Spot Location) must be successfully completed prior to this activity.

DURATION: 2 external orbits

DATA REQUIREMENTS: 30 HRC images (63 MB) will be down-linked.

ANALYSES & EXPECTED RESULTS: The continued ability of the software to position a star behind the 1".8 and 3".0 occulting spots and the occulting bar will be determined from the centroids of the star in the acquisition images and from the symmetry of the scattered light encircling the masks. For the 1".8 spot, the position of the occulted star can be verified from the residual diffraction spot at the center of the star's image. No such verification can be performed for the 3".0 spot unless it is badly misaligned with the occulting bar.

COMMENTS: The test of the repeatability of the coronagraphic deployment and

acquisition has been eliminated from this activity. The stochastic movement of the coronagraphic spots in the focal plane on daily to weekly timescales has been well established since the installation of ACS in March 2002. It is highly improbable that the failure of ACS in January 2007 has changed this situation for the better. Prior to the ACS failure, the locations of the coronagraphic spots were routinely measured as part of the weekly ACS Earth flat program, and the offsets for coronagraphic acquisition were updated shortly thereafter. This strategy is expected to continue after the repair of ACS during SM4.

AUTHOR/telephone/email: David Golimowski / 410-516-6181 / dag@pha.jhu.edu

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ACTIVITY TITLE: UV Sensitivity, Geometric Distortion, and Flat Field verifications.

ID: ACS20

APPLICABLE SMOV REQUIREMENTS: L.10.4.3.1.4, L.10.4.3.4.2, L.10.4.3.4.3

DESCRIPTION: L.10.4.3.1.4 – UV Monitoring. The standard UV Monitoring target NGC 6681 will be observed as soon as possible after exiting the BEA, this will have one orbit in F122M, one orbit covering all other spectral elements on the SBC, and one orbit covering all UV elements on the HRC. An internal orbit is always paired with externals for the SBC to obtain darks.

L.10.4.3.4.2 – Detector sensitivities and instrument configurations. Geometric distortion, Plate scale and orientation for the SBC and UV of HRC will be obtained through repeating 3 (of original 6) orbits of ACS/CAL 10722 on NGC 604 used to test geometric distortion of the SBC (using F122M, F150LP, F165LP) and provide near UV L-flats for the HRC (F250W).

L.10.4.3.4.3 – Pixel-to-pixel sensitivities. SBC internal flats of 2500s each will be obtained with the Deuterium lamp using two exposures per filter, e.g. two repeats of visits 11052 S1-S6, plus visits for PR110L and PR130L (16 internal orbits).

In general these checks will determine if the instrument performance is within the nominally expected bounds. Should this not be the case, then additional observations within the STScI annual calibration cycle may be needed to establish full calibration.

IMPLEMENTATION METHOD: SMS, stored command.

DEPENDENCIES: ACS07

DURATION: 6 External + 20 internal orbits.

DATA REQUIREMENTS: Average of 8 1024x1024 pixel images per orbit: 4 Gbit.

ANALYSES & EXPECTED RESULTS:

These results are generally at the endpoint of SMOV for ACS and are not needed for subsequent SMOV activities. Data for UV throughput checks will be analyzed using standard aperture photometry approaches as have been in place for the annual UV monitoring program. Data for low-frequency and pixel-to-pixel flat field checks will be analyzed using a combination of IRAF and standalone Fortran codes that were exercised within the past year. Geometric distortion analyses will also make use of codes exercised within the past year for the purpose of deriving the SBC geometric distortion calibration. The analyses required for flat-field checking and geometric distortion analysis are moderately time consuming.

COMMENTS:

The SBC portion of L.10.4.3.1.4 is covered in ACS09, this program contains only non-BEA targets to provide standard verification of instrument performance.

AUTHOR/telephone/email: Ron Gilliland (STScI)/410 338-4366/gillil@stsci.edu
Jennifer Mack(STScI)/410 [338-4565](tel:338-4565)/mack@stsci.edu
Colin Cox (STScI)/410 [338-4792](tel:338-4792)/cox@stsci.edu
Luigi Bedin (STScI)/410 [338-5061](tel:338-5061)/bedin@stsci.edu

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