11041,11042,11043: ACS CCD Daily Monitor

Purpose. This program consists of a series of basic tests to measure the readnoise and dark current of the ACS CCDs and to track the growth of hot pixels. The images acquired in this program are used for the creation of reference files (bias and dark frames) used for data reduction. This program will be executed every other day (Mon, Wed, Fri and Sun) for the entire cycle (Dec 2006 – June 2008). In order to facilitate scheduling the program will be split in three separate proposals to cover six months each.

Description. This program is essentially a copy of the equivalent program that executed during cycle 14. Four days a week a series of bias and dark frames will be collected. Four 1000 sec WFC dark frames are acquired at the default gain setting. HRC dark frames will be acquired in parallel. Four bias frames will be acquired before and after the dark frame sequence. Two of the bias frames will be at default gain setting (2 e-/ADU for both WFC and HRC) and the other two at the other supported gain settings (1 e-/ADU for WFC and 4e-/ADU for HRC). During Cycle 14 a change was introduced with the side-2 switch on July 2006. We removed any compression from bias and dark frames to eliminate the very low level noise introduced by the compression. This program is carried out with internal targets and should be scheduled during occultations. Frame acquisition need not to be contiguous.

Fraction GO/GTO Programs Supported. Every program using the ACS CCD's channels will make use of the reference files (superbias and superdarks) generated with the data collected with this program. Programs which endeavor to detect transient phenomenon (e.g. supernovae, variable stars, microlensing, etc) are particularly reliant on an up-to-date hot pixel catalog.

Resources Required: Observation. This program requires the acquisition of 16 internal frames with ACS ccds (8x1000 sec darks and 8 bias frames) every other day (four days a week) for a total of 64 frames every week. All of these data can be obtained during Earth occultation and represents approximatively 20% of the ACS occultation time. The program will be divided into three proposals of about 413 internal orbits each for a total of 1240 orbits.

Resources Required: Analysis. About 0.65 FTE will be required to reduce and analyze the data and to produce and deliver calibration files.

Products. From this program we will produce and deliver pipeline superdarks and superbiases suitable for calibration and later OTFR use.

Accuracy Goals. Our goal is to produce a clean daily dark (i.e. one in which each pixel is free from the affects of cosmic rays) as well as a biweekly superbias.

Scheduling and Special Requirements. We would prefer to avoid acquisition during SAA passages (SAA impacted orbit are usable) because the enhanced cosmic ray rate would impact our ability to discriminate hot pixels from multiple CR impacts and would populate the bias frames with unwanted CRs during readout.

11044: ACS External CTE Monitor

Purpose. This program will obtain a direct calibration of photometric losses due to imperfect CTE by imaging stars in 47 Tuc.

Description. Observations of 47 Tuc with half-FOV sized dithers, various filters, and exposure times are used to achieve different background levels to characterize impact of CTE on photometry. Compared to previous Cycles, a different observational strategy is used. For each pointing we will obtain 2 CR-SPLITs and 2-point dithering to allow cosmic ray and hot pixel rejection and provide a set of "clean" stars for the analysis of CTE effects on photometry. More specifically, since the CTE also depends on the background level, we will obtain 4 different background levels for HRC and 5 for WFC, using the F502N and F606W filters and different exposure times, from 30s to 400s per exposure. In this way, we will obtain background levels ranging from 0 to 50 e-/pixel. The observations will be CR-SPLIT (CR-SPLIT=2) and dithered (2-point dither pattern) thus the total number of exposures for WFC is 5 (bkg levels) x2 (CR-SPLIT) x2 (dithers) x3(positions on the sky) = 60. Five to six images can be done each orbit so the total orbit calculation for WFC leads to 11 orbits (verified with APT). For HRC, we will keep the field fixed and perform readout using 3 different amplifiers. The observations will be dithered and CR-SPLIT as done for WFC. Therefore 4 (bkg levels) x2 (CR-SPLIT) x 2 (dithers) x 3 (amplifiers) = 48 HRC images can be obtained in 4 orbits only. Therefore, the total number of requested orbits for each observing period is 15.

Fraction GO/GTO Programs Supported. About one third to one half of all WFC programs, with an increasing fraction with time as the effect grows larger. Programs which endeavor to perform high precision photometry are particularly reliant on the up-to-date CTE calibration.

Resources Required: Observation. This program requires 15 external orbits each time it executes. The next execution is February 2007 with a second epoch about one year later to provide tracking the CTE on a time scale of about 1 year in this 18-month calibration plan. Total request is 30 orbits to allow continued tracking of CTE development at a one year cadence.

Resources Required: Analysis. About 0.75 FTE will be required to plan, reduce and analyze the data, provide correction formulae and publish reports.

Products. Improved photometry correction formulae, to be published in an ISR.

Accuracy Goals. $\sim 10 - 20\%$ of the size of the correction, roughly $1 - 2\%$ in absolute photometry precision.

Scheduling and Special Requirements. This program is done about every 12 months.

11045: ACS Internal CTE monitor

Purpose. This program will measure the internal charge transfer efficiency (CTE) of the HRC and WFC detectors once per year, to track the accumulating CCD damage due to on-orbit radiation exposure. The internal CTE data can be much more easily related to ground testing for fostering engineering understanding, than the external CTE observations aimed at obtaining an empirical correction for science data.

Description. EPER (extended pixel edge response) and FPR (first pixel response) data will be collected over a range of signal levels, but skewed towards the low levels where CTE losses are most significant (although we have begun including more of the higher signal levels recently). The internal tungsten calibration lamps will be used, with default amps and gains. Both parallel and serial CTE measurements can be made with the data.

Fraction GO/GTO Programs Supported. Not directly used for calibration corrections, in an indirect sense supports all CCD observations.

Resources Required: Observation. About 35 internal orbits of CTE data at a wide range of signal levels will be obtained annually. Spanning this 18 month calibration submission requires two executions for 70 internal orbits. A one-orbit monthly check at the Fe55-like signal level (1620e) for WFC is also included in the anneal program.

Resources Required: Analysis. About 0.25 FTE will be required to reduce and analyze the data, and publish results. IDL scripts initially created pre-flight by Mike Jones (and later modified for inflight data by Marco Sirianni) will be used to reduce the EPER and FPR data.

Products. An ISR describing the CTE trend / forecast was published in April 2005, including a comparison against predictions based on similar pre- flight data, so further results will be continually added to the plots on the CTE webpage. Due to the switch to the side 2 electronics, and in particular the lower CCD operating temperature we will likely document any significant findings in another ISR.

Accuracy Goals. A fractional precision of at least 10e-7 (six 9s) for the measurements will be needed to track the effect, although higher precision is typical.

Scheduling and Special Requirements. There are no externally-pointed observations, so this program should be executed during Earth occultations, but not during SAA passages. Specially designed timing patterns (invoked via the CTE optional parameter) produce extra (75) overscan pixels for EPER data, and create the electronic knife-edge for FPR data. Short dark pseudo-bias frames are also obtained with the same CTE clocking pattern for bias correction. We would nominally execute this program in April 2007, but due to the CCD operating temperature change in July 2006, we would like to be scheduled earlier, in Oct/Nov 2006, to begin characterizing the new CTE sooner. To maintain annual coverage a second set will execute in late 2007.

11046: ACS CCD Hot Pixel Annealing

Purpose. To anneal out hot CCD pixels caused by radiation damage.

Description. Every four weeks the CCD TECs are turned off and heaters activated to bring the detector temperatures to about +20 degrees C. This state will be held for 6 hours after which the CCDs are returned to normal operating conditions. To assess the effectiveness of this procedure and to provide longitudinal data for hot pixel monitoring a bias and four dark images will be taken before and after for both WFC and HRC in parallel. This will replace the daily dark program for that day. The charge transfer efficiency (CTE) of the ACS CCD detectors declines as damage due to on-orbit radiation exposure accumulates. This degradation has been closely monitored at regular intervals, because it is likely to determine the useful lifetime of the CCDs. We now combine the annealing activity with the charge transfer efficiency monitoring and also merge into the routine dark image collection. To this end, the monthly (but not those at a large number of signal levels executed yearly in the Internal CTE Monitor) CTE EPER and FPR exposures have been moved into this proposal .

Fraction GO/GTO Programs Supported. Supports all CCD measurements which is about 90% of ACS observations.

Resources Required: Observation. 214 internal orbits.

Resources Required: Analysis. About 0.25 FTE will be required to analyze the data.

Products. Hot pixel counts as a function of time. CTE trend and forecast.

Accuracy Goals.

Scheduling and Special Requirements. All observations are internal and so should be scheduled during Earth occultations but not during SAA passages. Specially designed timing patterns (invoked via the CTE optional parameter) produce extra (75) overscan pixels for EPER data, and create the electronic knife-edge for FPR data. Short dark "pseudo-bias" frames are also obtained with the same CTE clocking pattern for bias correction.

11050: ACS UV Contamination Monitor

Purpose. To monitor possible variation of UV throughput with time. Also, as with all Cal programs using the SBC acquire dark reference data in occultation following external observation.

Description. The observations consist of imaging with SBC and HRC of the cluster NGC 6681, where several stars have been well-observed with STIS for its own UV sensitivity monitoring program. HRC observations will be made with the F220W, F250W, F330W filters and PR200L. The SBC observations will be through all six filters (F115LP, F122M, F125LP, F140LP, F150LP, F165LP), and in alternate epochs the prisms PR110L and PR130L. The observation will be taken twice a year for the SBC, since drifts have been shown to exist only at a moderate level. For this 18 month program this implies three visits for March 2007, August 2007 and March 2008 (Cycle 14 most recent: August 2006). For the HRC annual monitoring should suffice, and with the most recent Cycle 14 visit not scheduled until April 2007 a single visit just under one year later is requested. Two SBC dark frames of 1020 sec will follow the SBC orbits.

Fraction GO/GTO Programs Supported. The results from this calibration program will directly affect all GO and GTO programs doing UV observations, approximately 15%.

Resources Required: Observation. This program requires 4 external, and 3 internal orbits.

Resources Required: Analysis. The reduction and analysis of the data, as well as the delivery of relevant products and all documentation from this program will require approximately 0.2 FTE.

Products. Updates to UV photometric calibration zero points, dark reference files, and ISR.

Accuracy Goals. Goal is 1% for the UV photometry, and <10% for the relative SBC dark current (which is a very small absolute quantity).

Scheduling and Special Requirements. None.

11051: CCD Stability Monitor

Purpose.   This program will verify that the low frequency flat fielding, the photometry, and the geometric distortion are stable in time and across the field of view of the CCD arrays. Any deviations from stability will be quantified and necessary corrections derived.

Description.   A moderately crowded stellar field in the cluster 47 Tuc is observed every three months with the HRC (at the cluster core) and WFC (6 arcmin West of the cluster core) using the full suite of broad and narrow band imaging filters. The positions and magnitudes of objects will be used to monitor local and large scale variations in the plate scale and the sensitivity of the detectors and to derive an independent measure of the detector CTE. The UV sensitivity for the SBC and HRC will be addressed in a separate program.

Fraction GO/GTO Programs Supported. 100% of CCD programs.

Resources Required: Observation.   HRC: 1 orbit every 3 months for a total of 6 orbits.
WFC: 2 orbits every 3 months for a total of 12 orbits.
One visit each for WFC and HRC also desired just before the servicing mission, if not covered by standard cadence.
Total = 21 orbits for the 18 month period from Dec06-Jun08.

Resources Required: Analysis. Approximately 0.9 FTE.

Products.   Updates to the relative sensitivity as a function of position on the detector will be provided via updated flat field reference files. Any changes in absolute sensitivity of the detectors as a function of time will be used to update the CCD QE curves used by the pipeline. Variations of the geometric distortion will be parameterized for use in the pipeline as appropriate.

Accuracy Goals.   Variations with respect to previous observations will allow us to create flats which are accurate to 1% over the detector field of view. No absolute photometric calibration is provided by this program, although drifts in time of the sensitivity are tracked to ∼0.1% per year. Geometric distortion is tracked to level of ∼0.01 pixels across a quadrant scale.

Scheduling and Special Requirements.   None.

11052: ACS Internal Flat Fields.

Purpose. The stability of the CCD flat fields will be monitored using the calibration lamps and a sub-sample of the filter set.

Description. Internal flats will be obtained for the HRC and WFC detectors using the tungsten lamp and a subset of filters (F435W, F625W, F814W). F850LP will be added to the standard tracking set. High signal observations will be used to assess the stability of the pixel-to-pixel flat field structure and to monitor the position of the dust motes. Any changes in time of L-flats will also be tracked. To establish a baseline useful for reaction to possible instrument changes in the future one set of internal flats will be obtained for each filter other than F435W, F625W and F814W.

Fraction GO/GTO Programs Supported. 90%.

Resources Required: Observation. The CCD flats will be monitored once per year, for a total of 5 orbits (HRC = 1 orbit, WFC = 4 orbits). Two epochs for this 18-month period requires 10 orbits. One additional epoch of 5 orbits is desired for a baseline measurement just before the servicing mission. The one-time creation of internal flat baseline for all non-monitor filters requires 1 orbit per each of 12 WFC filters, and 1 orbit for each set of 3 HRC filters for a total addition of 17 orbits. The total number of internal orbits required is 32.

Resources Required: Analysis. Approximately 0.2 FTE.

Products. Results from this program will impact the standard flat field calibration files included in the pipeline, and an ISR will document the results.

Accuracy Goals. The accuracy of the flat field calibration is expected to be better than 1%.

Scheduling and Special Requirements. None.

11053: ACS Earth Flats

Purpose. Sky flats will be obtained by observing the bright Earth with the HRC and WFC. These observations will be used to verify the accuracy of the flats currently in the pipeline and to monitor any changes. Weekly coronagraphic monitoring is required to assess the changing position of the spots.

Description.   This program will obtain sequences of flat field images by observing the bright Earth. Coronagraphic observations will be taken in combination with the F330W filter at the beginning and the end of each orbit to assure sufficient illumination. The supplemental HRC and WFC observations will be taken to fill the orbit and will serve as verification of the stellar L-flat corrections currently used by the pipeline.

Fraction GO/GTO Programs Supported. About 50%.

Resources Required: Observation.   A single orbit is required each week to monitor the position of the coronographic spots, for a total of 78 orbits, all of which take place during Earth occultation.

Resources Required: Analysis. Approximately 0.15 FTE.

Products. Results from this program will verify if any changes are required to the flat field calibration files included in the pipeline. The coronagraphic spot positions will be used to update the spot position reference table.

Accuracy Goals.   The Earth flats will be statistically accurate to 0.25% per pixel. The position of the coronagraphic spot will be determined at the level of 1 pixel or better.

Scheduling and Special Requirements.   We require observations of the bright Earth during occultation.

11047: ACS CCD Post-Flash Verification

Purpose. To monitor performance of the post-flash facility. This will be the first test of post-flash with the Side 2 electronics (new LED used).

Description. Internal FLASH exposures are obtained at high SNR for each detector and each shutter side, as well as at each (LOW, MID, HIGH) LED current setting. The shutters are moved by inserting short internal cal lamp exposures between FLASH exposures. A series of short (1 s) FLASH exposures is also obtained without any intervening configuration change, to test short-term repeatability.

Fraction GO/GTO Programs Supported. Potentially supports all CCD measurements which is about 90% of ACS observations. Has not been activated for science observations so far, and is not supported for Cycle 15.

Resources Required: Observation. 4 internal orbits in each of two epochs.

Resources Required: Analysis. About 0.05 FTE will be required to analyze the data.

Products. Normalized pre-flash images at LOW, MID and HIGH LED current settings.

Accuracy Goals. This is a qualitative tracking of capability; actual use for data analysis support would require additional observations.

Scheduling and Special Requirements. Performed about once per year. Schedule for November of 2006 and 2007. No compression should be applied to the images.

11054: ACS Photo-& Spectrophotometry Abs. Cal.

Purpose.   Verify repeatability of the ACS instrumentation on a single bright star to ±0.2%. Determine any shift in the filter bandpasses since the preflight lab measurements. Determine the relative magnitude of the 3 primary WD calibrators to 0.1%. Refine the sensitivity calibration of the CCD prism and grisms and determine the repeatability of this calibration. Determine the level of variability of the three HST red standard stars VB-8 (M7), 2M0038+18 (L3.5) and 2M0559-14 (T5) and use the resulting observations to constrain the far red (>9000A) sensitivity post WFC cooldown and associated switch to Side 2 electronics. To support revision of the QE sensitivity curve add one orbit for WFC observation of the sdF8 SDSS standard BD+17d4708 in order to look for continuity vs. SED from O,F,M,L,T.

Description.   This program consists of three parts: (1) Observe a subset of the primary WDs with HRC and WFC to verify repeatability to 0.2%, because the filter shifts are based on photometric differences between stars of 1%. These observations are also required to establish relative magnitudes of the primary WD standards at the 0.1% level. The targets should be GD153 and G191B2B to supplement GD71, which was done in the Cycle 14 program 10740. One orbit on the most important filters, including the grism and the prisms, should be expended with each camera for both stars for a total of 4 orbits. (2) High S/N photometric and spectroscopic observations of three red stars, VB-8 (M7), 2M0038+18 (L3.5) and 2M0559-14 (T5) with WFC to verify the repeatability of these late type stars that are notorious for variability. Assuming stability is indicated use the results to quantify the QE curve in the far red. (3) Observe the SDSS sdF8 standard with the primary WFC filters and grism.

Fraction GO/GTO Programs Supported. 90%.

Resources Required: Observation.   8 Orbits.

Resources Required: Analysis. 0.5 FTE

Products. Better filter bandpasses, improved sensitivities, and more accurate flux standards.

Accuracy Goals.   See above.

Scheduling and Special Requirements.   None.

11048: ACS SBC MAMA recovery

Purpose.   This proposal is designed for the initial turn-on of the ACS MAMA detector and to permit recovery after an anomalous shutdown.

Description.   The Initial MAMA turn-on/recovery from anomalous shutdown consists of three tests: a signal processing electronics check, high voltage ramp-up to an intermediate voltage, and high voltage ramp-up to the full operating voltage. During each of the two high voltage ramp-ups, diagnostics are performed during a dark ACCUM. The turn-on is followed by a MAMA Fold Analysis.

Fraction GO/GTO Programs Supported. Supports all SBC measurements which is about 10% of ACS observations.

Resources Required: Observation.   4 internal orbits per occasion. Normally less than once per year.

Resources Required: Analysis. About 1 day (0.004 FTE) will be required to analyze the data.

Products. A TIR would be written to document the procedure and results.

Accuracy Goals.

Scheduling and Special Requirements.   It is a goal to schedule each visit when TDRSS is visible so that voltages and count rates can be monitored. Note that Visits containing MAMA high voltage activities must be scheduled outside of the SAAs. No SBC observations may be scheduled until analysis is complete.

11049: ACS SBC Darks

Purpose.   Monitor the SBC dark current as a function of time, and implicitly detector temperature during a multi-orbit visit.

Description.   SBC darks will be run in parallel by crafting coordinated parallels on either Cycle 15 NICMOS calibrations, or by finding a GO program for which the same may be done.

Fraction GO/GTO Programs Supported. Supports the approximately 10% of ACS observations using the SBC.

Resources Required: Observation.   This program uses 8 to 12 parallel (internal for this accounting) orbits split over two epochs.

Resources Required: Analysis. Estimate 0.1 FTE to craft the Phase II, analyze data and publish an ISR or TIR describing the results.

Products. Revised SBC dark reference file, ISR or TIR.

Accuracy Goals.   A relative accuracy of 10% is sought on the very small SBC dark current.

Scheduling and Special Requirements.   Must be crafted as a coordinated parallel with an appropriate NICMOS calibration or GO program.

11055: Color Dependent SBC Flats

Purpose. Investigate SBC flat fields for objects with a red (solar-like) spectrum. Observations of Saturn and Jupiter show two apparent flat field artifacts that are inconsistent with lamp and hot star flat fields: (1) a line approximately coincident with column 502 and about 1 pixel wide where solar system objects are seen to be about 7-9% brighter than on adjacent parts of the detector, and (2) a region near the left edge of the detector about 100 columns (3") wide that is about a factor of two fainter than expected. Existing observations of solar system objects have not been dithered and as a result cannot be used to unambiguously constrain the magnitude of these apparently color-dependent flat field artifacts.

Description. Saturn will be dithered over the detector in a 4x4 grid using 92 second exposures and two SBC filters. Examination of STIS G140L spectra of Saturn shows that the continuum flux from the disk cuts off sharply below about 1550 angstroms. So once localized auroral features are excluded, there will be little difference between the continuum flux seen in F125LP, F140LP and F150LP filters. The filter combination which will best isolate the continuum UV flux of the disk is the F150LP plus the F165LP. These two filters will be alternated at each grid position. These 32 exposures can be obtained in two external orbits. The observed surface brightness of Saturn in the F140LP is about 0.05 to 0.1 counts/pixel/second, and count rates for these other filters should be similar. By averaging of 10x10 pixel regions we should obtain a S/N of between 20 - 30 for each region. Jupiter would be an even better target, but it isn't clear that we can prove that SBC F150LP observations of Jupiter will be sufficiently below the 200000 cnt/second global limit.

Fraction GO/GTO Programs Supported. These could benefit the majority of SBC imaging programs which constitute about 5% of ACS use, and include more than 100 orbits dedicated to Jupiter and Saturn SBC imaging.

Resources Required: Observation. 2 external orbits.

Resources Required: Analysis. 0.1 FTE. Each image of Saturn will be divided up into a number of regions aligned with the planet's image. The position and flux in each of these regions will be measured and then input into the same scripts that have been previously used for producing low order flat fields from stellar measurements. Since we hope to use the existing software, the analysis should be relatively quick. The difference between the F150LP and F165LP longpass filter images should isolate a narrow bandpass near 1600 angstroms that can be used to determine how much of the LFLAT variability is due to changes in the red leak, and how much is intrinsic to FUV wavelengths.

Products. An alternate L-flat will be produced, which will be directly applicable to objects with a roughly G-type spectrum. We will also attempt to discern at what wavelengths the throughput is really varying, and make recommendations regarding the color dependence of the flat fields expected for all SBC imaging observations.

Accuracy Goals. Determine the L-flat appropriate for red objects to within a few percent or better. Estimate color dependence of all SBC low-order flat fields to within a few percent.

Scheduling and Special Requirements. This program would be best scheduled when Saturn is near opposition and at least 20" in diameter. This will constrain observations to occur between 15 Jan and 28 Feb 2007 or between 2-9 March 2007. After March 9, 2007 Saturn cannot be observed in two gyro mode until the end of October.

11056: Improved Sensitivity Calibration of SBC Prisms

Purpose. We propose to improve the sensitivity calibration of the SBC PR110L and PR130L prisms by observing additional calibrator targets.

Observations with the ACS/SBC PR110L of two solar type stars (GO-10114, GO-10718) showed a pronounced peak of counts at wavelength of about 3500Å. Re-analysis of two blue spectrophotometric standard stars, indicates that there is a residual sensitivity of the MAMA detectors much beyond the pre-flight measured one for wavelengths greater than 2000Å, e.g., a red leak.

Description. We will obtain observations of two flux standard stars, namely WD1657+343 and LTT9491. The blue standard star WD1657+343 has previously been observed with ACS/SBC and will serve as a reference point to track time dependent variations. LTT9491 is much redder and thus will be used to investigate the sensitivity curve of "red" targets. Additionally, LTT9491 shows various strong absorption lines which can be used to confirm the wavelength calibration of the PR110L and PR130L prisms.

The standard stars will be observed at a variety of pointings across the SBC detector in order to map spatial variations. The exposures can be kept short (typically 2 min per prism spectrum), but since the standard stars must be observed in separate visits, one orbit per target is required. The targets will be observed in sequences of three exposures: 2 direct imaging exposure (typically 15 s in F122M and F165LP, respectively) followed by the PR110L and PR130L exposures (120 s each).

For the standard star LTT9491 we require additional observations with ACS/HRC PR200L to obtain a secure calibration from about 1700 Åto 4000 Å. The observing sequence is similar to the PR110L and PR130L observations described above.

Fraction GO/GTO Programs Supported. These could benefit the majority of SBC programs which constitute about 10% of ACS use.

Resources Required: Observation. 1 orbit with ACS/SBC per standard star, i.e. 2 orbits. 1 orbit with ACS/HRC for LTT9491. Thus 3 orbits in total.

Resources Required: Analysis. The analysis will be carried out by the ST-ECF.

Products. The calibrations will be published in an ISR and made available to the community as configuration files for the aXe spectral extraction package.

Accuracy Goals. We aim to calibrate the total sensitivity curves of ACS/SBC PR110L and PR130L to better than 3% in the wavelength range up to 1800 Åand to better than 5% up to about 4000 Å.

Scheduling and Special Requirements. Preferably the observations should be scheduled as early as possible in order to make the calibrations available to the community.