Cycle 28 STIS Final Calibration Program Plan

STIS Team

STIS Calibration and Monitor Orbits Approved by Cycle

	# of Programs	External Orbits	Parallel Orbits	Internal Orbits	Total Orbits
Cycle 17	25	68	0	1816	1884
Cycle 18	20	22	0	1370	1392
Cycle 19	18	21	0	1418	1439
Cycle 20	20	21	0	1391	1412
Cycle 21	20	21	0	1392	1413
Cycle 22	19	21	0	1387	1408
Cycle 23	22	31	1	1380	1416
Cycle 24	21	27	1	1355	1386
Cycle 25	21	26	0	1355	1381
Cycle 26	21	27	1	1355	1383
Cycle 27	20	33	0	1358	1391
Cycle 28*	23	52	0	1349	1401

* Regular and special calibration and monitoring programs requested for cycle 28

STIS Cycle 27 Calibration and Monitoring Orbits Approved

Prop. ID	Title	External	External Parallel	Internal	Frequency (orbits x repeats)	Cycle 26 Allocation
CCD Monitors						
15734	STIS CCD Performance Monitor			**14**	**7x2**	**14**
15735-15737	STIS CCD Dark Monitor			**732**	**2x242 + 1x248**	**730**
15738-15739	STIS CCD Bias and Read Noise Monitor			**370**	**1x182 + 1x184+1x4**	**369**
15740	STIS CCD Hot Pixel Annealing			**39***	**3x13**	**39**
15741	STIS CCD Spectroscopic Flat-Field Monitor			**19**	**1x10 +9**	**19**
15742	STIS CCD Imaging Flat-Field Monitor			**4**	**1x4**	**4**
15743	STIS CCD Spectroscopic Dispersion Solution Monitor			**3**	**3x1**	**3**
15744	STIS CCD Sparse Field CTE			**50***	**50x1**	**50**
15745	STIS CCD Full Field Sensitivity	**1**			**1x1**	**1**
15746	STIS Slit Wheel Repeatability			**1**	**1x1**	**1**
15747	STIS CCD Spectroscopic Sensitivity Monitor	**5**			**L 1x3, M 2x1**	**5**
MAMA Monitors						
15748	STIS MAMA Spectroscopic Dispersion Solution Monitor			**7**	**7x1**	**7**
15749	STIS MAMA Full Field Sensitivity	**3**			**1x3**	**3**
15750	STIS MAMA Spectroscopic Sensitivity and Focus Monitor	**12**			**1x3/L, 1x1/M, 2x4/E**	**12**
15751	STIS FUV MAMA Dark Monitor			**54**	**6x9**	**54**
15752	STIS NUV MAMA Dark Monitor			**52**	**2x26**	**52**
15753	STIS MAMA NUV Flat-Field Monitor			**11***	**1x11**	**11**
15754	STIS MAMA Fold Distribution			**2**	**2x1**	**2**
Contingency programs						
15755	STIS MAMA Anomalous Recovery			**(8)**		**(8)**
Special programs						
16028	Absolute Flux Calibration of STIS MAMA G140L and G230L	**12**	**0**	**0**	**2+1+1+3+3+1+1**	**---**
TOTAL	**Cycle 27 orbits approved**	**33**	**0**	**1358 + (8)**		**Ext: 27 + 1P Int: 1355+(8)**

* Internal parallel orbits > 1800s.

Green means "executing on alternating cycle only"

( ) Indicates contingency orbits not included in Cycle 27 request.

Cycle 28 STIS Calibration Plan:
Routine Programs & Monitoring

STIS Team

11/06/2020

STIS Cycle 28 Calibration and Monitoring Orbits Requested

Prop. ID	Title	External	External Parallel	Internal	Frequency (orbits x repeats)	Cycle 27 Allocation
CCD Monitors						
16336	STIS CCD Performance Monitor			**14**	**7x2**	**14**
16337-16339	STIS CCD Dark Monitor			**728**	**1x242 + 1x242 + 1x248**	**732**
16340-16341	STIS CCD Bias and Read Noise Monitor			**365**	**1x182 + 1x183**	**370**
16342	STIS CCD Hot Pixel Annealing			**39***	**3x13**	**39**
16343	STIS CCD Spectroscopic Flat-Field Monitor			**19**	**1x10 + 1x9**	**19**
16344	STIS CCD Imaging Flat-Field Monitor			**4**	**1x4**	**4**
16345	STIS CCD Spectroscopic Dispersion Solution Monitor			**3**	**3x1**	**3**
16346	STIS CCD Sparse Field CTE			**50***	**50x1**	**50**
16347	STIS CCD Full Field Sensitivity	**1**			**1x1**	**1**
16349	STIS Slit Wheel Repeatability			**1**	**1x1**	**1**
16348	STIS CCD Spectroscopic Sensitivity Monitor	**5**			**1x3 (L) + 2x1 (M)**	**5**
MAMA Monitors						
16350	STIS MAMA Spectroscopic Dispersion Solution Monitor			**7**	**7x1**	**7**
16351	STIS MAMA Full Field Sensitivity	**3**			**1x3**	**3**
16352	STIS MAMA Spectroscopic Sensitivity and Focus Monitor	**12**			**1x3(L), 1x1(M), 2x4(E)**	**12**
16353	STIS FUV MAMA Dark Monitor			**54**	**6x9**	**54**
16354	STIS NUV MAMA Dark Monitor			**52**	**2x26**	**52**
16355	STIS MAMA FUV Flat-Field Monitor			**11**	**1x11**	**11***
16356	STIS MAMA Fold Distribution			**2**	**2x1**	**2**
Special and contingency programs						
16436	Monitoring the Three Primary White Dwarf Standard Stars	5			**1x1 + 2x1 + 2x1**	
16437	Absolute Fluxes of Faint WD Standards for Cross Calibration	12			**2x2 + 2x1 + 2x1 + 2x2**	**12**
16438	FUV Flux Variations at Off-Nominal Detector Positions	9			**3x3**	
16442	Assessing Flux Reproducibility in STIS Spatial Scans	5			**5x1**	
16357	STIS MAMA Anomalous Recovery (Contingency)			**(8)**		**(8)**
TOTAL	**Cycle 28 orbit request**	**52**	**0**	**1349+ (8)**		**Ext: 33** **Int: 1358+(8)**

* Internal parallel orbits > 1800s.

Green means "executing on alternating cycle only"

( ) Indicates contingency orbits not included in Cycle 28 request.

STIS Cycle 28 Calibration: Changes from Cycle 27

Two programs alternate between even and odd cycles:

- the STIS MAMA FUV Flat-Field Monitor will execute in Cycle 28 instead of the NUV Flat-Field Monitor
- the CCD Sparse Field CTE Internal program observations will use the GAIN = 4 setting this cycle (instead of GAIN = 1)

The "extra" four bias/read noise orbits have been eliminated from the daily CCD dark and bias/read noise monitors

Parallel exposures with WFC3 are added to the STIS MAMA Spectroscopic Sensitivity and Focus Monitor echelle visits

Four special calibration programs will be executed

STIS/CCD Programs

Note: STIS Cycle 28 Phase Is Include
Cycle 27 Usage Statistics

STIS CCD Performance Monitor
PI: Matthew Maclay

Purpose	To measure the baseline performance of the CCD detector.
Description	This program monitors the performance of the CCD detector on orbit for amplifier D only. Bias and flat field exposures are taken to measure read noise, CTE (EPER test), spurious charge, and gain values with full frame observations. Bias exposures are also taken in sub-array readouts to check the bias level for ACQ and ACQ/PEAK observations. All orbits < 1800s
Fraction GO/GTO Programs Supported	20.9% of STIS total exposure time (cycle 27).
Resources Required: Observations	14 internal orbits performed in 2 groups of 7
Resources Required: Analysis	2 FTE weeks for analysis and documentation.
Products	Possible update of the gain, bias level, and read noise values in ccdtab. This also provides a relative measure of CTI via the extended pixel edge response test. Possible flight software updates of table CCDBiasSubtractionValue. Regular updates to the STIS monitor web pages and a summary in the end of cycle ISR.
Accuracy Goals	Read noise good to +/- 0.3 ADU, gain error < 0.08 ADU
Scheduling & Special Requirements	Visits occur every 6 months in Mar and Sept.
Changes from Cycle 27	No changes

STIS CCD Dark Monitor (Parts 1, 2, and 3)
PI: Matthew Maclay

Purpose	Monitor dark current for the STIS CCD.
Description	Routine monitoring with Amp D and GAIN = 1: obtain 2 visits per day
Fraction GO/GTO Programs Supported	20.9% of STIS total exposure time (cycle 27)
Resources Required: Observations	242 (part 1) + 242 (part 2) + 246 (part 3) internal orbits (all <1800s)
Resources Required: Analysis	6 FTE weeks; Retrieve and construct superdarks. These superdarks are compared to previous superdarks and the image statistics are checked to see if there are any anomalous statistical deviations. CTI analysis based on short darks is performed.
Products	Weekly CRDS reference files (superdarks), regular updates of the monitor web page, and a summary in the end of cycle ISR.
Accuracy Goals	Superdark rms < 0.012 e-/s and S/N > 1.0 per pixel in superdarks.
Scheduling & Special Requirements	Two orbits each day.
Changes from Cycle 27	No Changes

STIS CCD Bias and Read Noise Monitor (Parts 1 & 2)
PI: Matthew Maclay

Purpose	Monitor the bias in the 1x1 bin settings at gain=1, and 1x1 at gain = 4, to build up high S/N superbiases and track the evolution of hot columns. Also GAIN=1 and GAIN=4, 1x1 biases through AMPS A and C to use in combination with biases taken through AMP D for monitoring of the read noise
Description	Take full frame bias exposures in the 1x1 bin settings at GAIN = 1, and at GAIN = 4 with nominal AMP D. Take full frame biases through AMPs A and C in GAIN = 1 and 4 as well for performing read noise monitoring. All exposures are internal and fit in occultation orbits.
Fraction GO/GTO Programs Supported	20.9% of STIS total exposure time (cycle 27)
Resources Required: Observations	182 (part 1) + 183 (part 2) internal orbits (all <1800s)
Resources Required: Analysis	2 FTE weeks. Retrieve and construct superbiases. These are compared to previous superbiases and the image statistics are checked to see if there are any anomalous deviations. Biases with AMPS A and C allow for monitoring of the read noise.
Products	Weekly CRDS reference files (superbiases) and a summary in the end of cycle ISR
Accuracy Goals	Superbiases RMS < 0.95 e- at GAIN = 1 1x1 and RMS < 1.13 e- at GAIN = 4 1x1, S/N > 1 per pixel.
Scheduling & Special Requirements	One orbit per day for the routine monitor. The additional biases for AMPS A & C should be taken for 6 consecutive days during most months.
Changes from Cycle 27	The AMP A & C observations are now obtained within the daily visits – so the "extra" 4 orbits are not needed.

STIS CCD Hot Pixel Annealing
PI: Matthew Maclay

Purpose	To anneal hot pixels. The effectiveness of the CCD hot pixel annealing is assessed by measuring the dark current behavior before and after annealing.
Description	The characteristics of the CCD will first be defined by a series of bias, dark, and flat-field exposures taken before the anneal. The CCD Thermoelectric cooler will be turned off to allow the CCD detector temperature to rise from ~ -80 C to +5 C. The CCD will be left in the uncooled state for approximately 12 hours. At the end of this period the Thermoelectric cooler is turned back on and the CCD is cooled to its normal operating temperature. Since the CCD on Side-2 does not have a thermistor, a 4 hour period, at a minimum, is necessary to ensure that the CCD is cool and stable. After the CCD has stabilized, bias, dark and flat-field images will be repeated to check for changes in the CCD characteristics. The flat-field exposures will permit evaluation of any window contamination acquired during the annealing period. Pure parallel mode.
Fraction GO/GTO Programs Supported	20.9% of STIS total exposure time (cycle 27)
Resources Required: Observations	39 internal orbits (3 every 4 weeks); all orbits >1800s.
Resources Required: Analysis	2 FTE weeks. By comparing the number of hot pixels before and after the anneal, we see if the hot pixels decrease and estimate the number of hot pixels that persist after the process.
Products	Hot pixel growth rate, median dark count rate, and a summary in the end of cycle ISR
Accuracy Goals	Measure the growth rate of hot pixels to within 1% if possible
Scheduling & Special Requirements	Pure parallel mode exposures. Anneals will execute every 4^{th} week using 3 orbits.
Changes from Cycle 27	No changes

STIS CCD Spectroscopic Flat-Field Monitor
PI: Joleen Carlberg

Purpose	Obtain medium resolution grating flats to determine the pixel-to-pixel variation for spectroscopic observations and produce the Cycle 28 reference p-flat (M and L modes).
Description	We use the tungsten lamp and the G430M grating to determine the pixel-to-pixel variation of the STIS CCD in spectroscopic mode. The flat exposures are taken with the 50CCD and 52x2 apertures at 5 offset positions in order to map -with a sufficient SNR- the whole sensitive area of the detector. The expected cumulative signal ≥1.4E6 ADU/pixels; while the expected accuracy will be ≤1.5%. All orbits are < 1800 s.
Fraction GO/GTO Programs Supported	20.9% of STIS total exposure time (cycle 27)
Resources Required: Observations	19 internal orbits (all <1800s)
Resources Required: Analysis	2.5 weeks FTE
Products	Reference files, summary in end of cycle ISR and special ISR as applicable
Accuracy Goals	≤1.5% flat field accuracy
Scheduling & Special Requirements	9 orbits with G430M/5612 & 50CCD spread across the cycle; 1 visit every ~40 days 10 orbits with the G430M/5612 & 52x2
Changes from Cycle 27	No changes

STIS CCD Imaging Flat-Field Monitor
PI: John Debes

Purpose	Purpose: Collect high SNR white light imaging flats (aperture=50CCD) for monitoring purposes and to create a new reference p-flat for coronagraphic (and imaging) observations.
Description	Once every 3 months, obtain a series of imaging CCD flats using the MIRROR and the unfiltered 50CCD aperture. The 3 months cadence will allow us to keep monitoring possible (but unlikely) variations across the cycle; while the combined observations will allow us to obtain an average signal ~620000 ADU/pix (similarly to the past cycles) and create a high accuracy (~1%) imaging p-flat. The remaining time in each orbit/visit will be used to monitor the stability of the CORON aperture due to the MSM limited reproducibility.
Fraction GO/GTO Programs Supported	20.9% of STIS total exposure time (cycle 27)
Resources Required: Observations	4 internal orbits
Resources Required: Analysis	4 weeks FTE
Products	Reference p-flat and TIR or ISR as relevant.
Accuracy Goals	~1% flat field accuracy
Scheduling & Special Requirements	1 orbit every 3 months.
Changes from Cycle 27	No changes

STIS CCD Spectroscopic Dispersion Solution Monitor
PI: Daniel Welty

Purpose	To monitor the wavelength calibration / dispersion solutions for some configurations of the STIS/CCD.
Description	Internal wavecals will be obtained with all 6 gratings (G230LB, G230MB, G430L, G430M, G750L, G750M) supported for use with the CCD, for settings chosen to cover Cycle 28 use and to overlap with those used in previous calibration programs (to continue long-term monitoring). All observations will be obtained with the 52x0.1 aperture, which maps to 2 pixels at the CCD. As in previous cycles, the HITM1 lamp will be used, as it has a more favorable spatial illumination pattern, dropping by only a factor of 3 at row 900 (near the E1 pseudo-aperture), relative to the peak brightness at row 420.
Fraction GO/GTO Programs Supported	20.9% of STIS total exposure time (cycle 27)
Resources Required: Observations	3 internal orbits
Resources Required: Analysis	2 FTE weeks
Products	Update wavelength dispersion reference file (as needed, with ISR); summary in the end of cycle ISR
Accuracy Goals	0.2 pixels (wavelength accuracy for row 900) -- Wavelength coefficients are tabulated every 32 rows in the CCD dispersion (_dsp) reference file. Exposure times in this program have typically been chosen to yield a S/N ratio of at least 10 per pixel in row 900 after combining 32 rows. This constraint must be satisfied in the left, middle, and right thirds of the image. Existing recent HITM1 wavecals were used to estimate exposure times.
Scheduling & Special Requirements	These observations are taken once per cycle.
Changes from Cycle 27	No changes

STIS CCD Sparse Field CTE Internal
PI: Sean Lockwood

Purpose	Re-establish an accurate correction for parallel register CTE losses that can be used for direct analysis of science data with negligible background. Do measurements for one gain setting (GAIN=4), alternating with GAIN=1 every-other-cycle.
Description	The sparse field CTE will be measured via internal calibration lamp observations taken through narrow slits. Using the onboard tungsten lamp, narrow slit images are projected at different positions on the detector. At each position a series of exposures is taken alternating between the 'A' and 'C' amplifiers for readout. The further the charge needs to be shifted to be read out, the more charge it will lose. For the parallel CTE measurement, the test will use the the cross disperser slits: 0.05x31NDB and 0.05x31NDA. In order to test the effects of different bias voltages and readout timing, the whole series of exposures are executed once for GAIN=4 and once for GAIN=1 every-other cycle; this process requires a total of 50 orbits per cycle which includes various sets of biases and darks.
Fraction GO/GTO Programs Supported	20.9% of STIS total exposure time was CCD (cycle 27)
Resources Required: Observations	50 internal visits (7/50 visits will exceed the 1800 s limit by ~100 s in order to capture the full sequence of exposures required for best analysis.)
Resources Required: Analysis	3 FTE weeks
Products	Determine slope for time dependent empirical flux correction of CTE, possible update of ccdtab reference file, and inclusion in a summary ISR.
Accuracy Goals	1%
Scheduling & Special Requirements	Schedule between 2020-November-01 and 2021-January-01. Visits should execute in order.
Changes from Cycle 27	Data taken for gain=4 instead of gain=1 (alternates every cycle).

STIS CCD Full-Field Sensitivity
PI: Matthew Maclay

Purpose	To monitor CCD sensitivity over the whole field of view.
Description	Measure a photometric standard star field in Omega Cen in 50CCD annually to monitor CCD sensitivity over the whole field of view. Keep the spacecraft orientation within a suitable range (+/- 5 degrees) to keep the same stars in the same part of the CCD for every measurement. This test will give a direct transformation of the 50CCD magnitudes to the Johnson-Cousins system for red sources. These transformations should be accurate to 1%. The stability of these transformations will be measured to the sub-percent level. These observations also provide a check of the astrometric and PSF stability of the instrument over its full field of view. All external orbits (> 1800s).
Fraction GO/GTO Programs Supported	20.9% of STIS total exposure time (cycle 27)
Resources Required: Observations	1 external
Resources Required: Analysis	1 FTE week
Products	Summary in the end of cycle ISR
Accuracy Goals	1%
Scheduling & Special Requirements	ORIENT 310.0D TO 310.0 D; BETWEEN 15-JAN-2021:00:00:00 AND 20-MAR-2021:00:00:00
Changes from Cycle 27	No changes

STIS Slit Wheel Repeatability
PI: Amy M. Jones

Purpose	To test the repeatability of slit wheel motions.
Description	A sequence of lamp spectra taken using grating G230MB
Fraction GO/GTO Programs Supported	97.0% of STIS total exposure time (cycle 27)
Resources Required: Observations	One internal orbit (24 exposures, ~40 mins total) once per cycle.
Resources Required: Analysis	2 FTE days
Products	The average and maximum shifts observed in the dispersion and the spatial direction. Possible ISR that sums up analysis results for the past few cycles.
Accuracy Goals	Shifts should be smaller than 0.5 pixels.
Scheduling & Special Requirements	Between Nov 01,2020 and Jan 31, 2021
Changes from Cycle 27	No changes

STIS CCD Spectroscopic Sensitivity Monitor
PI: Joleen Carlberg

Purpose	Monitor the spectroscopic sensitivity of the STIS CCD using both low- and medium-resolution gratings to reveal contamination issues that may affect the spectroscopic throughput.
Description	This program will monitor the STIS CCD spectroscopic sensitivity using a high-declination spectroscopic calibration star (AGK+81D266). The results will be compared to previous observations to detect trends. The L modes will be observed at the nominal and E1 positions every four months with one orbit per visit. The M modes will be observed at the nominal and E1 positions as well, once per year with two orbits per visit.
Fraction GO/GTO Programs Supported	20.9% of STIS total exposure time (cycle 27)
Resources Required: Observations	5 external orbits
Resources Required: Analysis	7 FTE weeks: 3 FTE weeks for sensitivity analysis, 2 weeks for ISR, 2 FTE weeks for CTE correction verification
Products	Updated STIS TDSTAB file, an ISR on STIS sensitivity monitoring, summary in end of cycle ISR
Accuracy Goals	Minimum signal to noise of 50 per resolution element at the least sensitive wavelength.
Scheduling & Special Requirements	1 orbit every 4 months for L modes. 2 orbits/year for M modes.
Changes from Cycle 27	No changes

STIS/MAMA Programs

STIS MAMA Spectroscopic Dispersion Solution Monitor
PI: Daniel Welty

Purpose	To monitor the wavelength calibration / dispersion solutions for some STIS MAMA configurations.
Description	Internal wavecals will be obtained with gratings at primary and secondary central wavelengths chosen to cover Cycle 28 use and to overlap with configurations used in previous calibration programs (to continue long-term monitoring). This program uses the LINE lamp for a total of about 1.6 hours (typically at a lamp current of 10 mA) – consuming about 0.1% of the 15000 mAhour expected lifetime. The HITM2 lamp (which is brighter below 1270 A) is now used for two of the shorter wavelength settings. Moderately deep wavecals are included for some echelle modes and for some first order modes to ensure detection of weak lines. All orbits < 1800s.
Fraction GO/GTO Programs Supported	79.1% of STIS total exposure time (cycle 27)
Resources Required: Observations	7 internal orbits
Resources Required: Analysis	6 FTE weeks
Products	Update wavelength dispersion reference file (as needed; with ISR); summary in end of cycle ISR
Accuracy Goals	0.1-0.2 pixels internal wavelength precision.
Scheduling & Special Requirements	These observations are taken once per cycle. The shortest wavelength settings should avoid orbits in which the FUV glow is strong (if possible).
Changes from Cycle 27	No changes

STIS MAMA Full-Field Sensitivity
PI: Matthew Maclay

Purpose	To monitor the sensitivity of the FUV-MAMA and NUV-MAMA over the full field
Description	By observing the globular cluster NGC6681 once every year at roughly the same orientation, we will monitor the full-field sensitivity of the MAMA detectors and their astrometric and PSF stability. These observations will be used to look for contamination, throughput changes, or formation of color centers in the photocathode and window that might be missed by spectroscopic monitoring or difficult to interpret in flat-fielding. Although this test is done using MAMA imaging modes, the confirmation of detector stability and uniformity provided by this monitor is important for spectroscopic observations as well. All orbits > 1800s.
Fraction GO/GTO Programs Supported	79.1% of STIS total exposure time (cycle 26)
Resources Required: Observations	3 external orbits
Resources Required: Analysis	1 FTE week
Products	Summary in the end of cycle ISR
Accuracy Goals	1%
Scheduling & Special Requirements	Should roughly match most common orient from previous observations. ORIENT 260.0D TO 266.0 D; BEFORE 16-JUN-2021:00:00:00
Changes from Cycle 27	No Changes

STIS MAMA Spectroscopic Sensitivity & Focus Monitor
PI: Joleen Carlberg

Purpose	Monitor the sensitivity of each STIS MAMA grating mode to detect any changes due to contamination or other effects, and monitor the STIS focus in spectroscopic and imaging modes.
Description	- SENSITIVITY: Obtain exposures in each of the two low-resolution MAMA spectroscopic modes every 4 months, in each of the 2 medium-resolution modes once a year, and in each of the 5 echelle modes every 3 months, using unique calibration standards for each mode (L: GRW+70D5824, M: AGK+81D266, E: BD+28D4211), and compare the results to the first observations to detect any trends. - FOCUS: For this cycle we will continue to monitor the STIS focus (small aperture throughput as a function of UV wavelength) by including a direct comparison between the G230LB 0.1X0.09 and 52x2 throughput, as well as a narrow band OII CCD image during each L-Mode visit. We will continue to also include an OII image with the M-mode visit. Echelle visits will now include parallel WFC3 observations.
Fraction GO/GTO Programs Supported	Focus monitor: 100% of STIS exposures. Sensitivity monitor: 79.1% of STIS total exposure time (cycle 26)
Resources Required: Observations	12 external orbits
Resources Required: Analysis	8 FTE weeks: 3 FTE weeks for sensitivity analysis, 2 weeks for ISR, 3 for focus.
Products	Updated STIS TDSTAB file and ISRs on STIS sensitivity monitoring and focus monitoring. Summary in the end of cycle ISR.
Accuracy Goals	Minimum signal to noise of 50 per resolution element at the least sensitive wavelength. 10% for focus changes.
Scheduling & Special Requirements	Visits need to be approximately equally spaced throughout the cycle. MAMA monthly offsets cancelled for L and M mode observations. SAA-free orbits.
Changes from Cycle 27	Echelle mode visits now include parallel WFC3/F438W observations to independently monitor the focus. Each orbit will provide six or seven 205 s exposures with UVIS2. We expect 7-10 stars of sufficient brightness for PSF analysis in any given parallel field.

STIS FUV MAMA Dark Monitor
Sean Lockwood

Purpose	Monitor the behavior of the dark current in the FUV MAMA detector, provide data for dark count corrections for faint object observations, and also provide a check on the health of the detector
Description	Every six weeks a set of six exposures of 1300s is taken with the FUV MAMA with the shutter closed. The exposures are evenly spread over a six-hour SAA-free period.
Fraction GO/GTO Programs Supported	39.6% of STIS total exposure time (cycle 27)
Resources Required: Observations	54 internal visits
Resources Required: Analysis	2 FTE-weeks
Products	Dark current images and temperature-dependent formula for applying to an individual observation. Update to monitoring webpage. DQ flags for pipeline super-darks.
Accuracy Goals	1% (statistical error on the total number of counts in an image)
Scheduling & Special Requirements	Groups of visits spaced apart ~every 6 weeks SAA free
Changes from Cycle 27	No changes

STIS NUV MAMA Dark Monitor
PI: Amy M. Jones

Purpose	Monitor the behavior of the dark current in the NUV MAMA detector, provide data for dark count corrections for faint object observations, and also provide a check on the health of the detector
Description	Every two weeks a set of two 1300 s exposures is taken with the NUV MAMA with the shutter closed. The exposures are taken separated by six hours within an SAA-free period. This separates long and short term temporal effects.
Fraction GO/GTO Programs Supported	39.5% of STIS total exposure time (cycle 27)
Resources Required: Observations	52 internal visits
Resources Required: Analysis	2 FTE-weeks
Products	Dark reference files and tables modeling time and temperature dependence of dark rates. Update to monitoring webpage.
Accuracy Goals	1%
Scheduling & Special Requirements	Pairs of visits spaced apart every 2 weeks SAA free
Changes from Cycle 27	No changes

STIS FUV-MAMA Flat-Field Monitor
PI: Amy M. Jones

Purpose	The goal of this program is to obtain FUV-MAMA flat-field observations to create new p-flats with a SNR of ~100 per low-res pixel. The flats are obtained with the Krypton lamp, and the MR grating G140M, similarly to the cycle 26 program. However the exact instrument setup (slit width and central wavelength) might change depending on the desired count level (which will be close to the internally allowed global rate limit).
Description	Past experience and observations have shown that 11 visits are sufficient to build a p-flat with the required SNR~100 per low-res pixel. The G140M flats will be taken with the slit at 5 different offset positions in order to illuminate the detector regions which are normally shadowed by the slit bars. The exact instrument setup (slit width and central wavelength) may change during the cycle depending on the desired count level.
Fraction GO/GTO Programs Supported	39.6% of STIS total exposure time (cycle 27)
Resources Required: Observations	11 internal orbits (all orbits < 1800s).
Resources Required: Analysis	4 FTE weeks
Products	A combination of this and past cycle frames to produce a new reference p-flat and ISR, as applicable.
Accuracy Goals	1.0% accuracy in per low-res pixel (i.e., 2x2 high-res pixels)
Scheduling & Special Requirements	FUV- and NUV-MAMA flat observations are executed on alternate cycles to save lamp lifetime.
Changes from Cycle 27	This cycle is for FUV-MAMA flats, while Cycle 27 was for NUV-MAMA flats.

STIS MAMA Fold Distribution
PI: Thomas Wheeler

Purpose	The fold analysis provides a measurement of the distribution of charge cloud sizes incident upon the anode providing some measure of changes in the pulse-height distribution of the MCP and, therefore, MCP gain.
Description	While globally illuminating the detector with a flat field, the valid event (VE) rate counter is monitored, while various combinations of row and column folds are selected.
Fraction GO/GTO Programs Supported	79.1% of STIS total exposure time (cycle 27)
Resources Required: Observations	2 internal orbits
Resources Required: Analysis	0.5 FTE day.
Products	The results will be sent to the STIS Team and Steve Franka of Ball Aerospace.
Accuracy Goals	N/A
Scheduling & Special Requirements	This proposal is executed annually.
Changes from Cycle 27	No changes

Contingency Programs

STIS MAMA Recovery from Anomalous Shutdown
PI: Thomas Wheeler

Purpose	Safe and orderly recovery of either MAMA detector from an anomalous shutdown.
Description	The recovery procedure consists of three separate tests (i.e. visits) to check the MAMA's health after an anomalous shutdown. Each must be successfully completed before proceeding onto the next. They are: (1) signal processing electronics check, (2) slow, intermediate voltage high-voltage ramp-up, and (3) ramp-up to full operating voltage.
Fraction GO/GTO Programs Supported	79.1% of STIS total exposure time (cycle 27)
Resources Required: Observations	8 internal orbits
Resources Required: Analysis	If activated, 0.5 FTE day per test.
Products	For tests 1-3, only a Go/No-Go to proceed will be given.
Accuracy Goals	N/A
Scheduling & Special Requirements	This is a contingency proposal activated only in the event of an anomalous shutdown. This proposal is usually followed by the STIS MAMA Fold Distribution proposal.
Changes from Cycle 27	No changes

Special Programs

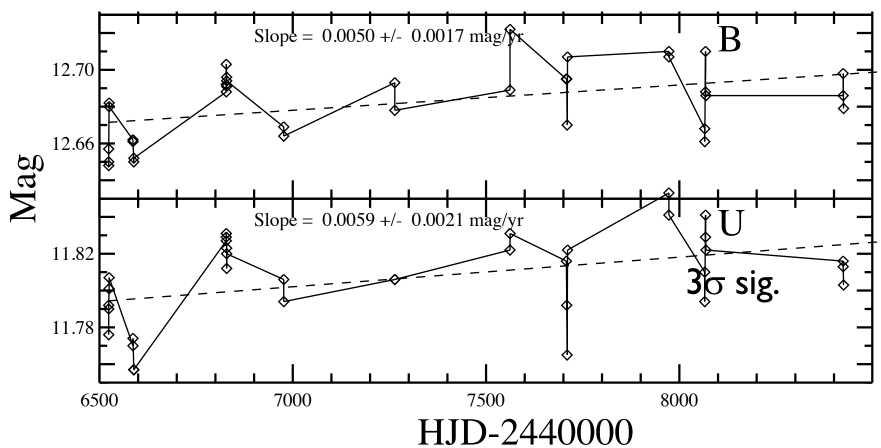
Monitoring the 3 Primary White Dwarf Standard Stars
PI: Ralph Bohlin

Purpose	Repeated observations of the 3 primary WD standards (G191B2B, GD153, GD71) can reveal any variability in any one of the 3, as well as in our MAMA and CCD monitor standards (GRW+70 2824, AGK+81 266). STIS should observe the primary WD triad with a cadence of every alternate year. Rather than putting 'all our eggs in one basket' and depending only on single sensitivity monitoring stars, prudence suggests that return visits in low dispersion by STIS to the fundamental triad should be executed at something approaching the historic cadence. In addition to variability checks, each new observation adds to the statistical precision of the STIS flux calibration that is defined by these 3 stars.
Description	Observations are in the 5 low dispersion modes G140L, G230L, G230LB, G430L, and G750L with the 52x2 slit. For efficiency, the STIS MAMA and CCD observations will be combined in the same visit; and the wavecals and fringe flats will be pushed to the end-of-orbit occultation, as possible. The MAMA observations may violate a current bright-object limit but have been grandfathered in, because the many past observations have not caused a problem.
Fraction GO/GTO Programs Supported	50%
Resources Required: Observations	5 external orbits
Resources Required: Analysis	0.1 FTE
Products	The standard data analysis produces figures that illustrate the average change in response for the 5 STIS low dispersion modes in comparison to the triad of primary standards. The uncertainty in the STIS TDS correction is determined by the level of agreement between the triad of WDs and the respective monitoring standards. Updated absolute flux calibration.
Accuracy Goals	<1%
Scheduling & Special Requirements	No
Changes from Cycle 27	Same as Cycles 24 and 26

Monitoring the Three Primary WD Standards

- **Fundamental standard stars should be observed to safe-guard against possible variability of the two primary STIS sensitivity monitor stars GRW+70D5824 (MAMA; 12 orbits) and AGK+81D266 (CCD; 5 orbits).**
- **Historically, STIS observed three standard WD stars as frequently as every year. After a brief lapse, they are now being observed every other year.**
- **G191B2B can only be observed with the CCD modes (G230LB, G430L, G750L) -- which can all be done in one orbit.**
- **Fainter WDs GD153 and GD71 are observed with both CCD (G430L, G750L) and MAMA (G140L, G230L), and require two orbits each.**

Ground-based photometry hints at possible long-term variability of GRW+70D5824 (Bohlin & Landolt 2015)



~0.03 mag (~3%) over 2000 days

Absolute Fluxes of Faint White Dwarf Standards for Cross Calibration

Bohlin, Deustua, & Welty

Purpose	Using 4 STIS first-order modes, obtain high S/N SEDs for 3 faint WDs used as flux standards for COS and one fainter WD in the All-sky Faint WD Network. This program will augment previous programs (15487, 16028) to obtain the 3 epochs of high S/N spectra needed to establish the four WDs as high-quality standards with STIS. These spectra will yield improved modern (post-SM4) calibrations of the important STIS FUV-MAMA G140L and NUV-MAMA G230L modes and enable more reliable cross calibration – over a range in flux levels -- with COS, JWST, and Roman.
Description	Comparisons of the COS low order modes (G140L, G230L) to the corresponding STIS low order modes (G140L, G230; pre-SM4) for WD0308-565, WD1657+343 and WD1057+719 reveal differences in the STIS/CALSPEC and COS/STIS SED ratios with time (after correcting for TDS) and wavelength. Differences have also been noted between STIS and WFC3 fluxes for the fainter LB 769. We have identified 3 possible causes: (1) errors in the models of the fainter (V~14-16) WDs, (2) errors in the determination of TDS in the STIS modes, and/or (3) differences in pipeline details. Improving the CALSPEC models requires both full spectral coverage between 0.1 and 1 micron and (ideally) a minimum of 3 epochs of observation per spectrum. Cross-checking the TDS requires (ideally) a minimum of 3 stars with coeval observations. Observations of SDSS J151421 will provide a crucial link to verify the new faint (15-19 mag) WD grid.
Fraction GO/GTO Programs Supported	100% of observations in G140L and G230L
Resources Required: Observations	WD0308-565: 2x2 orbits with STIS/G140L, G230L, G430L, G750L WD1057+719: : 2x1 orbits with G750L WD1657+343: 2x1 orbits with G750L SDSS J151421 (LB 769): 2x2 orbits with G140L, G230L, G430L, G750L
Resources Required: Analysis	Reductions will be carried out with two different pipelines (CALSTIS, Bohlin IDL) to calibrate and extract the spectra, using different extraction heights (e.g. 7, 11, 15, 22 pixels) to test the implementation. The analysis will include determination of the best-fit WD models (determined from Teff and log g from the spectral features), a comparison of the synthetic to measured fluxes (to "fix" a fiducial TDS zeropoint), and non-linear fits to the TDS. 0.3 FTE total.
Products	Improved CALSPEC models and SEDs for the WDs. Improved CALSTIS. Possibly improved TDS. ISR.
Accuracy Goals	Reduce the slopes from +/- 4% to a few tenths of a percent. Improve the precision of the TDS from peak to peak of 3-4% to ~1-1.5%. Improve the accuracy of the absolute flux calibration to ~1% in the NUV and FUV.
Scheduling & Special Requirements	Visits for the 3 COS standards should be obtained close together in time and (ideally) within the same quarter as the corresponding routine COS monitoring observations of those stars.
Changes from Cycle 27	N/A

Faint WD Standard Stars for Cross Calibration

The 3 primary STIS WD standards provide the basis for flux calibration for all the HST instruments, but fainter secondary standards are needed for WFC3, ACS, COS – and for JWST and Roman; accurate cross calibration is crucial.

Having high quality spectra at 3 epochs for 3 standard stars enables recognition of any variations in any individual object.

Some STIS spectra of the 3 COS WDs were obtained in cyc27 (PID 16028), but additional spectra are needed to provide higher S/N and/or three independent epochs:

WD0308-565: G140L, G230L, G430L, G750L (two 2-orbit visits)
WD1057+719: G750L (two 1-orbit visits)
WD1657+343: G750L (two 1-orbit visits)

LB 769 (aka SDSS J151421.27+004752.8), with V~16.5, is a new standard that will provide a crucial tie-in to the even fainter WD all-sky network for JWST and Roman (PIDs 12967, 13711, 15113; see Narayan et al. 2016, 2019; Calamida et al. 2019). An initial STIS epoch was obtained in cyc25 (PID 15487), but revealed a 2% difference between STIS and WFC3 in the visible. Two additional STIS epochs are needed to establish this new fainter standard. (two 2-orbit visits)

STIS MAMA Exploration of FUV Flux Variations at Off-Nominal Detector Positions
PI: Joleen Carlberg

Purpose	Assess the accuracy of current pipeline FUV LFLTFILE reference files. Develop and test new LFLTFILE files as needed.
Description	- Currently, only G140L has a true LFLTFILE (G140, E140M, E140H use a dummy single-valued flat). To test for uncorrected low-spatial order variations in the FUV flat field, standard stars GRW+70D5824 and G191B2B will be observed with G140L and G140M at multiple locations on the MAMA detector, sampling the range of locations that GO observations are centered due to the monthly MAMA offsetting. If uncorrected variations >1% are detected, the lamp spectra taken for generating PFLTFILE files will be used to create a new LFLTFILE following the discussion in ISR 1996-15. These data will also be used to test the improvements made by these new flat files.
Fraction GO/GTO Programs Supported	48% of STIS (100% of spectroscopic FUV exposures)
Resources Required: Observations	9 external orbits
Resources Required: Analysis	6 FTE weeks: 3 FTE weeks for analysis, 2 weeks for ISR, 1 for reference file delivery
Products	Updated STIS FUV LFLTFILE as needed. ISR.
Accuracy Goals	Minimum signal to noise of 100 per resolution element across > 75% of spectral range.
Scheduling & Special Requirements	MAMA monthly offsets cancelled. SAA-free orbits.
Changes from Cycle 27	N/A

PROGRAM GOALS

- Obtain a modern data set for mapping sensitivity variations
- Quantify any discrepancy in flux measurements made of standard stars at different locations across the detector, specifically near D1 and within monthly offsets
- Test 3 modes: G140L (S/N~100), G140M/1272 (S/N ~100), G140M/1567 (S/N ~ 56)
- Test across the detector and densely in most-used regions:
  - 1 orbit to test 5 to 7 locations around nominal
  - 1 orbit to test 5 to 7 locations around D1
  - 1 orbit to test 5 to 7 locations evenly spaced across remaining detector
- TOTAL ORBITS: 3 per mode times 3 modes = 9 orbits

Assessing Flux Reproducibility in STIS Spatial Scans
PI: D. E. Welty

Purpose	Investigate the reproducibility of fluxes (from orbit to orbit and visit to visit) – and thus the ability to characterize exoplanetary transits – in STIS spatially scanned spectra of the known exoplanet host star 55 Cnc. Compare with the performance achievable with other observational approaches (e.g., WFC3/UVIS, STIS stare mode).
Description	Fifty identical short (12 arcsec) scans of 55 Cnc will be obtained with G750L over five consecutive orbits, with the transit of the well-known super-Earth 55 Cnc e placed during orbits 3 and 4. Custom cosmic ray correction, defringing, and de-trending procedures will be used to characterize systematic instrument-related flux variations and to recover and characterize the transit curve – both in total (white light) flux and in narrower spectral intervals. The observed inter-orbit and intra-orbit flux variations will be compared with those from similar spectra obtained in special program 15383 and with those from archival STIS staring-mode observations of 55 Cnc.
Fraction GO/GTO Programs Supported	About a dozen GO programs concerning exoplanets were approved for cycle 28. The results will also be relevant for other studies requiring high S/N spectra (e.g., of standard stars or for detection of weak absorption features) and/or highly reproducible time series fluxes – for which spatial scanning can be a useful option.
Resources Required: Observations	5 external orbits (1 visit)
Resources Required: Analysis	2 FTE weeks analysis (using software developed for program 15383); 2 FTE weeks documentation
Products	ISR describing stability of fluxes (with comparisons to program 15383), assessment of how well the transit can be characterized
Accuracy Goals	30 ppm in de-trended white-light fluxes (as obtained for similar scans in program 15383)
Scheduling & Special Requirements	Middle of 55 Cnc e transit in occultation between orbits 3 and 4 (get beginning of transit in orbit 3 and end of transit in orbit 4)
Changes from Cycle 27	N/A

Results from 15383 and Proposed Plan

The systematic difference between the orbits – ~400 ppm for the 15383 data – is smaller than those typically seen for pointed/saturated exposures (which can be as high as several thousand ppm).

Within each orbit, the differences among the scans are also smaller than those often seen for pointed/saturated exposures.

The trends in the relative fluxes differ somewhat with wavelength.

For the total ("white-light") flux, the scatter about the de-trending fits is of order 30 ppm – comparable to the best values achieved in any previous studies of exoplanet host stars with HST. Somewhat larger values are found for narrower wavelength regions.

De-fringing the images both effectively removes the fringes and appears to reduce the scatter about the de-trending fits by of order 15-20% at the longer wavelengths.

STIS staring mode spectra on similar targets have exhibited visit-to-visit non-repeatability at >100 ppm and differences in the intra-orbit patterns – which have limited their utility for characterizing exoplanet atmospheres.

We need to understand the inter-orbit and visit-to-visit variations (and differences in de-trending)

We propose to obtain a longer (5 orbit) set of scanned spectra – also covering a transit – to further investigate the inter-orbit and (potential) inter-visit variations and to see how well the transit can be characterized with STIS scanned spectra.

Placing the 1.6-hr transit in orbits 3 and 4 will allow both coverage of the ingress and egress and clear delineation of the intra orbit trends in out-of-transit orbits 2 and 5. (Fluxes in orbit 1 often do not follow the same pattern as the following ones, but may be usable via de-trending if relevant dependencies can be identified.)

Cycle 27 Usage Statistics

STIS Cycle 27 Usage Statistics for each Configuration/Mode

Configuration/Mode	Percentage of STIS Prime Exposure Time		Percentage of STIS SNAP Exposure Time	
	C26	C27	C26	C27
CCD	**12.7%**	**20.9%**	**--**	**--**
CCD/Imaging	10.1%	3.0%	--	--
CCD/Spectroscopy	2.6%	17.9%	--	--
MAMA/FUV	**61.7%**	**39.6%**	**--**	**--**
FUV/Imaging	14.3%	0.0%	--	--
FUV/Spectroscopy	47.4%	39.6%	--	--
MAMA/NUV	**25.6%**	**39.5%**	**--**	**--**
NUV/Imaging	0.0%	0.0%	--	--
NUV/Spectroscopy	25.6%	39.5%	--	--

STIS Cycle 27 Usage Statistics for each Grating/Mirror Combination

Configuration/Mode	Grating/Mirror	Percentage of STIS Prime Science Exposure Time		Percentage of STIS SNAP Science Exposure Time	
		C26	C27	C26	C27
STIS/CCD	G230LB	0.4%	2.7%	--	--
(20.9%)	G230MB	0.0%	2.6%	--	--
	G430L	0.6%	6.6%	--	--
	G430M	0.6%	3.2%	--	--
	G750L	0.4%	1.5%	--	--
	G750M	0.7%	1.4%	--	--
	MIRROR/CORON	10.1%	3.0%	--	--
STIS/MAMA-FUV	E140H	1.0%	7.0%	--	--
(39.6%)	E140M	40.4%	8.5%	--	--
	G140L	6.0%	17.0%	--	--
	G140M	--	7.2%	--	--
	MIRROR	14.3%	--	--	--
STIS/MAMA-NUV	E230H	19.3%	1.6%	--	--
(39.5%)	E230M	3.3%	10.4%	--	--
	G230L	3.0%	27.5%	--	--
	G230M	--	--	--	--
	MIRROR	--	--	--	--

Cycle 27 Instrument Usage Statistics Based on Approved Programs

- STIS orbits comprised ~12.3% of all GO prime orbits in Cycle 27

Instruments	Prime Orbits Usage	SNAP Orbit Usage
ACS	19.9%	47.7%
COS	27.7%	--
STIS	12.3%	--
WFC3	40.1%	52.3%
FGS	0.0%	--

(from 11/12/2019 presentation on Cycle 27 TAC and Mid-cycle results by C.Leitherer)