Instrument Science Report COS 2021-04

Summary of COS Cycle 27 Calibration Plan

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ABSTRACT

We summarize the calibration activities for the Cosmic Origins Spectrograph (COS) on the Hubble Space Telescope during Cycle 27, which ran from November 2019 through October 2020. We give an overview of the COS calibration plan and COS usage statistics, and we briefly describe major changes with respect to the previous cycle. High-level executive summaries for each calibration program comprising Cycle 27 are also given here. Results of the analysis attached to each program are published in separate ISRs.

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1. Introduction

The Cosmic Origins Spectrograph (COS) was installed on the Hubble Space Telescope in May 2009. Cycle 27 was the eleventh cycle of on-orbit operations for COS, running from November 2019 through October 2020. Each cycle, the COS team monitors the performance of the COS instrument through routine calibration programs that are designed to monitor instrument throughput, dispersion solutions, dark rates, and overall performance of the FUV and NUV channels. Updates to the COS reference files are made, as necessary, based on the results of the data analyses performed by the COS Team. The Cycle 27 calibration plan is composed of 10 regular calibration programs, 2 contingency programs and 2 special calibration programs (i.e., Cycle 27 only) that were designed for the exploration of lifetime position 5 on the COS FUV detector. There are also several carryover programs, consisting of five engineering programs and four science verification programs, that remain unchanged each year with regards to their structure and orbit request numbers.

In this document we give an overview of the overall COS usage with respect to other HST instruments and we summarize the distribution of COS FUV and NUV usage per mode and cenwave (Section 2). In Section 3, we provide an overview of the 10 individual programs that comprise the regular COS Cycle 27 calibration plan and we summarize the changes applied to some of the regular Cycle 27 calibration programs compared to Cycle 26 (James et al. 2020). Section 4 contains the high-level executive summaries for all calibration programs comprising the Cycle 27 COS plan.

2. Overview of COS Usage in Cycle 27

2.1 Prime Orbit Usage Statistics by HST Instrument

The HST orbit usage in terms of science time allocation is published yearly shortly after the phase II submission deadline and can be found at https://www.stsci.edu/contents/newsletters/2019-volume-36-issue-02/hst-cycle-27-proposal-selection. Table 1 summarizes the distribution of GO prime orbits and SNAP orbits among the HST instruments currently active. Based on phase II submission statistics for Cycle 27, the COS usage comprises ~27.7% (~748 orbits) of all approved GO prime orbits, making COS the second most used instrument this cycle. Compared to Cycle 26, the COS GO prime usage has increased by 4.7%. There were no orbits allocated for COS SNAP proposals in Cycle 27.

Table 1: Cycle 27 allocation of science time amongst HST Instruments

Instruments	GO Prime Orbits Usage	GO SNAP Orbit Usage
ACS	19.9%	47.7%
COS	27.7%	0%
STIS	12.3%	0%
WFC3	40.1%	52.3%
FGS	0.0%	0%

2.2 COS Prime Orbit Usage Statistics by Mode

COS usage statistics by mode can be found in `/grp/hst/cos/user_support/Cycle27/stats.` Based on Cycle 27 phase II submissions, 98.8% of the total COS prime observing time consists of *science* exposures and the remaining 1.2% of the total COS prime observing time consists of target acquisition exposures. Of the 98.8% of COS *science* observing time, 90.1% is used for COS FUV spectroscopic exposures, 9.8% is used for NUV spectroscopic exposures, and 0.1% is used for NUV imaging exposures. Of the 1.2% target acquisition exposures, 97.2% are NUV imaging acquisition exposures and 2.8% are FUV spectroscopic acquisition exposures. The breakdown among observing modes is summarized in Table 2. This distribution differs from that of Cycle 26, which had 100% FUV spectroscopic science exposures. The ~10% rise in NUV spectroscopic usage is primarily due to a UV spectroscopic treasury proposal that was awarded 133 orbits, which is nearly a fifth of all COS orbits awarded in Cycle 27.

Table 2: COS usage statistics by mode for Cycle 27 (breakdown by percentage of time usage)

Configuration/Mode	**Prime Usage** (science exposures)	**Prime Usage** (acquisition exposures)	**SNAP Usage** (science exposures)
FUV / Spectroscopy	90.1%	2.8%	0%
NUV / Imaging	0.1%	97.2%	0%
NUV / Spectroscopy	9.8%	0%	0%

2.3 COS Prime Orbit Usage Statistics by Mode and Grating

Table 3 summarizes the COS science observing time usage by mode and grating for the FUV and NUV channels. Both channels show moderately-different statistics when comparing Prime usage between this cycle and the last, which we expand on in the next paragraphs. In regards to SNAP usage, in Cycle 26, there were no SNAP orbits allocated due to the delta-cycle restrictions put in place. In Cycle 27, SNAP programs were available, but none were allocated to COS.

The FUV channel represents ~90% of COS Prime usage in Cycle 27, with G130M being the most commonly used grating with 50% of Prime usage, followed by G160M at 26.7% and G140L at 13.4%. Compared to Cycle 26, the G140L grating usage decreased by ~21%, the G130M usage increased by ~25%, and the G160M usage decreased by ~15%. This makes G130M the most used grating in Cycle 27, even though it was the least used in Cycle 26. The rise of G140L and G160M in Cycle 26 was mainly due to the introduction of the two new cenwaves G140L/800 and G160M/1533. Their demand seems to have leveled off, although the two new cenwaves are still the most used modes in their grating this cycle. Lastly, we note that the usage of the blue modes (G130M/1055+1096) decreased slightly from Cycle 26, from 1.6% of the total FUV usage to 0%.

For the NUV channel Prime usage, we see an upswing as compared to Cycle 26. In that cycle, none of the NUV gratings were used. Now we see that ~10% of Prime usage is in the NUV, with G230L at 0.7%, G185M at 6.6%, G225M at 2.5% and G285M at 0%. Similarly, there was no usage of NUV/Imaging during Cycle 26, but we see a small (<1%) usage in Cycle 27.

Table 3: COS science usage statistics by mode and grating in Cycles 27 and 26

Configuration	Grating	COS Prime Science Exposure Time		COS SNAP Science Exposure Time	
		C27 (%)	C26 (%)	C27 (%)	C26 (%)†
COS/FUV	G140L	13.4	34.3	0.0	---
(C27: 90.1% prime)	G130M	50.0	24.4	0.0	---
	G160M	26.7	41.3	0.0	---
COS/NUV	G230L	0.7	0.0	0.0	---
(C27: 9.9% prime)	G185M	6.6	0.0	0.0	---
	G225M	2.5	0.0	0.0	---
	G285M	0.0	0.0	0.0	---
	MIRROR A/B	<0.1	0.0	0.0	---

†Due to the delta-cycle restrictions on Cycle 26 programs, there were no SNAP orbits allocated.

2.4 COS FUV Mode and FP-POS Distribution

Starting in Cycle 21, the COS FUV user community was asked to use all four FP-POS positions unless otherwise justified scientifically when observing with the COS FUV channel, in order to mitigate the effect of gain sag on the FUV detector and preserve a high quality of data in the archive. This requirement is actively monitored and enforced by the COS Team Contact Scientists (CS) during the Phase II technical review period. Figure 1 displays the FP-POS usage by grating and cenwave for Cycle 27. Note that this distribution is based on Phase II submissions only and does not yet reflect any changes that might have been requested by the COS CS Team. Due to the COS2025 policies enforced in Cycle 25, G130M/1291 usage is now restricted to FP-POS 3+4 only. Overall, with the exception of G130M/1291, the FP-POS usage is distributed quite evenly for a given grating/cenwave combination for all gratings, indicating that the COS FUV community has successfully integrated our requirement into their science observing plans this cycle. The G130M/1291 mode remains the most used of all COS/G130M cenwaves, regardless of the newly enforced restrictions. Noteworthy is the fact that the usage of the FP-POS=ALL feature was clearly the preferred dithering technique for almost every mode, with the exception of G130M/1291+1309 and G160M/1533+1600.

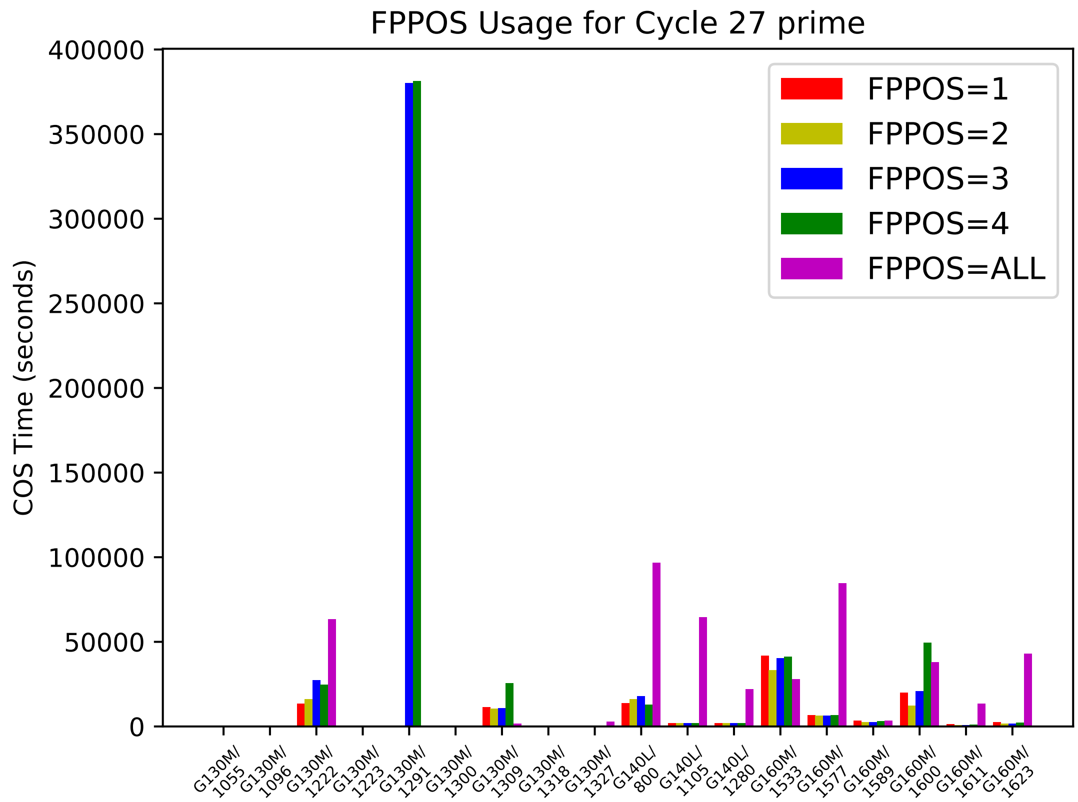

Figure 1: Cycle 27 distribution of FP-POS among COS modes. Due to COS2025 policies enforced in Cycle 25, G130M/1291 usage is now restricted to FP-POS 3+4 only. Other than this, relatively even FP-POS dithering was performed among COS FUV configurations following the COS Team requirements.

3. Overview of the Regular Cycle 27 Calibration Programs

The Cycle 27 calibration plan is composed of 10 regular calibration programs, 2 contingency programs designed to recover science operations in the FUV and NUV in case of an anomalous detector shutdown, and 2 special calibration programs (Cycle 27 only) designed for the exploratory phase of lifetime position 5 (LP5). No adjustments to the programs were made as a result of the Cycle 27 TAC results. Table 4 provides a list of the calibration programs with their respective program IDs (Column 1) and title (Column 2). Column 3 reports the number of orbits executed [allocated] for each program, divided into external and internal orbits. Column 4 indicates the frequency of the visits for each monitoring program. Column 5 provides the reference to the ISR summarizing the data analysis and results obtained for each program and Column 6 lists the accuracy goal required for each program.

In Cycle 27, the COS team began the exploratory phase in preparation for the instrument's fifth lifetime position. Two special calibration programs were approved for this effort. We list these programs below. Detailed descriptions will be provided in the program-related ISRs.

- Testing for Systematics When Moving the COS Aperture Block (PID 16052)
- Initial Test of COS/FUV Spectrum Placement at Lifetime Position 5 (PID 16106)

Table 4. High-level summary of regular Cycle 27 calibration programs

PID	Title	Orbits used Executed [Allocated]		Frequency	Products	Accuracy Achieved
		External	Internal			
15771	**Cycle 27 COS FUV Detector Dark Monitor**	--	260 [260]	5/week	ISR XXX	0.1% in global dark rate uncertainty
15772	**Cycle 27 COS FUV Detector Gain Maps**	--	10 [8 + 2 C]	4/6 months + Once per HV change	ISR XXX	~0.1 Pulse Height bins
15773	**Cycle 27 COS FUV Spectroscopic Sensitivity Monitor**	28 [28+26C]	--	3/2 months + 2/year	ISR 2021-02	<2% relative TDS calibration for standard modes and <10% for blue modes
15774	**Cycle 27 COS FUV Wavelength Scale Monitor**	3 [3]	--	1/year	ISR XXX	G140L 150 km/s, 9 pix G130M 7.5 km/s, 3 pix (G130M/1096 15 km/s, 6 pix) G160M 7.5 km/s, 3 pix
15775	**Cycle 27 COS FUV Target Acquisition Monitor**	2 [2]	--	1/year	ISR XXX	target centering to within ±0.3”
15776	**Cycle 27 COS NUV Detector Dark Monitor**	--	52 [52]	1/week	ISR XXX	0.2% in global dark rate uncertainty
15777	**Cycle 27 COS NUV MAMA Fold Distribution**	--	1 [1]	1/year	ISR XXX	<5% on peak location of fold distribution
15778	**Cycle 27 COS NUV Spectroscopic Sensitivity Monitor**	4 [4]	--	6 months	ISR XXX	<2% relative TDS calibration
15779	**Cycle 27 COS NUV Wavelength Scale Monitor**	1 [1]	--	1/year	ISR XXX	G230L 175 km/s, 2.0-3.7 pix G185M 15 km/s, 1.7-2.4 pix G225M 15 km/s, 2.3-3.2 pix
15780	**Cycle 27 COS NUV Target Acquisition Monitor**	3 [3]	--	1/year	ISR XXX	0.5 NUV pixel

C Contingency orbits

Reference files are updated “as needed” to maintain instrument calibration within the required specifications. For several programs, regularly updated reference files are produced. For many others, results are either posted on the web, or simply documented in their respective ISR. Currently available reference files can be found at the following web address: https://hst-crds.stsci.edu. Other products resulting from the calibration program include COS Instrument Science Reports (ISRs), COS Technical Instrument Reports (TIRs), and updates to the COS Instrument (IHB) and Data (DHB) Handbooks. Links to these documents can be found at: http://www.stsci.edu/hst/instrumentation/cos/documentation. Note that TIRs are only available on the internal STScI web site. In order to retrieve TIRs from outside STScI, a request needs to made through the HST Help Desk Portal at https://hsthelp.stsci.edu.

4. Executive Summary for each Individual Program

We provide a high-level summary of the purpose, requirements and orbit allocation for each of the 10 regular calibration programs comprising the regular Cycle 27 calibration plan. Results of the monitoring analysis are reported separately in program-specific ISRs (see Table 4 for reference number).

Program ID 15771:
Cycle 27 COS/FUV Detector Dark Monitor
PI: D. Dashtamirova

Purpose	Perform routine monitoring of FUV XDL detector dark rate. The main purpose is to look for evidence of a change in the dark rate, both to track on-orbit time dependence and to check for a developing detector problem.
Description	Monitor the FUV detector dark rate by taking TIME-TAG science exposures with no light on the detector. Five times every week a 22-min exposure is taken with the FUV detector with the shutter closed. The length of the exposures is chosen to make them fit in Earth occultations. All orbits < 1800s.
Fraction GO/GTO Programs Supported	90% of COS total science exposure time in Cycle 27.
Resources Required: Observations	260 internal orbits. All orbits < 1800s.
Products	Provided ETC and IHB dark rate estimates, along with weekly monitoring for changes and a summary in the end of cycle ISR. Updated monitor and COS webpages. As allowed by resources and necessitated by data quality: improved dark subtraction method and updated bad-pixel tables.
Accuracy Goals	Obtain enough counts to track 1% level changes on timescales of ~1-3 months.
Scheduling & Special Requirements	5x / week at nominal HV during Earth occultation.
Changes from Cycle 26	No changes.

Program ID 15772:
Cycle 27 COS FUV Detector Gain Maps
PI: D. Sahnow

Purpose	Obtain gain maps of the FUV detector before and after changes to the nominal high voltage levels, and periodically during the cycle. These data will be used to check that the expected modal gain is achieved for HV changes, and to track the modal gain as a function of time.
Description	Use the deuterium lamp to illuminate the appropriate LP2/LP3/LP4 regions of the COS FUV detector at the following times: • LP4 Standard Modes: Snapshot to monitor the change in gain every 6 months (2 orbits) • LP4 G130M/1222: Snapshot to monitor the change in gain every 6 months (2 orbits) • LP3 Standard Modes: Snapshot to monitor the change in gain every 6 months (2 orbits) • LP2 Blue Modes: Snapshot to monitor the change in gain every 6 months (2 orbits)
Fraction of GO/GTO Programs Supported	90% of COS total science exposure time in Cycle 27.
Resources Required: Observations	8 internal orbits + 2 contingency orbits per HV change
Products	Gain map files. These were used to update the GSAGTAB, update the BPIXTAB for the LP2/5 region, and also improved the models of gain vs. HV and gain vs. exposure. 2 contingency orbits were activated for the HV raise that occurred on Oct. 5, 2020.
Accuracy Goals	0.1 pulse height bin
Scheduling & Special Requirements	Every 6 months and immediately before and immediately after any HV change.
Changes from Cycle 26	No changes.

Program ID 15773:
COS FUV Spectroscopy Sensitivity Monitor
PI: Ravi Sankrit

Purpose	Monitor the sensitivity of each FUV grating to detect any change due to contamination or other causes. The FUV gratings are the most heavily used modes on COS and have also experienced several changes in the time-dependent spectroscopic sensitivity since launch. These trends are grating, segment, and wavelength dependent.
Description	To track the TDS as a function of wavelength we obtain exposures of two standard stars (WD0308-565 and GD71) every 2 months with all FUV gratings. The monitoring sequence consists of two visits, for a total of 5 orbits. The 2-orbit visit (GD71) covers the G130M/1096/FUVB, G160M/1533/FUVA, G160M/1577/FUVA, and G160M/1623/FUVA modes. The 3-orbit visit (WD0308-565) covers G130M/1222, G130M/1291, G130M/1327/FUVA, G130M/1055/FUVA, G160M/1533/FUVB, G160M/1577/FUVB, G160M/1623/FUVB, G140L/800, G140L/1105, and G140L/1280 modes. The standard shortest and longest wavelength settings for each grating, the G130M "blue-modes" and 1291, and the two new cenwaves are covered in the program.
Fraction of GO/GTO Programs Supported	90% of COS total science exposure time in Cycle 27.
Resources Required: Observations	28 external orbits + (26 contingency external orbits needed if major changes in trends are seen during cycle)
Products	Time-Dependent Sensitivity reference files for the blue modes and standard modes were delivered on July 29, 2020 and October 6, 2020, respectively. ETC throughputs were updated, as were the COS monitoring webpages. A summary ISR for the standard modes is published as COS ISR 2021-02, and one for the blue modes will also be produced.
Accuracy Goals	- SNR of 15 per resel at wavelength of least sensitivity for the standard modes, SNR of 25 per resel at wavelength of most sensitivity for the blue modes. For the blue modes, this will ensure S/N > 15 for l> 1030 Å for 1096/FUVB, l>1130 Å for 1055/FUVA and 1222/FUVB. SNR of 5 per resel in the short wavelength region for G140L/800, which yields SNR of 32 per 20 Å bin (used in the TDS analysis). - TDS calibration better than 5% absolute and 2% relative calibration for both the blue modes and standard modes.

Scheduling & Special Requirements	• Monitoring sequence occurred every 2 months starting in December 2019 • The FUVA turn-off of the GD71 visit was hidden in the GS-ACQ • GD71 was not visible from late April to early August 2020, resulting in a reduced monitoring sequence for the month of June (1 visit)
Changes from Cycle 26	• Added new cenwaves, G160M/1533 and G140L/800 to monitor for all visits (rather than visit 03 onwards, as in Cycle 26 delta request), resulting in two additional orbits.

Program ID 15774: Cycle 27 COS FUV Wavelength Scale Monitor

PI: W. Fischer

Purpose	This program monitors the offset (zero-point) between the wavelength scale set by the internal wavecal versus that defined by absorption lines in external target AV 75 obtained through the PSA.
Description	This program monitors the zero-point offset between the internal and external wavelength scales. To verify and monitor this, the program takes spectra of AV 75 with the G130M/1096-1222-1291-1327, G160M/1577-1623, and G140L/1105-1280 cenwaves. Spectra are compared to convolved STIS spectra and those obtained with previous iterations of the program.
Fraction GO/GTO Programs Supported	90% of COS total science exposure time in Cycle 27.
Resources Required: Observations	3 external orbits
Products	Summary ISR. An updated wavelength dispersion reference file was not necessary during Cycle 27.
Accuracy Goals	G140L 150 km/s, 7.5-12.5 pixels G130M 15 km/s, 5.7-7.5 pixels G160M 15 km/s, 5.8-7.2 pixels
Scheduling & Special Requirements	Executed once per cycle. ORIENT was set to avoid bright field targets, so visibility is restricted. March (15 days): preferred window to maintain pattern of ~12 months between visits.
Changes from Cycle 26	No changes.

Program ID 15775:
Cycle 27 COS FUV Target Acquisition Monitor
PI: D. Sahnow

Purpose	Monitor COS FUV ACQ/PEAKD and PEAKXD Performance at LP4 (with NUM_POS > 1).
Description	At LP4 the cross-dispersion (XD) target acquisition (TA) uses the new NUM_POS > 1 algorithm for ACQ/PEAKXD. This is the same algorithm used for ACQ/PEAKD, but oriented in the XD direction. This method moves the telescope through a linear pattern of XD steps that completely or partially vignette the target light with the PSA. This allows the targets position relative to the edges of the aperture to be defined, and allows the target to be centered. This pattern moves the target up and down on the FUV detector (in Y). Because there are detector effects such as gain sag and Y-walk, and areas of the detector with non-uniform response (like previous LPs), it is desirable to monitor the FUV PEAKXD centering over multiple cycles to watch for unexpected changes. Each FUV grating is tested, and the G130M test includes an along-dispersion ACQ/PEAKD to verify the NUV-to-FUV LP4 SIAF entries in both AD and XD.
Fraction GO/GTO Programs Supported	3% of Cycle 27 target acquisitions used the FUV channel.
Resources Required: Observations	2 external orbits.
Products	Summary ISR.
Accuracy Goals	FUV Spectroscopic XD TAs are required to center the target to within ±0.3” (~ ±3 rows), with the goal of routine centering to ± 0.1” (~ 1 row). Targets not centered to within 0.3” are subject to vignetting and loss of spectral resolution. Along-dispersion centering requirements are cenwave-specific, but the strictest requirement is ±0.106” for the G130M grating.
Scheduling & Special Requirements	Executed annually, and within 30 days from Visit PB of NUV program (same target).
Changes from Cycle 26	No changes

Program ID 15776:
Cycle 27 COS/NUV Detector Dark Monitor
PI: C. Magness

Purpose	Perform routine monitoring of the MAMA detector dark current. The main purpose is to look for evidence of a change in the dark rate, both to track on-orbit time dependence and to check for a developing detector problem.
Description	Monitor the NUV detector dark rate by taking TIME-TAG science exposures without illuminating the detector. Twice every other week a 22-min exposure is taken with the NUV (MAMA) detector with the shutter closed. The length of the exposures is chosen to make them fit in Earth occultation. All orbits < 1800s.
Fraction GO/GTO Programs Supported	10% of COS total science exposure time in Cycle 27.
Resources Required: Observations	52 internal orbits. All orbits < 1800s.
Products	Provided ETC and IHB dark rate estimates, along with weekly monitoring for changes and a summary in the end of cycle ISR. As allowed by resources and necessitated by data quality: updated bad-pixel tables. Updated monitor webpage.
Accuracy Goals	30%
Scheduling & Special Requirements	Executed twice every other week, in Earth occultation
Changes from Cycle 26	No changes.

Program ID 15777:
Cycle 27 COS NUV MAMA Fold Distribution
PI: T. 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	~97% of Cycle 27 target acquisitions use the NUV.
Resources Required: Observations	1 internal orbit
Products	The results were sent to the COS Team and Ball Aerospace (Steve Franka).
Accuracy Goals	5% accuracy on the peak position of the fold distribution
Scheduling & Special Requirements	Executed annually.
Changes from Cycle 26	No changes.

Program ID 15778:
Cycle 27 NUV Spectroscopic Sensitivity Monitor
PI: W. Fischer

Purpose	Monitor sensitivity of all NUV gratings to detect any change due to contamination or other causes. Track time dependence of the sensitivity with wavelength. The NUV gratings on COS have degraded at an overall steady rate since the start of on-orbit operations, with the bare-Aluminum gratings (G225M and G285M) degrading at a faster rate (~-3 and -11%/yr) than the MgF_2 coated gratings (G185M and G230L, ~0%/yr).
Description	This program obtains exposures with NUV gratings using external targets WD1057+719 (G230L) and G191B2B (G185M, G225M). The following modes are monitored: G230L/2635-2950, G185M/1786-1921-2010, and G225M/2186-2306-2410. Due to its rapidly declining sensitivity, G285M was removed from the monitoring after Cycle 26. These cenwaves constitute the reddest, middle, and bluest central wavelengths containing only first-order light, with the exception of G230L. Observations of G185M/2010 and G225M/2306-2410 were added to the monitoring program in Cycle 24 to provide data at both the extreme cenwaves and the middle cenwaves for the M gratings to characterize the effect of wavelength dependence on the TDS.
Fraction GO/GTO Programs Supported	10% of COS total science exposure time in Cycle 27.
Resources Required: Observations	4 external orbits - 2 visits of 2 orbits each.
Products	A new NUV Time-Dependent Sensitivity Reference File was delivered on July 30, 2020. This new file substantially improved the flux calibration to be within 5% of the models at all wavelengths. A summary ISR will also be produced.
Accuracy Goals	Characterize evolution of TDS within 2%.
Scheduling & Special Requirements	Observed at 6 month intervals.
Changes from Cycle 26	No changes. [The G285M grating was also removed in Cycle 26, when only 4 orbits were awarded and executed.]

Program ID 15779:
Cycle 27 COS NUV Wavelength Scale Monitor
PI: W. Fischer

Purpose	This program monitors the offset (zero-point) between the wavelength scale set by the internal wavecal versus that defined by absorption lines in external target HD 6655 obtained through the PSA.
Description	This program monitors the zero-point offset between the internal and external wavelength scales. To verify and monitor this, the program takes spectra of HD 6655 with the G185M/2010, G225M/2217, and G230L/2635-2950-3000 cenwaves. Spectra are compared to convolved STIS spectra and those obtained with previous iterations of the program.
Fraction GO/GTO Programs Supported	10% of COS total science exposure time in Cycle 27.
Resources Required: Observations	1 external orbit. Schedulability is set to 60% to fit all observations within the orbit.
Products	Summary ISR. An updated wavelength dispersion reference file was not necessary during Cycle 27.
Accuracy Goals	G230L 175 km/s, 2.0-3.7 pixels G185M 15 km/s, 1.7-2.4 pixels G225M 15 km/s, 2.3-3.2 pixels
Scheduling & Special Requirements	Executes once per cycle. Star is in a crowded field, and all the stars have significant proper motion. Careful selection of guide stars is required. Aug/Sept (31 days): preferred window to maintain pattern of ~12 months between visits, acquire good GS pair.
Changes from Cycle 26	No changes.

Program ID 15780:
Cycle 27 COS NUV Target Acquisition Monitor
PI: D. Sahnow

Purpose	Monitor COS NUV Target Acquisition (TA) Parameters and Performance. Measure/monitor the WCA-to-PSA/BOA offsets used for imaging target acquisition, and WCA-to-PSA offsets for NUV spectroscopic TAs.
Description	There are 4 NUV ACQ/IMAGE mechanism combinations: 2 science apertures (SAs: PSA & BOA) x 2 mirror modes (MIRRORA & MIRRORB). During SMOV, the WCA-to-PSA+MIRRORA offset was determined by an aperture scan; the other WCA-to-SA offsets were bootstrapped from this offset. We verify the ACQ/IMAGE co-alignment in a similar manner. Three targets of different brightnesses are required to bootstrap across the pairings. All NUV spectroscopic WCA-PSA offsets, all WCA-SA imaging offsets, and co-alignment for all ACQ/IMAGE modes are monitored by this program. PSA spectra of the targets are obtained with all NUV gratings to track any changes in the spectroscopic WCA-to-PSA offsets. All FUV TA monitoring is now done in a separate program.
Fraction GO/GTO Programs Supported	97% of Cycle 27 target acquisitions used the NUV.
Resources Required: Observations	3 external one-orbit visits. Each visit uses a target of different brightness to match the ACQ/IMAGE modes being verified.
Products	Updated NUV imaging WCA-to-SA offsets, NUV Spectroscopic WCA-to-PSA offsets, and summary ISR.
Accuracy Goals	Imaging WCA-to-SA offsets need to be known to better than 0.5 NUV pixels in both dispersion and cross-dispersion (XD). Spectroscopic WCA-to-PSA offsets to 0.5 XD pixel.
Scheduling & Special Requirements	Executed annually (in the Fall). All three visits executed within 30 days of each other.
Changes from Cycle 26	No changes.

Change History for COS ISR 2021-04

Version 1: 22 Mar 2021 – Original Document

References

James, B. et al., 2020, COS ISR 2020-01 "Summary of COS Cycle 26 Calibration Plan"