Instrument Science Report COS 2020-01(v2)

Summary of COS Cycle 26 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 26 which ran from November 2018 through October 2019. We give an overview of the COS calibration plan, 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 26 are also given here. Results of the analysis attached to each program are published in separate ISRs.

Contents

1. Introduction

The Cosmic Origins Spectrograph (COS) was installed on the Hubble Space Telescope in May 2009. Cycle 26 was the tenth cycle of on-orbit operations for COS, running from November 2018 through October 2019. 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 26 calibration plan is composed of 10 regular calibration programs, 2 contingency programs and 3 special calibration programs (i.e., Cycle 26 only) that were designed to accommodate COS Calibration programs when operating HST in one-gyro mode. 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.

Cycle 26 was classed as a `delta Cycle' for the HST user community. The delta-cycle was designed to accommodate the increased workload expected during 2019 due to the (potential) launch of JWST and the JWST TAC in 2018. As part of the delta-cycle, Cycle 26 HST proposals were restricted to be either Medium' or Large. Other types of proposals (Small, Treasury, Archive, and SNAP) were not considered. As a result of it being a delta-cycle, the Cycle 26 calibration program orbit request differed slightly from previous cycles in that *all* calibration programs were restricted to be `unchanging' during the spring orbit request. In order to accommodate potential changes to the COS calibration cycle resulting from Cycle 26 usage statistics, a `delta-Cycle 26 orbit request' was made in winter 2018 (after the Cycle 26 phase II deadline).

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 12 individual programs that comprise the COS Cycle 26 calibration plan and we summarize the changes applied to some of the regular Cycle 26 calibration programs compared to Cycle 25 (James et al. 2019). Section 4 contains the high-level executive summaries for the all calibration programs comprising the Cycle 26 COS plan.

2. Overview of COS Usage in Cycle 26

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 in `/grp/hst/cos/user_support/Cycle26/stats`. 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 26, the COS usage comprises ~23% (~511 orbits) of all approved GO prime orbits, making COS the second most used instrument this cycle. Compared to Cycle 25, the COS GO prime usage has decreased slightly by 1.8%. Due to the delta-cycle restrictions on Cycle 26 programs, there were no SNAP orbits allocated in Cycle 26. COS SNAP orbits represented ~16% of the total SNAP orbit allocation in Cycle 25.

Table 1: Cycle 26 allocation of science time amongst HST Instruments

Instruments	GO Prime Orbits Usage	GO SNAP Orbit Usage
ACS	11.2%	N/A
COS	23.0%	N/A
STIS	14.9%	N/A
WFC3	50.9%	N/A
FGS	0.0%	N/A

2.2 COS Prime Orbit Usage Statistics by Mode

Based on Cycle 26 phase II submissions, 96.5% of the total COS prime observing time consists of *science* exposures and the remaining 3.5 % of the total COS prime observing time consists of target acquisition exposures. Of the 96.5% of COS *science* observing time, 100% is used for COS FUV spectroscopic exposures and 0% is used for NUV spectroscopic exposures. Of the 3.5% target acquisition exposures, >99% are NUV imaging acquisition exposures and <1% are FUV spectroscopic acquisition exposures. The breakdown among observing modes is summarized in Table 2. This distribution is different to that obtained in Cycle 25 in that during the previous cycle, ~10% of the COS science observing time utilized NUV spectroscopy. The 100% science usage for FUV spectroscopy reflects the continued high demand for FUV spectroscopic capabilities from the HST user community.

Table 2: COS usage statistics by mode for Cycle 26 (breakdown by percentage of time usage)

Configuration/Mode	**Prime Usage** (science exposures)	**SNAP Usage** (science exposures)
FUV / Spectroscopy	100%	N/A
NUV / Imaging	0.0%	N/A
NUV / Spectroscopy	0.0%	N/A

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. For the FUV channel, the prime orbit usage statistics in Cycle 26 are slightly different to those in Cycle 25 for the G130M and G160M gratings. In Cycle 25, G130M was the most used of the FUV gratings with 50.4% of prime science time, however in Cycle 26 G160M is now the most used FUV grating at 41.3%. The increase in G160M usage is related to the new G160M/1533 cenwave commissioned for Cycle 26. The blue mode cenwaves represent ~% of total G130M observing time with a breakdown among the blue mode cenwaves as follows: G130M/1055 (0%), and G130M/1096 (7%). The Cycle 26 blue mode usage has increased somewhat (~7%) compared to the Cycle 25 usage (<1%), primarily due to the new COS2025 rules. The G140L is now the second most used of the FUV gratings, with a significant increase in its prime usage (by ~23.2%) compared to Cycle 25. This is primarily due to the new G140L/800 cenwave commissioned for Cycle 26. The new G140L/800 cenwave is the most used cenwave for this grating and represents ~78% of the total G140L science observing time (15% and 7% for the G140L/1105 and G140L/1280 configurations, respectfully).

For the NUV channel, the prime orbit usage statistics in Cycle 26 are somewhat different from those in Cycle 25. None of the NUV gratings are used in Cycle 26, compared to ~10% of prime GO usage in Cycle 25. Similarly, there is no usage of NUV/Imaging during Cycle 26, compared to the small (<1%) usage seen in previous cycles.

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

Table 3: COS science usage statistics by mode and grating in Cycles 26 and 25

Configuration	**Grating**	**Percentage of COS Prime Science Exposure Time**		**Percentage of COS SNAP Science Exposure Time**	
		C26 (%)	**C25 (%)**	**C26 (%)**	**C25 (%)**
COS/FUV	**G140L**	**34.3**	**11.1**	**---**	**0.8%**
(C26: 100% prime)	**G130M**	**24.4**	**50.4**	**---**	**84.1**
	G160M	**41.3**	**28.2**	**---**	**--**
COS/NUV	**G230L**	**---**	**7.8**	**---**	**15.1**
(C26: 0% prime)	**G185M**	**---**	**0.5**	**---**	**--**
	G225M	**---**	**2.0**	**---**	**--**
	G285M	**---**	**---**	**---**	**--**
	MIRROR A/B	**---**	**<0.1**	**---**	**--**

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 26. 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 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 G140L/1280 and for most of the G160M cenwaves in Cycle 25.

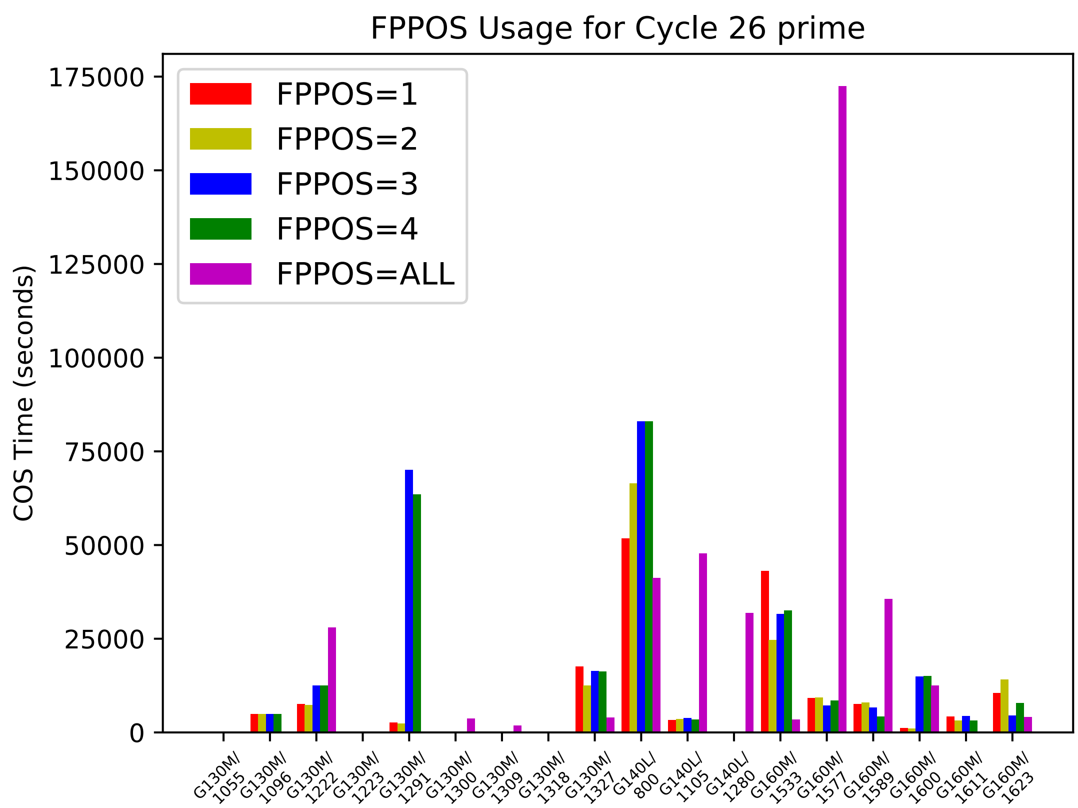

Figure 1: Cycle 26 distribution of FP-POS among COS modes. Due to COS2025 policies inforced in Cycle 25, G130M/1291 usage is now restricted to FP-POS 3+4 only. Other than this, relatively even FP-POS dithering was performed among COS FUV configurations following the COS Team requirements.

3. Overview of the Regular Cycle 26 Calibration Programs

The Cycle 26 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 3 special calibration programs (Cycle 26 only) designed to accommodate COS Calibration programs when operating HST in one-gyro mode. 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.

Due to delta-cycle restrictions, *all* Cycle 26 programs were continuations of the monitoring programs from the previous cycle during the spring orbit request. No adjustments were made to the monitoring programs as a result of the Cycle 26 TAC results. In winter 2018, as part of the delta-cycle calibration request, small modifications were made to the FUV TDS monitoring program to accommodate the new G160M/1533 and G140L/800 cenwaves from Visit 03 onwards by adding six additional orbits. This resulted in an increase of 6 external orbits compared to Cycle 25.

In Cycle 26, 3 special calibration programs were approved to accommodate COS Calibration programs when operating HST in one-gyro mode. We list these programs below. Detailed descriptions will be provided in the program-related ISRs.

- COS FUV Spectroscopic Sensitivity Monitor: One-Gyro Connection Program (PID 15680)
- COS Side 2 Initial NUV Checkout for Back-up Target in One-Gyro Mode (PID 15681)
- COS Side 2 Initial FUV Checkout for Back-up Target in One-Gyro Mode (PID 15682)

Table 4. High-level summary of regular Cycle 26 calibration programs

PID	Title	Orbits used Executed [Allocated]		Frequency	Products	Accuracy Achieved
		External	Internal			
15533	**Cycle 26 COS FUV Detector Dark Monitor**	--	260 [260]	5/week	ISR 2020-08	0.1% in global dark rate uncertainty
15534	**Cycle 26 COS FUV Detector Gain Maps**	--	8 + 2[C] [8]	4/6 months + Once per HV change	ISR 2020-07	~0.1 Pulse Height bins
15535	**Cycle 26 COS FUV Spectroscopic Sensitivity Monitor**	26+16[C] [26]	--	3/2 months + 2/year	ISR 2020-06	<2% relative TDS calibration for standard modes and <10% for blue modes
15536	**Cycle 26 COS FUV Wavelength Scale Monitor**	3 [3]	--	1/year	ISR 2020-03	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
15537	**Cycle 26 COS FUV Target Acquisition Monitor**	2[2]	--	1/year	ISR XXX	target centering to within ±0.3”

15538	**Cycle 26 COS NUV Detector Dark Monitor**	--	52 [52]	1/week	ISR XXX	0.2% in global dark rate uncertainty
15539	**Cycle 26 COS NUV MAMA Fold Distribution**	--	1 [1]	1/year	ISR 2019-14	<5% on peak location of fold distribution
15540	**Cycle 26 COS NUV Spectroscopic Sensitivity Monitor**	4[4]	--	6 months	ISR 2020-02	<2% relative TDS calibration
15541	**Cycle 26 COS NUV Wavelength Scale Monitor**	1[1]	--	1/year	ISR 2020-04	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
15542	**Cycle 26 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 a document 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 26 calibration plan. Results of the monitoring analysis are reported separately in program-specific ISRs (see Table 4 for reference number).

Program ID 15533: Cycle 26 COS/FUV Detector Dark Monitor
PI: Camelia Magness

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	97% of COS total exposure time in Cycle 26
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 25	No changes.

Program ID 15534: Cycle 26 COS FUV Detector Gain Maps
PI: David 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 GO/GTO Programs Supported	97% of COS exposure time in Cycle 26
Resources Required: Observations	8 internal orbits
Products	Gain map files. These were used to update the GSAGTAB (and possibly the BPIXTAB), and also improved the models of gain vs. HV and gain vs. exposure.
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 25	No changes.

Program ID 15535: 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 *(as seen in slide 11).*
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 (prior to the introduction of the new cenwaves), the G130M "blue-modes" and 1291, and the two new cenwaves are covered in the program.
Fraction GO/GTO Programs Supported	97% of COS exposure time in Cycle 26
Resources Required: Observations	26 external orbits + (16 contingency external orbits needed if major changes in trends are seen during cycle)
Products	Time-Dependent Sensitivity reference file for G160M/1533 and G140L/800 was created and delivered January 2020. ETC throughputs were updated, as were the COS monitoring webpages. The blue-modes and standard-modes TDSTABs should be delivered early June 2020. A summary ISR 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 2% for standard modes and 10% for blue modes

Scheduling & Special Requirements	• Monitoring sequence occurred every 2 months starting in December 2018 • The new cenwaves were introduced in February 2019 (second set of visits) • The FUVA turn-off of the GD71 visit was hidden in the GS-ACQ • GD71 was not visible from late April to early August 2019, resulting in a reduced monitoring sequence for the month of June (1 visit)
Changes from Cycle 25	• Added new cenwaves, G160M/1533 and G140L/800 to monitor, resulting in one extra orbit per LP4 visit starting with visit 03 (adds 6 orbits to the total) • Turn off FUVA during the G160M observations of WD0308-565 to save on detector usage.

Program ID 15536: Cycle 26 COS FUV Wavelength Scale Monitor

PI: Will 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	97% of COS total exposure time in Cycle 26
Resources Required: Observations	3 external orbits
Products	Summary ISR. An updated wavelength dispersion reference file was not necessary during Cycle 26.

Accuracy Goals	G140L 150 km/s, 9 pixels G130M 7.5 km/s, 3 pixels (G130M/1096 15 km/s, 6 pix) G160M 7.5 km/s, 3 pixels
Scheduling & Special Requirements	Executed once per cycle. ORIENT was set to avoid bright field targets, so visibility is restricted. While the March 19 visit was the preferred window to maintain pattern of ~12 months between visits, the visit failed and was rescheduled for June 25.
Changes from Cycle 25	No changes.

Program ID 15537: Cycle 26 COS FUV Target Acquisition Monitor

PI: David 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	10% of Cycle 26 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 25	No changes

Program ID 15538: Cycle 26 COS/NUV Detector Dark Monitor

PI: Camelia 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	3% of COS total exposure time in Cycle 26

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 25	No changes.

Program ID 15539: Cycle 26 COS NUV 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	~90% of Cycle 26 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 25	No changes.

Program ID 15540: Cycle 26 NUV Spectroscopic Sensitivity Monitor

PI: Will 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 all 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. These cenwaves constitute the reddest, middle, and bluest central wavelengths containing only first order light with the exception of G230L.

Fraction GO/GTO Programs Supported	3% of COS total exposure time in Cycle 26
Resources Required: Observations	4 external orbits - 2 visits of 2 orbits each.
Products	Time-Dependent Sensitivity Reference File and a summary ISR.
Accuracy Goals	Characterize evolution of TDS within 2%.
Scheduling & Special Requirements	Observed at 6 month intervals.
Changes from Cycle 25	G285M was removed from the program due to lack of usage.

Program ID 15541: Cycle 26 COS NUV Wavelength Scale Monitor

PI: Will 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	3% of COS total exposure time in Cycle 26

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 26.
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	Executed once per cycle. Star is in a crowded field, and all the stars have significant proper motion. Careful selection of guide stars was required. Aug/Sept was the preferred window to maintain pattern of ~12 months between visits, acquire good GS pair
Changes from Cycle 25	No changes.

Program ID 15542: Cycle 26 COS NUV Target Acquisition Monitor

PI: David 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	90% of Cycle 26 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 25	No changes.

Change History for COS ISR 2020-01

Version 1: 29 May 2020 – Original Document
Version 2: 13 July 2020 – Correction that Cycle 26 was the tenth cycle of on-orbit operations for COS

References

James, B. et al., 2019, COS ISR 2019-20 "Summary of COS Cycle 25 Calibration Plan"