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Cycle 26 COS NUV Wavelength Scale Monitor

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ABSTRACT

We report on the monitoring of the zero points of the COS NUV dispersion solutions during Cycle 26 in program 15541. Select cenwaves were monitored for all NUV gratings except for G285M, which is no longer monitored due to its rapidly declining sensitivity and lack of general observer use since Cycle 21. Comparisons to COS monitoring data obtained in previous cycles indicate internal stability within the allowed ranges of zero points. Comparisons to STIS data indicate small but persistent COS offsets of 1 – 3 pixels toward shorter wavelengths. The cause of this is not yet well understood.

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1. Introduction

Analysis of data from thermal vacuum testing (TV03) indicates that grating-dependent offsets may develop in the dispersion solutions for the Cosmic Origins Spectrograph Near-Ultraviolet (COS NUV) channel (Oliveira et al. 2010). To determine whether any such changes are taking place, the COS NUV wavelength scale monitor obtains data annually for select cenwaves with gratings G185M, G225M, and G230L. The spectra are cross-correlated with COS spectra from the Cycle 18 iteration of this program, since that was the first to monitor all current settings, and with STIS data to measure any changes in the zero points of the dispersion solutions.

2. Observations

The Cycle 26 NUV wavelength monitoring program (PID 15541, PI W. Fischer) consisted of one visit of one orbit to check the zero points of the dispersion solutions of the following gratings: G185M (cenwave 2010), G225M (cenwave 2217), and G230L (cenwaves 2635, 2950, and 3000). These cenwaves were chosen for continuity with previous iterations of the program. The target was HD 6655, a star of spectral type F8V. Visit 01, on 2019 September 20 – 21, executed successfully.

The acquisition sequence consisted of ACQ/SEARCH followed by ACQ/PEAKXD and ACQ/PEAKD using cenwave G230L/2635. The exposure times were 860 s for the G185M observation, 440 s for the G225M observation, and 80 s for each of the three G230L observations. All data were taken at FP-POS 3.

The Cycle 26 program was identical to its Cycle 25 predecessor (PID 15388, PI W. Fischer), which was summarized by Fischer (2019b). Starting in Cycle 25 there were two changes that we plan to retain going forward. First, the monitoring of grating G285M was discontinued due to its rapidly declining sensitivity (Fischer 2019a) and lack of general observer use since Cycle 21. Second, the program was reduced from two visits per year to one, due to the relatively low use of the NUV channel compared to the FUV and the stability of the zero points, as shown in the following section.

3. Analysis and Results

To check the internal stability of the zero points, the Cycle 26 COS spectra were cross-correlated with COS spectra of the same star obtained with the same settings in the Cycle 18 instance of the NUV wavelength monitoring program (PID 12422, PI C. Oliveira). Each stripe contains multiple stellar absorption lines and covers a small range of wavelengths, so we cross-correlated the entire stripe instead of select windows. The shifts for Cycle 26 and for all previous cycles are plotted in Figure 1. Although G285M is no longer included in the program, we show previous results for G285M/2676, the G285M cenwave with the most complete past monitoring, for reference. Each visit is compared to the Cycle 18 visit that matches it most closely in

Table 1. Pixel Shifts from Cycle 26 Cross-Correlation

		COS-COS Shifts (px)[1]			COS-STIS[2]		Allowed
Grating	Cenwave	Stripe A	Stripe B	Stripe C	Stripe	Shift (px)	Range (px)
G185M	2010	−1.8	+0.6	+0.1	···	···	1.2 – 1.7
G225M	2217	+0.1	+0.3	+0.4	C	+0.7	1.6 – 2.3
G230L	2635	··· [3]	0.0	··· [4]	B	+1.2	1.4 – 2.6
G230L	2950	0.0	0.0	··· [4]	B	+2.8	1.4 – 2.6
G230L	3000	+0.2	+0.4	··· [4]	B	+1.4	1.4 – 2.6

[1]Shifts are those required to bring the Cycle 26 Visit 01 data (2019 September 20 – 21) into agreement with the Cycle 18 Visit 03 data (2011 September 1).

[2]Shifts are those required to bring the Cycle 26 Visit 01 data into agreement with the STIS data. Cenwave 2010 has no stripes that overlap with the STIS data; the other cenwaves each have one such stripe, as shown.

[3]The detector has extremely low sensitivity at these wavelengths.

[4]This stripe suffers from contamination by second-order light.

time of year. For example, Cycle 26 Visit 01 data (2019 September 20 – 21) were compared to Cycle 18 Visit 03 data (2011 September 1). All data were reprocessed with the most recent DISPTAB (Plesha et al. 2017).

To check the external stability of the zero points, the Cycle 26 COS spectra were also cross-correlated in the same way with Cycle 17 STIS E230M data (PID 12085, PI C. Oliveira). The shifts for Cycle 26 and all previous cycles are plotted in Figure 2.

The shifts from the Cycle 26 cross-correlations appear in Table 1 alongside the allowed ranges. These are the estimated contributions to the wavelength uncertainties from internal sources, which include the accuracy of the wavelength scale, the dispersion relation, aperture offsets, distortions, and drifts. They are estimated to be 1.2 – 1.7 pixels for G185M, 1.6 – 2.3 pixels for G225M, and 1.4 – 2.6 pixels for G230L (Oliveira et al. 2010).

The COS-COS shifts are within the specifications except for stripe A of G185M/2010, which exceeds its allowed range by 0.1 pixels. Figure 1 shows that this agreement has generally persisted since the early days of COS. The COS-STIS shifts are within the specifications except for stripe B of G230L/2950, which exceeds its allowed range by 0.2 pixels. Figure 2 shows that shifts of a few pixels, always in the positive direction but not wildly outside of the allowed ranges, have routinely been observed in the comparison of COS NUV wavelength solutions to those of STIS in this program. The cause of this is not yet well understood.

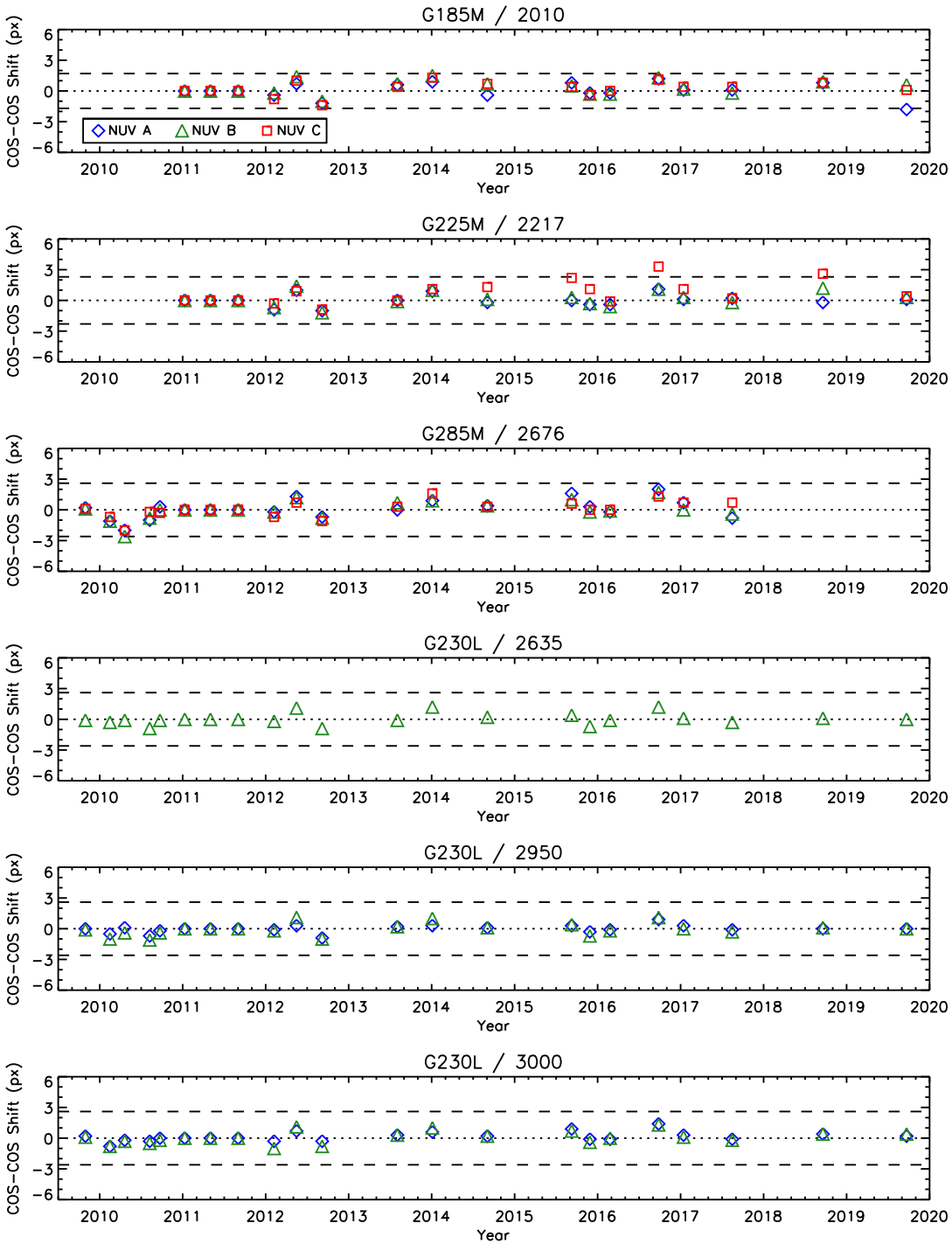

Figure 1. Plots of COS-COS shifts for the six cenwaves monitored since Cycle 18 (2011) or before, demonstrating internal stability. Shifts are those required to bring each spectrum into agreement with Cycle 18 data obtained at a similar time of year. Symbol types distinguish among stripes. Dashed lines indicate the maximum of each grating's allowed range.

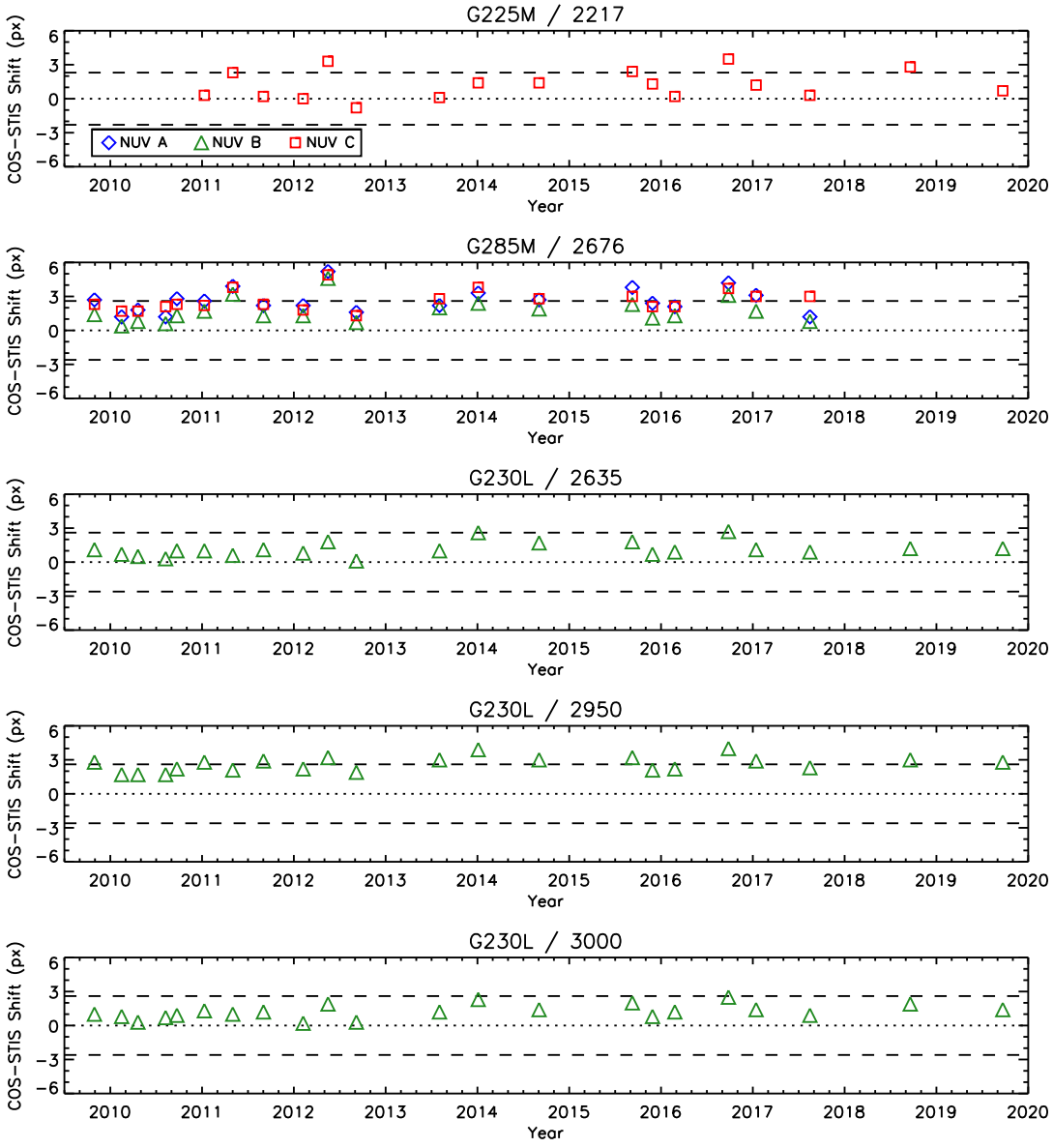

Figure 2. Plots of COS-STIS shifts for the five cenwaves monitored routinely since Cycle 18 (2011) or before in which at least one stripe overlaps with the STIS E230M data, demonstrating external stability. Shifts are those required to bring each COS spectrum into agreement with the STIS spectrum. Symbol types distinguish among stripes. Dashed lines indicate the maximum of each grating's allowed range.

4. Continuation Plan

This program continues in Cycle 27 as PID 15779 and is identical to the Cycle 26 version.

Change History for COS ISR 2020-04

Version 1: 16 June 2020 – Original Document

References

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