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Cycle 25 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 25 in program 15388. Select cenwaves were monitored for all NUV gratings except for G285M, which was removed from the program 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. Comparisons to STIS data indicate small but persistent COS offsets of 1–3 pixels toward shorter wavelengths; investigation into this is forthcoming.

Contents

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 and with STIS data to measure any changes in the zero points of the dispersion solutions.

2. Observations

The Cycle 25 NUV wavelength monitoring program (PID 15388, PI W. Fischer) consisted of one visit of one orbit to check the zero points of the dispersion solutions for the following gratings: G185M (cenwave 2010), G225M (cenwave 2217), and G230L (cenwaves 2635, 2950, and 3000). The target was HD 6655, a star of spectral type F8V. Visit 01, on 2018 August 28, suffered from a guide star acquisition failure, and no data were obtained. The visit was rescheduled as Visit 51, and data were successfully obtained on 2018 September 18.

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 25 program had some differences from its Cycle 24 predecessor (PID 14859, PI P. Sonnentrucker), which was summarized by Fischer (2018). The program was changed from two visits per year to one, retaining the usual August/September visit, and G285M was removed from the monitoring due to its rapidly declining sensitivity (Taylor 2018) and lack of general observer use since Cycle 21.

3. Analysis and Results

To check the internal stability of the zero points, the Cycle 25 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. The shifts for Cycle 25 and for all previous cycles are plotted in Figure 1. Each visit is compared to the Cycle 18 visit that matches it most closely in time of year. For example, Cycle 25 Visit 51 data (2018 September 18) 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 25 COS spectra were also cross-correlated with Cycle 17 STIS E230M data (PID 12085, PI C. Oliveira). The shifts for Cycle 25 and all previous cycles are plotted in Figure 2.

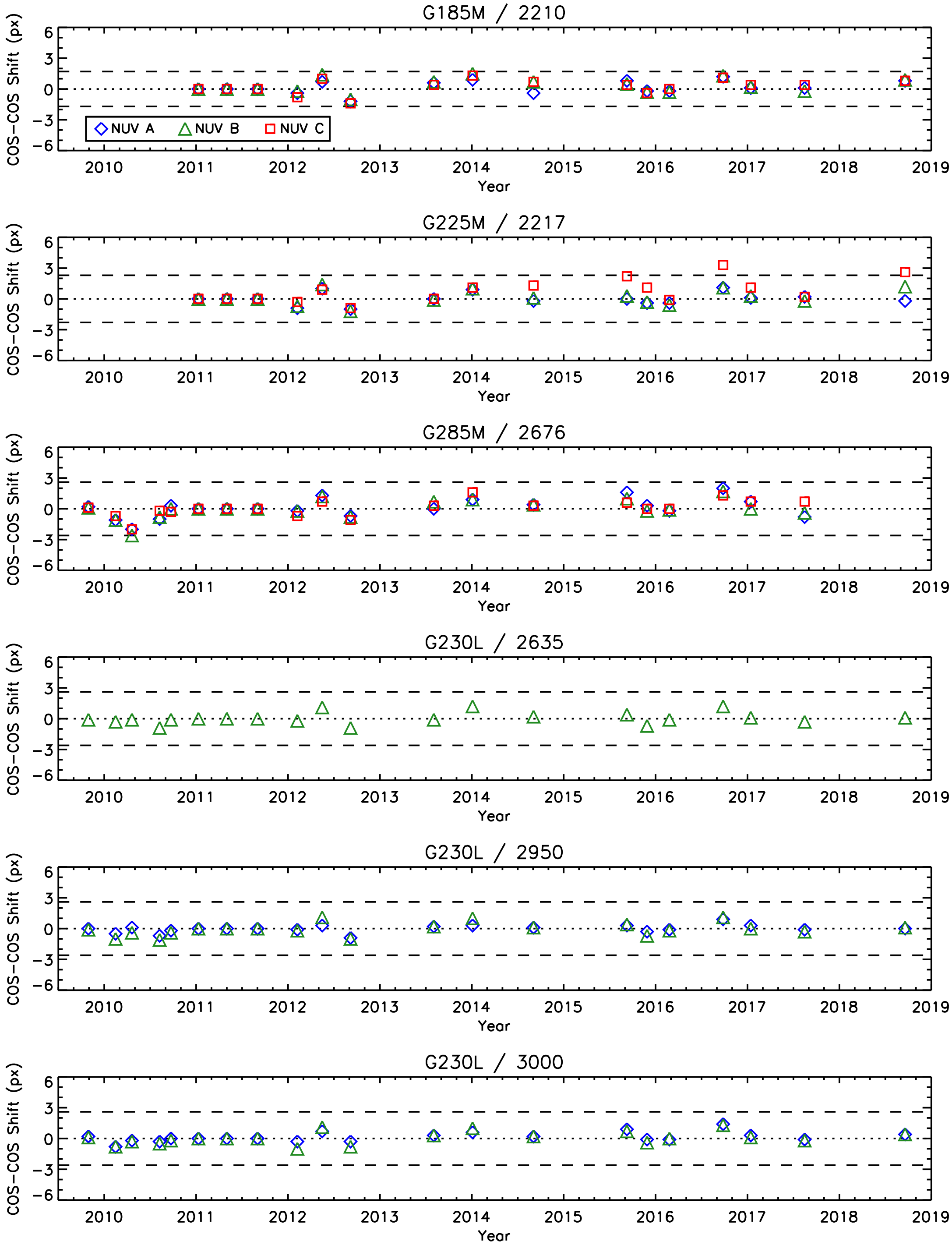

Figure 1. Plots of COS-COS shifts for the six cenwaves monitored since Cycle 18 (2011) or before. Shifts are those required to bring each spectrum into agreement with Cycle 18 data obtained at a similar time of year. Symbol types distinguish among stripes. Dashed lines indicate the maximum range of each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

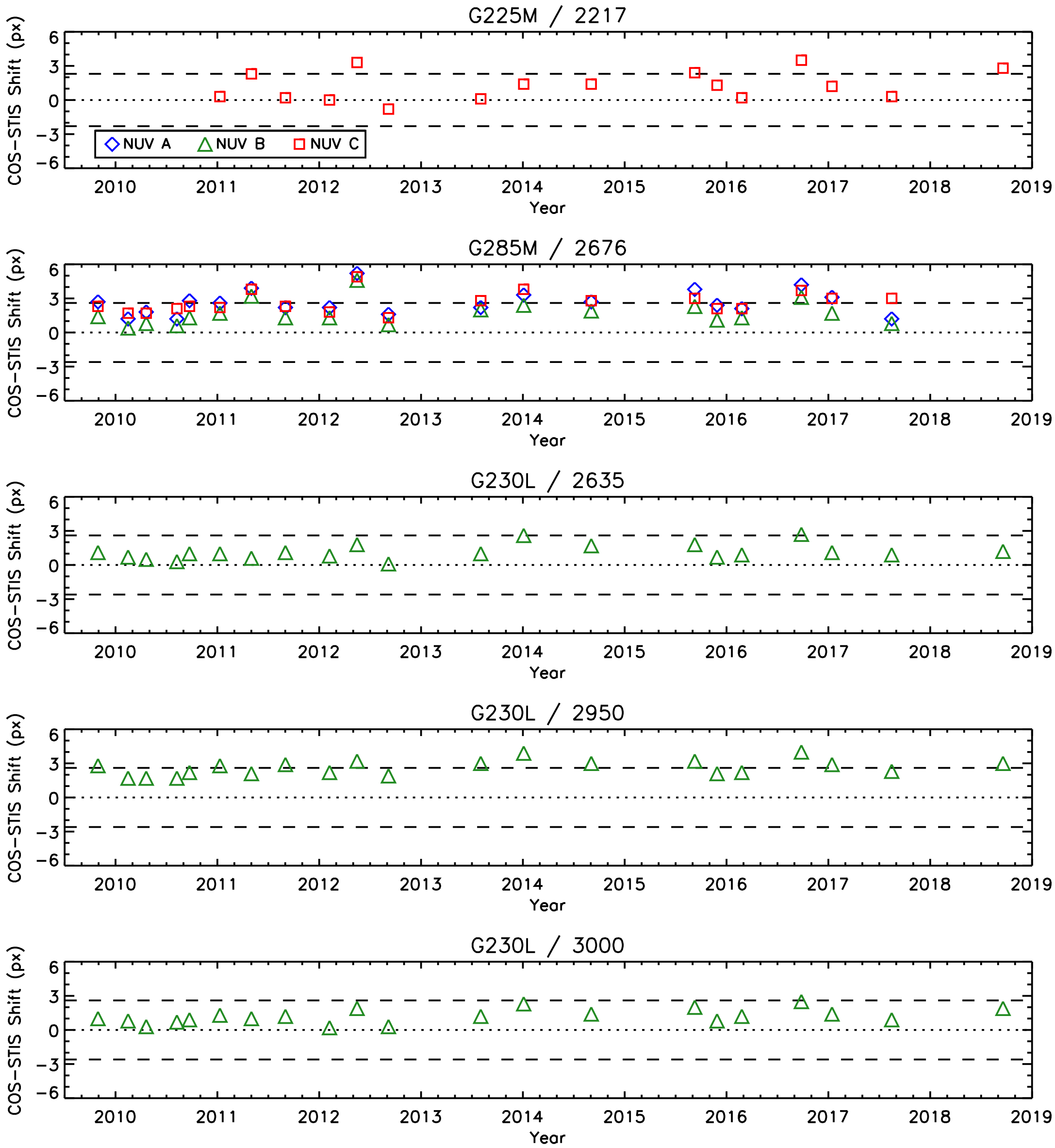

Figure 2. Plots of COS-STIS shifts for the five cenwaves monitored routinely since Cycle 18 (2011) or before in which at least one stripe overlaps with the STIS E230M data. Shifts are those required to bring each COS spectrum into agreement with the STIS spectrum. Symbol types distinguish among stripes.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

Table 1. Pixel Shifts from Cross-Correlation

		COS-COS Shifts (px)[1]			COS-STIS[2]		Allowed
Grating	Cenwave	Stripe A	Stripe B	Stripe C	Stripe	Shift (px)	Offset (px)
G185M	2010	+0.8	+0.9	+0.8	...	...	1.2 – 1.7
G225M	2217	−0.2	+1.2	+2.6	C	+2.8	1.6 – 2.3
G230L	2635	... [3]	+0.1	... [4]	B	+1.2	1.4 – 2.6
G230L	2950	0.0	+0.1	... [4]	B	+3.0	1.4 – 2.6
G230L	3000	+0.4	+0.4	... [4]	B	+1.9	1.4 – 2.6

[1]Shifts are those required to bring the Cycle 25 Visit 51 data (2018 September 18) into agreement with the Cycle 18 Visit 03 data (2011 September 1).

[2]Shifts are those required to bring the Cycle 25 Visit 51 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.

The shifts from the Cycle 25 cross-correlations appear in Table 1 alongside the internal error goal. This is the contribution to the wavelength uncertainty from internal sources, which include the accuracy of the wavelength scale, the dispersion relation, aperture offsets, distortions, and drifts. It is expected 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 C of G225M, which exceeds its allowed range by 0.3 pixels. Figure 1 shows that this agreement has generally persisted since the early days of COS. The COS-STIS shifts range from within specification to slightly out of specification. Figure 2 shows that shifts of a few pixels, always toward shorter wavelengths 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. Analysis to understand the reason for these offsets is forthcoming.

4. Continuation Plan

This program continues in Cycle 26 as PID 15541 and is identical to the Cycle 25 version.

Change History for COS ISR 2019-15

Version 1: 22 July 2019 – Original Document

References

Fischer, W. J. 2018, COS ISR 2018-06, "Cycle 24 COS FUV Internal/External Wavelength Scale Monitor"

Oliveira, C., Béland, S., Keyes, C., & Niemi, S. 2010, COS ISR 2010-05, "SMOV: COS NUV Wavelength Calibration"

Plesha, R., Sonnentrucker, P., Oliveira, C., & Roman-Duval, J. 2017, COS ISR 2017-02, "Updates to the COS/NUV Dispersion Solution Zero-points"

Taylor, J. M. 2018, COS ISR 2018-11, "Cycle 24 COS/NUV Spectroscopic Sensitivity Monitor"