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Cycle 24 COS NUV Internal/External Wavelength Scale Monitor

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ABSTRACT

We report on the monitoring of the COS NUV wavelength scale zero-points during Cycle 24 in program 14859. Select cenwaves were monitored for all NUV gratings. The target and cenwaves have remained the same since Cycle 18, with changes only to the target acquisition sequence and the number of visits per cycle. With minor exceptions, measured offsets are within the error goals. The declining sensitivity of the G285M grating is beginning to present a challenge for precise cross-correlation.

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1. Introduction

This program monitors the offset between the internal and external NUV wavelength scales. This offset is referred to as DELTA in the wavelength dispersion solution reference file and corrects for the shift between the wavelength calibration aperture (WCA) and primary science aperture (PSA) in the 2003 thermal vacuum testing (TV03) versus the shift between the WCA and PSA on orbit: $(WCA - PSA)_{TV03} - (WCA - PSA)_{orbit}$. Analysis of TV03 data indicates that this offset is cenwave and FP-POS independent for a particular grating, but it is grating dependent (Oliveira et al. 2010, ISR 2010-05). To monitor this effect, this calibration program takes data for all NUV gratings and select cenwaves that span the full NUV range.

2. Execution

This program comprises two identical visits of one orbit each to monitor the wavelength scales of the following gratings: G185M (cenwave 2010), G225M (cenwave 2217), G285M (cenwave 2676), and G230L (cenwaves 2635, 2950, and 3000). All data were taken at FP-POS 3. The target was HD 6655, a star of spectral type F8V. Visits 01 and 02 executed successfully on January 13 and August 15, 2017.

The program has monitored the same target and cenwaves in each cycle since Cycle 18 (PID 12422). Beginning with Visit 03 in Cycle 22 (PID 13975), the acquisition sequence was changed to ACQ/SEARCH followed by ACQ/PEAKXD and ACQ/PEAKD to avoid previous difficulties. Beginning in Cycle 23 (PID 14443), the program was changed from three visits per year to two.

3. Analysis and Results

A cross-correlation analysis was performed between archival STIS E230M data and the COS data. The results of the COS-STIS analysis appear in Table 1. Since not all settings have wavelength regions that overlap with the STIS E230M data, offsets were also measured relative to the corresponding visits of the Cycle 19 instance of this program (PID 12722). The results of the COS-COS analysis appear in Table 2. The specifications for NUV wavelength accuracies are 1.2 – 1.7 px for G185M, 1.6 – 2.3 px for G225M, 1.6 – 2.6 px for G285M, and 1.4 – 2.6 px for G230L (Oliveira et al. 2010, ISR 2010-05). We find that the measured offsets are within the error goals for nearly all observed cenwaves. The only exceptions are stripe C of G185M/2010 in the August COS-COS comparison, which exceeds the error goal by 0.1 px, and several stripes in the COS-STIS comparison of G285M/2676, which are affected by low signal.

Due to the declining sensitivity of the G285M grating (Taylor et al. 2017, ISR 2017-13), the signal to noise ratio obtained for the 2676 cenwave in 90 s was only ~ 5 . The peaks in the cross-correlation functions for this grating are therefore broad and weak relative to those of the other gratings.

Table 1. Pixel shifts from COS-STIS Cross-correlation¹

Visit	Stripe	G185M 2010	G225M 2217	G285M 2676	G230L 2635	G230L 2950	G230L 3000
Jan. 13	A	... ²	... ²	+3.1	... ^{2,3}	... ²	... ²
	B	... ²	... ²	+1.7	+0.9	+2.3	+1.2
	C	... ²	+1.2	+3.0	... ^{2,4}	... ^{2,4}	... ^{2,4}
Aug. 15	A	... ²	... ²	+1.2	... ^{2,3}	... ²	... ²
	B	... ²	... ²	+0.8	+0.9	+2.3	+0.9
	C	... ²	+0.3	+3.0	... ^{2,4}	... ^{2,4}	... ^{2,4}

¹Shifts are those required to bring the COS data into agreement with the STIS data.

²This stripe has no overlap with the STIS data.

³The detector has extremely low sensitivity at these wavelengths.

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

Table 2. Pixel shifts from COS-COS Cross-correlation (Cycle 24 vs. Cycle 19)^{1,2}

Visit	Stripe	G185M 2010	G225M 2217	G285M 2676	G230L 2635	G230L 2950	G230L 3000
Jan. 13	A	+0.7	+0.9	+0.8	... ³	+0.4	+0.6
	B	+0.7	+1.0	+0.2	+0.3	+0.3	+1.1
	C	+1.1	+1.1	+1.5	... ⁴	... ⁴	... ⁴
Aug. 15	A	+1.2	+1.2	+0.4	... ³	+0.7	+0.3
	B	+0.8	+1.0	+0.2	+0.7	+0.8	+0.4
	C	+1.8	+1.1	+1.5	... ⁴	... ⁴	... ⁴

¹Shifts are those required to bring the Cycle 24 data into agreement with the Cycle 19 data.

²Cycle 19 data were reprocessed with the most recent DISPTAB (Plesha et al. 2017, ISR 2017-02).

³The detector has extremely low sensitivity at these wavelengths.

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

4. Continuation Plan

This program continues in Cycle 25 under PID 15388 and has been reduced to just one visit, which was deemed sufficient due to the continued stability of the NUV wavelength solution. The G285M grating (cenwave 2676) has been removed from the monitoring because of its declining sensitivity and lack of use by guest observers since Cycle 21.

Change History for COS ISR 2018-05

Version 1: 15 February 2018 - Original Document

References

Oliveira, C., Beland, S., Keyes, C., & Niemi, S. 2010, Instrument Science Report COS 2010-05, “SMOV COS NUV Wavelength Calibration”

Plesha, R., Sonnentrucker, P., Oliveira, C., & Roman-Duval, J. 2017, Instrument Science Report COS 2017-02, “Updates to the COS/NUV Dispersion Solution Zero-points”

Taylor, J. 2017, Instrument Science Report COS 2017-13, “Cycle 23 COS/NUV Spectroscopic Sensitivity Monitor”