Instrument Science Report COS 2024-07(v1)

Cycle 29 COS NUV Wavelength Scale Monitor

David M. French[1]

[1]Space Telescope Science Institute, Baltimore, MD

18 June 2024

ABSTRACT

We report results of the Cycle 29 COS NUV dispersion solution zero point monitoring program 16538. Monitored modes include G230L cenwaves 2635, 2950, and 3000, G225M cenwave 2217, and G185M cenwave 2010. Spectra of target star HD 6655 were obtained approximately one year from the Cycle 28 iteration of this program. Results from cross-correlations with reference COS and STIS data show that all monitored modes are found to be within specifications.

Contents

Operated by the Association of Universities for Research in Astronomy, Inc., for the National Aeronautics and Space Administration.

1. Introduction

Thermal-vacuum data testing completed in 2003 (TV03) indicated that grating-dependent zero point offsets could develop over time in the Cosmic Origins Spectrograph Near-Ultraviolet (COS NUV) channel wavelength solutions (Oliveira et al. 2010). Starting in Cycle 18, the COS NUV wavelength scale monitor annually obtains data across a selection of G185M, G225M, and G230L cenwaves to check for any such offsets. These data are cross-correlated with STIS spectra of the same target, as well as COS data from the Cycle 18 version of this program, to measure any changes to the accuracy of the dispersion solution zero points.

2. Observations

The Cycle 29 NUV wavelength calibration monitoring program (PID 16538; PI W. Fischer) executed on September 15, 2022. The program observed HD 6655, a star of spectral type F8V, for a single 1-orbit visit.

The acquisition sequence consisted of an ACQ/SEARCH followed by an ACQ/PEAKXD and ACQ/PEAKD using cenwave G230L/2635, each with a 1 s exposure time. Exposures were then taken with the following modes: G230L (cenwaves 2635, 2950, and 3000; 80 s exposure each), G225M (cenwave 2217; 440 s exposure), and G185M (cenwave 2010; 860 s exposure). All exposures where taken at FP-POS 3.

This Cycle 29 program was identical to the Cycle 28 version (PID 16325; PI T. Fischer; Fischer 2022). All Cycle 25 and later iterations of this program were adjusted based on the COS2025 rules designed to prolong the COS detector lifetime (Oliveira et al. 2018). The major changes include the removal of monitoring for grating G285M due to sensitivity loss, and the reduction of visits from 2 to 1 for the NUV monitoring program. See Fischer (2019) for a discussion of these adjustments.

3. Analysis and Results

The external and internal stability of the COS NUV wavelength scale is measured yearly by cross-correlating new observations with reference spectra of the same target taken from Cycle 17 STIS E230M spectra (PID 12085; PI C. Oliveira), and from the Cycle 18 COS/NUV monitoring program (PID 12422; PI C. Oliveira). Each NUV stripe covers a relatively small wavelength range, so we cross-correlate each entire stripe with the appropriate reference stripe or spectrum.

The COS-COS shifts for Cycle 29 and previous cycles are plotted in Figure 1. We include previous results for cenwave G285M/2676, which is no longer monitored, for continuity. Each visit is compared to the Cycle 18 visit that matches closest in time of year. The COS-STIS shifts for Cycle 29 and previous cycles are plotted in Figure 2. All

Table 1. Pixel shifts from Cycle 29 COS-COS and COS-STIS Cross-Correlation [a]

		COS-COS Shifts (px)			COS-STIS Shifts [b]		
Grating	Cenwave	Stripe A	Stripe B	Stripe C	Stripe	Shift (px)	Tolerance
G185M	2010	– 0.8	0.0	+ 0.1	...		1.2 – 1.7
G225M	2217	+ 0.2	0.0	+ 0.6	C	+ 0.8	1.6 – 2.3
G230L	2635	...[c]	+ 0.2	...[d]	B	+ 1.6	1.4 – 2.6
G230L	2950	– 0.3	+ 0.2	...[d]	B	+ 1.8	1.4 – 2.6
G230L	3000	+ 0.1	– 0.2	...[d]	B	+ 1.1	1.4 – 2.6

[a] Cross correlation shifts are the pixel offset required to bring Cycle 29 results into agreement with Cycle 17 (STIS) and Cycle 18 (COS) data.

[b] Cenwave 2010 has no stripes overlapping with available STIS data. The other cenwaves each have a single overlapping stripe, as shown.

[c] Cenwave 2635 stripe A has extremely low sensitivity.

[d] G230L stripe C suffers from second order light contamination.

data were first reprocessed with the newest available NUV dispersion solutions (Plesha et al. 2017; French & Fischer 2023).

The shifts from both COS-COS and COS-STIS Cycle 29 analyses are given in Table 1. For each mode we provide the allowed tolerances, which are estimated from internal wavelength uncertainties in the accuracy of the wavelength scale, the dispersion solution, 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 all well within the allowed ranges, which has remained true since the earliest COS observations. The Cycle 29 COS-STIS shifts are also within specifications.

4. Program Continuation

This program continues into Cycle 30 as PID 16938 and is identical to this Cycle 29 version.

Change History for COS ISR 2024-07

Version 1: 10 June 2024 - Original Document

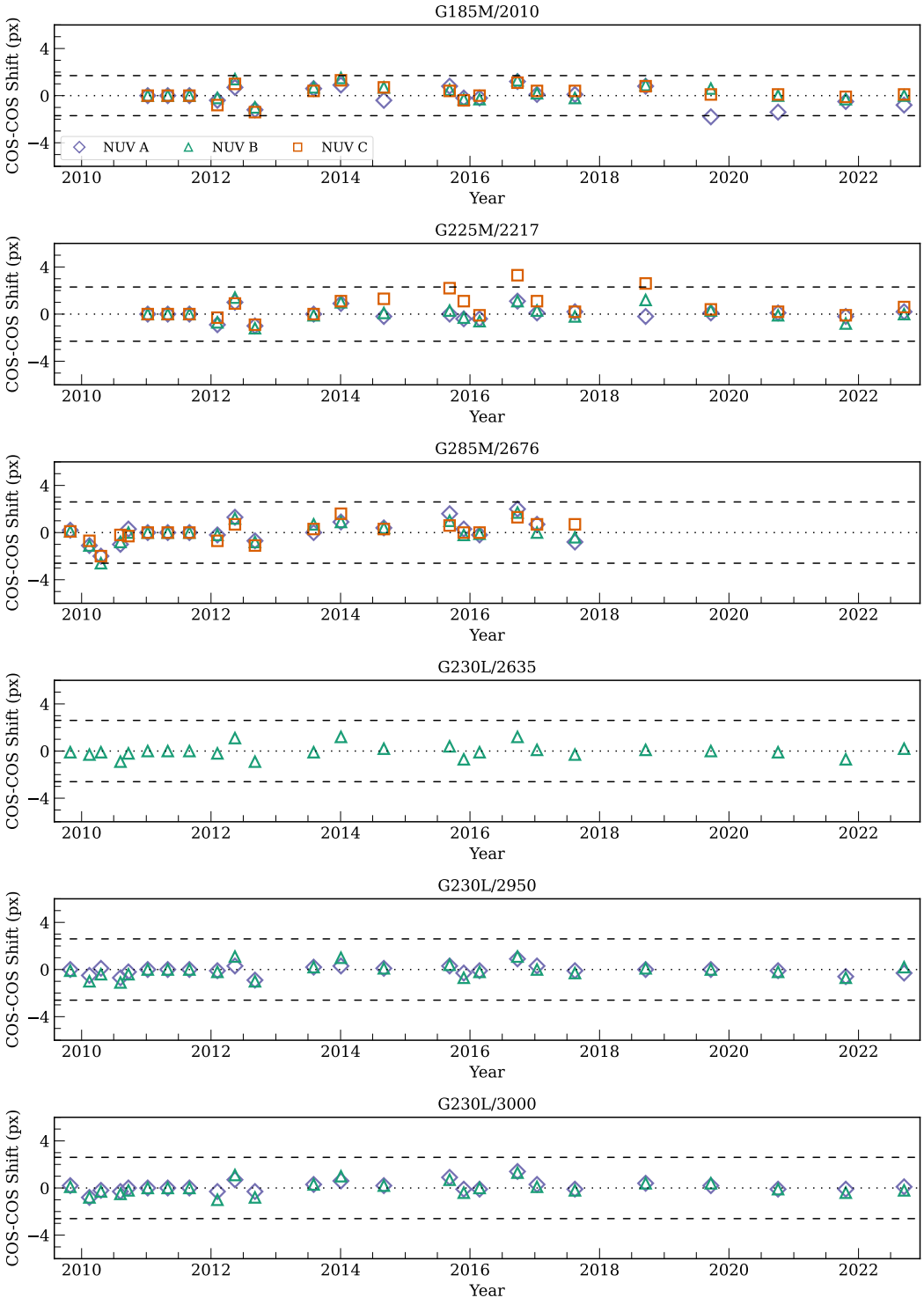

Figure 1. Plots of the measured pixel shifts between the COS Cycle 18 reference spectra and COS Cycle 18-29 data as a function of observation date for each monitored mode. Results from stripes A, B, and C are shown as purple diamonds, green triangles, and orange squares, respectively. Wavelength accuracy requirements are indicated by dashed lines.

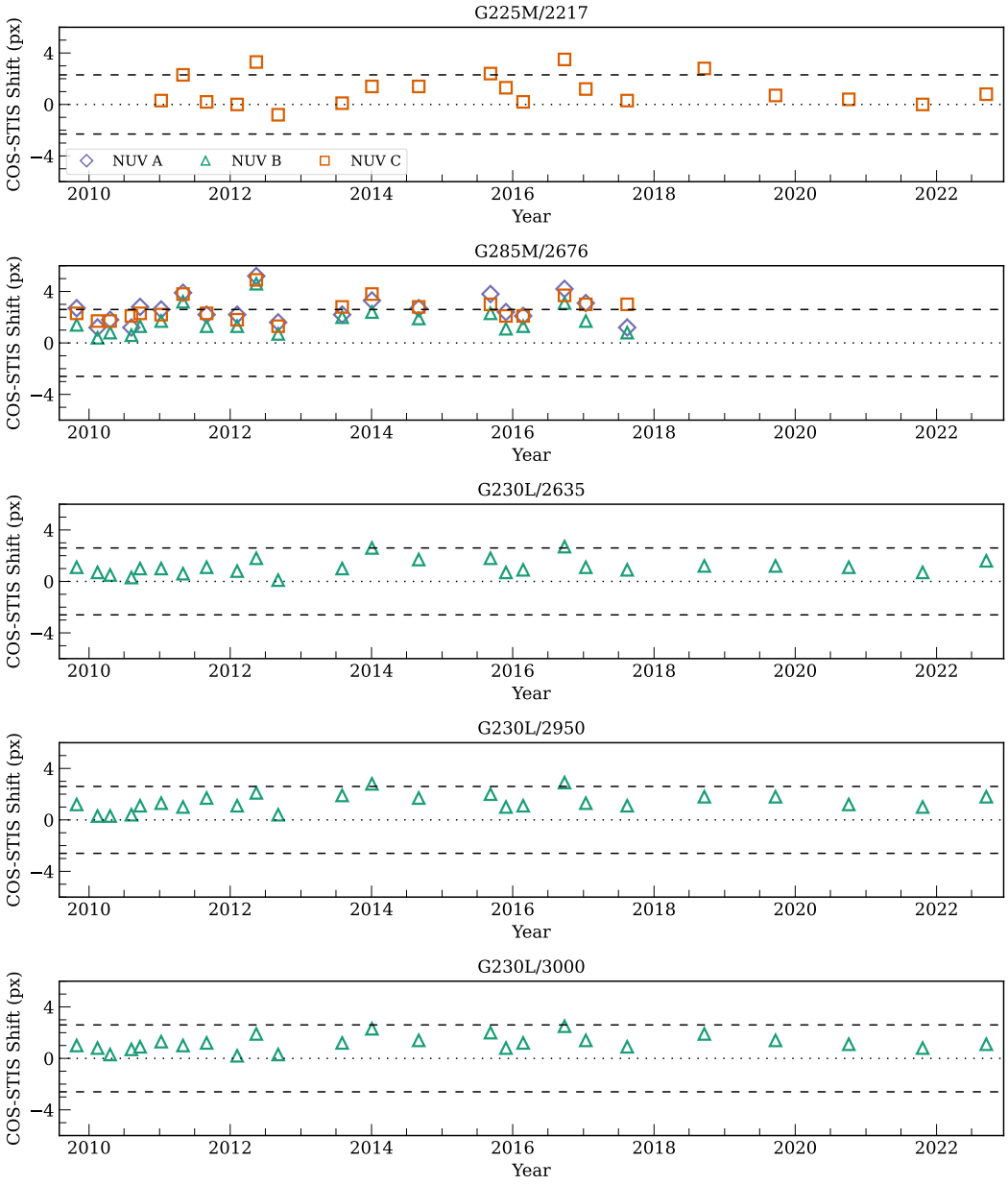

Figure 2. Plots of the measured pixel shifts between the STIS reference spectra and COS Cycle 18-29 data as a function of observation date for each monitored mode. Wavelength accuracy requirements are indicated by dashed lines. Results from stripes A, B, and C are shown as purple diamonds, green triangles, and orange squares, respectively.

References

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