# COS2025: Extending the Lifetime of the FUV channel of the Cosmic Origins Spectrograph to 2025

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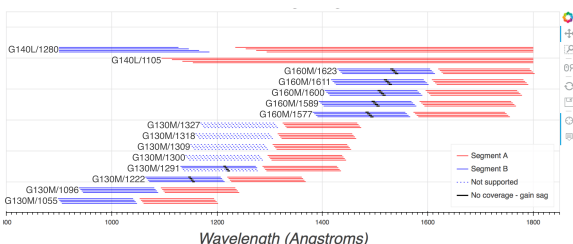
1. Motivation
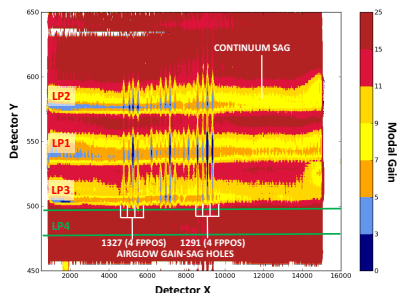
The COS FUV microchannel plate detector's efficiency at converting incoming photons into detectable events decreases with usage. This depletion of the detector's gain (i.e. gain sag) results in unusable regions of the COS/FUV detector (see regions of low gain in above figure). The main culprit of gain sag in the COS/FUV detector is Lyα geocoronal emission at 1216 Å that fills the COS 2.5" aperture whenever the G130M grating is used with the 1291/1300/1309/1318/1327 cenwaves on Segment B. In order to mitigate this gain sag, a number of strategies have been employed over the past 8 years of operations. These range from moving to different lifetime positions, to managing the high voltage to extract a smaller amount of charge, to re-distributing the cenwave usage so that Lyα does not produce a gain-sag hole in a given location. We are now at a point where none of the strategies above will, without any other changes, allow us to continue operating the COS/FUV detector to 2025. To address this a new COS2025 policy has been developed.

This new policy, with the goal of retaining full science capability of COS/FUV to 2025, places restrictions on the G130M cenwaves allowed at the current Lifetime Position 4 (LP4).

2. Summary of Supported and Available FUV Modes

Table 1: Target Acquisition Modes

LIFETIME POSITION	2	3	4
FP-POS	3	3	3
G130M/1055	X	X	X
G130M/1096	X	X	X
G130M/1222	X	X	X
G130M/1291	X	X	✔
G130M/1300	X	X	FUVA
G130M/1309	X	X	FUVA
G130M/1318	X	X	FUVA
G130M/1327	X	X	FUVA
G160M/ALL	X	X	✔
G140L/ALL	X	X	✔

Table 2: Science Modes

LIFETIME POSITION	2	2	2	2	2	3	3	3	3	3	4	4	4	4	4
FP-POS	1	2	3	4	ALL	1	2	3	4	ALL	1	2	3	4	ALL
G130M/1055	✔	✔	✔	✔	✔	X	X	X	X	X	X	X	X	X	X
G130M/1096	✔	✔	✔	✔	✔	X	X	X	X	X	X	X	X	X	X
G130M/1222	X	X	X	X	X	X	X	X	X	X	✔	✔	✔	✔	✔
G130M/1291	X	X	X	X	X	AVAIL	AVAIL	AVAIL	AVAIL	AVAIL	FUVA	FUVA	✔	✔	FUVA
G130M/1300	X	X	X	X	X	AVAIL	AVAIL	AVAIL	AVAIL	AVAIL	FUVA	FUVA	FUVA	FUVA	FUVA
G130M/1309	X	X	X	X	X	AVAIL	AVAIL	AVAIL	AVAIL	AVAIL	FUVA	FUVA	FUVA	FUVA	FUVA
G130M/1318	X	X	X	X	X	AVAIL	AVAIL	AVAIL	AVAIL	AVAIL	FUVA	FUVA	FUVA	FUVA	FUVA
G130M/1327	X	X	X	X	X	AVAIL	AVAIL	AVAIL	AVAIL	AVAIL	FUVA	FUVA	FUVA	FUVA	FUVA
G160M/ALL	X	X	X	X	X	X	X	X	X	X	✔	✔	✔	✔	✔
G140L/ALL	X	X	X	X	X	X	X	X	X	X	✔	✔	✔	✔	✔

AVAIL = Available mode use only (approval needed)
✔ = Supported mode (all GOs can use, no approval needed)
FUVA = Supported mode, but only with Segment = FUVA (all GOs can use)
X = Not supported or available to GOs

The COS2025 policy minimizes the number of locations on the detector where the geocoronal Lyα emission falls at LP4, by not supporting the SEGMENT B G130M 1300/1309/1318/1327 cenwaves and reducing the number of FP-POS for 1291 from four to two. In this way the geocoronal Lyα emission falls on fewer locations on the detector, and LP4 can be used until the continuum level reaches a low modal gain. This thereby significantly extends the usability of LP4 with minimal impacts on science return, although it will result in small gain sag holes as described in Section 4. The above tables summarize the supported and available target acquisition (Table 1) and science modes (Table 2) as a function of lifetime position, for each COS/FUV cenwave, following the new COS2025 policy. If 4 FP-POS observations with G130M segment B are desired, the 1222 cenwave is recommended. We note that G160M and G140L still support all the previous modes, although the wavelength coverage of the G160M settings are affected (see Section 4 below).

3. FUV Wavelength Range Tool

To assist users in preparing their proposals for COS observations, we have developed a COS/FUV Wavelength Tool that allows users to visualize how the wavelength ranges covered by the allowed COS FUV settings (i.e. settings in supported mode) overlap with those of settings that have been withdrawn (i.e. not in supported mode) to preserve the lifetime of the COS FUV detectors. This tool is available from the COS2025 website (see link in Section 4). The withdrawn settings are plotted with dotted lines, while those in supported mode are plotted with solid lines. For each setting displayed, the four FP-POS are shown, from 1 to 4, lowest to highest on the figure. This tool is interactive, with the ability to pan, zoom in and out, save files, and hover over lines in the figure to display the wavelength at the cursor location.

4. FUV Wavelength Ranges Affected by Gain Sag

Table 3: G130M Affected Wavelengths

Grating	Cenwave	Segment	FP-POS	λ_{min} (Å)	λ_{max} (Å)
G130M	1291	B	3	1214.4	1219.4
G130M	1291	B	4	1212.0	1217.0
G130M	1222	B	1	1152.8	1157.8
G130M	1222	B	2	1150.3	1155.3
G130M	1222	B	3	1147.8	1152.8
G130M	1222	B	4	1145.4	1150.3

The COS2025 strategy allows users to obtain Segment B data with G130M/1291/FP-POS=3,4. Over time, Lyα airglow will sag these detector regions, which will become unusable. This means that other settings, projecting light into these detector regions, will also be affected. The wavelength ranges that will be affected by future gain sag holes at LP4 are summarized in Table 3 (G130M) and Table 4 (G160M). Users should consider carefully whether a wavelength region of interest falls in any of the affected wavelength ranges given in Tables 3 and 4. Information lost in the new FUVB gaps can be recovered with the use of 4 FP-POS with G160M and G140L, and galactic Lyα can be observed at LP3.

Table 4: G160M Affected Wavelengths

Grating	Cenwave	Segment	FP-POS	λ_{min} (Å)	λ_{max} (Å)
G160M	1577	B	1	1490.7	1496.8
G160M	1577	B	2	1487.7	1493.8
G160M	1577	B	3	1484.6	1490.7
G160M	1577	B	4	1481.6	1487.7
G160M	1589	B	1	1502.4	1508.5
G160M	1589	B	2	1499.3	1505.4
G160M	1589	B	3	1496.3	1502.4
G160M	1589	B	4	1493.2	1499.3
G160M	1600	B	1	1513.8	1519.9
G160M	1600	B	2	1510.7	1516.8
G160M	1600	B	3	1507.6	1513.8
G160M	1600	B	4	1504.6	1510.7
G160M	1611	B	1	1525.6	1531.7
G160M	1611	B	2	1522.6	1528.7
G160M	1611	B	3	1519.5	1525.6
G160M	1611	B	4	1516.4	1522.6
G160M	1623	B	1	1537.7	1543.8
G160M	1623	B	2	1534.6	1540.7
G160M	1623	B	3	1531.6	1537.7
G160M	1623	B	4	1528.5	1534.6

For more information on this policy, see the COS2025 webpage at this URL or scan the QR code to the right:
http://www.stsci.edu/hst/cos/cos2025

This poster is available at this URL or scan the QR code to the right:
http://www.stsci.edu/hst/cos/documents/cos_posters