Updated Status and Performance at the Fourth HST COS FUV Lifetime Position

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The Move to LP4

To mitigate the adverse effects of gain sag on the spectral quality and accuracy of Hubble Space Telescope's Cosmic Origins Spectrograph FUV observations, COS FUV spectra will be moved from Lifetime Position 3 (LP3) to a new pristine location on the detectors at LP4 in October 2017. To achieve maximal spectral resolution while preserving detector area, the spectra will be shifted in the cross-dispersion (XD) direction by -2.5" (about -31 pixels) from LP3 or -5" (about -62 pixels) from the original LP1. The spectral resolution at LP4 is expected to decrease by ~10-15% compared to LP3. To support the move to LP4, several calibration and processing updates were needed. We describe these changes as well as an overview of the move in this poster.

Lamp Spectrum

At LP4, the wavelength calibration aperture (WCA) lamp spectrum can overlap with previously gain-sagged regions from the LP2 spectrum location (see Figure 1). Depending on the mode used and the along-dispersion (AD) position of the WCA spectrum, some strong lines may fall on gain sag holes and appear weaker or disappear completely from the lamp spectrum. Simulations and calibration data showed that the wavelength calibration step in CalCOS fails for some G160M observations because the lamp line ratios change. To address this problem, we have updated the Wavecal Parameters Reference Table and CalCOS. By relaxing the cross-correlation parameters, CalCOS is able to correctly calculate the shift of the 2-D image on the detector for all observations.

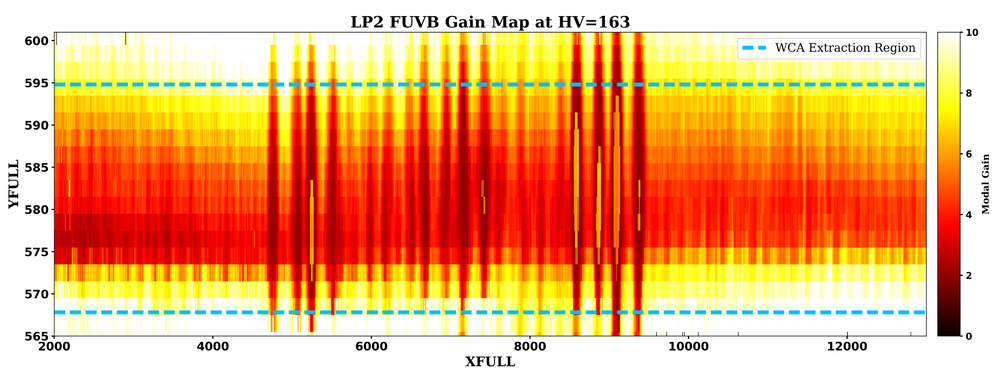


Figure 1 (right): Gain map at LP2 with the center of the LP4 G160M WCA spectrum

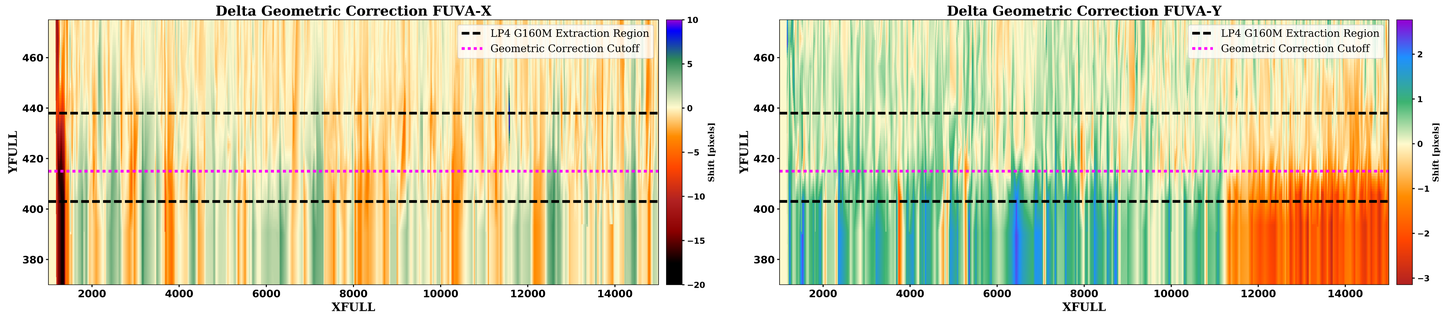


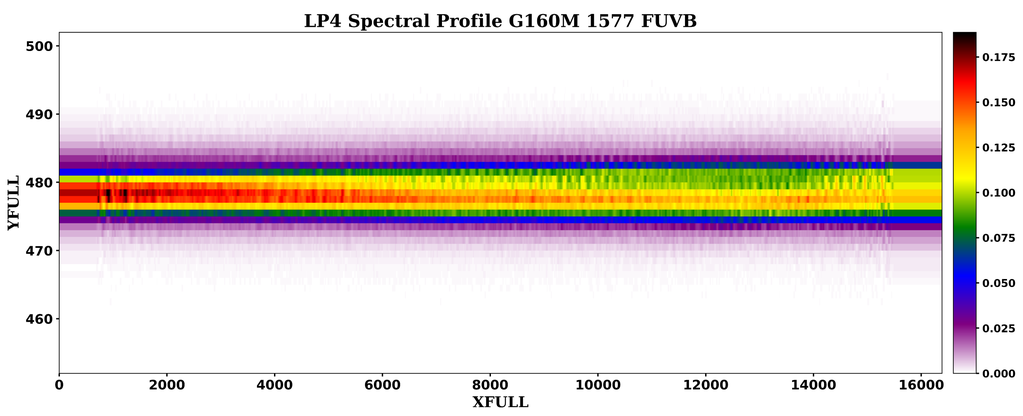
Figure 2: Delta geometric correction in the X-direction (left) and Y-direction (right) for FUVA, with the LP4 G160M extraction region overlaid.

Delta Geometric Distortion Correction

CalCOS corrects for geometric distortions due to differences between the inferred and actual sizes of the FUV pixels. However, the current geometric correction does not extend low enough on the FUV detector to correct the entire LP4 spectral region. To mitigate this, we are implementing a new correction at LP4, the delta geometric correction, which is applied in addition to the current correction. This will not only extend the geometric correction to lower Y values, but will also correct for known errors in the current correction. See Figure 2 for examples of the delta geometric correction at LP4.

Profiles and Traces

Any residual geometric distortions are removed from spectral profiles using a library of 1-D spectral centroid "trace" locations. By measuring and removing this residual distortion, the spectral profiles become smoother and more easily modeled. After this trace correction has been applied, the observed spectral image is aligned with a 2-D profile template in order to perform two-zone spectral extraction. Figures 3 and 4 show a sample profile at LP4 and the spectral traces for each grating. The LP4 traces and profiles closely resemble those at LP3.



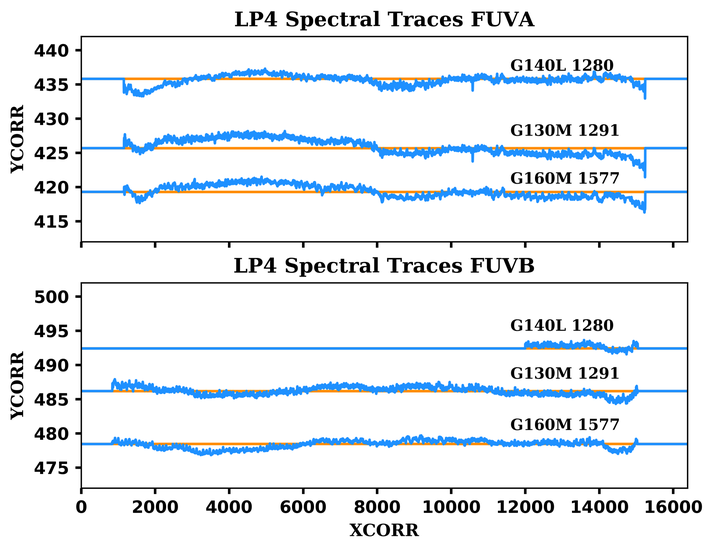


Figure 3 (left): A 2-D reference profile for G160M/1577 FUVB. **Figure 4 (right):** LP4 spectral traces for each FUV grating, sampling cenwaves 1280, 1291, and 1577. The scatter (in blue) about the orange lines is the shift applied to data.

Changes to Observing Modes at LP4

To extend the lifetime of LP4, there may be restrictions to the existing observing modes. These changes will be announced to the community in the near future. In addition, we will be adding a new cenwave, G130M/1223, which will complement the existing G130M/1222 cenwave by providing similar resolution to 1291/FUVB on the FUVA segment. Lyα airglow falls in the detector gap for G130M/1222 and 1223, reducing gain sag.