

Summary of the Post-COSTAR Side 2 Sensitivity Monitors for GHRIS

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ABSTRACT

The sensitivity of the GHRIS on Side 1 and Side 2 has been measured approximately every 3 months since Cycle 4. The measurements were done with the ultraviolet flux standard BD+28°4211. Significant time dependence was detected in the Side 1 data, and led to a recalibration of the G140L sensitivity, as discussed in GHRIS-ISR-085. Trends are also detected in the Side 2 sensitivity monitors, although they are much less than those found for G140L.

1. Introduction

As part of all the GHRIS calibration plans since Cycle 4, a routine monitoring of the ultraviolet flux standard BD+28°4211 has been performed in order to document any changes of the GHRIS sensitivity. This star is one of the primary ultraviolet standards and has been monitored extensively since the beginning of Cycle 4. It is not known to be variable. Time dependencies were found in the Side 1 G140L grating and led to a recalibration of the sensitivity files for that grating. Please see GHRIS-ISR-085 for the details. This Instrument Science Report will deal only with data for Side 2 since the installation of COSTAR.

2. Observations

The Side 2 observations were done as part of Cycles 4, 5, and 6 calibration programs 5599, 6172, and 6898. BD+28°4211 was acquired into the LSA with a 3×3 spiral search using mirror N2, (followed by a peak-up for the Cycle 4 observations only). Centering was confirmed by taking an image with the LSA. A series of spectra in the ACCUM mode were taken with gratings G160M, G200M, and G270M. Central wavelengths were 1200, 1500, 2000, 2500, and 3000 Å. This sequence was repeated approximately every 3 months. A list of observations is given in Table 1. All observations were successful

except the spectrum at 1200 Å, intended to be obtained on 3 May 95 (SMS 95123), which was lost due to a carousel reset.

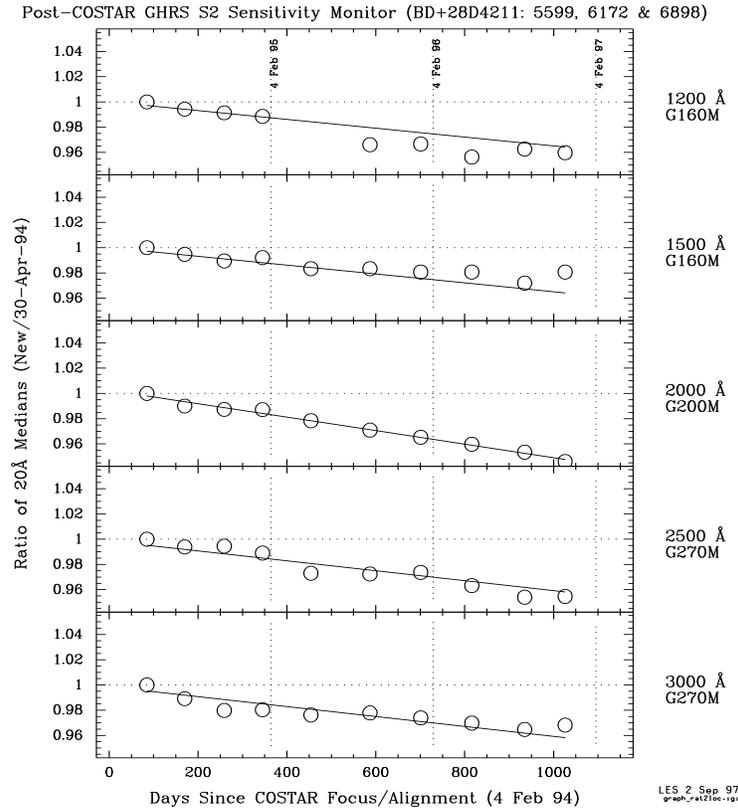
Table 1. Post-COSTAR Side 2 sensitivity monitor observations

Program	Date	G160M 1200	G160M 1500	G200M 2000	G270M 2500	G270M 3000
5599	94 Apr 30	z29i0109t	z29i010at	z29i010ct	z29i010et	z29i010ft
	94 Jul 24	z29i0209t	z29i020at	z29i020ct	z29i020et	z29i020ft
	94 Oct 21	z29i0309t	z29i030at	z29i030ct	z29i030et	z29i030ft
	95 Jan 15	z29i040at	z29i0409t	z29i040ct	z29i040et	z29i040ft
	95 May 04	lost	z29i510at	z29i510ct	z29i510et	z29i510ft
6172	95 Sep 14	z2ud0906t	z2ud0908t	z2ud090bt	z2ud090ht	z2ud090ft
	96 Jan 06	z2ud1906t	z2ud1908t	z2ud190bt	z2ud190ft	z2ud190ht
	96 Apr 29	z2ud2906t	z2ud2908p	z2ud290bt	z2ud290ft	z2ud290hp
	96 Aug 27	z2ud3906t	z2ud3908t	z2ud390bt	z2ud390ft	z2ud390ht
6898	96 Nov 26	z3jy1908t	z3jy1906t	z3jy190bt	z3jy190ht	z3jy190ft

Table 2. Correction factors applied to existing Side 2 medium-resolution-grating sensitivity files for the creation of time-dependent sensitivities.

Date	G160M	G200M	G270M
30 Apr 1994	0.997256	0.998059	0.995226
24 Jul 1994	0.994269	0.993509	0.991879
21 Oct 1994	0.991142	0.988745	0.988374
15 Jan 1995	0.98812	0.984141	0.984988
3 May 1995	0.984325	0.97836	0.980735
14 Sep 1995	0.979616	0.971186	0.975458
6 Jan 1996	0.97561	0.965084	0.970969
30 Apr 1996	0.971569	0.958928	0.96644
27 Aug 1996	0.967388	0.952558	0.961754
26 Nov 1996	0.96419	0.947686	0.958171

Figure 1: Side 2 sensitivity since Cycle 4. The five panels are for central wavelengths of 1200, 1500, 2000, 2500, and 3000 Å. Each point represents the ratio of the median count rates, measured over 20 Å, relative to the count rates measured on 30 Apr 94 over the same 20 Å (the first data point). The lines represent the fits to all the points for one grating. There is a slight wavelength dependence not taken into account by the fits for G160M and G270M.



3. Results for Side 2 (1200 to 3000 Å)

The results for Side 2 are presented in Figure 1. This figure shows the median of count rate ratios over 20 Å bins for BD+28°4211 centered at 1200, 1500, 2000, 2500, and 3000 Å (from top to bottom). The ratios are relative to the first Cycle 4 observations, taken on 30 April 94 (SMS 94120). Ten data points are in each panel, except in the 1200 Å panel, for which no data were obtained on 3 May 95 (SMS 95123, see above).

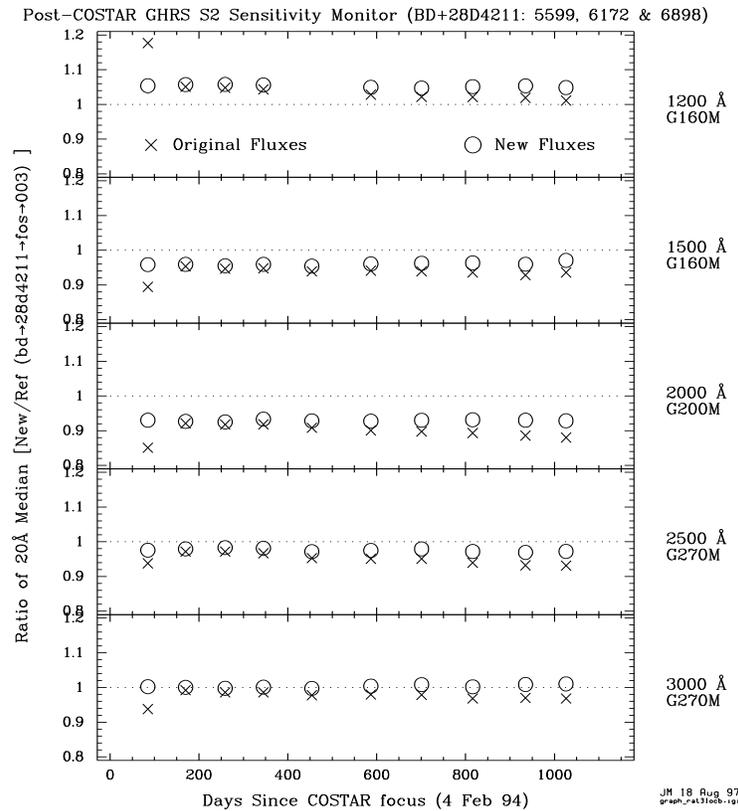
The dashed vertical lines mark off 1 year intervals. The solid lines represent the fits to all the points for one grating. The errors of each individual data point are 1%. Side 2 of the GHRM has experienced a slight sensitivity decrease by about 2% per year since the beginning of Cycle 4. This trend is present at all five wavelength points. The decrease is somewhat above the 1 sigma error of an individual data point.

4. Correcting for Sensitivity Decreases over Time

The baseline sensitivity files used by **calhrs** reflect the state at the beginning of Cycle 4. To allow for more precise calibration of Side 2 observations, a fit was made to each set of data shown in Figure 1. The fit is slightly different for each wavelength. Accordingly, the data for the G160M 1200 and 1500 Å data were fit together, as were the data for G270M 2500 and 3000 Å. Table 2 lists the correction factors applied to the current CDBS post-COSTAR sensitivity files to account for time dependence.

While verifying these results, we found there was still an offset apparent in the data. The post-COSTAR sensitivity monitor data were flux-calibrated with sensitivity files which were corrected for changes with time. Figure 2 again shows Side 2 sensitivity monitors since Cycle 4, with the five panels for central wavelengths of 1200, 1500, 2000, 2500, and 3000 Å. This time, however, each point represents the ratio of the median (time-corrected) flux measured over 20 Å relative to the flux measured in the BD+28°4211 reference spectrum (crcalspec\$bd_28d4211_fos_003.tab) over the same 20 Å.

Figure 2: Side 2 sensitivity monitors since Cycle 4 after correcting the post-COSTAR sensitivity files for changes with time and flux-calibrating. The five panels are for central wavelengths of 1200, 1500, 2000, 2500, and 3000 Å. Each point represents ratio of the median flux measured over 20 Å relative to the flux measured in the BD+28°4211 reference spectrum over the same 20 Å.



Since this comparison shows an offset from the reference star, I decided to see how good the sensitivity calibration looks with the original sensitivity data. Therefore, I went back to 1994 data and flux calibrated the μ Col data from the original Cycle 4 Sensitivity Calibration program 5596. Then I compared the GHRS fluxes to the same μ Col reference file (crcalobs μ _col_006.tab) used in GHRS ISR-088 to redo Ech-A and G140M sensitivities. I was taking mean and median values across the entire GHRS spectrum, which is about 40 Å. The results for the medians are presented in Figure 3. The same exercise was repeated for BD+28°4211 data; and then a similar but independent check was done for both stars by Jennifer Mack, all of which confirm the results shown here.

While none of the deviations are greater than 10%, there appears to be some residual shape not accounted for in the Side 2 sensitivities. Also, these sensitivity files were put into CDBS before the repeat of the G200M LSA observations, which were lost due to shutter management problems, which explains why the G200M LSA ratios look so low. The G200M LSA sensitivity and vignetting could be improved by analyzing the repeat observations.

5. Correcting for Residual Shape in the Sensitivity Files

We attempted to correct for the variations seen in Figure 3 by fitting the LSA and SSA data individually with second-order spline3 functions and multiplying the existing sensitivity files by the result. However, when the same data are recalibrated using that product and then compared to the μ Col reference file, the same general shape is still apparent, although the magnitudes of the differences have been suppressed and the data are more centered around unity, as shown in Figure 4. Perhaps a recalibration of the Side 2 medium resolution gratings would produce a better result, but we leave this as an exercise for the future.

6. Conclusion

There is a residual shape apparent in the sensitivity calibration of the Side 2 Medium Resolution Gratings. The results of the GHRS Side 2 sensitivity monitor suggest that since Cycle 4 the GHRS sensitivity changes between 1200 and 3000 Å do not exceed about 5%. We find consistent evidence for a time-dependence of the sensitivity with a decline rate of about 2% per year.

Figure 3: Comparison of Cycle 4 Side 2 Sensitivity Calibration program 5596 to the μ Col reference file. GHRM data were flux calibrated using the post-COSTAR sensitivity files currently in CDBS. Medians across the entire spectrum ($\sim 40\text{\AA}$) were measured and compared to the same wavelength bins in the μ Col reference spectrum.

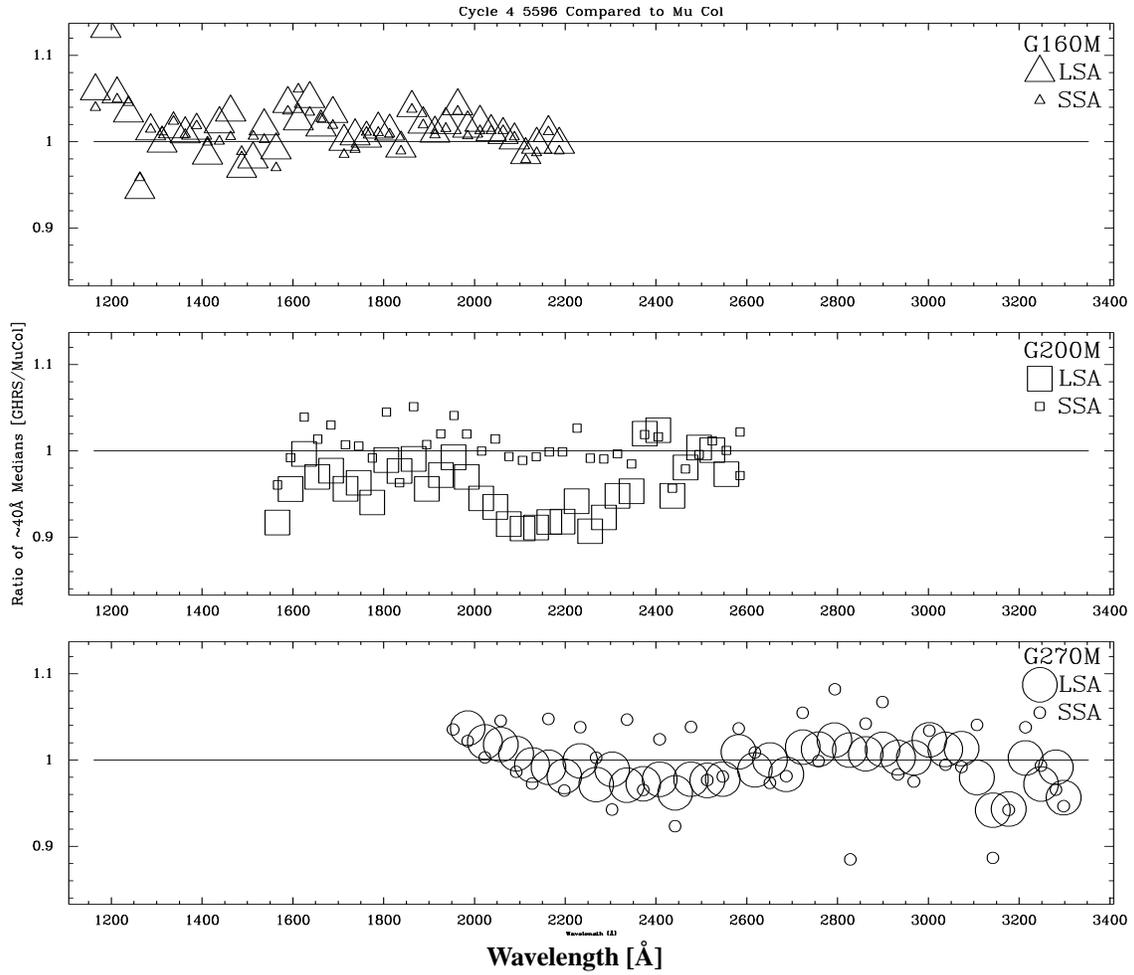


Figure 4: Comparison of Cycle 4 Side 2 Sensitivity Calibration program 5596 to μ Col reference file. GHRS data were flux calibrated using new sensitivity files made by multiplying the post-COSTAR sensitivity files currently in CDBS by second order spline3 functions fit to the data in Figure 3. Medians across the entire spectrum ($\sim 40\text{\AA}$) were measured and compared to the same wavelengths in the μ Col reference spectrum.

