An Updated Analysis Of The Accuracy of the LWR Degradation Correction Method

Catherine L. Imhoff
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ABSTRACT: The revised values of the Clavel et al. LWR sensitivity degradation correction results have been checked against the original calibration star fluxes. The new values appear to work well for data through 1982 or 1983. The correction algorithm derived by Holm (1985) gives similar results. However there is some evidence that the camera's sensitivity degradation has accelerated in the last two years.

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In the last newsletter, Clavel et al. (1986) presented corrected values for the sensitivity degradation of the LWR camera. The corrections were necessary due to an error in the camera temperature sensitivity algorithm used in their first analysis. The following report is the summary of a reanalysis of the new LWR degradation correction values.

The method is similar to that in the previous analysis, which was applied to the original set of LWR degradation values (Imhoff 1986). A total of 12 spectra have been analyzed. All are optimum point-source spectra of HD 60753 taken between 1982 and late 1985. The experimental version of the GSFC RDAF routine IUELO was used to apply the revised degradation corrections and to correct for THDA-sensitivity effects. The exposure time was corrected for OBC digitization and camera response time. The spectra were linearly interpolated to the same wavelength scale using the RDAF routine MULTERP. The spectra were trimmed to wavelengths between 1900 and 3300 A. A new, more sophisticated version of the RDAF routine BLEMISH was used to linearly interpolate across portions of the spectra affected by microphonics (nearly all of the spectra were affected by a ping) and the hot spot at 2200 A.

The twelve spectra were chosen so that there were three spectra at each of four given epochs (see Table 1). Mean fluxes were computed at each epoch from the appropriate 3 spectra. A correction to the flux scales was made to put them on the same scale as Bohlin's (1986) absolute calibration, for ease of comparison to the standard star fluxes provided by him. Note that the absolute calibration used does not matter, since it cancels out in the analysis given below. Next the ratio of the mean fluxes corrected for LWR degradation to the Bohlin (1986) calibration star fluxes was computed for each epoch. The results are given in Figure 1. The ratios are offset by 0.2 from each other, for clarity. A straight line representing a ratio of 1.0 is overplotted for each epoch.

Table 1
LWR Spectra of HD 60753

Epoch 1982.4	LWR 13122, 13356, 13442
Epoch 1982.9	LWR 14385, 14593, 14774
Epoch 1985.0	LWR 16947, 17200, 17248
Epoch 1985.9	LWR 17768, 17857, 17832

The mean corrected fluxes at epoch 1982.4 are good, but tend to be a little high at longer wavelengths and a little low at shorter wavelengths. This introduces a wavelength-dependent error on the order of several percent, and is most noticeable at the longest wavelengths. The mean corrected fluxes at epoch 1982.9 are similar, but seem overall a little lower. The average ratio over all wavelengths for all six spectra taken in 1982 is 0.997 (RMS deviation = 0.052). One may conclude that the method works well for 1982 data. This is as one might expect since Clavel et al.'s results are based on 1978-1983 data. However, there is a small wavelength-dependent effect.

The mean corrected fluxes at epoch 1985.0 and at epoch 1985.9 are definitely too low, especially at the shorter wavelengths. Dips are seen at 2600 A, 2400 A, and 2000 A (note that the largest sensitivity correction must be applied at 2300 A). Overall the fluxes are about 4% too low, but at some wavelengths the error is twice as large. Again the wavelength-dependent effect is seen.

These results appear to confirm Clavel et al.'s (1986) suggestion that the LWR degradation has increased in the last year or two. However no change is evident in the quick-look broad band sensitivity monitoring results (Sonneborn and Garhart 1986).

It is interesting to note that the revised Clavel numbers now match Holm's (1985) numbers very well. In the last report, Holm's correction algorithm gave fluxes too low by 3.5% for spectra taken in 1985. From the current analysis we know that this result was probably not an error in his algorithm but due to the recent higher rate of LWR sensitivity degradation. Figure 2 shows a comparison of the results discussed above with the mean fluxes of HD 60753 corrected using the Holm algorithm. The three spectra used to derive the mean fluxes corrected with Holm's algorithm are given in my previous report. Only one of these three is in common with the spectra analyzed here. Even so, one can see that there is considerable agreement in the resulting ratios for spectra obtained at about the same epoch (1985.1). Both correction algorithms yield fluxes which are about 4 percent too low overall, with RMS deviations of about 5 percent.

My previous analysis of Clavel et al.'s original, incorrect degradation values failed to detect their error. It seems that this was a fortuitous occurence, in that the error was masked by the recent increase in the LWR camera degradation for the data that were analyzed. If the analysis had been applied to an earlier set of data, the error would have been evident.

It may be noted that both Holm's and Clavel's methods assume that the camera sensitivity degradation is linear with time. There is good reason to reevaluate such an assumption. The results above indicate that the LWR camera sensitivity changes may be accelerating. In addition, the LWP camera sensitivity appears to have gone up at the end of 1983, when the camera became heavily used, as may be seen in the report by Sonneborn and Garhart. Thus it seems likely that any sensitivity correction method, to be completely successful, may need to deal with a more complex time dependence for the camera sensitivity.

References:

Bohlin, R. C. 1986, NASA IUE Newsletter No. 29, pg. 66 (also Ap. J., 308, 1001).

Clavel, J., Gilmozzi, R., and Prieto, A. 1986, NASA IUE Newsletter No. 31, pg. 83.

Holm, A. V. 1985, NASA IUE Newsletter No. 26, pg. 11.

Imhoff, C. L. 1986, NASA IUE Newsletter No. 29, pg. 5.

Sonneborn, G., and Garhart, M. P. 1986, NASA IUE Newsletter No. 31, p. 29.

Figure 1

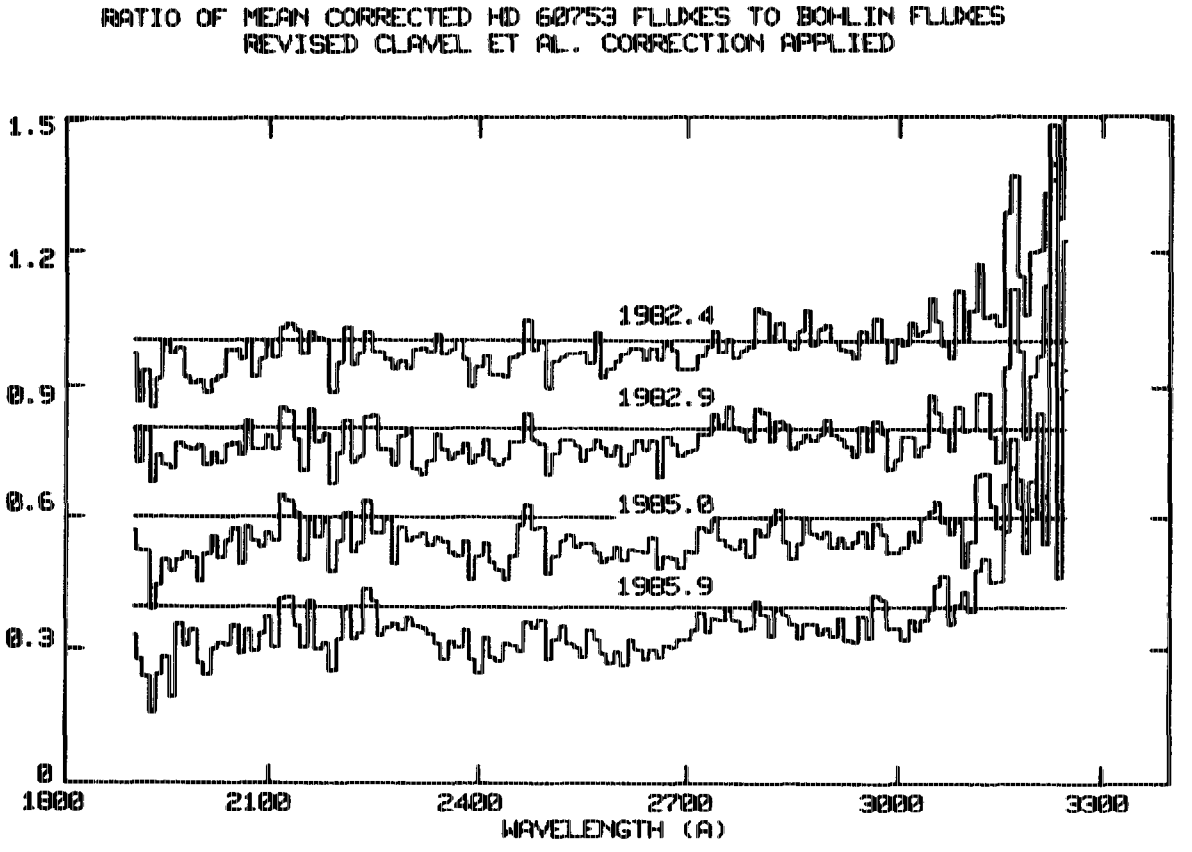
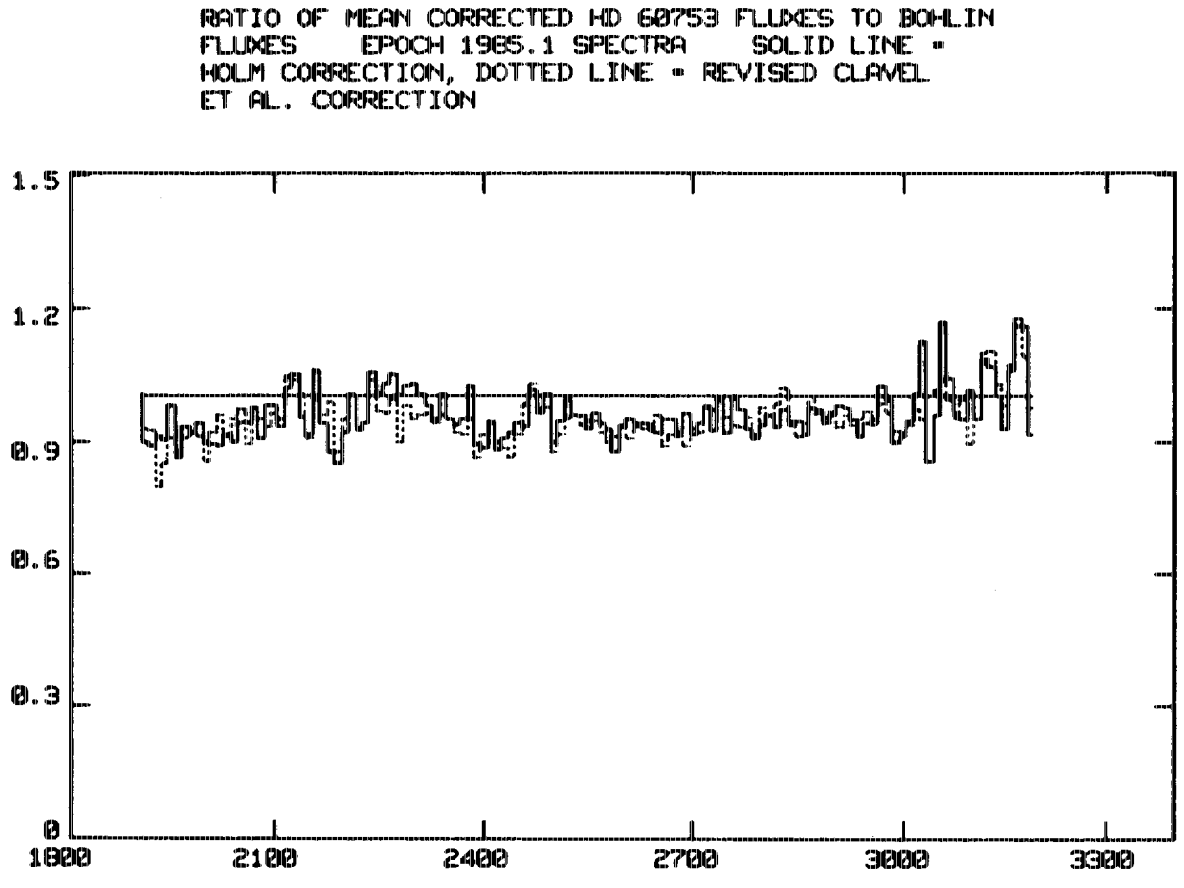

RATIO OF MEAN CORRECTED HD 60753 FLUXES TO BOHLIN FLUXES
REVISED CLAVEL ET AL. CORRECTION APPLIED
1.5
1.2
0.9
0.6
0.3
0
1982.4
1982.9
1985.0
1985.9
1800
2100
2400
2700
3000
3300
WAVELENGTH (A)

Figure 2


RATIO OF MEAN CORRECTED HD 60753 FLUXES TO BOHLIN FLUXES EPOCH 1985.1 SPECTRA SOLID LINE = HOLM CORRECTION, DOTTED LINE = REVISED CLAVEL ET AL. CORRECTION
1.5
1.2
0.9
0.6
0.3
0
1800
2100
2400
2700
3000
3300