THE RESPONSE TIME OF THE LWP CAMERA

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Abstract: IUE's cameras require a small interval of time to respond to the commands to turn on and off. The response time for the LWP camera is here determined to be 126 msec (±16 msec). This value corresponds very closely to the previously derived mean value of 120 msec (±15 msec) for the LWR and SWP cameras.

Discussion: The SEC and UVC voltages of the IUE cameras respond to commands on and off in some characteristic time interval. If the time required for the voltages to rise does not exactly equal the time required for the voltages to fall, there will be a net "response time" for the camera. For short exposures, this delay can affect the actual exposure time by a significant amount. Such an effect is important for calibration spectra, which typically are short exposures of hot stars, as well as for spectra obtained for Guest Observer programs.

Schiffer and Holm (1980; also in Schiffer 1980) have determined the response time for the LWR and SWP cameras. They found that a camera response time of about 120 milliseconds (±15 msec) characterizes both cameras. This report presents a determination of the response time for the LWP camera using the same techniques.

The actual exposure time is affected not only by the camera response time but by the quantization of the commanded time into integral "tics" of the on-board computer timer. These tics are in units of 0.4096 seconds. Any given exposure time is rounded down to an integral number of "OBC tics". Thus the actual exposure time for a given spectrum may be represented by the following expression:

$$t(expo) = N * 0.4096 \text{ sec} - T_r,$$

where t(expo) is the actual exposure time, N is the number of OBC tics, and T_r is the camera response time. Take for example a nominal exposure of 4 seconds. Such an exposure would be rounded down to 9 OBC tics, or 3.69 seconds, less a response time of 0.12 sec, or an actual exposure time of 3.57 seconds. The resulting integration is only 89% of the nominal exposure time.

The following technique is used to determine the camera response time. If one compares a single exposure of N * 0.4096 sec duration to a multiple exposure consisting of M exposures of a single OBC tic (0.4096 sec), then

$$\frac{M * (0.4096 - T_r)}{N * 0.4096 - T_r} = \frac{FN(M)}{FN(1)} = R,$$

where T_r is the camera response time, FN(1) is the flux level in flux numbers for the single exposure, FN(M) is the flux level for the M multiple exposures, and R is the ratio of the flux numbers. Solving for T_r,

$$T_r = \frac{M * 0.4096 - R * N * 0.4096}{M - R} .$$

LWP test images were obtained during a calibration shift on 1983 July 4. The following low dispersion spectra were acquired for the calibration star HD 93521 (spectral type O9 V):

LWP 1945	nominal 3 sec exposure (7 OBC tics)
LWP 1946	9 expos of 0.4096 sec each
LWP 1947	10 expos of 0.4096 sec each
LWP 1948	nominal 3 sec exposure

The exposure times were chosen so that the flux levels of the resulting spectra would be comparable. If this were not the case, significant errors can arise due to nonlinearities in the Intensity Transfer Function (see e.g., Holm, et al. 1982).

The flux numbers for each spectrum were obtained using the RDAF procedure IUELO. The two nominal exposures were then averaged to form the standard reference spectrum. The flux levels of those two spectra were in excellent agreement. The mean ratio of the flux numbers (LWP 1945/LWP 1948) was 0.996, or better than 1% overall agreement.

The next step is to form the ratio of the flux numbers for each of the multiple spectra to the reference spectrum. The wavelength range was limited to the relatively well exposed portion of the spectrum, i.e. FN > 10,000. Then the ratios were binned over 100 A intervals. These results are given in Table 1. For comparison, the original flux numbers were averaged over 100 A intervals then ratioed. The mean ratios were essentially the same, within 0.3%.

Substituting the mean ratios into the above equation for the response time, we obtain a value of 114 msec from the 9x exposure and 137 msec from the 10x exposure. The mean determination of the LWP response time is thus 126 msec (±16 msec). This value agrees very well with the previously determined value of 120 msec (±15 msec) for the response times of the LWR and SWP cameras (Holm and Schiffer 1980).

Table 1

Flux Ratios for Multiple Exposures to the Reference Spectrum

Wavelength	Mean FN	Ratio (9x/Ref)	Ratio (10x/Ref)
2000 A	12106	0.989	1.042
2100	13873	0.941	1.007
2200	12840	0.994	0.997
2300	15570	0.968	0.955
2400	20534	0.941	0.982
2500	25608	0.982	1.019
2600	28682	0.958	1.027
2700	30265	0.955	0.984
2800	25422	0.965	1.005
2900	20773	0.961	0.983
3000	13041	0.979	0.996
	Mean	0.967	1.000
	St. Dev.	0.018	0.024

References:

Holm, A., Bohlin, R. S., Cassatella, A., Ponz, D. P., and Schiffer, F. H. 1982, Astron. Ap., 112, 341.

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Schiffer, F. H., III, and Holm, A. V. 1980, internal memo.