A PROGRESS REPORT ON THE STUDY OF SWP CAMERA ARTIFACTS

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16 September 1988

ABSTRACT

Fifty-one sky background images were used to look for artifacts in the SWP camera. We confirm the discovery by Hackney, Hackney, and Kondo (1984, 1985) of a number of artifacts in SWP low-dispersion spectra with long exposure times. The most prominent artifacts, which mimic emission features, occur at the following wavelengths: 1279, 1288, 1492, 1517, 1537, 1662, 1699, 1734, 1750, 1770, 1821, 1847, and 1958 angstroms. Most of the artifacts have been with the camera since launch of the IUE satellite. There is a prominent continuum hump between 1450 and 1570 angstroms which is increasing with time. The existence and strength of certain features is dependent on whether point-source or extended-source processing is used.

INTRODUCTION

IUE spectra are affected by a number of contaminants that mimic spectral features (Grady and Imhoff 1985). A study by Hackney, Hackney, and Kondo (1984, 1985) demonstrates the existence of spurious emission features which occur at fixed position in long-exposure SWP images. In this report, the term "camera artifacts" will be used to designate the spurious emission features. Since the artifacts could impact the scientific results obtained from certain IUE observations, it was decided to study sky background images to see which artifacts could be mistaken for spectral features. This is a progress report on the camera artifact study for SWP images; whenever the word image appears in this report, it will refer to an SWP image unless otherwise stated.

SELECTION OF DATA

The photowrites of 130 SWP sky background images with exposures times of 3 hours or greater were inspected. Images with large cosmic ray hits or residual spectra from previous overexposures in the low-dispersion extraction region were not used; 52 images were considered useful. IUE plots of the individual spectra used in each group were also examined. One spectrum containing a low level hit at 1768 angstroms was excluded; therefore 51 images were used for the study of artifacts in the SWP camera. These were averaged in sequential groups of 8 to 10 images.

REDUCTION OF DATA

Each image was extracted from the line-by-line file twice, once as a point-source and once as an extended-source, with the standard IUESIPS parameters. Since the emission features are not apparent in short exposures, it has been assumed that they are due to hot spots which increase in DN level with time. If this assumption is valid, then we can apply the absolute calibration curve to the sky background spectra to determine their effect on an exposure of any length. The assumption will be tested in the future by further studies of sky backgrounds with various exposure times as well as null images.

The spectra used for this study were separated into groups and averaged (Table 1). Eight low dispersion images were taken before implementation of the new IUESIPS software at GSFC on 4 November 1980. These were averaged to find artifacts inherent to the SWP camera before that date; the resulting spectrum for the point-source processing will be designated as 'A' in the figures and that for extended-source processing as 'B'. Seven of the 43 images taken after 4 November 1980 were obtained in high dispersion. These seven were processed as low dispersion images and averaged; in the figures they will be designated as 'I' and 'J' for point- source and extended-source processing respectively. The remaining 36 low-dispersion images were used for a point-source average, designated as 'K', and an extended-source average, designated as 'L'. These 36 images were also broken into three chronological groups. The first covers the period from 11/24/80 to 2/26/82 and contains 17 averaged spectra for the point-source processing and 16 averaged spectra for the extended-source processing and are labeled 'C' and 'D' respectively in the figures. The middle group covers the period from 8/4/82 to 8/16/84 and contains 11 averaged spectra for both processing schemes, they are labeled 'E' and 'F' for the point- and extended-source processing respectively in the figures. The last group covers the period from 8/15/85 to 9/23/87 and contains only 8 spectra, which is why it is noisier than the other averaged spectra. These were labeled 'G' and 'H' in the figures for extended and point-source processing respectively.

To verify that the features we see in the spectra are actually artifacts, spectrum 'I' was plotted just below spectrum 'K' in Figure 1a and 'J' below 'L' in Figure 1b. If the features are emission from some source, they would have appeared at different positions on the camera target and would not have shown up in the high dispersion images processed as low dispersion. With the exception of geocoronal Lyman-alpha present in the low-dispersion spectra, there is no evidence that any of the features are real sky emission features.

Figures 2a and 2b are a plot of four spectra arranged in chronological order, with the earliest spectra at the top and the latest spectra at the bottom. Figure 2a shows the point-source spectra and 2b shows the extended- source spectra; the top and bottom spectra in these figures are averages of eight spectra each, and are therefore more noisy. It can be seen that the narrow features have remained relatively constant with time. However, the large-scale structure, particularly the bump at 1450 - 1570 angstroms, is enhanced

at later times. This may simply be due to the fact that the same absolute calibration curve was applied to all of the spectra, but the sensitivity degredation over time is a function of wavelength (Garhart and Teays 1988). Further tests with null and standard star spectra are planned to investigate this possibility.

In Figure 3 the 'K' and 'L' averages have been plotted to show the differences and similarities between point-source and extended-source processing. The large number of images averaged to produce the spectra plotted in Figure 3 insure a much higher signal-to-noise. The consistency of the patterns, as shown in Figures 1 and 2, demonstrates that this finger print will appear in every long exposure taken in low-dispersion on the SWP camera.

The features in Figure 3 are listed in Table 2 according to wavelength for both point- and extended-source processing along with their flux and whether or not they were reported by Hackney, Hackney, and Kondo (1984, 1985). Two of the features they reported were not found in this study, they are near 1890 and 1480 angstroms.

CONCLUSION

The spectral imprint reported by Hackney, Hackney and Kondo (1984, 1985) has been present over the entire lifetime of the SWP camera. In the extended-source spectra, the feature at 1750 angstroms is the strongest and could be misidentified as N III] at 1750 angstroms. In the point-source spectra, the feature at 1662 angstroms is strong and could be misidentified as O III] at 1663 anstroms. It is obvious from the measured fluxes that these features affect exposures with durations on the order of hours, particularly those of very weak sources. If many of the features are due to only one or a few pixels, then the contamination effects may be very strong for studies of individual lines from the line-by-line files. The next step is this investiagation will be to perform this analysis on the line-by-line files for the SWP sky backgrounds, and then extend this investigation to the LWP and LWR cameras.

REFERENCES

Garhart, M.P. and Teays, T.J. 1988, NASA IUE Newsletter, 35, 99.

Grady, C.A., and Imhoff, C.L. 1985, NASA IUE Newsletter, 28, 86.

Hackney, K.R.H., Hackney, R., and Kondo, Y. 1985, B.A.A.S., 16, 904.

Hackney, R.L., Hackney, K.R.H., and Kondo, Y. 1984, NASA CP-2238, 335.

TABLE 1

Average Spectrum	No. of Spectra	Dates	Dispersion	Processing
'A'	8	10/04/78 to 10/24/80	low	low, point
'B'	8	10/04/78 to 10/24/80	low	low, extended
'C'	17	11/24/80 to 2/26/82	low	low, point
'D'	17	11/24/80 to 2/26/82	low	low, extended
'E'	11	8/04/82 to 8/16/84	low	lot, point
'F'	11	8/04/82 to 8/16/84	low	low, extended
'G'	8	8/15/85 to 9/23/87	low	low, point
'H'	8	8/15/85 to 9/23/87	low	low, extended
'I'	7	10/30/81 to 9/24/87	high	low, point
'J'	7	10/30/81 to 9/24/87	high	low, extended
'K'	36	11/24/80 to 9/23/87	low	low,point
'L'	36	11/24/80 to 9/23/87	low	low, extended

TABLE 2

WAVELENGTH		FLUX		PREVIOUSLY DETECTED?
Point Source	Extended Source	Point Source	Extended Source	
1279	1280	.145E-13	.162E-13	YES
1288	1288	.150E-13	.153E-13	NO
1490	1492	.409E-13	.460E-13	NO
1518	1517	.275E-13	.336E-13	NO
NOT DETECTED	1537		.233E-13	NO
1662	NOT DETECTED	.180E-13		YES
1699	1699	.838E-14	.109E-13	NO
1724	1721	.487E-14	.160E-14	NO
1734	1734	.119E-13	.145E-13	NO
1750	1750	.273E-13	.556E-13	YES
1769	1770	.202E-13	.264E-13	NO
1823	1821	.140E-13	.198E-13	NO
1846	1847	.188E-13	.227E-13	NO
1874	1873	.524E-14	.823E-14	YES
1883	1883	.649E-14	.828E-14	NO
1900	1902	.852E-14	.103E-13	NO
NOT DETECTED	1914		.715E-14	NO
1959	1958	.982E-14	.101E-13	NO

Figure 1a

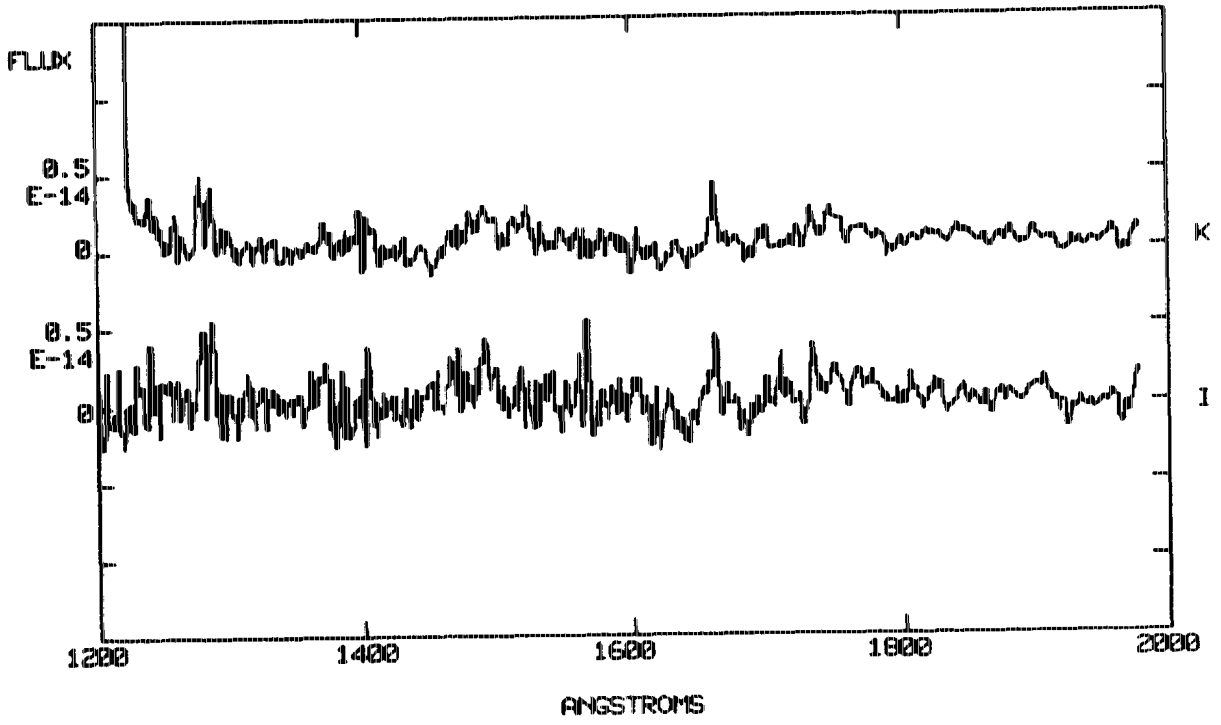

Figure 1b

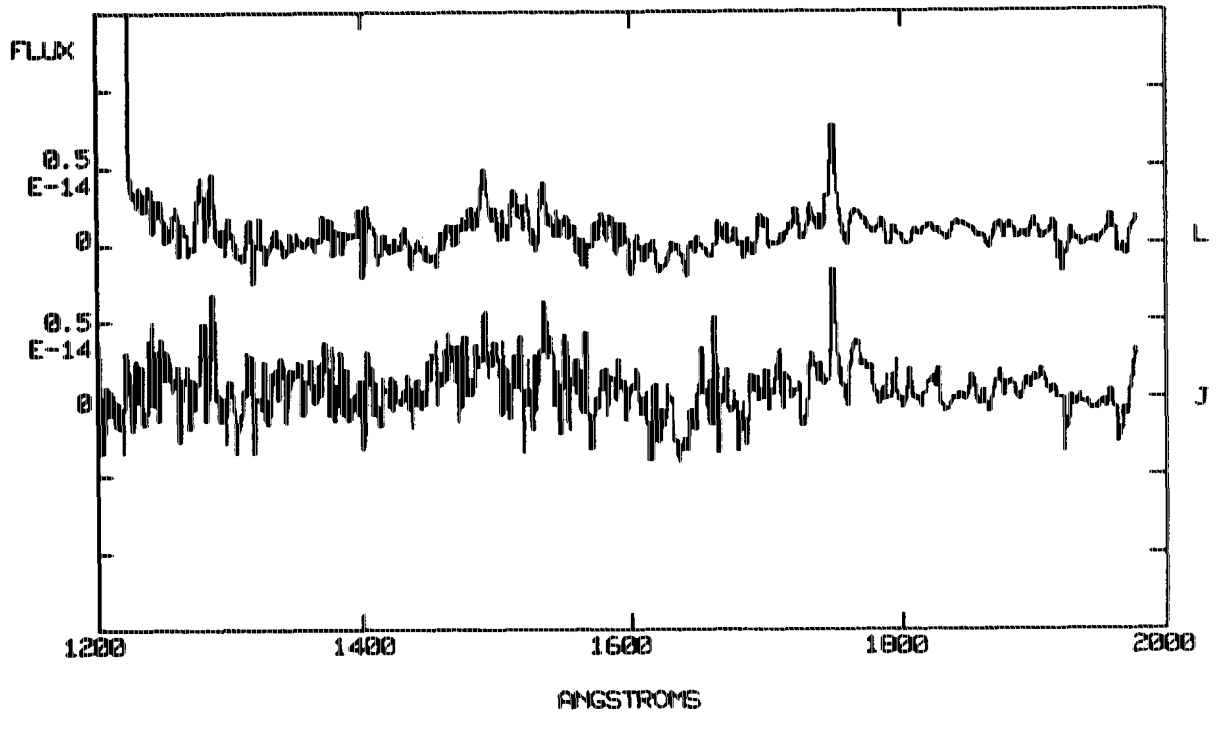

Figure 1. Sky background spectra. (a) Processed as point-source: low dispersion (K) and high dispersion (I). (b) Processed as extended-source: low dispersion (L) and high dispersion (J).

Figure 2a

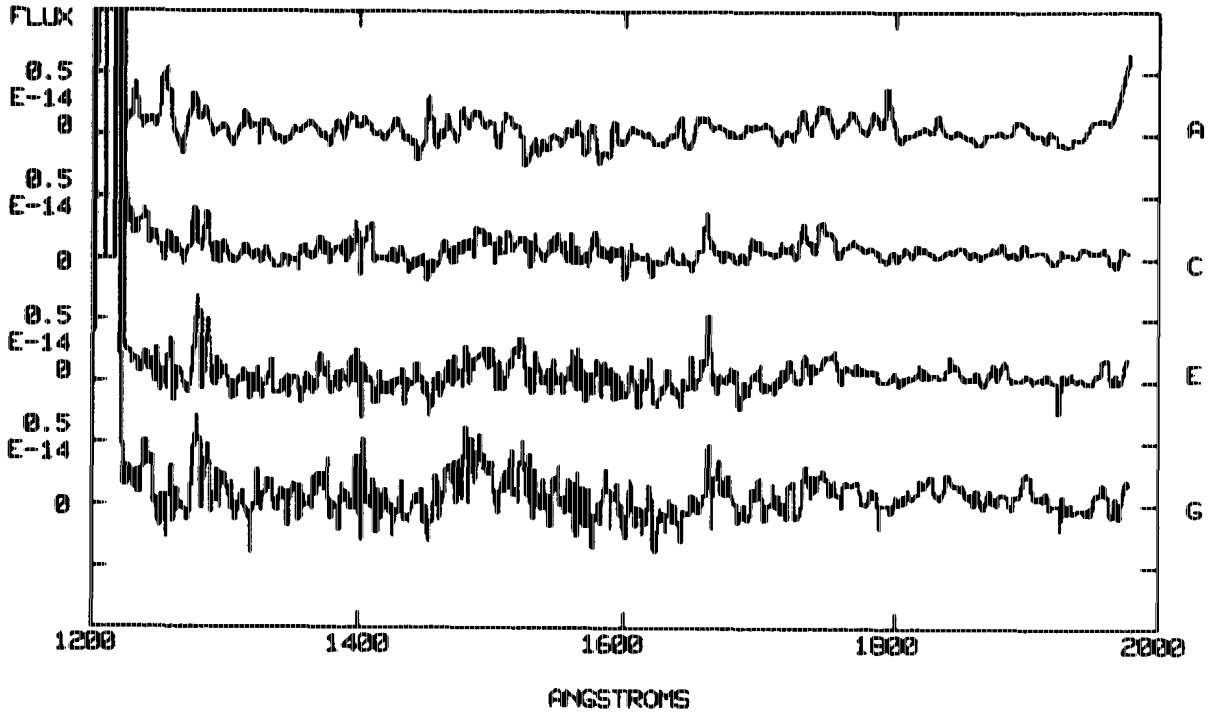

Figure 2b

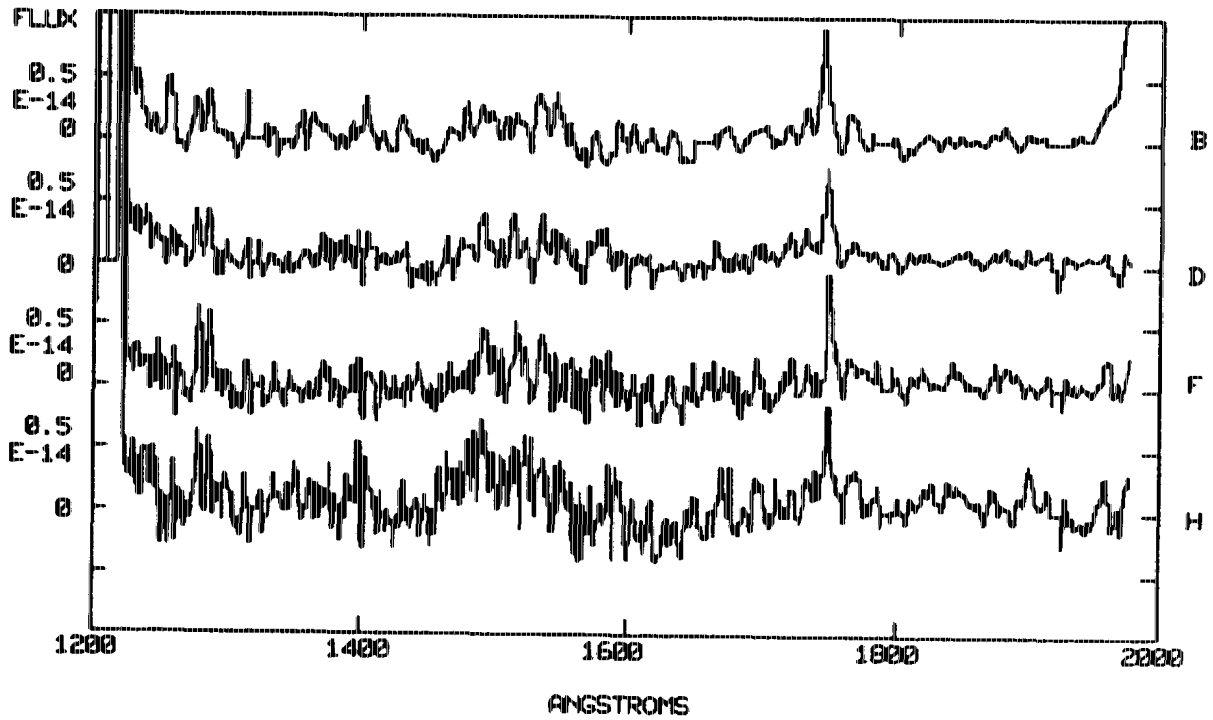

Figure 2. Sky background spectra arranged in chronological order. (a) Processed as point-source (A,C,E,G). (b) Processed as extended-source (B,D,F,H).

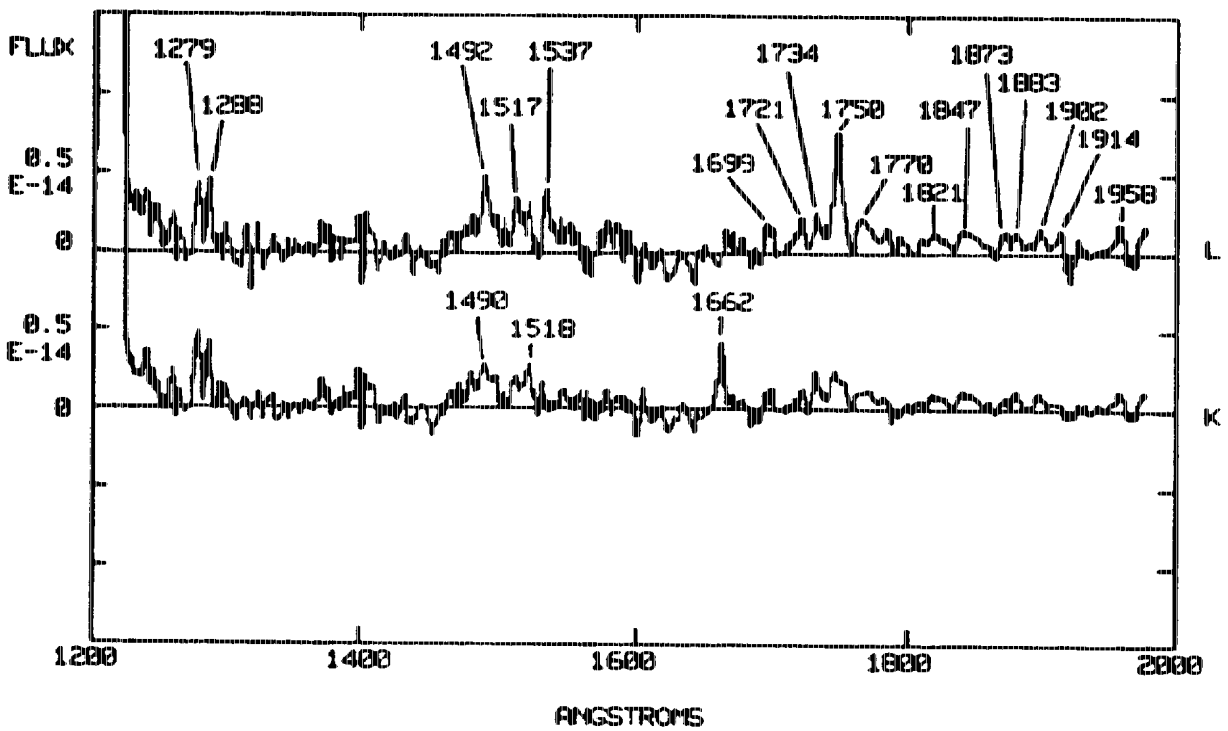

Figure 3. Sky background spectra (average of 36 individual exposures); the spectrum designated 'L' is extended-source extraction and the spectrum designated 'K' is point-source extraction.