# SWP 1515 Å Artifact

Michele D. De La Peña
Computer Sciences Corporation / IUE Observatory

## I Introduction

Analyses of featureless short wavelength IUE spectral data have revealed a distinctive absorption artifact at 1515 Å. Although this "feature" is now known to be present in a variety of the SWP spectral data, its presence in the featureless white dwarf spectra analyzed for flux calibration studies was the catalyst for further investigation and allowed the absolute determination of this "feature" as an artifact.

## II The Feature

Figure 1 is an average of twenty individual spectra of the white dwarf, G191-B2B. The spectra were produced with the standard extraction method of the NEWSIPS image processing system, a Signal Weighted Extraction Technique, SWET. Since a white dwarf is a featureless continuum source, the noticeable absorption feature present at 1515 Å spawned an investigation to determine the cause, astronomical or otherwise, of this new feature.

Figure 2 is an average of seventeen individual spectra of an IUE standard star, BD +28 4211. The 1515 Å feature is also readily apparent in this average. However, no transition of astronomical significance is known to correspond to this wavelength.

## III One Dimensional Analysis

Figures 3 and 4 are single spectrum extractions of G191-B2B processed through standard IUESIPS and NEWSIPS, where NEWSIPS is now using a boxcar extraction in order to allow an appropriate comparison of the two image processing systems. Since the 1515 Å feature is present in both the IUESIPS and NEWSIPS extractions in these figures (solid vertical lines), several sources can be eliminated from the list of potential causes. The SWET extraction technique is vindicated as the culprit because the feature is apparent with a NEWSIPS boxcar extraction, as well as with the standard IUESIPS boxcar extraction. Having the feature present in the extractions of both systems also eliminates the possibility that the NEWSIPS system is somehow introducing this spurious feature. Despite the major differences in the

image processing techniques employed by the two systems, the feature is apparent in both datasets. The implication is that a fundamental input data structure utilized by both systems may contain a persistent "flaw". The only input data used by *both* systems to process an image are the ITF and the raw image itself. However, the NEWSIPS system is using a "raw" space SWP ITF (Epoch 1985), whereas the IUESIPS system is using a geometrically corrected SWP ITF (Epoch 1978). Therefore, this artifact is independent of both the ITF epoch and creation method! In addition, not only is this artifact found in these recently obtained observations (1991), but it also can be found in extracted spectra acquired in late 1978.

## IV Two Dimensional Analysis

Since the spectral data is extracted from a two-dimensional image (SILO), a resampled version of the photometrically corrected LI data in order to align the low dispersion spectral format parallel to the horizontal direction, the SILO image was examined at 1515 Å for further clues as to the nature of the absorption feature. Figure 5 is a contour plot of a SILO image whose spectral counterpart exhibited the 1515 Å feature. The x-axis parallels the dispersion direction and is in units of wavelength, and the y-axis represents the spatial information in the file. The contours have been drawn only at the lowest intensity levels. There is a broad deficit of intensity along the edge of the spectral swath in the 1515 Å bin; this wavelength is marked by the vertical dashed line. In examination of the data from this perspective, it is clear that the "feature" is **not** astronomical in origin. The 1515 Å feature does not correspond to any known permanent ITF artifact, and does not have any $\nu$ error flags associated with the wavelength bin. The deficit in intensity noted between Lines 50 – 52 in the 1196 Å bin is a reseau and is appropriately flagged by the $\nu$ flag system. Although there appear to be several regions where there may be a deficit of flux on the periphery of the spectral swath, the 1515 Å feature is fairly broad and repeatable from spectrum to spectrum.

Figure 6 shows individual lines "extracted" from the SILO image. The x-axis is wavelength, and the y-axis is FN and also denotes the particular extraction line (*i.e.,* L:46). The short vertical dashed line in each plot marks the 1515 Å bin. In Lines 47 – 49 there is the distinct absorption artifact which is low enough in intensity to offset the flux in the remaining lines at that wavelength such that in the determination of the total flux for the bin, this deficit "edge" effect is apparent.

Using the VD data file, the pixels of low intensity in the SILO image can be traced back to their original location in the LI and RI data. The pixels in the ITF image used for the photometric correction can also be examined for any anomaly.

There is present a region of lower intensity at the appropriate wavelength in the LI data, but the deficit is immediately *adjacent* to the spectral swath and is not nearly as apparent as in the resampled image. Since both IUESIPS and NEWSIPS suffer from this anomalous feature, it appears that the nature of the resampling algorithms of the two systems (bilinear for

IUESIPS and modified Shepard method for NEWSIPS) serves to enhance, to varying amounts, this deficit region. Neither the RI nor the ITF image appear unusual in character.

## V Potential Cause

Although the RI and ITF images are not unusual at the pixel locations corresponding to the 1515 Å artifact, a more detailed examination did reveal a potential source for the artifact – lack of sensitivity. There are several adjacent pixels along the edge of the low dispersion spectral swath which appear to be less sensitive than the neighboring pixels. This has been determined by comparison of the raw science data for SWP40573 to the null level of the SWP ITF (Epoch 1985). These pixels have DN values at the same intensity as the null level of the ITF; the neighboring background pixels have a range of +/− 2 DN as compared to the null level. Consequently, when the photometric correction is applied, these pixels produce a truly flat (linearized) region, in contrast to the neighboring pixels which produce a flat region only *on average* since there is some statistical noise associated with the data. This trough of minimum intensity then encroaches upon the adjacent pixels during the resampling of the data in the conversion from the LI to the SILO file. It is simply the unfortunate circumstance that these pixels reside along the edge of the spectral swath, and therefore, manifest themselves as the flux deficit in the extracted data.

## VI Summary

Although further analysis is required to ensure that the actual cause of the 1515 Å feature has been correctly determined, it appears that this feature is yet another of the menagerie of spectral artifacts that the archival researcher needs to be aware of the existence to avoid misidentification. Further observations and investigation are planned to determine definitively the cause of this artifact.

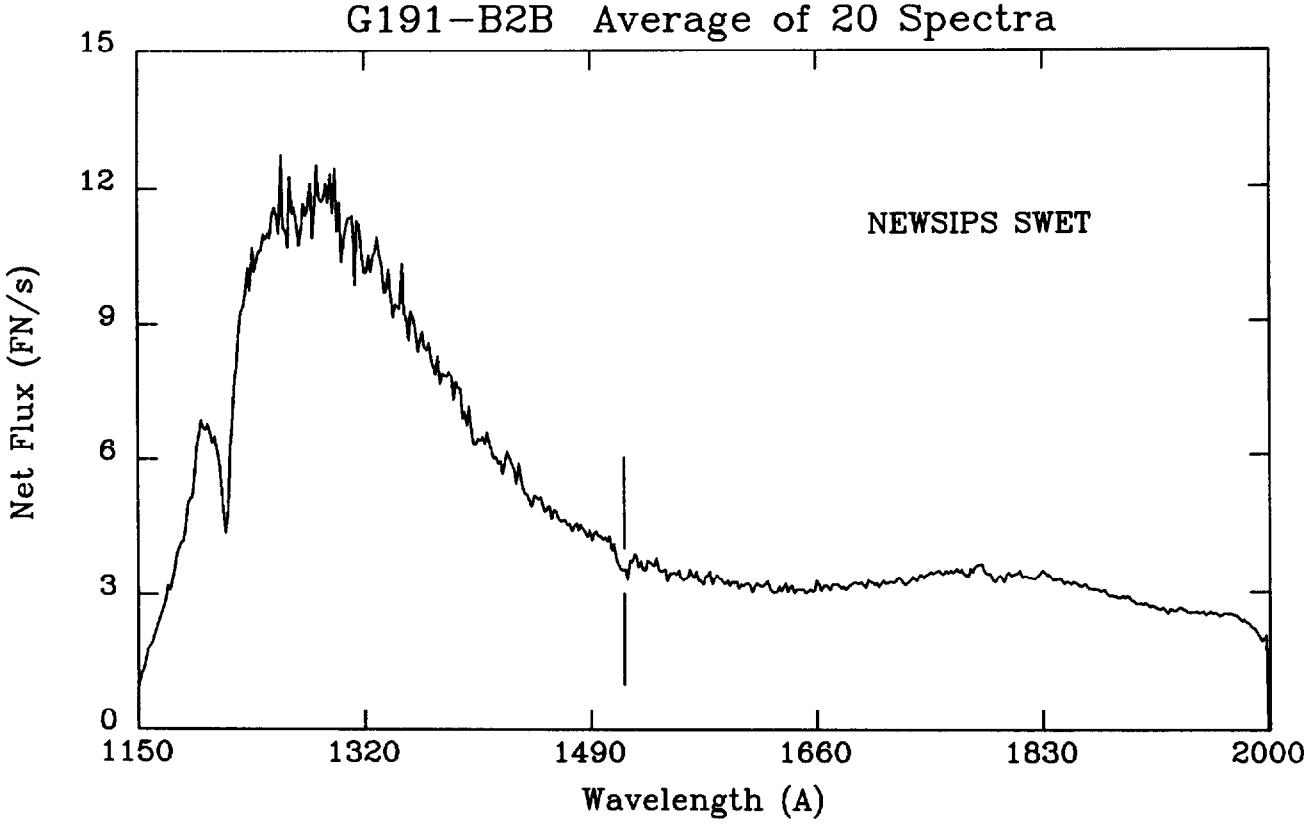



Figure 1

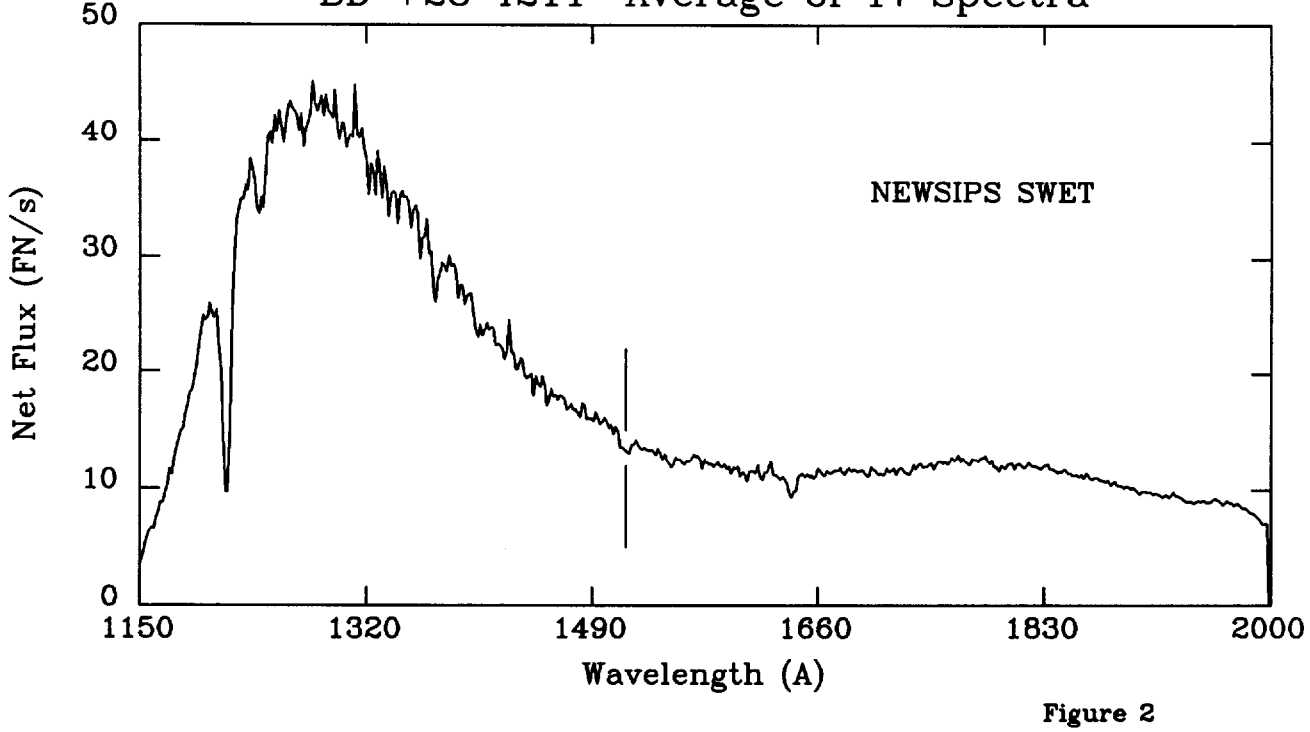



Figure 2

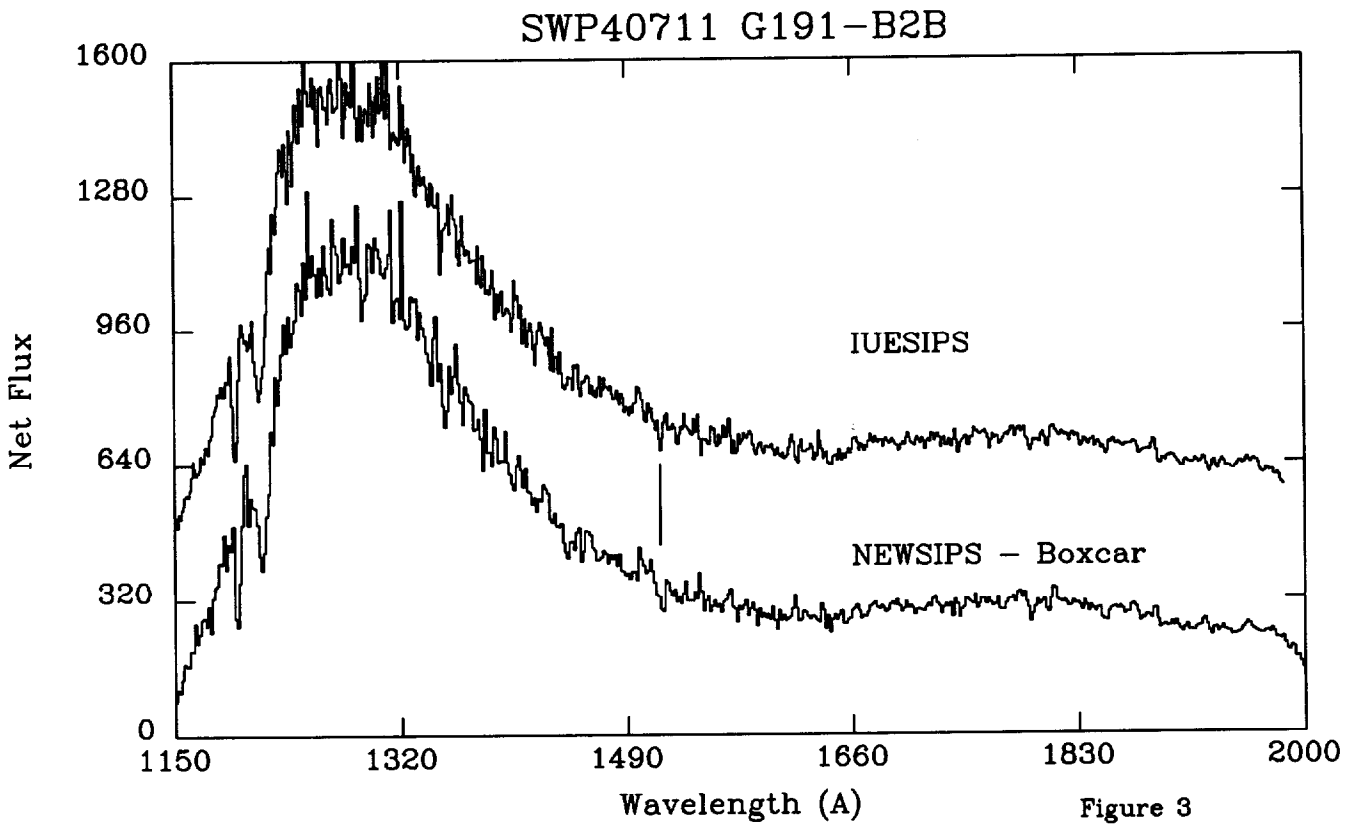



Figure 3

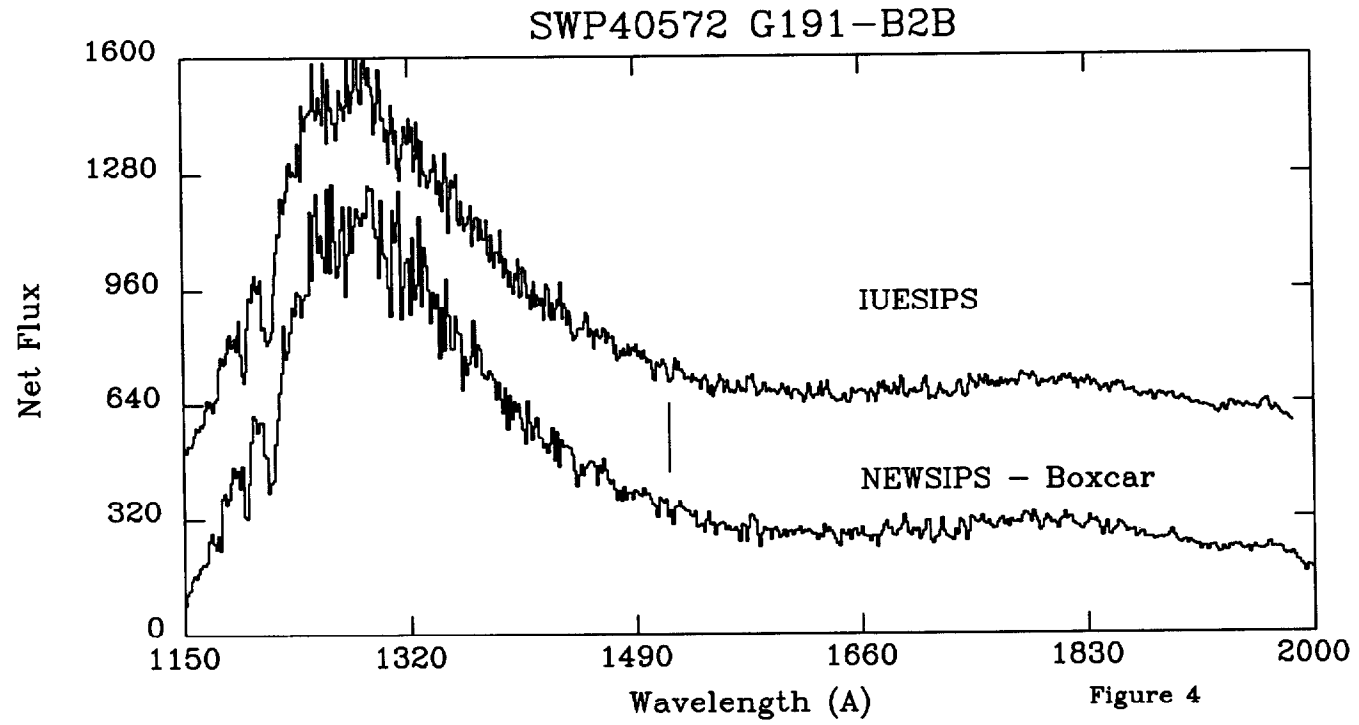



Figure 4

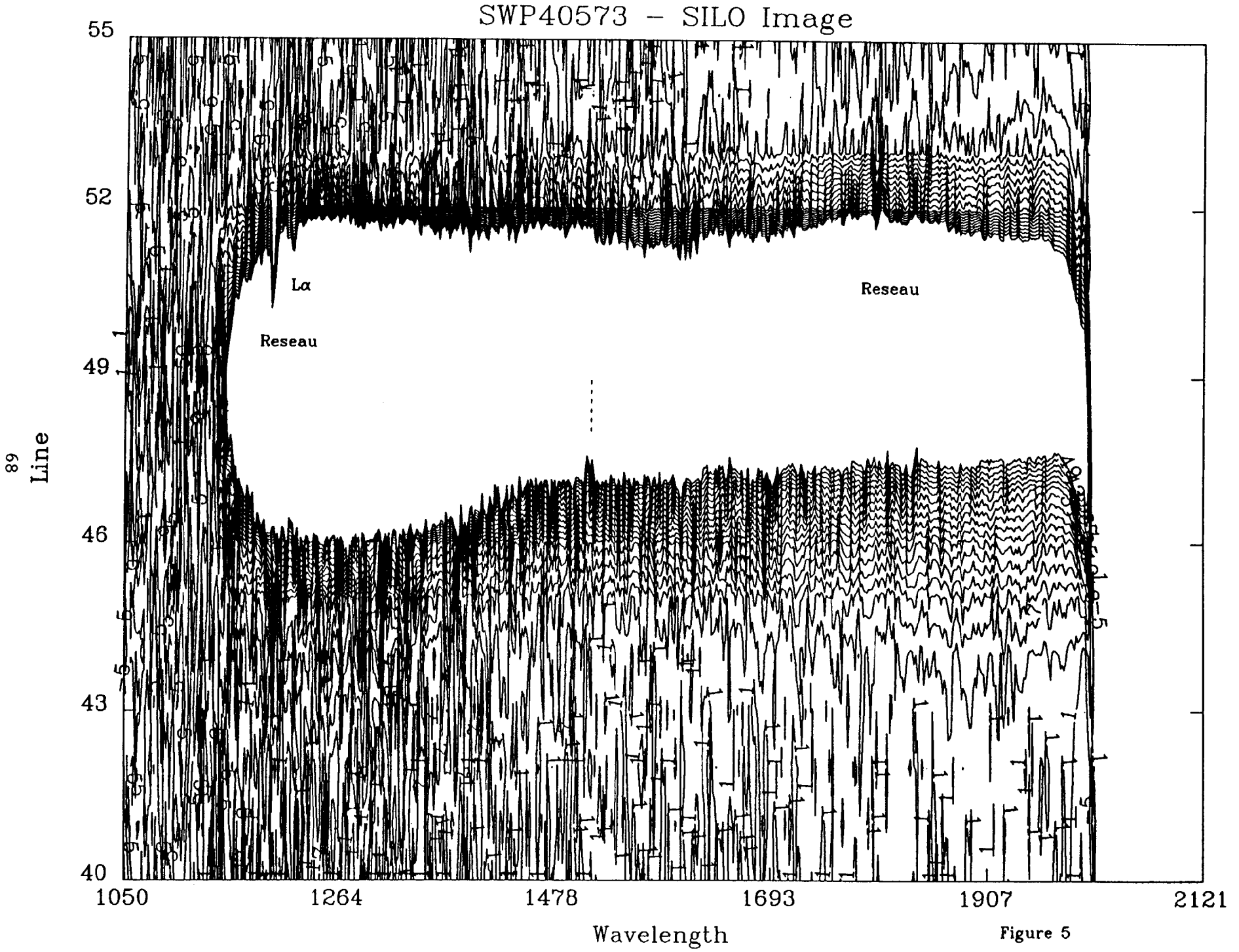
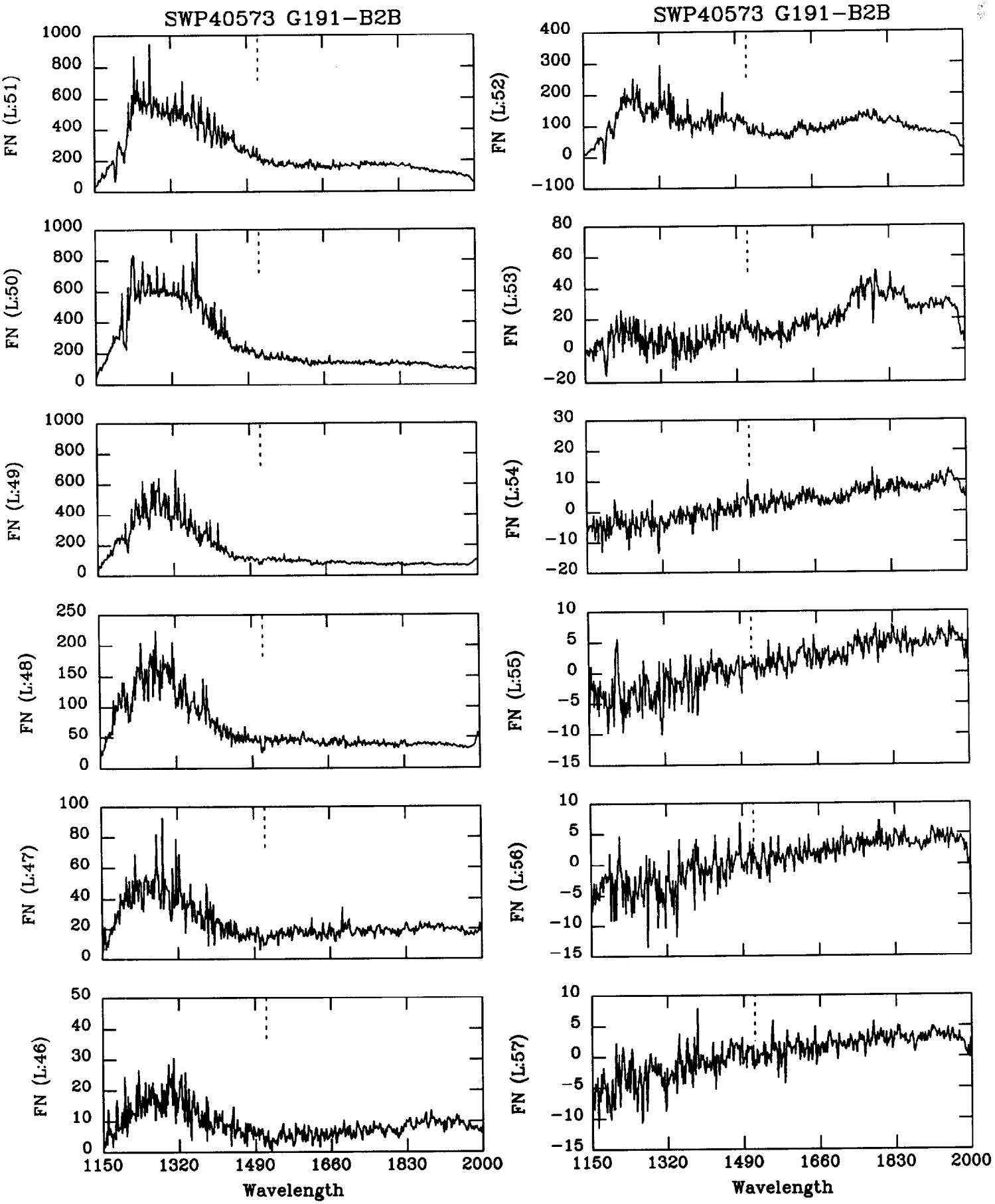

SWP40573 – SILO Image
55
52
49
46
43
40
Line
89
Lα
Reseau
Reseau
1050
1264
1478
1693
1907
2121
Wavelength

Figure 5

Figure 6


SWP40573 G191-B2B
SWP40573 G191-B2B
FN (L:51)
FN (L:52)
FN (L:50)
FN (L:53)
FN (L:49)
FN (L:54)
FN (L:48)
FN (L:55)
FN (L:47)
FN (L:56)
FN (L:46)
FN (L:57)
1150
1320
1490
1660
1830
2000
Wavelength
Wavelength