First Order LSFs for the Nominal vs. E1 Apertures

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ABSTRACT

A calibration program was carried out to determine the spectroscopic LSFs at the pseudo-aperture locations (E1 apertures) for the first order CCD modes. Observations were taken with the narrowest 52X0.05 arcsec slit to minimize the effect of the aperture on the determination of the LSFs. Observations were repeated in the nominal location (close to the middle of the detector) as well as the pseudo (E1) location (close to row 900) of the apertures to facilitate easy comparison of the LSFs at the two locations. Observations of the emission line object V1016-Cyg were used to determine the LSFs in G430L and G750L modes. A comparison of the LSFs at the nominal and the pseudo locations show no measurable difference for all the modes. This suggests that the LSFs determined for the nominal positions of the slits can also be used for the pseudo locations.

1. Introduction

STIS CCD has charge transfer inefficiency (CTI) effects which are increasing with time. The lower part of the CCD suffers most from the CTI effects, and the effect of the CTI decreases progressively for the upper rows. As a result, it is often desirable to place the source at the upper part of the detector in order to minimize the CTI effects on spectra obtained in first-order CCD modes. Hence a set of pseudo-aperture locations (E1 apertures) were implemented corresponding to approximately row 900 of the detector. However, it was unclear whether the LSFs at these locations are substantially different from the LSFs at nominal aperture locations close to row 512 of the detector. A calibration program (GO 8929) was carried out to check whether the LSFs at the two locations are different, and if so, to determine the exact shape of the LSFs for the pseudo-apertures.

2. Observations

Observations were taken with the narrowest 52X0.05 arcsec slit, where the effect of the aperture on the LSFs is expected to be small. Observations of the emission line object V1016-Cyg were used to determine the LSFs in G430L and G750L modes. For these L-
modes, observations were taken both in the nominal aperture location (close to the middle of the detector), as well as the pseudo aperture location (E1, close to row 900) to facilitate easy comparison of the LSFs at the two locations. Hen 1357 and 51 Peg were observed for G430M and G750M modes. However, these observations were taken only at the pseudo-aperture locations.

3. Data Analysis and Results

The x1d files were used to compare the LSFs obtained in the nominal and the pseudo locations. The specific files used for G430L observations are io6ih10020_crj_x1d.fits and o6ih10040_crj_x1d.fits. The specific files used for the G750L observations are o6ih100e0_crj_x1d.fits and o6ih100g0_crj_x1d.fits. Figures 1 and 2 show the LSFs obtained for the blue and red parts of the G430L mode, respectively, and Figures 3 and 4 show the LSFs obtained for the blue and red parts of the G750L mode, respectively. The dotted lines are the LSFs obtained at the nominal aperture locations and the solid lines are the LSFs obtained at the pseudo aperture locations. There is no measurable difference between the LSFs observed at the nominal and pseudo locations for either of these two modes.

Linewidths were measured at various positions of the spectrum for the nominal and the pseudo locations. While the absolute linewidths in units of pixels vary over the spectrum (as seen from Table 1), the linewidths at the same part of the spectrum are identical for both modes. For example, Table 1 shows the derived line widths at two positions for the G750L mode. Considering the fact that the line widths are expected to be accurate to about 0.05 pixels, there is a remarkable agreement between the linewidths derived for the two aperture locations.

This result is reassuring, indicating that the spectra obtained at all locations for extended sources can be treated with the same LSF (as has indeed been traditionally done). This result is also not surprising, since the width of the apertures are expected to be uniform over the entire length of the slit.

<table>
<thead>
<tr>
<th>X-Location (pix no.)</th>
<th>Line Width for the nominal slit (pixels in x-direction)</th>
<th>Line Width for E1 slit (pixels in x-direction)</th>
</tr>
</thead>
<tbody>
<tr>
<td>265</td>
<td>1.92</td>
<td>1.92</td>
</tr>
<tr>
<td>170</td>
<td>1.66</td>
<td>1.64</td>
</tr>
<tr>
<td>92</td>
<td>1.47</td>
<td>1.45</td>
</tr>
</tbody>
</table>
The expected difference for the wider slits is also small since the PSF variation across the STIS CCD detector is not large. In any case, the simulations of the LSFs for the wider slits were done using the LSFs obtained at the narrowest slits, which were then convolved with appropriate PSFs. It is worth noting here the location and orientation of the “ghost” image (the intensity of which is about 1% that of the primary image, STIS Instrument Handbook, Fig. 5.10) is expected to be different for the nominal and the pseudo apertures. These observations were taken with the 0.05 arcsec slits for which the effect of the “ghost” is minimal. Hence these LSFs do not take the effect of the “ghost” into account.

For the G430M and G750M modes, the observations were taken only at the pseudo-locations. In principle, these observations can be compared with the previous observations taken at the nominal locations to check if there is any difference between the LSFs taken at the nominal and the pseudo aperture locations. However, given the fact that the L-modes show no measurable difference, and that the slit used is identical for the L and M modes, it is clear that the M-mode LSFs should be identical for the M modes as well. Hence, such an additional exercise was deemed unnecessary.

The above results suggest that the LSFs determined for the nominal positions of the slits (available from http://www.stsci.edu/hst/stis/performance/spectral_resolution/) can also be used for the pseudo (E1) locations.
Figure 1: The LSFs for the G430L mode.
Figure 2: The LSFs for the G430L mode.
Figure 3: The LSFs for the G750L mode.
Figure 4: The LSFs for the G750L mode.