Location of FOS Polarimetry Spectra

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Abstract

The location of the spectra for polarimetric observations were determined for both the red and blue detectors using calibration maps obtained on May 12 1993 (proposal ID 4697). The analysis for the blue side detector showed that the positions of the spectra are relatively stable. Since the in-orbit GIMP corrections are now conducted routinely, the red detector can be used for polarimetry. Hence, in-flight Y-bases for the red detector were determined for the first time.

1.Observations and Analysis

The FOS polarizer splits the light passing through it into two beams with orthogonal states of linear polarization. These two beams (lower and upper spectra corresponding to the ordinary and extra-ordinary rays) are seen as two nearly parallel spectra on the detector, since the splitting is in the direction perpendicular to the direction of dispersion. To obtain polarimetry data the two spectra have to be sampled at each position angle of the waveplate. The two spectra are acquired by sampling at two positions in the Y-direction (the direction perpendicular to the diode array) of the FOS detector. This type of sampling implies that at a given time only half of the incoming flux is recorded on the diode array. To achieve the sampling described, the location of the lower spectrum (YBASE), the offset between the lower and upper spectra (YRANGE) and the size of the deflections (YPITCH) are required. At the start of the calibration observation optimum values for YBASE, YRANGE and YPITCH were determined for each detector and grating combination. The observations in the calibration program were then used to verify/correct the values for YBASE, YRANGE and YPITCH.

Calibration observations to determine the location of the FOS spectropolarimetry spectra for both the red and blue detectors were obtained on May 12 1993 (proposal ID 4697). The observations consist of maps with YSTEPS = 24 centered approximately at the expected locations of each of the lower and upper spectra. The map is obtained by sampling the 512 diodes in the array in 24 YSTEPS. The image therefore has 512×24 pixels in the figure. Cross-cuts through the maps as described below were used to determine the values

for YBASE, YRANGE and YPITCH. Since we do not expect the position of the spectrum to vary on small scales, the data were binned over 30 diodes for each cross-cut. An example of the YSTEPs vs counts in each bin of 30 diodes is shown in Figure 1. Next, the YSTEP, and hence the YBASE, with the most counts (above the noise level) for each cut was determined. Depending on the grating the location of the spectra show some S-shaped distortion (see Figure 2). The optimal y-base value determined for the location of the spectra was such that it minimized the effects of the distortion. Once the locations of the lower and upper spectra were determined the values of YBASE, YRANGE and YPITCH were determined as follows;

YBASE = y-base value which gives the location of the lower spectrum
YRANGE = difference in the y-bases of the lower and upper spectra/16
YPITCH = YDAC units $\times$ 2048 / y-base units

The YPITCH values used for the observations were the values optimized for binary target acquisition. All the spectra observed for this analysis are within the nominal range, hence, it was not necessary to change the YPITCH values.

2. Results

The y-bases determined for both the blue and red sides are shown in Table 1. For the G130H grating the curvature of the spectrum in the short wavelength region is very steep. Thus optimizing the y-base value was very difficult. Hence, we have optimized the y-base value for the 1300 – 1600 Å region. Since the blue side was calibrated earlier we could check on the stability of the location of the spectra. We found that the variation was less than 15 y-bases. This variation can easily be due to the filter grating wheel non-repeatablity. Therefore, the optimum YBASE, YRANGE and YPITCH values for the blue side are the average of the present analysis and the previous analysis (CAL/FOS-78). The YBASE, YRANGE and YPITCH values now in the Pipeline Data Base for both the red and blue detectors are shown in Table 2.

Table 1: Y–base values for the Spectra

Grating	Waveplate	Lower spectrum (y–base)	Upper spectrum (y–base)
		Blue Detector	
G130H	B	−1135	−250
G190H	B	−1473	−609
G270H	B	−1853	−1133
G160L	B	−1354	−506
		Red Detector	
G190H	B	−776	88
G270H	B	−99	717
G400H	A	−1909	−1093

Table 2: Location of Spectra

Grating	Waveplate	YBASE	YRANGE	YPITCH
		Blue Detector		
G130H	B	−1121	54	1846
G190H	B	−1494	54	1846
G270H	B	−1878	45	2043
G160L	B	−1354	53	1846
		Red Detector		
G190H	B	−776	54	1834
G270H	B	−99	51	1834
G400H	A	−1909	51	1834

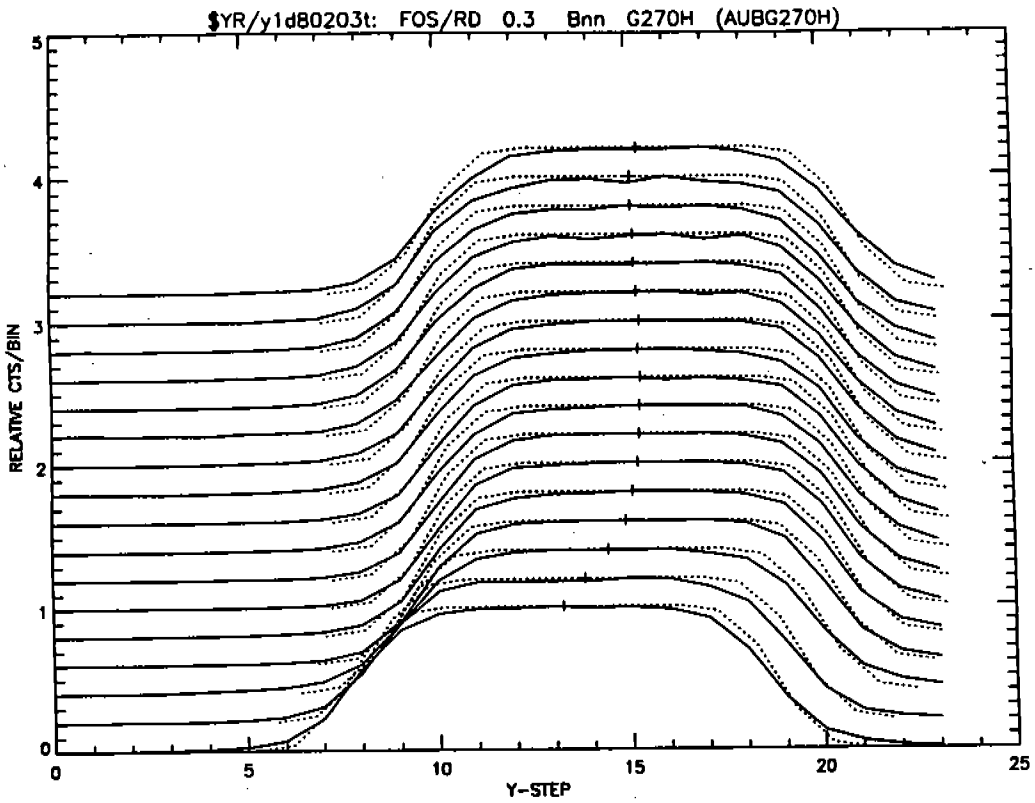

FIG-1. An example of the YSTEPs vs counts in each bin of 30 diodes used to determine the location of the spectrum. The dotted line is the cross-correlation function whose peak (indicated by crosses) is the best position of the spectrum for that bin.

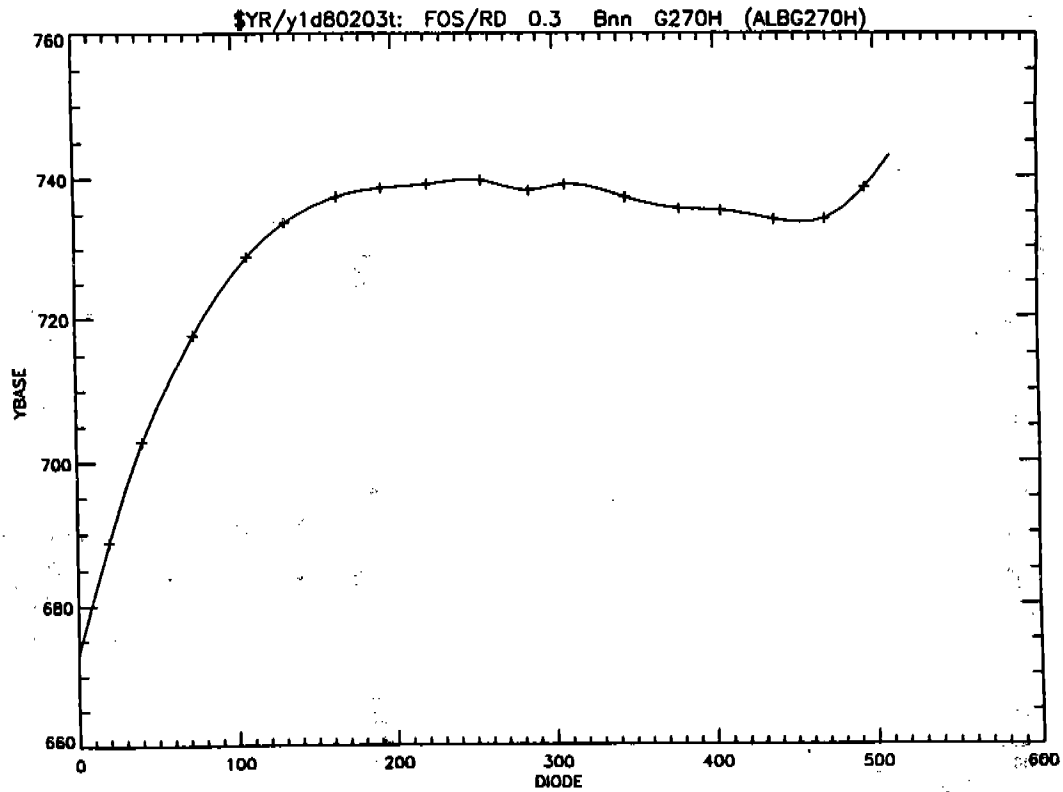

FIG-2. An example of the S-shaped distortion in the location of the spectrum on the diode array.