THE FOS DIODE HEIGHT

I. N. Evans
Space Telescope Science Institute

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Abstract

The effective height of the FOS diode array is determined to be $1\farcs291 \pm 0\farcs007$ for both the blue and red Digicon detectors from data acquired during SMOV proposal 5626. These determinations are combined with the requirement that the effective diode height equal 256 Y-bases to derive revised Y-pitch values for the detectors. Y plate scale and YUSCALE values corresponding to the revised Y-pitch values are computed.

I. Test Description

The FOS plate scale is determined for both the blue and detectors by SMOV proposal 5626. This proposal executed on 1994 March 30 (day 94.089; blue side), and 1994 March 31 (day 94.090; red side). The operation of this proposal is described in detail by Koratkar et al. (1994), which should be consulted for additional information. Suffice it to say here that for each detector, two dwell scans of a star with accurate astrometric coordinates are performed to place the target at 30 distinct locations within the `4.3` aperture (for the blue side, data from only 29 steps are usable). At each step position, a short exposure white light (mirror) `ACQ` image is obtained with 64 Y-steps each separated by 16 Y-bases.

During the `ACQ` scan, the image of the photocathode is electromagnetically deflected in Y so that different portions of the photocathode are positioned on the diode array at each successive Y-step. Initially, the image of the star on the photocathode will fall beyond the $+Y$ edge of the diode array. The Y position of each subsequent step is incremented by 16 Y-bases. Eventually the star is imaged onto the $+Y$ edge of the diode array, and then remain on the diode array for successive Y-steps until the $-Y$ edge of the diode array is reached. Since the FWHM of the core of the point spread function (PSF) is $\sim$10–15 Y-bases in height, and since the wings of the PSF extend even further, a smooth variation of intensity is detected as the PSF crosses the diode Y edges. Measuring the separation between the half intensity points in the Y direction provides a direct measure of the effective diode height in Y-bases. The latter is converted to physical units through application of the FOS plate scale.

II. Results

The upper and lower half intensity points of the stellar image for each `ACQ` scan are determined using the STSDAS task APERLOCY. In Table 1 the observed stellar image heights in

units of Y-bases (i.e., $Y_{\rm upper} - Y_{\rm lower}$) from each individual measurement are presented, together with the mean values. The Y plate scale values from Koratkar et al. (1994; $0\farcs0786\,{\rm pix}^{-1}$ blue, $0\farcs0812\,{\rm pix}^{-1}$ red, where $1\,{\rm pix} = 16\,Y$-bases) are used to convert from Y-bases to arcseconds, yielding stellar image heights of $1\farcs294 \pm 0\farcs011$ (blue) and $1\farcs290 \pm 0\farcs009$ (red). These values are the convolution of the diode height and the PSF. Deconvolving an assumed PSF core width $\sim 0\farcs060$ yields a measured diode height of $1\farcs293 \pm 0\farcs011$ for the blue side and $1\farcs289 \pm 0\farcs009$ for the red side. The computed diode height is almost independent of the assumed PSF core width for reasonable values of the latter. Since the measured diode heights for both detectors are in good agreement, the mean value, $1\farcs291 \pm 0\farcs007$, is adopted as the effective diode height for both detectors. This measurement of the effective diode height is 4.8% larger than the nominal post-COSTAR value of $1\farcs232$ (Koratkar et al. 1994), but is consistent with the estimates of Bhattacharya and Hartig (1991).

Again using the plate scale values from Koratkar et al. (1994), the effective diode height determined above corresponds to 262.80 Y-bases for the blue detector, and 254.38 Y-bases for the red detector. The binary search target acquisition processor requires that the detector Y-pitch be set such that the effective diode height is equal to 256 Y-bases. To determine a revised value for the Y-pitch from the current value, the following equation is used:

$$Y'_{\rm pitch} = \frac{Y_{\rm height}}{256} Y_{\rm pitch}, \tag{1}$$

where $Y_{\rm pitch}$ is the current value of the detector Y-pitch, $Y_{\rm height}$ is the current effective diode height in units of Y-bases, and $Y'_{\rm pitch}$ is the new Y-pitch value to be determined.

Using equation (1), scaling to 256 Y-bases/effective diode height yields for the blue detector a revised Y-pitch value

$$\begin{aligned} Y'_{\rm pitch} &= \frac{262.80}{256} 1846, \\ &= 1895, \end{aligned}$$

where the current detector Y-pitch is 1846. Similarly, for the red detector,

$$\begin{aligned} Y'_{\rm pitch} &= \frac{254.38}{256} 1834, \\ &= 1822, \end{aligned}$$

where the current detector Y-pitch is 1834.

With the Y-pitch values set to give 256 Y-bases/effective diode height and an effective diode height of $1\farcs291$, the revised Y plate scale for both detectors would be identical, with a value of $0\farcs08069\,{\rm pix}^{-1}$ ($1\,{\rm pix} = 16\,Y$-bases), corresponding to a YUSCALE value (in the Y direction) of 4957.40 in units of 1/32 pseudo-microns per arcsecond. This differs from the current PDB value (5216.82) by 5.0%.

References

Bhattacharya, B. and Hartig, G. 1991, FOS Instrument Science Report CAL/FOS-068

Koratkar, A., Wheeler, T., Evans, I., Lupie, O., Taylor, C., Keyes, C., and Kinney, A. 1994, FOS Instrument Science Report CAL/FOS-123

Table 1

ACQ Scan Stellar Image Y-Height Measurements

Blue		Red	
Rootname	Y-bases	Rootname	Y-bases
Y2B80105T	262.71	Y2B80205T	252.79
		Y2B80206T	257.96
Y2B80107T	266.61	Y2B80207T	254.92
Y2B80108T	266.56	Y2B80208T	255.60
Y2B80109T	266.10	Y2B80209T	256.19
Y2B8010AT	262.92	Y2B8020AT	251.96
Y2B8010BT	263.79	Y2B8020BT	255.02
Y2B8010CT	264.27	Y2B8020CT	255.02
Y2B8010DT	261.70	Y2B8020DT	254.16
Y2B8010ET	264.52	Y2B8020ET	256.86
Y2B8010FT	261.22	Y2B8020FT	251.81
Y2B8010GT	259.12	Y2B8020GT	252.02
Y2B8010HT	262.61	Y2B8020HT	251.76
Y2B8010IT	261.67	Y2B8020IT	253.83
Y2B8010JT	262.88	Y2B8020JT	255.07
Y2B8010KT	263.70	Y2B8020KT	253.89
Y2B8010LT	265.13	Y2B8020LT	254.71
Y2B8010MT	266.48	Y2B8020MT	255.03
Y2B8010NT	267.32	Y2B8020NT	255.38
Y2B8010OT	265.85	Y2B8020OT	253.98
Y2B8010PT	263.15	Y2B8020PT	251.59
Y2B8010QT	262.64	Y2B8020QT	255.24
Y2B8010RT	265.12	Y2B8020RT	255.18
Y2B8010ST	262.72	Y2B8020ST	250.65
Y2B8010TT	263.68	Y2B8020TT	255.33
Y2B8010UT	262.08	Y2B8020UT	254.34
Y2B8010VT	261.20	Y2B8020VT	252.33
Y2B8010WT	261.28	Y2B8020WT	254.12
Y2B8010XT	259.14	Y2B8020XT	254.73
Y2B8010YT	262.97	Y2B8020YT	254.69
Mean	263.42 ± 2.14	Mean	254.20 ± 1.69