RESULTS OF TESTS RELATED TO TARGET ACQUISITION, MARCH-AUGUST, 1988

A. L. Kinney

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ABSTRACT

Several tests related to target acquisition were carried out at LMSC in March and August of this year. These concerned the sensitivity of the interstices of the diodes and relative aperture location when illuminated by the TA LEDs compared to their location when illuminated by the Ambient ST Optical Simulator (ASTOS).

The interstices were found to have effectively half the sensitivity of the diodes themselves when illuminated with a spot of approximately 14 μ. The aperture images remained in the same position on the blue side when illuminated by the TA LEDs and by the ASTOS. However, on the red side the apparent aperture position was different by about 12 microns in Y (perpendicular to the diode array) when illuminated by the ASTOS in comparison to the position when illuminated by the TA LEDs. This difference in position must be removed when offsetting to FOS apertures after performing an LED aperture acquisition, since the shift is comparable to the size of the A4 (14 μ) aperture image.

The apertures were illuminated by the LEDs and mapped. Recommendations for exposure times for aperture acquisitions are made based on the counts in these maps.

I. SENSITIVITY OF DIODE INTERSTICES

A target was simulated by illuminating the lower A4 aperture ($0''.1$) with the ASTOS FEL lamp (a 1000 Watt tungsten halogen lamp, number GS-245 set at 7.0 amps) with the camera mirror in place on the blue side. This produces an image at the photocathode of about 14 μ square. A series of 10 exposures were taken with XSTEP=1, and with XBASE stepping across the width of the diode. Figure 1 shows the change in total counts as the aperture image steps across the edge of the diode.

If we assume that the interstices have uniform sensitivity across their nominal extent of 6.4 XBASE units, we find that the region has about half the sensitivity of the diodes themselves when illuminated as described. An extended source of illumination cannot be used to probe the structure of the region between the diodes. The structure is of great interest because point sources could disappear into a blind area in the interstices. X-stepping should get around that problem, but more information on the actual structure would be useful. These data are consistent with the interstices being totally dead over a region the size of the expected point source image.

II. APERTURE LOCATION ACCORDING TO ILLUMINATION

During TA firmware tests at LMSC in March, there was seen to be a difference in the position found by the firmware depending on whether the apertures were illuminated by the TA LEDs or by the ASTOS. This difference was verified by running the firmware using both the leading and the trailing edge, and by mapping the apertures when illuminated by both the LEDs and the ASTOS. In August, after the replacement of the heatpipes, the maps were done again.

Both the ASTOS the TA LEDs were used to illuminate the apertures on both the red and the blue sides. The apertures were mapped with 85 YSTEPS. A cross correlation was done between the mapped apertures illuminated by the ASTOS and those illuminated by the TA LEDs using XCOR and FGRCM, two IDL programs designed by Hartig and Lindler. The relative positions in X and in Y are listed in Table 1 for the two firmware tests in March and for the aperture maps in both March and August.

The aperture positions with the two sources of illumination differ little on the blue side - less than 1 μ on average in X, and about 1.2 μ in Y. The aperture positions differ somewhat more on the red side however, by 2.3 μ in X and by 12.1 μ in Y on average. These maps gave results consistent with the maps taken in March, and with firmware tests in March. In all cases, the blue side positions differed by approximately 2 μ between the TA LED illuminated apertures and the ASTOS illuminated apertures, while the red side positions differed in the X direction by about 2 μ but differed in the Y direction by 12 to 13 μ. There is a trend for the differences to be the smallest for the smallest apertures, and to be the largest for the largest apertures.

The source of the offset is probably the non-uniform illumination of the TA LEDs and the strong possibility that the LED does not fill the beam, but only catches an edge of the optics. In contrast, the ASTOS fills the optics uniformly and should give a good approximation of the aperture positions when illuminated by the telescope.

The difference in position in Y on the red side must be taken into account when offsetting to the A4 aperture. If an LED acquisition were done for the A4 0.″1 aperture, and then an offset were performed without correction, the position of the telescope would be off by almost the full width of the aperture, placing the target well outside of the aperture.

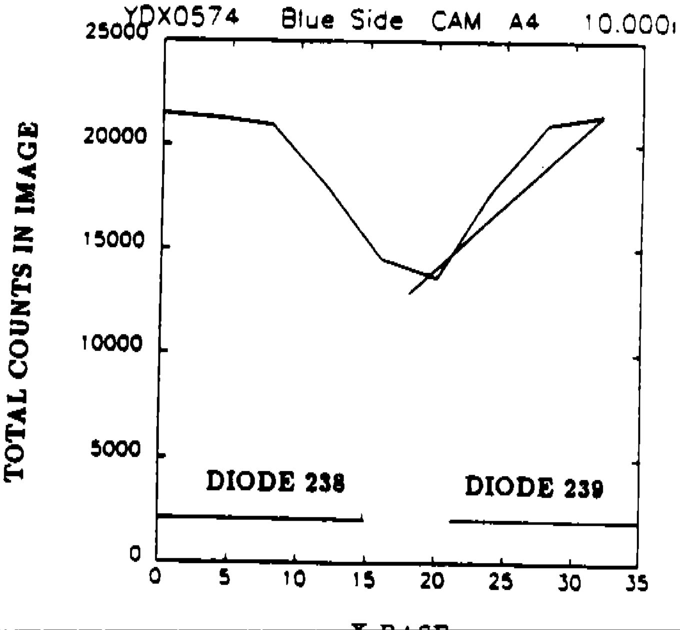

Figure 1 The total counts in the image versus the offset XBASE position.

III. LED EXPOSURE TIMES

Aperture acquisitions will be done for the smallest (A4 0".1 square, A3 0".25 square and B3 0".3 circular) apertures by illuminating the aperture with the TA LEDs and using on-board Binary Search or Firmware acquisitions. Maps of the apertures illuminated by the TA LEDs were done so that exposure times could be estimated. The peak count rates for apertures illuminated by the TA LEDs are listed in Table 2, along with exposure times where applicable.

Simulations and calculations show that there should be at least 300 counts in each y-step of an acquisition exposure (see the FOS Target Acquisition Handbook, CAL/FOS-043 for more details). This leads to quite short exposure times, where most of the total time of the acquisition is in overhead, not in actual exposure. It is assumed that there will be 11 y-steps for a Binary Search and 16 y-steps for a Firmware acquisition, so the exposure times as listed on the logsheets are the time needed for 1 y-step multiplied by 11 for Binary Search and by 16 for Firmware. Exposure times of 11 seconds (corresponding to 1 second per y-step) are recommended for most of the apertures that we expect to use for aperture acquisitions in Binary Search except for the smallest (A4) aperture on the blue side, where an exposure time of 44 seconds is recommended. Exposure times of 16 seconds (corresponding to 1 second per y-step) are recommended for most Firmware aperture acquisitions except for acquisitions of the smallest (A4) aperture on the blue side, where an exposure time of 64 seconds is recommended. Exposure times have also been given for the larger apertures, although those apertures will not ordinarily need aperture acquisitions. Since Binary Search cannot be performed on the largest apertures, no times are given for them.

These exposure times will lead to higher counts in the peak than the nominal 300. This effects the optional parameter BRIGHT. BRIGHT and FAINT are used in acquisition software as the upper and lower limits of counts for acceptable targets. BRIGHT is set at 10 times the number of counts expected if the entire exposure time were on-target. Recommended values for BRIGHT and recommended exposure times are given in Table 2. The exposure times for the larger apertures are calculated so that the BRIGHT optional parameter does not exceed 6.5E5, so that BRIGHT will not overflow.

The TA LEDs do not illuminate the apertures uniformly. Figure 2 shows a map of the TA aperture (A1) on both the blue and the red side when illuminated by the TA LEDs. The blue side peaks at the x edge of the aperture at diode number 235 and falls off steeply towards the other side of the aperture at diode number 245. The counts on the blue side decrease slightly as the diode array is stepped across the aperture. The red side is more uniform than the blue. It shows slightly lower counts at diode 262 and slightly higher counts towards the other edge of the aperture at diode 275. The counts on the red side increase slightly as the diode array is stepped across the aperture.

TABLE 1

BLUE SIDE APERTURE LOCATIONS

Ap	ΔX^+ Fw*	ΔX^+ Aug.	ΔX^+ Ave.	ΔY^+ Fw*	ΔY^+ Aug.	ΔY^+ Ave.	Ap + Size
B1	3.12, 3.12	-0.83	1.80	2.49, 0.83	3.13	2.15	70
B2	1.56, 1.56	0.43	1.18	0.00, 1.66	1.43	1.03	42
A2	6.24, 3.12	0.40	3.25	4.15, 4.98	1.90	3.68	70
A3	1.56, 1.56	0.64	1.25	3.32, 3.32	0.56	2.40	35
A4	0.00, 0.00	2.21	0.74	1.66, 3.32	-1.02	1.32	14
Ave.	2.49, 1.87	0.56		2.32, 2.82	1.20		

RED SIDE APERTURE LOCATIONS

Ap	ΔX^+ Fw*	ΔX^+ March	ΔX^+ Aug.	ΔX^+ Ave.	ΔY^+ Fw*	ΔY^+ March	ΔY^+ Aug.	ΔY^+ Ave.	Ap + Size
B1	1.56, 1.56	2.28	2.76	2.04	-13.3, -13.3	-14.6	-12.6	-13.4	70
B2	3.12, 1.56	1.98	1.79	2.11	-10.8, -10.8	-13.4	-12.1	-11.8	42
A2	3.12, 3.12	2.75	2.43	2.86	-16.6, -16.6	-14.6	-12.6	-15.1	70
A3	1.56, 1.56	2.08	2.51	1.92	-13.3, -11.6	-12.9	-12.9	-12.7	35
A4	0.00, 1.56	1.36	2.02	1.24	-10.0, -9.10	-11.2	-10.1	-10.1	14
Ave.	1.92, 1.92	2.09	2.30		12.8, 12.3	-13.34	-12.07		

+Differences in positions are in units of μ (TA LED - ASTOS) and can be compared to the size of the aperture used, also given in μ.

* The firware tests were run twice on the blue side (March 15th and 16th) and twice on the red side (March 17th).

The firmware test resolution is 1.56 μ in X and 0.83 μ in Y. After the column of firmware position and aperture map position, the average of those positions is given.

TABLE 2

BLUE TA LED EXPOSURES

Aperture	Peak Count Rates	Binary Search Exp. Time	Firmware Exp. Time	BRIGHT
B1	4869	11s	16s	1.35E5
B2	1986	11s	16s	5.46E4
B3	12248	11s	16s	3.35E5
A1	35790	NA	10s	6.50E5
A2L	6180	11s	16s	1.70E5
A2U	5047	11s	16s	1.39E5
A3L	1859	11s	16s	5.11E4
A3U	1647	11s	16s	4.53E4
A4L	318	44s	64s	3.30E4*
A4U	308	44s	64s	3.30E4*
C1L	14646	11s	16s	4.02E5
C1U	12944	11s	16s	3.54E5
C2	12304	NA	16s	3.38E5
C3	20318	NA	16s	5.58E5
C4	14991	NA	16s	4.12E5

RED TA LED EXPOSURES

Aperture	Peak Count Rates	Binary Search Exp. Time	Firmware Exp. Time	BRIGHT
B1	24767	10s	15s	6.50E5
B2	9544	11s	16s	2.62E5
B3	57595	4.5s	6.5s	6.50E5
A1	102428	NA	3.6s	6.50E5
A2L	23810	10s	15s	6.50E5
A2U	29477	8.8s	12.8s	6.50E5
A3L	7336	11s	16s	2.01E5
A3U	9049	11s	16s	2.49E5
A4L	1521	11s	16s	3.30E4*
A4U	1152	11s	16s	3.30E4*
C1L	51010	5s	7.4s	6.50E5
C1U	61317	4.2s	6.1s	6.50E5
C2	61456	NA	6.1s	6.50E5
C3	75296	NA	5.0s	6.50E5
C4	72668	NA	5.2s	6.50E5

Note that the peak counts are corrected for paired pulse correction, which is about a factor of 2 for the largest aperture (A1) on the red side.

* This is the default value of the optional parameter BRIGHT.

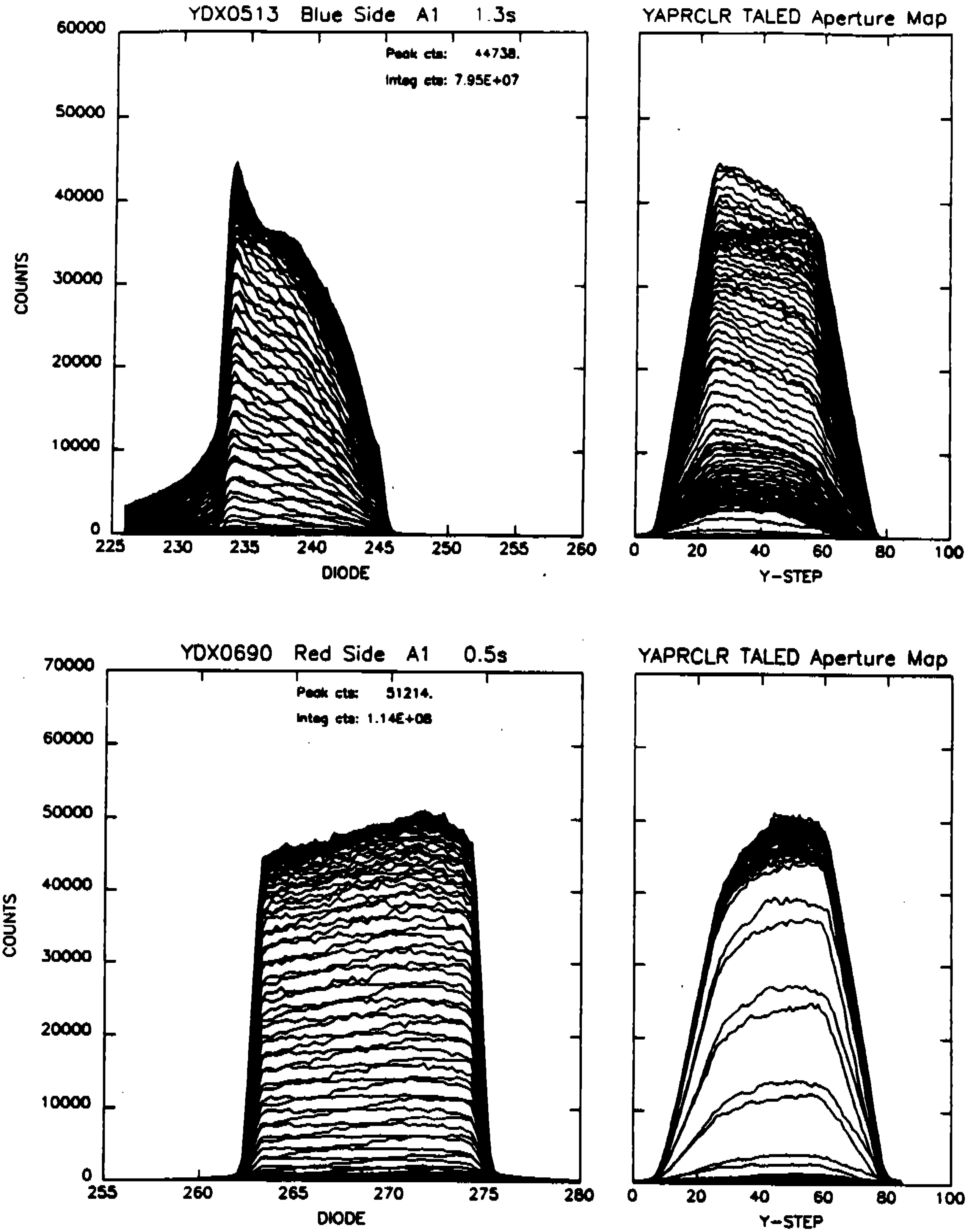

FIGURE 2 Aperture maps of the large (A1) aperture illuminated by the TA LEDs. Top figure is data file YDX0513. Bottom figure is data file YDX0690. Both data files are processed by the program YAPRCLR.