Short Version

ANALYSIS OF FOS ON-ORBIT DETECTOR BACKGROUND WITH BURST NOISE REJECTION

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Abstract

We have reduced and analyzed a subset of the FOS detector background data from proposal SV1316 as a function of the burst noise rejection parameter "REJLIM". For a frame time of 0.25 seconds and the lowest possible rejection setting of 2 or more counts per array readout (REJLIM=1), the FOS detector background is reduced to around the 0.002c/s/d level (about 20% of the "normal" background). As with the normal background, the REJLIM background is a function of geomagnetic latitude. Comparison of this REJLIM detector data with expectations from a Poisson distribution generally indicates that a large fraction of the noise has a burst noise origin. The use of REJLIM should lead to improved S/N for faint object observations and an improvement of the FOS limiting magnitude performance. However, for the REJLIM=1 setting, the Red Side frame time was not set fast enough to distinquish between a burst noise or Poisson character for the detector background. SV1316 with REJLIM=1 should be rerun on the Red side with a 0.05 second or shorter frame time.

I. FOS Detector Background Considerations

The FOS detector background specification is $\leq$ 0.002 counts/second/diode. Lockheed thermo-vacuum ground measurements in 1985 yielded detector background numbers a factor of 7 better than this specification (i.e. $\sim$.0003 c/s/d.)

From the beginning of the FOS design phase, it had been predicted that the orbital radiation field would considerably increase the detector background above the intrinsic "ground" measured detector noise. Indeed, at the time, calculations for the predicted level of FOS detector orbital noise yielded numbers in excess of 0.01 c/s/d. However, it was believed that this "orbital noise" enhancement would have a burst character where several or more diodes would simultaneously register a count as a high energy particle deposited energy in the detector faceplate and diode array target. To reduce the background to the specification, a burst noise rejection feature was designed into the FOS that would edit out, in real time, frames of data that had counts exceeding a prescribed number.

The FOS was designed so that the frame time could be set fast enough so that most frames would be expected from Poisson statistics of starlight to have at most only 1 count per 512 diode data frame for faint objects. It was believed that any larger summed count would be caused by the orbital noise source and be rejected by the FOS software. This technique proved effective during our Digicon ground based astronomy program (Beaver *et al* 1976) in removing cosmic ray burst noise and observatory transient electrical noise (such as guider relay glitches) from our science data.

At present the default FOS frame time is 0.25 seconds, after which the total number of counts from the array can be summed and tested for frame rejection. However the frame time can be set by the observer down to a minimal value of 0.02 seconds, limited by the FOS hardware readout speed. Following each frame time is a dead time of 0.01 seconds in which the electronics are reinitialized. The observational strategy for selecting the optimum rejection parameter "REJLIM" and FOS frame rate is discussed by Rosenblatt *et al* 1991a and the reader is referred to that article for a discussion of the issues. Improper setup of the FOS burst noise rejection software could lead to rejection of all the observer's science data! However some FOS faint observations, such as the FOS/GHRS HeII Gunn-Peterson Program, may only be possible with the successful operation of REJLIM.

Model calculations of the Blue detector background (Rosenblatt *et al.* 1991b) indicate that most of the FOS orbital background originates from cosmic ray transits through the Digicon faceplate. The average transit of a single cosmic ray proton through the Digicon faceplate results in the near instantaneous flash of several thousand Cerenkov photons onto the Digicon photocathode! However, it is calculated that only about 14% of the cosmic rays that transit the faceplate cause diode count events in the detector due to geometric dilution and other attenuation factors. Additionally the model predicts that for those cosmic rays that result in registered counts from the FOS detector, 15% of these events are detected as a single count in the diode array. Thus for a rejection setting of 2 or more counts (REJLIM=1), the model suggests, at best, about an 85% reduction in the FOS Blue detector background. One of the goals of this series of observations is to measure the FOS background performance at various "REJLIM" settings. Model predictions (Rosenblatt *et al* 1991a) indicate that the FOS limiting magnitude performance should be improved by several magnitudes by the use of the FOS burst noise rejection mode.

II. Proposal SV1316 REJLIM Data

In CAL/FOS-071 and CAL/FOS-080 Instrument Science Reports it is shown that without burst noise rejection the "normal" measured FOS detector orbital background varies by as much as a factor of 2 during an orbit and that this variation is correlated with geomagnetic latitude. The "normal" orbital FOS background variation is shown in Table 1. Note that at the same latitude the "normal" Red side detector background is about 1.7 times greater than the "normal" Blue side background.

SV1316 is the standard FOS Dark Measurements Proposal. In a number of SV runs of SV1316, REJLIM was disabled by setting it to -1 (Lyons *et al* CAL/FOS-080). However for the runs analyzed in this report, REJLIM was set to a positive integer. The output of each run in SV1316 is comprised of 16 separate sets of 23 observations each. Each observation is 5 seconds long so each set is 115 seconds. The frame live time selected for all these observations is 0.25 seconds. During the readout of each 0.25 second frame, the diode array count is summed; if the sum is greater than the REJLIM value supplied, then that frame is rejected. The substepping and overscan were set such that 512 channels were read out. There is therefore a direct relationship between diode number and channel.

Table 2 lists the file information for all the SV1316 REJLIM observations. In the Appendix* are the background reductions for all the SV1316 REJLIM runs, broken up into their component files. In order to compare these results to the results from the previous "normal" (REJLIM=-1) SV1316 measures for determining the detector background, it is necessary to determine the geomagnetic latitude for the new data. This has been done and is listed in the Appendix tables. The number of times that REJLIM was exceeded during each exposure is also indicated. The total planned exposure time for each observation run is 1820 seconds, however the actual exposure time is less by the number of frames rejected multiplied by the frame time of 0.25 seconds.

The early dated files with no results indicated were set up improperly with all the bad diodes active. This of course caused rejection of all data frames for those observations. For reference purposes we also list the numbers of the official noisy diodes disabled for each run of SV1316 in Table 3. Several other diodes failed intermittently and were rejected from the counts. These unofficial noisy diodes are listed in Table 2. Note that diodes are numbered starting from 0 for the first diode.

In the appendix reductions the final figure at each REJLIM setting shows the background as a function of geomagnetic latitude for the Blue and Red tubes. At any particular REJLIM setting, it appears that the residual background remains correlated with geomagnetic latitude (shown as the solid line on the figure). It is also evident that once the background is correlated with geomagnetic latitude, interesting second order systematic

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* – Note that there are two versions of this report: a "long" version with all reductions and a "short" version with only sample reductions for several extreme REJLIM settings.

TABLE 1: FOS Normal Background Versus Geomagnetic Latitude

Magnetic Latitude	Background (c/s/d) (BLUE SIDE)	(RED SIDE)
-40.0	1.25E-02	2.07E-02
-35.0	1.01E-02	1.69E-02
-30.0	8.66E-03	1.45E-02
-20.0	7.06E-03	1.19E-02
-10.0	6.36E-03	1.08E-02
0.0	6.17E-03	1.04E-02
10.0	6.36E-03	1.08E-02
20.0	7.06E-03	1.19E-02
30.0	8.66E-03	1.45E-02
35.0	1.01E-02	1.69E-02
40.0	1.25E-02	2.07E-02
BACKGROUND AVERAGED OVER LATITUDE	0.0077	0.014

TABLE 2: FOS - SV1316 - REJLIM Dark File Summary

Detector - BLUE

root	date	set	times fired	net on time (sec)	counts	<rate> (c/s/d)	anomalous diodes &counts
Y0E81E	03/10/91	1	1475	1471.3	1405	1.93E-03	
Y0E81B	27/11/90	2	—		—		Bad Diodes On
Y0E81Z	03/03/91	2	950	1602.5	2614	3.30E-03	
Y0E81N	04/03/91	2	1112	1562.0	2772	3.61E-03	
Y0E81D	21/01/91	3	528	1708.0	3143	3.66E-03	398(62)
Y0E821	19/03/91	3	477	1720.8	3054	3.54E-03	
Y0E81P	06/04/91	3	606	1688.5	3405	4.06E-03	
Y0E81R	12/12/90	4	—		—		Bad Diodes On
Y0E81F	18/12/90	4	—		—		Bad Diodes On
Y0E823	04/04/91	4	397	1740.8	3744	4.31E-03	
Y0E81T	08/01/91	6	214	1786.5	4182	4.67E-03	398(262)
Y0E81H	12/03/91	6	222	1784.5	5545	6.22E-03	
Y0E81V	25/01/91	8	142	1804.5	7080	7.84E-03	
Y0E81J	05/10/91	8	93	1816.8	5100	5.60E-03	
Y0E81L	29/01/91	10	50	1827.5	5891	6.43E-03	
Y0E81X	14/02/91	10	42	1829.5	5369	5.85E-03	

Detector - RED

root	date	set	times fired	net on time (sec)	counts	<rate> (c/s/d)	anomalous diodes & counts
Y0E80L	02/10/91	1	2263	1274.3	1655	2.64E-03	308(2),412(4)
Y0E80H	17/12/90	2	—		—		Bad Diodes On
Y0E815	01/03/91	2	1347	1503.3	3460	4.64E-03	308(12),412(8)
Y0E80T	07/03/91	2	1363	1499.3	3523	4.73E-03	308(9),412(3)
Y0E80J	01/03/91	3	1023	1584.3	5125	6.51E-03	308(10),412(10)
Y0E817	23/03/91	3	662	1674.5	4395	5.22E-03	308(15),412(6)
Y0E80V	07/04/91	3	706	1663.5	4475	5.36E-03	308(11),412(49)
Y0E80X	12/12/90	4	—		—		Bad Diodes On
Y0E819	13/04/91	4	564	1699.0	5573	6.54E-03	308(10),412(130)
Y0E80Z	13/01/91	6	300	1765.0	8011	9.04E-03	308(61),412(17)
Y0E80N	09/02/91	6	226	1783.5	6626	7.41E-03	308(11),412(12)
Y0E811	23/01/91	8	177	1795.8	8528	9.49E-03	308(23),412(16)
Y0E80R	29/01/91	10	68	1823.0	8388	9.16E-03	308(20),412(17)
Y0E813	12/02/91	10	57	1825.8	8060	8.79E-03	308(15),412(21)

TABLE 3: List of Officially Disabled Diodes Off During REJLIM Tests (Diodes Numbered from 0)

RED Detector	Disabled Diodes
Y0E80X	2, 6, 110, 212, 285, 405, 409, 486
Y0E80H	"
Y0E80Z	"
Y0E811	"
Y0E80R	"
Y0E80N	"
Y0E813	"
Y0E815	"
Y0E80J	"
Y0E80T	"
Y0E817	2, 6, 110, 197, 212, 285, 405, 409, 486
Y0E80V	"
Y0E819	"
Y0E80L	"
BLUE Detector	
Y0E81B	31, 47, 49, 55, 201, 218, 219, 223, 225, 268, 409, 427, 451, 465, 472
Y0E81R	"
Y0E81F	"
Y0E81T	"
Y0E81D	"
Y0E81V	"
Y0E81L	"
Y0E81X	"
Y0E81Z	"
Y0E81N	"
Y0E81H	"
Y0E821	"
Y0E823	31, 47, 49, 55, 73, 201, 218, 223, 225, 235, 241, 268, 284, 398, 409, 451, 465, 472, 497
Y0E81P	"
Y0E81E	31, 47, 49, 55, 73, 201, 218, 223, 225, 235, 241 268, 284, 398, 409, 441, 451, 465, 471, 472, 497
Y0E81J	"

variations are evident when different observations at the same REJLIM setting are compared. Some of these departures from the solid curve appear to be due to passage near the South Atlantic Anomaly (SAA). Although all these SV1316 orbits are officially outside our FOS avoidance contour, some probably come close enough to cause slightly elevated backgrounds due to SAA high energy particles. After all, the SAA avoidance contour is set at the 0.02c/s/d level, while these SV1316 backgrounds are generally many times lower than this contour level.

Table 4 lists the ratio of the background with REJLIM rejection to the normal background averaged over the geomagnetic latitude of the observations. Also listed is the percentage of time lost from the observation due to rejection of the 0.25 second frames with counts greater than the REJLIM setting.

The average FOS background at a particular REJLIM setting and geomagnetic latitude is determined by multiplying the "% of normal" number (divided by 100, of course) in Table 4 by the appropriate background number in Table 1. Thus, at 0^o geomagnetic latitude, the average FOS background for REJLIM=1 is 1.5×10^{-3} c/s/d for the Blue side and 1.87×10^{-3} c/s/d for the Red side.

For the Red and Blue detector the measured background improvement ratio is similar with the Red slightly better. At a REJLIM of 1 we achieve about a 5 times reduction in background with a penalty of about 25% loss in observation time. At a REJLIM of 3 and 4, the background is around 50% of that with no rejection. At the higher values tested of 8 and 10 we are running around 85% of the normal background values. Here only the large bursts appear to have been rejected. Large bursts as high as several hundred counts have been seen in FOS background data. Note that in some rare cases frames may have been rejected due to the detection of multiple bursts.

In order to investigate whether the degree of background rejection is above that expected from a Poisson distribution for random detector events, we use for the Poisson statistic the following formula for the number of frames "F" in the observation with a number of counts "n"

$$F=(T\cdot c\cdot N)^n \cdot e^{-t\cdot c\cdot N} \cdot T/(T\cdot n!) \qquad \text{(Eq. 1)}$$

"T" is the total observation exposure time (1840 seconds)
"t" is the FOS frame interval time in seconds (0.25 seconds)
"N" is the number of active diodes
"c" is average count rate in counts/second/diode for the subexposure

The numbers listed in columns of Table 4 marked "% Poisson dark expectation" are derived by integration of equation 1. These numbers are to be directly compared with the previous column "% of normal dark", the measured dark reduction factor due to burst noise rejection.

As seen in Table 4, the measured Blue detctor background reduction from burst noise rejection is well above rejection expectations for Poisson distributed light. Thus it is likely that REJLIM settings down to 1 on the Blue side will be potentially useful for the observations of faint objects.

TABLE 4: SV1316 Measured Detector Observation Time Lost and Dark Reduction Due to Burst Rejection Along With the Comparison Dark Reduction Expectation for a Poisson Type Distribution.

	BLUE DETECTOR			RED DETECTOR		
REJLIM SETTING	% time lost	% of normal dark	% Poisson dark expectation	% time lost	% of normal dark	% Poisson dark expectation
1	20	24	38	31	18	17
2	14	39	75	29	35	48
3	7	49	93	11	48	74
4	5	54	98	8	57	89
6	3	71		4	65	
8	2	83		3	70	
10	1	92		1	80	

However, as seen in Table 4, the Red detector background reduction for REJLIM=1 is essentially the same as that predicted from a Poisson distribution; it is only at the higher REJLIM settings that the burst character of the Red detector background is evident. The frame time used for the Red side is not fast enough to differentiate the Poisson distribution from the burst noise type for low REJLIM settings. In order to accurately characterize the Red detector background at a REJLIM setting of 1, the frame time in the REJLIM proposal needs to be decreased to 0.05 seconds or less.

III. Signal Rejection Considerations

As mentioned, the REJLIM strategy requires an FOS frame rate sufficiently fast that, at most, a single count from the observed faint object will be seen in a frame time. In this case it is assumed that multiple count events will be from particle noise, and the frame will be rejected. For any given object signal level, there is an optimal REJLIM number and frame rate combination. Note that, in practice, this optimum frame time is not simply the shortest possible FOS frame time of 0.02 seconds because of the 0.01 second dead time that follows each frame. Obviously making the frame time shorter than required from object signal level considerations leads to unnecessary added dead time losses.

Since the arrival distribution of starlight is Poisson distributed, Equation 1 can be used to deduce the object signal losses at a particular FOS frame time and REJLIM setting. For REJLIM of 1 and a fractional signal loss of "f", the frame time is given by

$$t = -\ln(1-f)/(N \cdot c) \qquad \text{(Eq. 2)}$$

where "N" is the number of diodes summed per frame
and "c" is the object average count rate in counts per second per diode.

For example in the case of acceptance of $<$ 10% signal loss ($f<0.1$) from a QSO with 0.003 c/s/d average signal across the diode array, then the frame time must be set to $<$ 0.07 seconds. Of course this signal loss is due to starlight REJLIM rejection solely; additional signal loss from the burst noise rejection of frames, indicated in Table 4 under "% time lost", must also be accounted for to determine the total signal to noise loss statistic.

For REJLIM $>$ 1 the solution for frame time "t" cannot be put in such a simple form but must be iterated. However for the important REJLIM=2 setting, the relationship is given by

$$f = 1-(1+a) \cdot e^{-a} \qquad \text{(Eq. 3)}$$

where $a = N \cdot c \cdot t$

For a 10% signal loss at the REJLIM=2 setting, the resulting frame time jumps to 0.35 seconds for 0.003 c/s/d average signal.

An important point to consider when using the REJLIM setting is zeroth order light and night sky lines since in some observing configurations these are registered onto the diode array. Although the zeroth order light falls on a different section of the array than the spectrum, it will still be included in the sum which will be compared to the threshold. Thus, when zeroth order light is included, an otherwise correct threshold setting might reject all the frames and no data will be acquired. In order to avoid this potential problem, the specific diodes on which the zeroth order light falls must be turned off. Care must be taken to include all the diodes hit during quarter stepping and overscanning. Similar action must be taken for night sky lines. The number of diodes affected varies as aperture size. Also care needs to be taken to identify potentially bad diodes as quickly as possible to avoid loss of all the data.

IV. Conclusion

For a REJLIM setting of 1, the measured Blue detector background reduction of 76% is somewhat less than the model prediction of 85%. In the Rosenblatt *et al* 1991a reference, this difference is accounted for by the addition of a constant Poisson noise source with an average count of 0.002 c/s/d to the cosmic ray Cerenkov component. However, several parameter values in the cosmic ray Cerenkov simulation could probably be "tweaked" to also account for this small effect.

We know of Poisson type components which add to the dominant faceplate Cerenkov component. These include photocathode thermionic emission, direct penetration of the diode array by high energy particles and false triggering of the discriminators caused by electronic noise. However, when the diode array is deflected behind the photocathode mask, the count rate for the Blue detector drops to a very low ~0.0002 c/s/d level (Rosenblatt *et al* 1992), indicating also the background level expected for the non-Cerenkov components in the photocathode image region.* Either there is a very small amount of light emission (at about 0.0018 c/s/d) forward of the photocathode toward the FOS optics or the Cerenkov software model needs iteration. Additional SV 1316 observations at a faster frame time (say 0.05 sec) for a REJLIM setting of 1 and 2 would likely resolve this interesting issue.

While the background unknowns in the Blue detector are very small, the Red detector burst noise rejection performance is more uncertain. As mentioned, at lower REJLIM settings of 1 and 2, the frame time needs to be considerably decreased to determine if a significant Poisson component is present in the data. This issue is of some concern since an attempt at deflecting the array behind the photocathode mask (see CAL/FOS-071) produced no indication of a mask edge. This anomalous result has not been satisfactorily explained or further investigated. Thus, the Red detector's true burst noise rejection performance at low REJLIM values awaits further test results.

FOS observations with REJLIM settings for one or two counts will likely be rare (but important) occasions. However, for general observations of faint objects, a REJLIM setting between five and ten counts would lead to a significant reduction of the large cosmic ray events without serious signal and time losses. At a REJLIM setting of five, the FOS background is reduced to about 60% of the normal background; the 10% level for signal loss occurs at 0.02 c/s/d for the default 0.25 second frame time.

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* – Note that the thermionic emission rate from the mask is expected to be similar to the emission rate from the photocathode image area since the photocathode is also deposited on the mask.

References

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APPENDIX 1

FOS Blue Detector

Blue REJLIM runs between 2 and 8 are
available from UCSD's FOS Project Office

SV1316 - Dark Files - Blue - y0e81 - E01T to E0GT REJLIM=1

file	counts (adjusted)	times fired	count rate (adjusted)	count rate (calculated)	magnetic latitude	ratio
y0e81E01T	82.	80	0.17E-02	0.65E-02	12.93	.26
y0e81E02T	77.	78	0.16E-02	0.62E-02	1.732	.26
y0e81E03T	90.	81	0.19E-02	0.63E-02	-9.173	.30
y0e81E04T	90.	114	0.21E-02	0.70E-02	-19.51	.30
y0e81E05T	93.	125	0.22E-02	0.83E-02	-28.57	.27
y0e81E06T	93.	137	0.23E-02	1.02E-02	-35.30	.22
y0e81E07T	98.	137	0.24E-02	1.17E-02	-38.70	.21
y0e81E08T	106.	134	0.26E-02	1.14E-02	-38.01	.23
y0e81E09T	104.	96	0.23E-02	0.96E-02	-33.40	.24
y0e81E0AT	78.	65	0.16E-02	0.78E-02	-25.81	.20
y0e81E0BT	70.	59	0.14E-02	0.67E-02	-16.31	.21
y0e81E0CT	74.	65	0.15E-02	0.62E-02	-5.81	.24
y0e81E0DT	70.	50	0.14E-02	0.62E-02	4.97	.22
y0e81E0ET	82.	70	0.17E-02	0.67E-02	15.44	.25
y0e81E0FT	103.	67	0.21E-02	0.77E-02	24.87	.27
y0e81E0GT	95.	117	0.22E-02	0.93E-02	32.40	.23

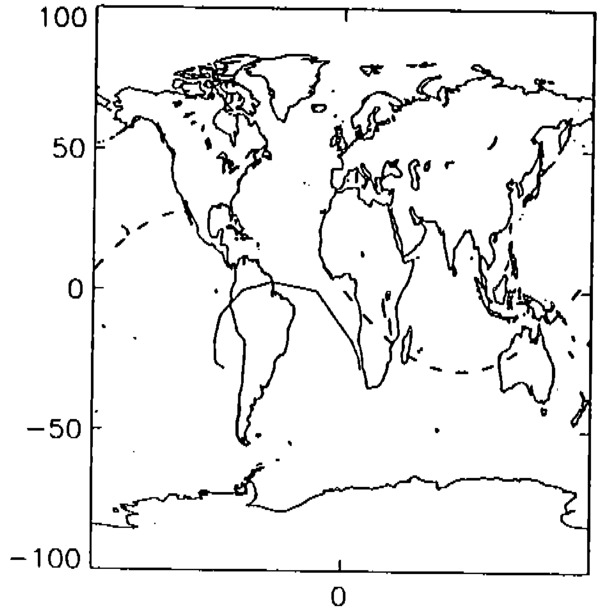
FOS – SV1316 – REJLIM Dark Test BLUE REJLIM = 1

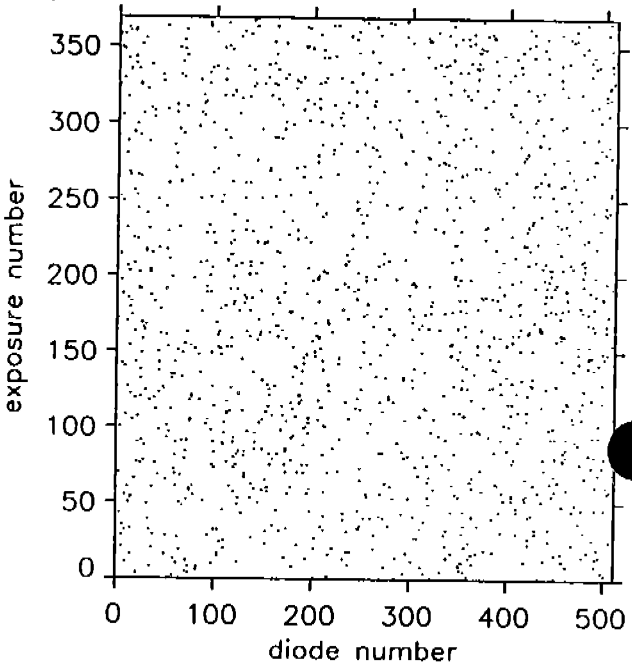
– Y0E81E – 03/10/91

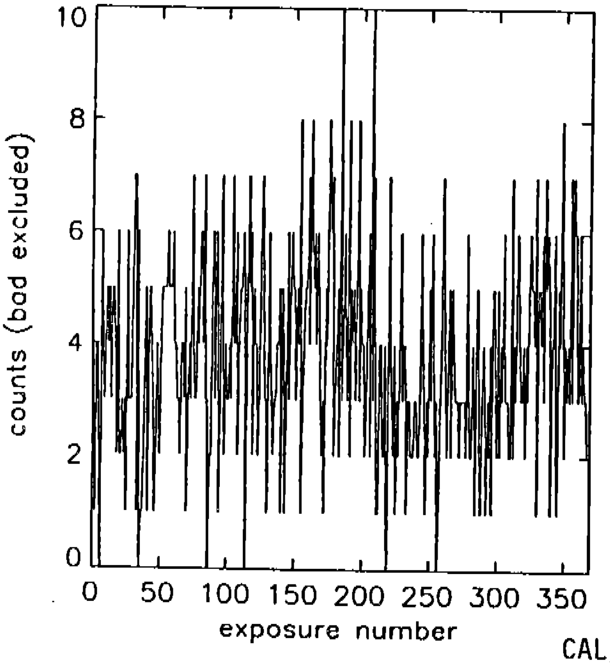
– $\Omega_{(range)}$ = 177W to 556E

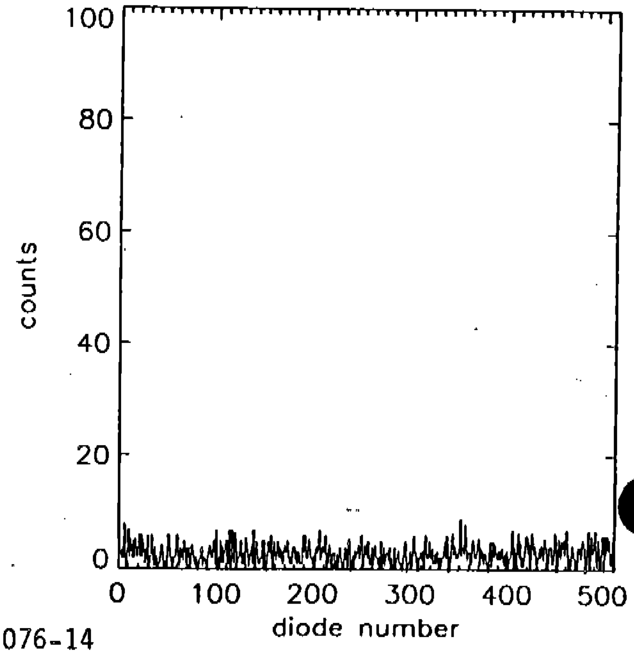
– anomalous diodes

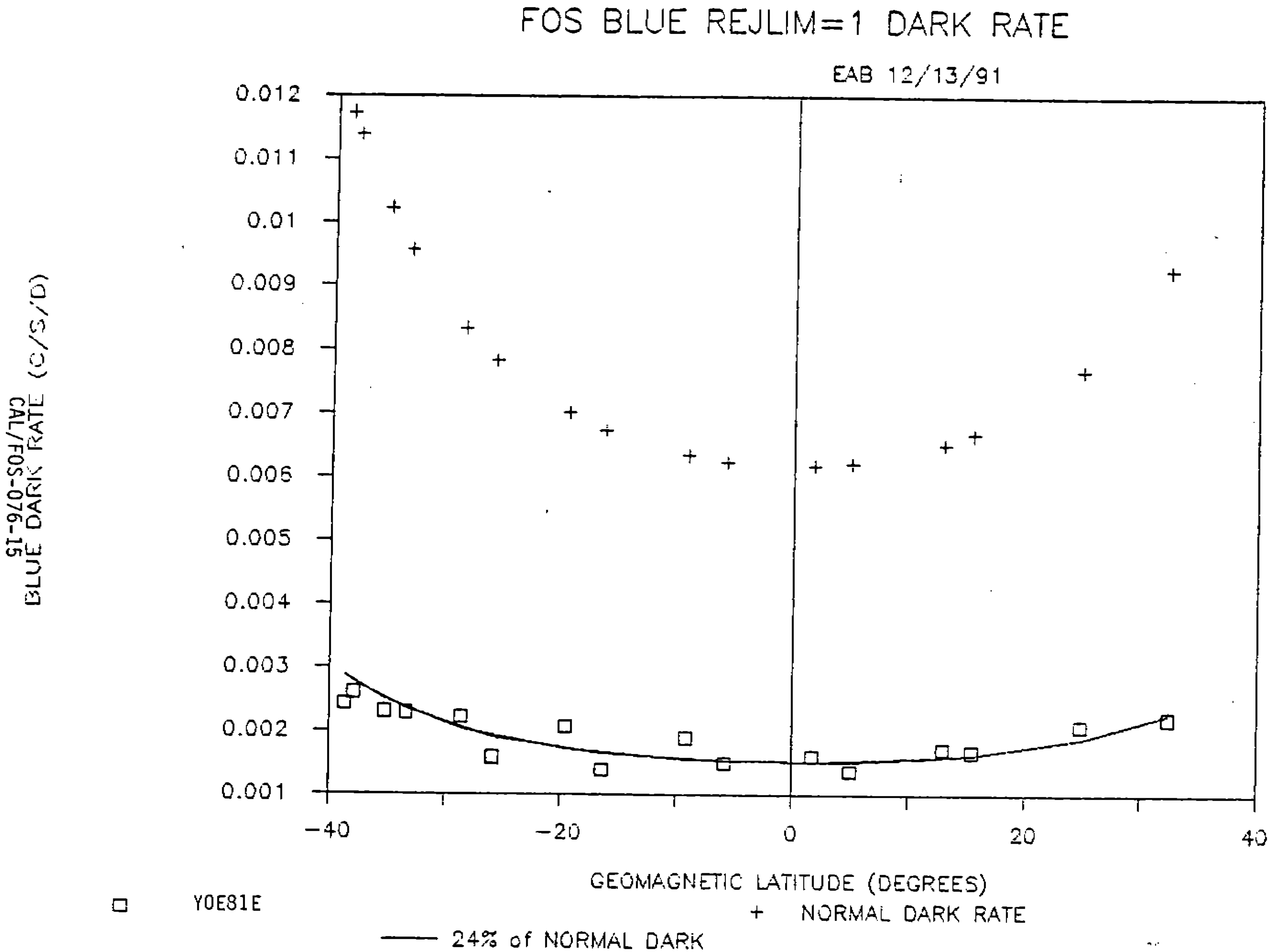
zero – 8, 31, 47, 49, 55, 73, 81, 101, 103, 115, 139, 148, 151, 158, 201, 213, 218, 222, 223, 225, 230, 235, 238, 241, 268, 279, 281, 282, 284, 291, 296, 307, 313, 329, 339, 380, 398, 406, 408, 409, 423, 441, 451, 463, 465, 471, 472, 481, 486, 496, 497











FOS BLUE REJLIM=1 DARK RATE
EAB 12/13/91
BLUE DARK RATE (C/S/D)
0.012
0.011
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
-40
-20
0
20
40
GEOMAGNETIC LATITUDE (DEGREES)
Y0E81E
+ NORMAL DARK RATE
24% of NORMAL DARK

SV1316 - Dark Files - Blue - y0e81 - X01T to X0GT   REJLIM=10

file	counts (adjusted)	times fired	count rate (adjusted)	count rate (calculated)	magnetic latitude	ratio
Y0E81X01T	442.	2	0.77E-02	0.67E-02	-16.20	1.15
Y0E81X02T	321.	1	0.56E-02	0.62E-02	2.20	.90
Y0E81X03T	231.	4	0.40E-02	0.63E-02	7.65	.64
Y0E81X04T	287.	1	0.50E-02	0.65E-02	12.47	.77
Y0E81X05T	227.	2	0.40E-02	0.67E-02	16.13	.59
Y0E81X06T	334.	2	0.58E-02	0.69E-02	18.20	.84
Y0E81X07T	329.	4	0.58E-02	0.69E-02	18.39	.83
Y0E81X08T	328.	2	0.57E-02	0.68E-02	16.65	.85
Y0E81X09T	321.	5	0.56E-02	0.65E-02	13.18	.86
Y0E81X0AT	291.	3	0.51E-02	0.63E-02	8.37	.81
Y0E81X0BT	311.	1	0.54E-02	0.62E-02	2.65	.87
Y0E81X0CT	313.	3	0.55E-02	0.62E-02	-3.32	.88
Y0E81X0DT	326.	4	0.57E-02	0.63E-02	-9.13	.90
Y0E81X0ET	388.	5	0.68E-02	0.66E-02	-14.18	1.03
Y0E81X0FT	468.	1	0.81E-02	0.69E-02	-17.96	1.18
Y0E81X0GT	452.	2	0.79E-02	0.71E-02	-19.99	1.12

SV1316 - Dark Files - Blue - y0e81 - L01T to L0GT   REJLIM=10
(one file is missing at this time)

file	counts (adjusted)	times fired	count rate (adjusted)	count rate (calculated)	magnetic latitude	ratio
Y0E81L01T	327.	2	0.57E-02	0.68E-02	17.01	.84
Y0E81L02T	422.	1	0.73E-02	0.70E-02	19.59	1.05
Y0E81L03T	374.	4	0.65E-02	0.71E-02	20.14	.93
Y0E81L04T	359.	5	0.63E-02	0.69E-02	18.60	.91
Y0E81L05T	339.	5	0.59E-02	0.67E-02	15.16	.89
Y0E81L07T	364.	1	0.63E-02	0.62E-02	4.22	1.02
Y0E81L08T	345.	3	0.60E-02	0.62E-02	-2.23	.97
Y0E81L09T	350.	3	0.61E-02	0.63E-02	-8.61	.97
Y0E81L0AT	335.	0	0.58E-02	0.66E-02	-14.35	.88
Y0E81L0BT	402.	2	0.70E-02	0.70E-02	-18.87	1.01
Y0E81L0CT	397.	4	0.70E-02	0.72E-02	-21.62	.96
Y0E81L0DT	322.	2	0.56E-02	0.73E-02	-22.23	.77
Y0E81L0ET	350.	2	0.61E-02	0.71E-02	-20.57	.86
Y0E81L0FT	330.	4	0.58E-02	0.68E-02	-16.83	.85
Y0E81L0GT	516.	5	0.91E-02	0.65E-02	12.79	1.39

FOS – SV1316 – REJLIM Dark Test BLUE REJLIM = 10

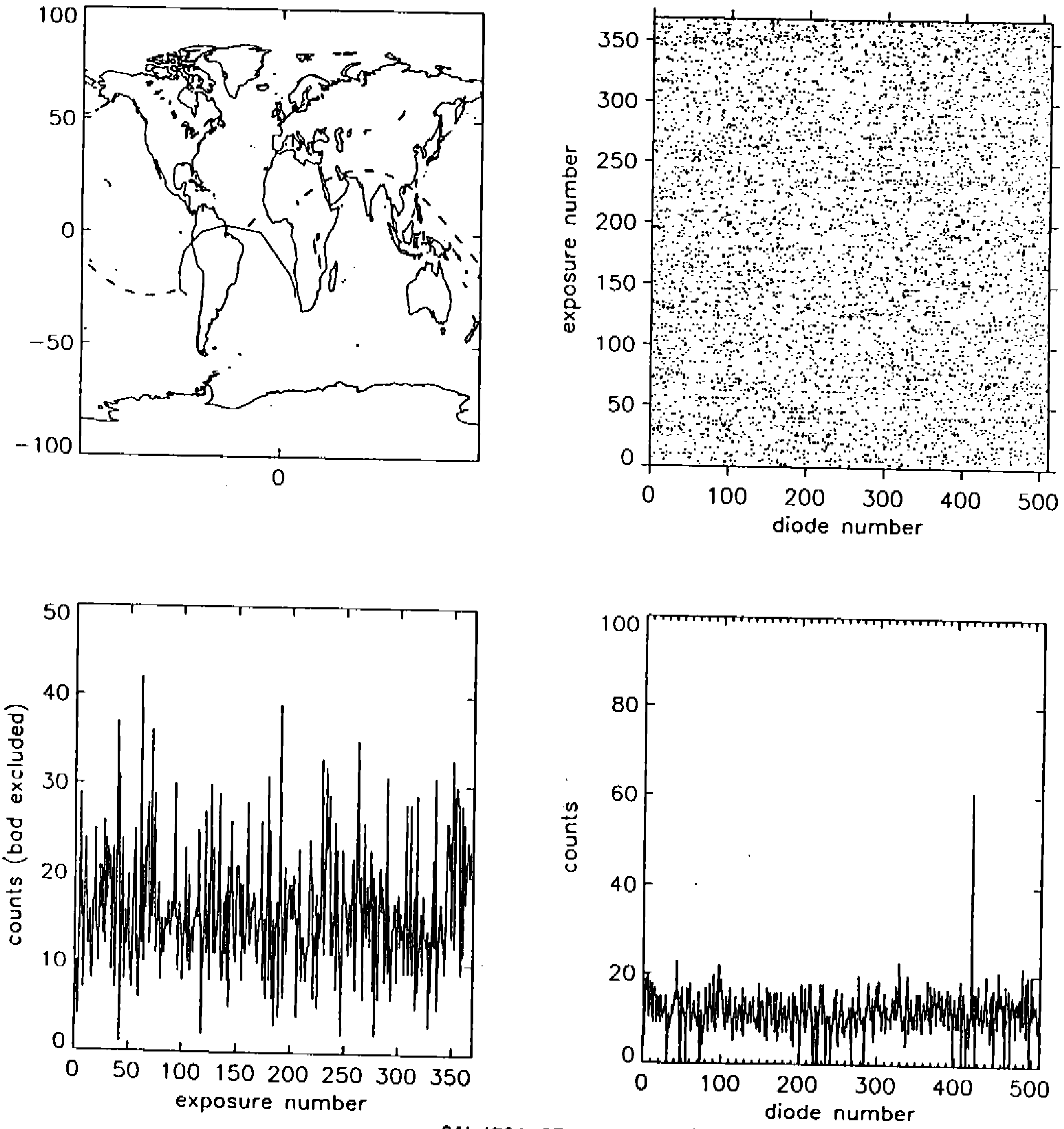
– Y0E81L – 29/01/91

– $\Omega_{(range)}$ = 12W to 35W

– anomalous diodes

zero – 31, 47, 49, 55, 73, 201, 218, 219, 223, 225, 235, 241, 268, 284, 398, 409, 415, 427, 451, 465, 472, 497

bad – 422



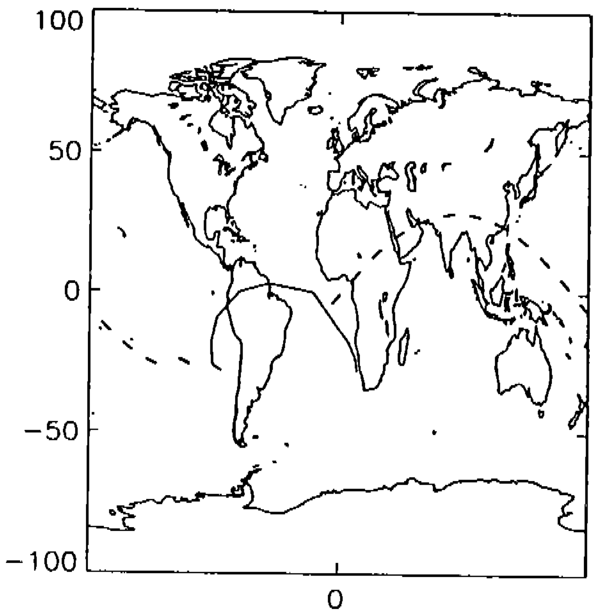
FOS – SV1316 – REJLIM Dark Test BLUE REJLIM = 10

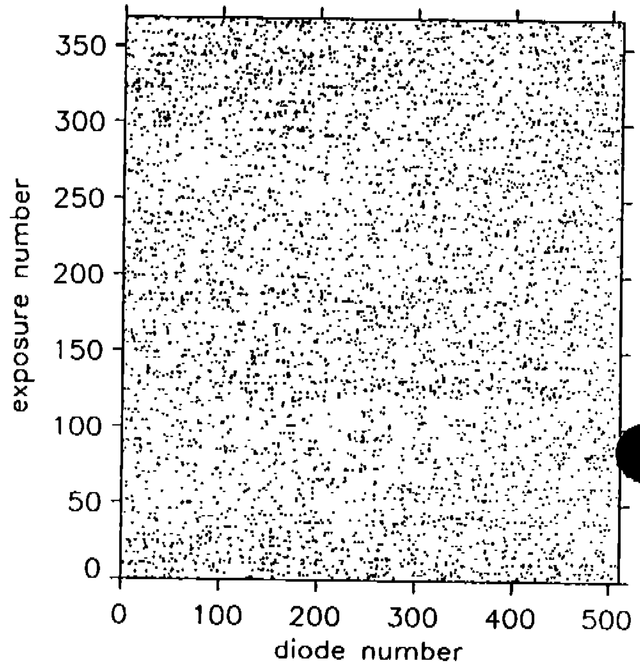
– Y0E81X – 14/02/91

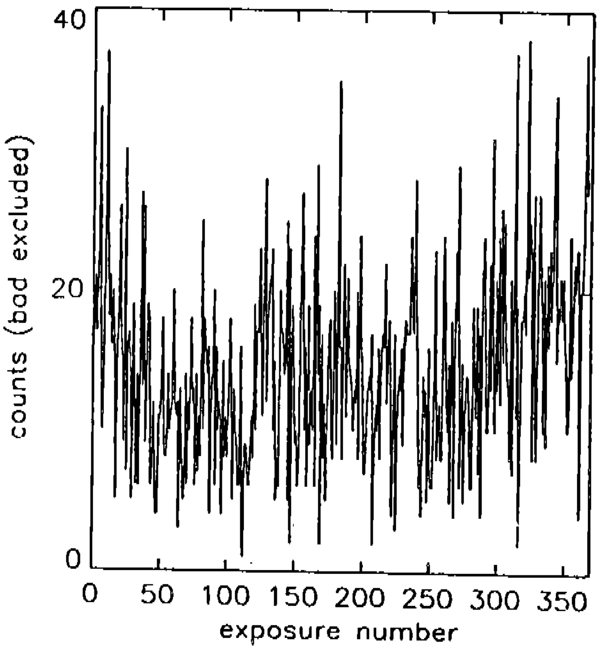
– $\Omega_{(range)}$ = 9E to 15W

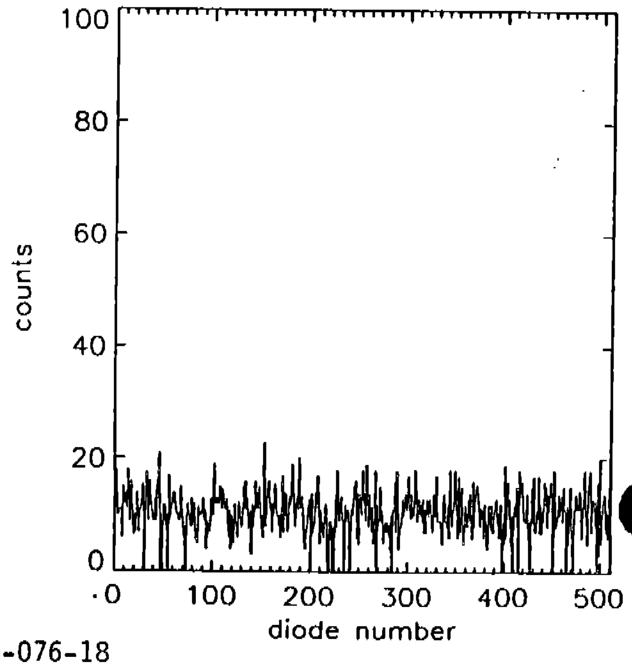
– anomalous diodes

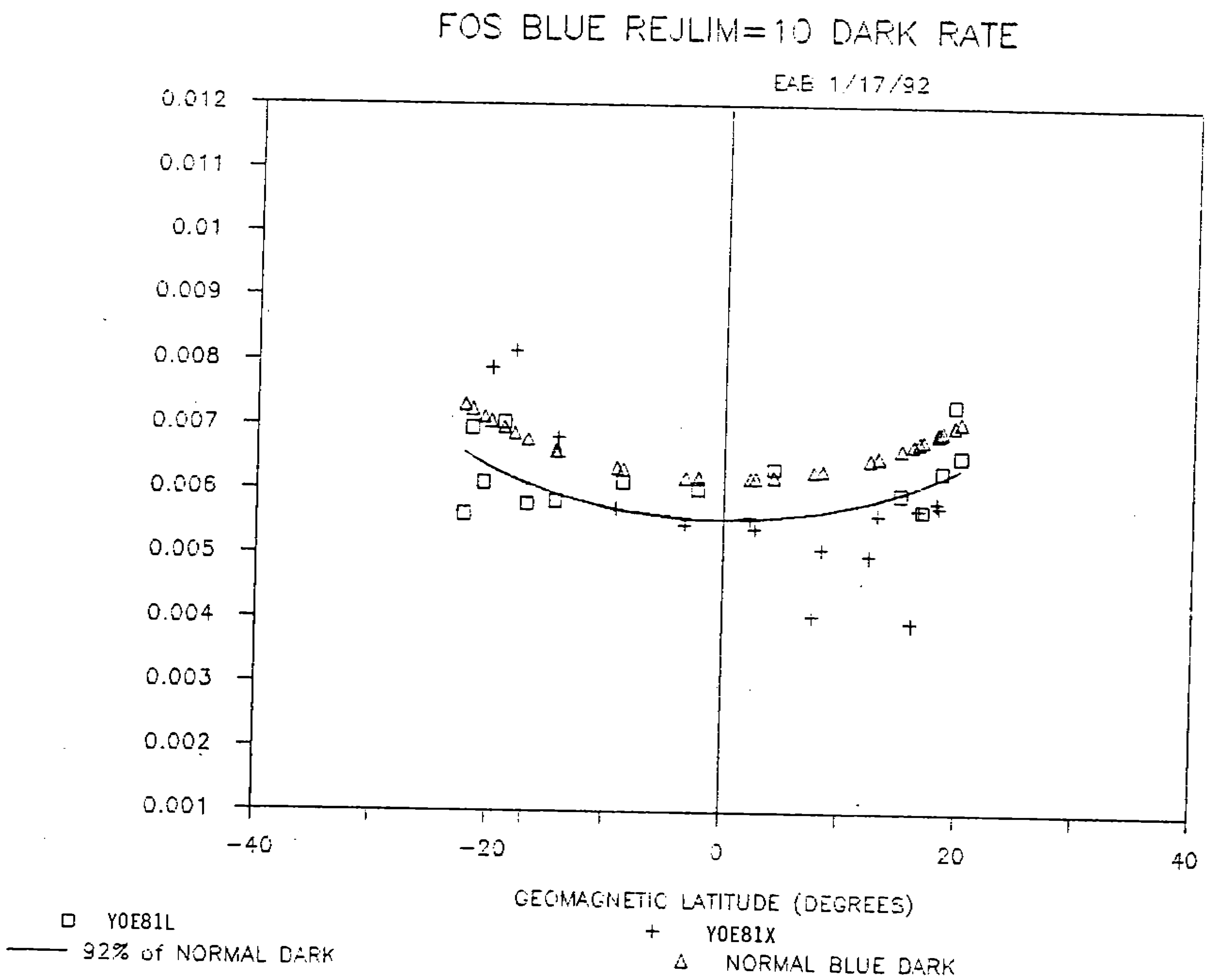
zero – 31, 47, 49, 55, 73, 201, 218, 219, 223, 225, 235, 241, 268, 284, 398, 409, 415, 427, 451, 465, 472, 497










FOS BLUE REJLIM=10 DARK RATE
EAB 1/17/92
BLUE DARK RATE (C/S/D)
0.012
0.011
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
-40
-20
0
20
40
GEOMAGNETIC LATITUDE (DEGREES)
□ YOE81L
—— 92% of NORMAL DARK
+ YOE81X
Δ NORMAL BLUE DARK

APPENDIX 2

FOS Red Detector

Red REJLIM runs between 2 and 8 are
available from UCSD's FOS Project Office

SV1316 - Dark Files - Red - y0e80 - L01T to L0GT REJLIM=1

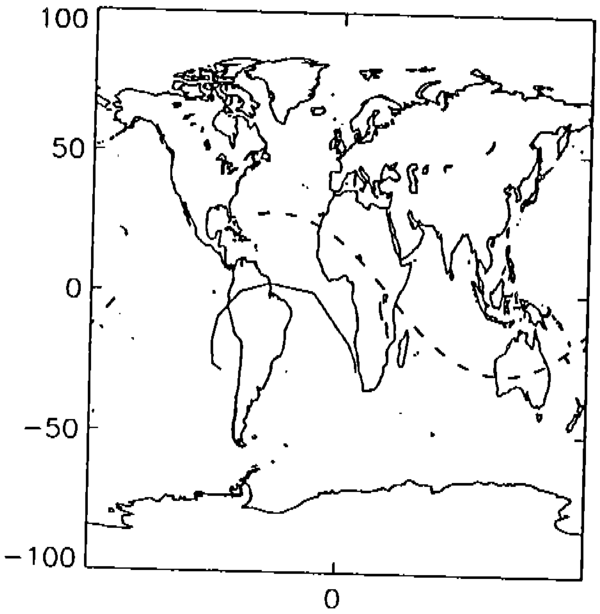
file	counts (adjusted)	times fired	count rate (adjusted)	count rate (calculated)	magnetic latitude	ratio
y0e80L01T	116.	188	0.34E-02	1.99E-02	39.18	.17
y0e80L02T	113.	131	0.27E-02	1.86E-02	37.15	.15
y0e80L03T	91.	102	0.20E-02	1.56E-02	31.43	.13
y0e80L04T	91.	126	0.22E-02	1.27E-02	23.00	.17
y0e80L05T	96.	105	0.22E-02	1.07E-02	12.94	.20
y0e80L06T	113.	121	0.27E-02	1.00E-02	2.10	.27
y0e80L07T	95.	123	0.22E-02	1.03E-02	-8.86	.22
y0e80L08T	96.	145	0.24E-02	1.18E-02	-19.30	.21
y0e80L09T	109.	164	0.29E-02	1.45E-02	-28.59	.20
y0e80L0AT	112.	195	0.34E-02	1.77E-02	-35.64	.19
y0e80L0BT	114.	205	0.36E-02	2.00E-02	-39.34	.18
y0e80L0CT	102.	198	0.31E-02	1.97E-02	-38.88	.16
y0e80L0DT	121.	163	0.32E-02	1.71E-02	-34.36	.19
y0e80L0ET	110.	121	0.26E-02	1.38E-02	-26.73	.19
y0e80L0FT	92.	93	0.20E-02	1.14E-02	-17.09	.18
y0e80L0GT	84.	83	0.18E-02	1.01E-02	- 6.38	.18

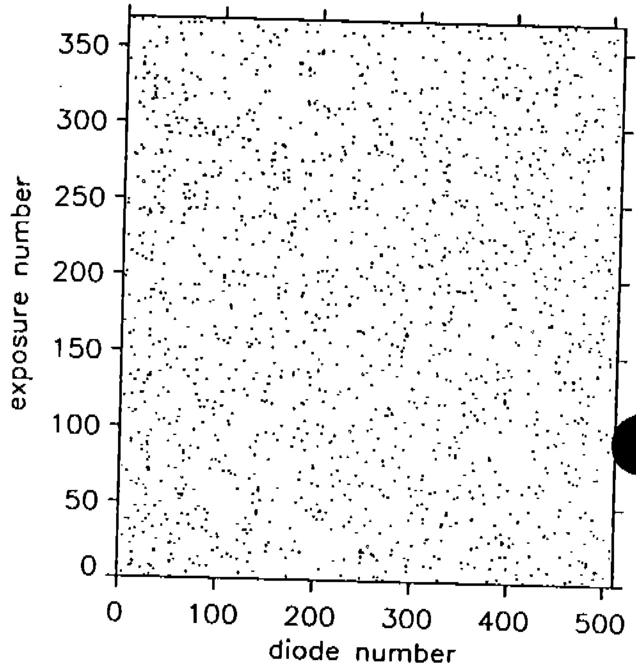
FOS – SV1316 – REJLIM Dark Test RED REJLIM = 1

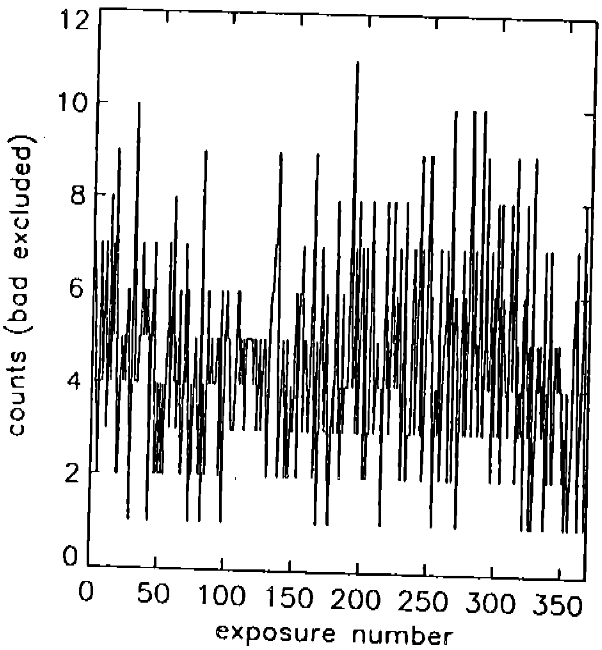
– Y0E80L – 02/10/91

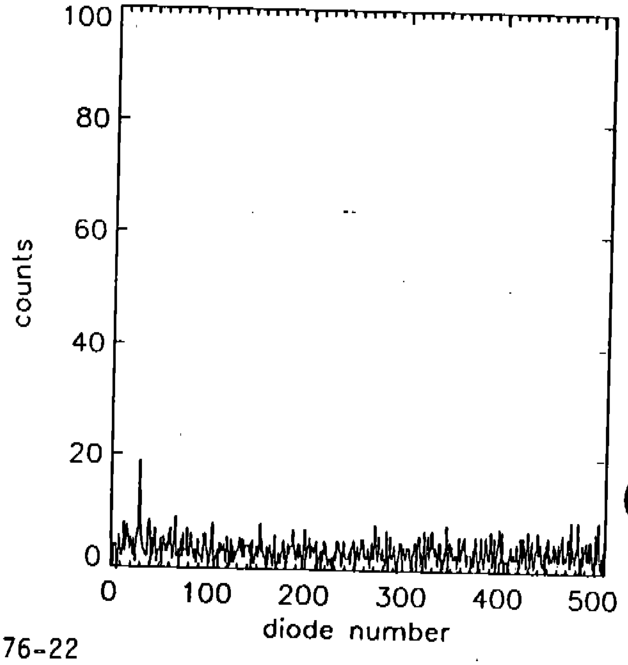
– $\Omega_{(range)}$ = 137W to 156W

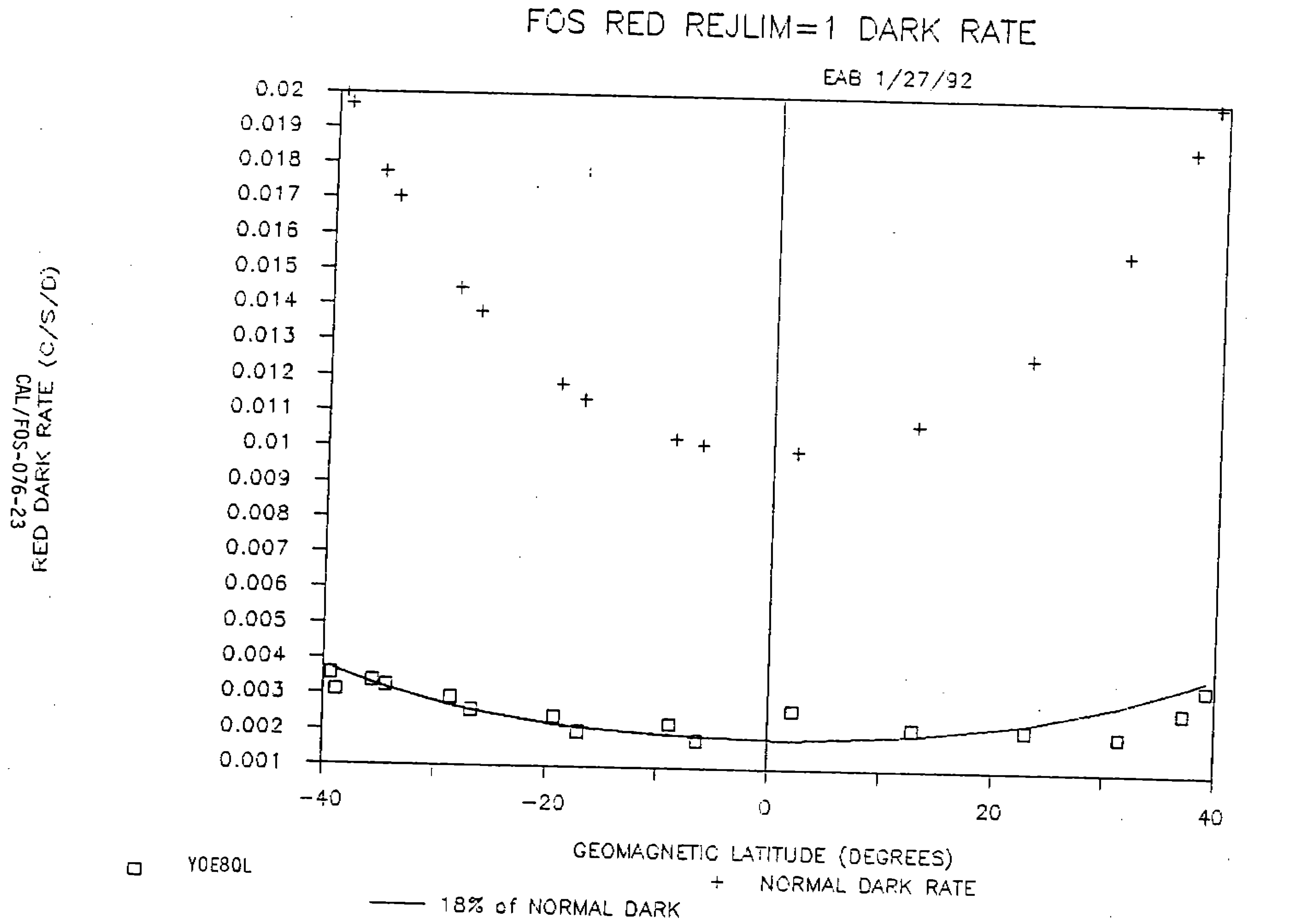
– anomalous diodes
zero – 2, 6, 52, 106, 110, 144, 197, 212, 216, 228, 251, 285, 294, 309, 314, 321, 347, 378, 396, 405, 409, 448, 484, 486, 508, 510










FOS RED REJLIM=1 DARK RATE
EAB 1/27/92
RED DARK RATE (C/S/D)
0.02
0.019
0.018
0.017
0.016
0.015
0.014
0.013
0.012
0.011
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
-40
-20
0
20
40
GEOMAGNETIC LATITUDE (DEGREES)
Y0E80L
+ NORMAL DARK RATE
18% of NORMAL DARK

SV1316 - Dark Files - Red - y0e80 - R01T to R0GT REJLIM=10

file	counts (adjusted)	times fired	count rate (adjusted)	count rate (calculated)	magnetic latitude	ratio
y0e80R01T	577.	3	0.10E-01	1.00E-02	-0.87	1.01
y0e80R02T	620.	5	0.11E-01	1.01E-02	-6.26	1.07
y0e80R03T	580.	3	0.10E-01	1.05E-02	-10.96	.96
y0e80R04T	514.	7	0.90E-02	1.10E-02	-14.55	.82
y0e80R05T	504.	3	0.88E-02	1.00E-02	-2.21	.88
y0e80R06T	432.	3	0.75E-02	1.00E-02	3.23	.75
y0e80R07T	458.	5	0.80E-02	1.03E-02	8.39	.78
y0e80R08T	539.	5	0.94E-02	1.07E-02	12.76	.88
y0e80R09T	486.	5	0.85E-02	1.12E-02	15.89	.76
y0e80R0AT	519.	1	0.90E-02	1.14E-02	17.36	.79
y0e80R0BT	549.	3	0.96E-02	1.14E-02	17.08	.84
y0e80R0CT	545.	8	0.96E-02	1.10E-02	14.89	.87
y0e80R0DT	487.	2	0.85E-02	1.05E-02	11.21	.80
y0e80R0ET	529.	4	0.92E-02	1.01E-02	6.40	.91
y0e80R0FT	538.	7	0.94E-02	1.00E-02	.93	.95
y0e80R0GT	548.	4	0.96E-02	1.01E-02	-4.69	.95

SV1316 - Dark Files - Red - y0e81 - 301T to 30GT REJLIM=10

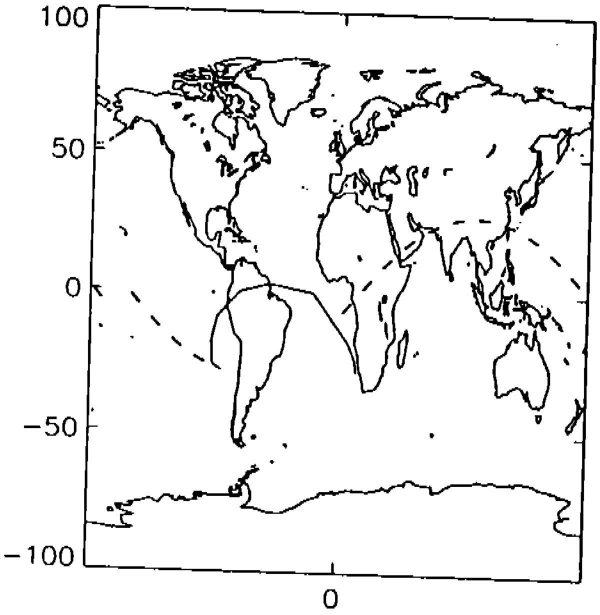
file	counts (adjusted)	times fired	count rate (adjusted)	count rate (calculated)	magnetic latitude	ratio
y0e81301T	511.	2	0.89E-02	1.04E-02	-9.87	.85
y0e81302T	487.	5	0.85E-02	1.13E-02	-16.48	.76
y0e81303T	519.	2	0.90E-02	1.23E-02	-21.62	.73
y0e81304T	545.	7	0.96E-02	1.32E-02	-24.80	.73
y0e81305T	509.	8	0.90E-02	1.34E-02	-25.54	.67
y0e81306T	588.	1	0.10E-01	1.29E-02	-23.70	.79
y0e81307T	434.	3	0.76E-02	1.18E-02	-19.51	.64
y0e81308T	427.	3	0.74E-02	1.08E-02	-13.48	.69
y0e81309T	565.	2	0.98E-02	1.07E-02	12.48	.92
y0e8130AT	444.	2	0.77E-02	1.18E-02	19.31	.65
y0e8130BT	543.	5	0.95E-02	1.31E-02	24.57	.72
y0e8130CT	647.	4	0.11E-01	1.41E-02	27.56	.80
y0e8130DT	556.	7	0.98E-02	1.42E-02	27.76	.70
y0e8130ET	475.	3	0.83E-02	1.33E-02	25.18	.62
y0e8130FT	464.	0	0.80E-02	1.20E-02	20.13	.67
y0e8130GT	382.	3	0.66E-02	1.20E-02	20.13	.67

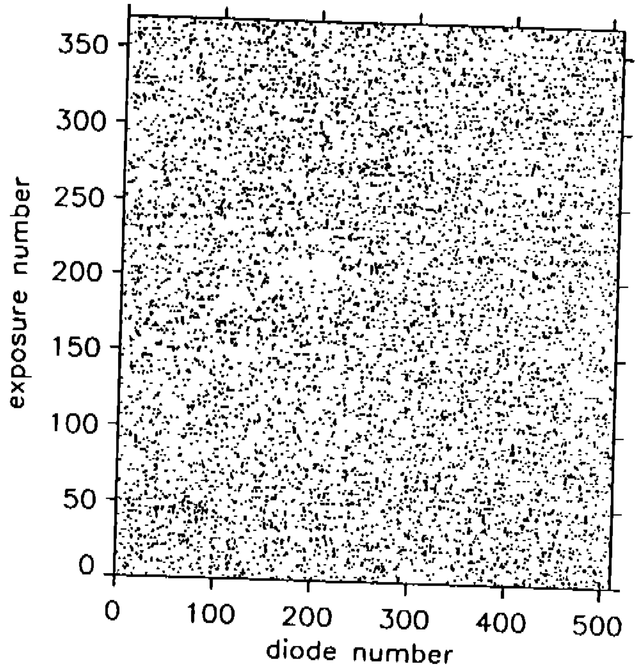
FOS – SV1316 – REJLIM Dark Test   RED   REJLIM = 10

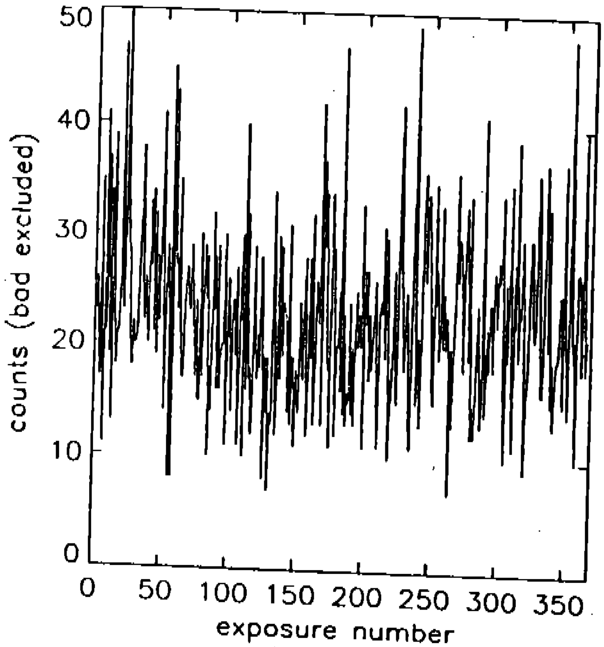
– Y0E80R – 29/01/91

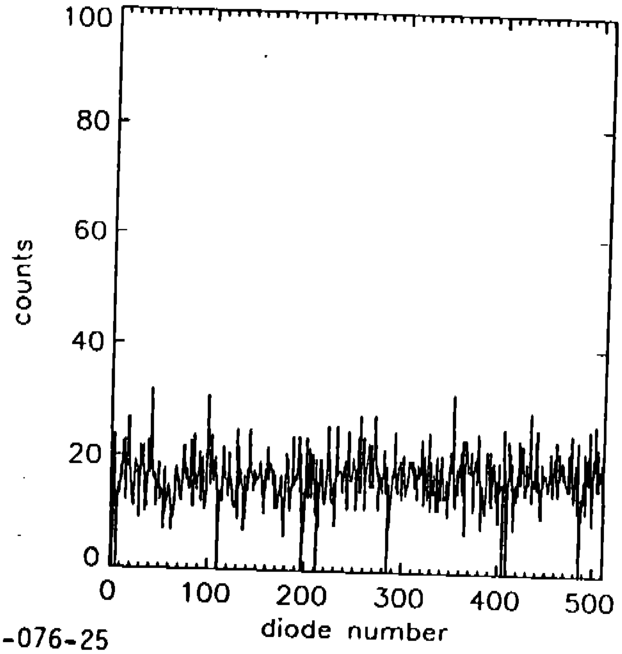
– $\Omega_{(range)}$ = 26E to 1E

– anomalous diodes
zero – 2, 6, 110, 197, 212, 285, 405, 409, 486









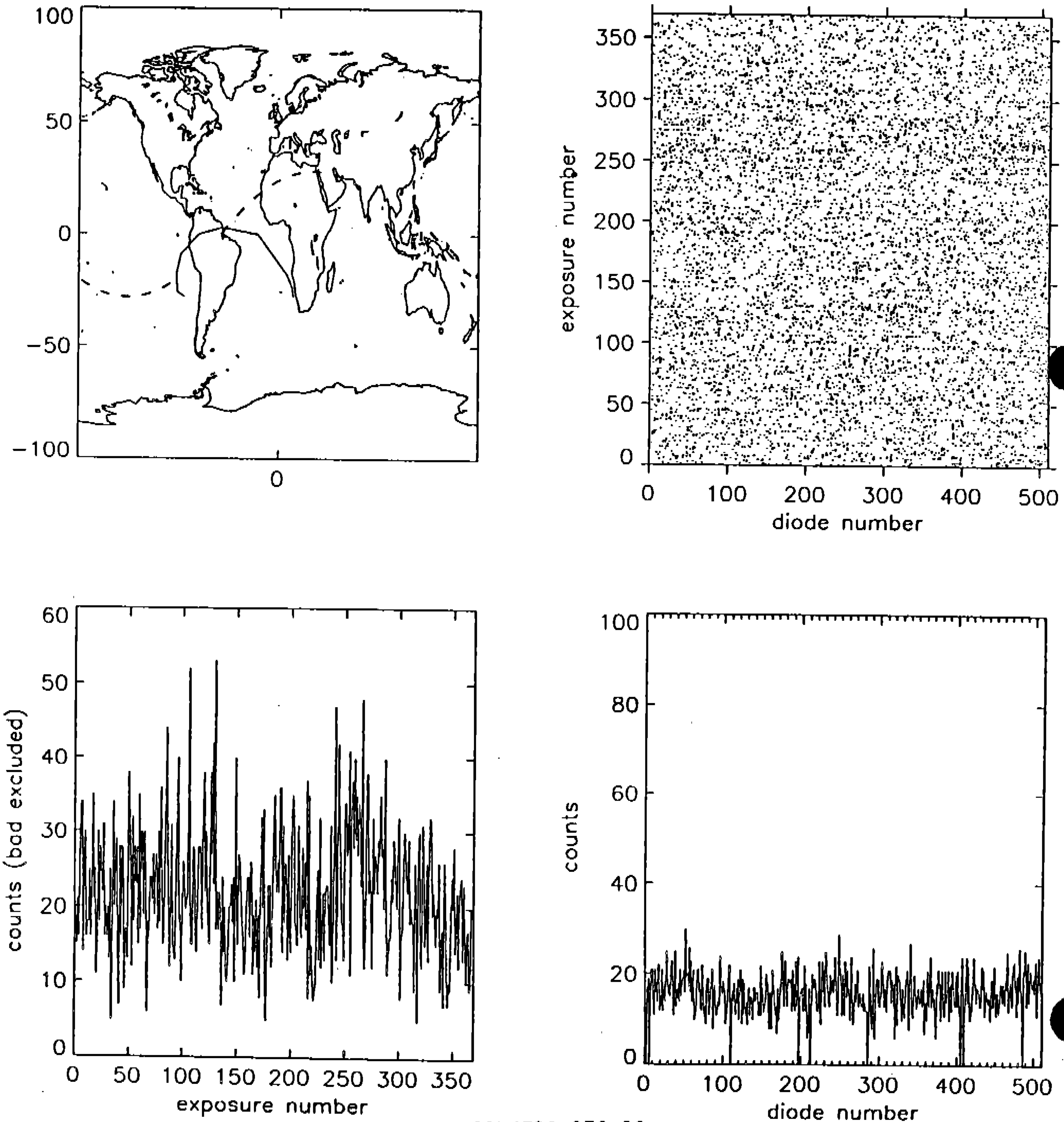
FOS – SV1316 – REJLIM Dark Test RED REJLIM = 10

– Y0E813 – 12/02/91

– $\Omega_{(range)}$ = 40W to 62W

– anomalous diodes

zero – 2, 6, 110, 197, 212, 285, 405, 409, 486



FOS RED REJLIM=10 DARK RATE

EAB 1/17/92