

NOT SO GRIM RESULTS OF IMAGING
GAMMA RAY MONTE CARLO EVENTSV.J. Stenger
University of Hawaii
1 June 1983

The gamma ray imaging program developed in Hawaii (HDC 1-83) has been tested using the 1 TeV Monte Carlo events provided by Durham. The Durham tape is processed first to produce a file which looks just like the data file generated from the Mt. Hopkins real data tapes. Thus the Monte Carlo events can be processed exactly like real data.

Basically the same ten showers are positioned in 25 m steps along the east-west and north-south axes with 0° zenith. The image reconstruction algorithms are those discussed in HDC 1-83, viz., centroid plus principle axis. No χ^2 fitting has been done at this stage. Also, I have not yet tried to simulate off-axis showers by displacing the images in the image plane. These results are thus just the first go-around.

The results are shown in the figures. There are two sets of six each. The first set for 19 PMT's, and the second set for 37.

1. Zenith vs. Core Distance. Here zenith is the distance from the center of the image plane to the reconstructed centroid of the image, in degrees. Do not confuse with direction of shower. The scatter plot shows the number of events in each bin, where "+" is one event, "A" is 10, etc. The solid line is the median curve; half above, half below. While the median increases with core distance, the spread of points shows that zenith is not a particularly good measure of core distance.

2. XC vs. Core Position along East-West Axis. The centroid x-coordinate follows the core position along the east-west axis, but seems to be displaced about -3°. Explanations welcome.

3. YC vs. Core Position along North-South Axis. A similar effect is observed.

4. Impact vs. Core Distance. The impact parameter is defined in HDC 1-83, but repeating, it is the distance of closest approach of the reconstructed shower axis to the center of the image plane, in degrees. It is the quantity which I hope to cut on to remove background and is a measure of the angular resolution of the instrument. The median is below 0.3° for core distances < 100 m. There is, of course, a spread with some events over 0.5° (Ted Turver's 0.5°?), but I consider these results promising.

5. Impact Parameter Distribution, All Zeniths. The distribution in impact parameter shows a mean of 0.44°, if the mean of 420 events of which only 10 are independent is meaningful.

6. Impact Parameter Distribution, Zenith < 0.8. A cut on the reconstructed zenith can be used to enhance the sample of smaller core distances. Here a

cut of 0.8° is seen to reduce the impact parameter mean to 0.31° , with a clearly more peaked distribution.

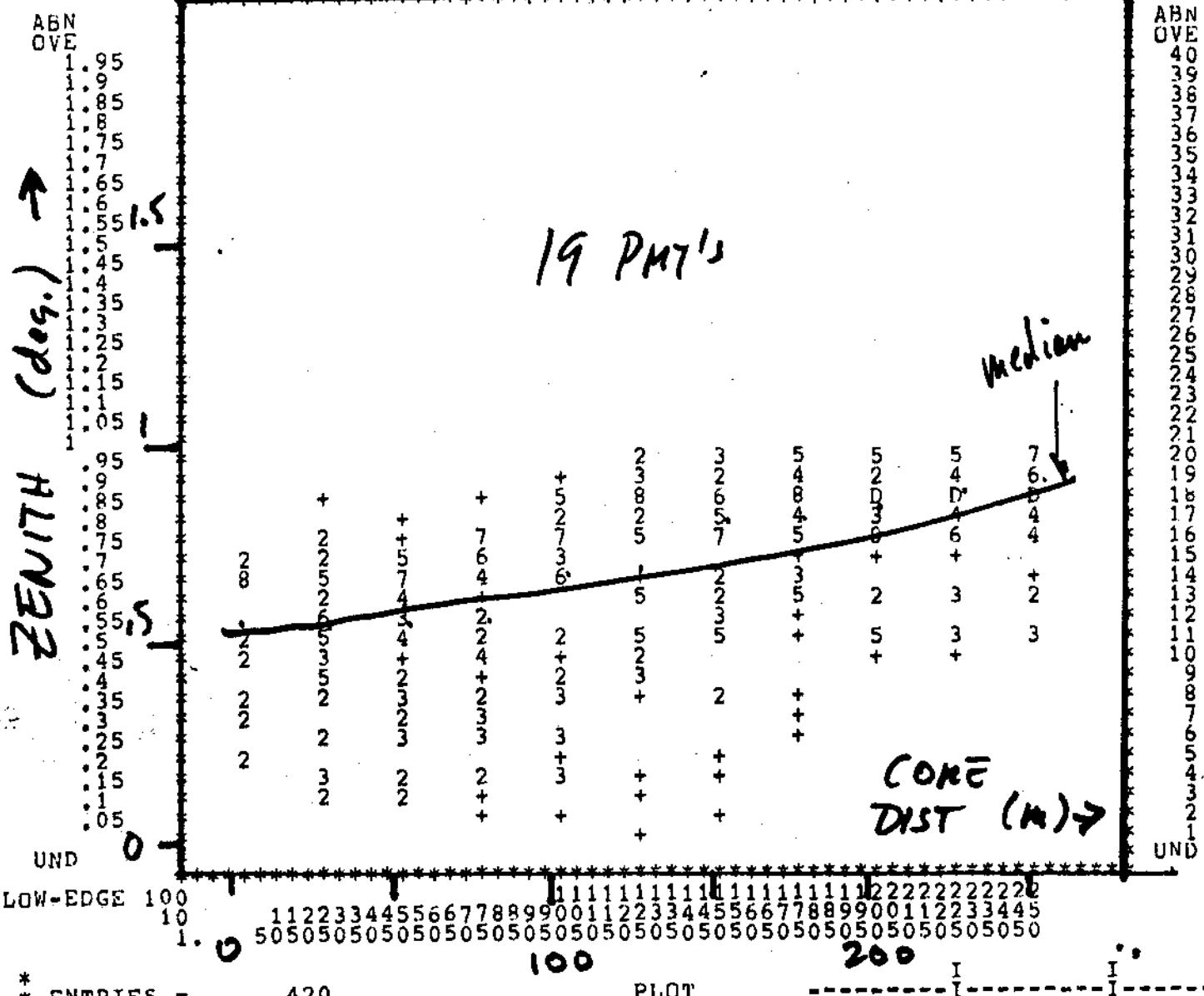
Figures 7-12 show the corresponding results for 37 PMT's. In Figs. 7-9 we see that the reconstructed centroid is a better measure of core distance in this case. The impact parameter results in Figs. 10-12 are not any better, possibly even worse! I must think about this and try some other things.

MEASURED ZENITH VS. COPE DISTANCE

HBOOK ID = 6

DATE 23-MAY-83

CHANNELS 10 U 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 V A B



* ENTRIES = 420
* SATURATION AT = 255
* SCALE .,+ 2,3,.+., A,B,
* STEP = 1 MINIMUM=0

PLOT
STATISTICS

200 I I
----- I 420 I
----- I I

Fig. 1

XC VS. XLOC

HBOOK ID = 8

DATE 23-MAY-83

CHANNELS 10 U 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 V B

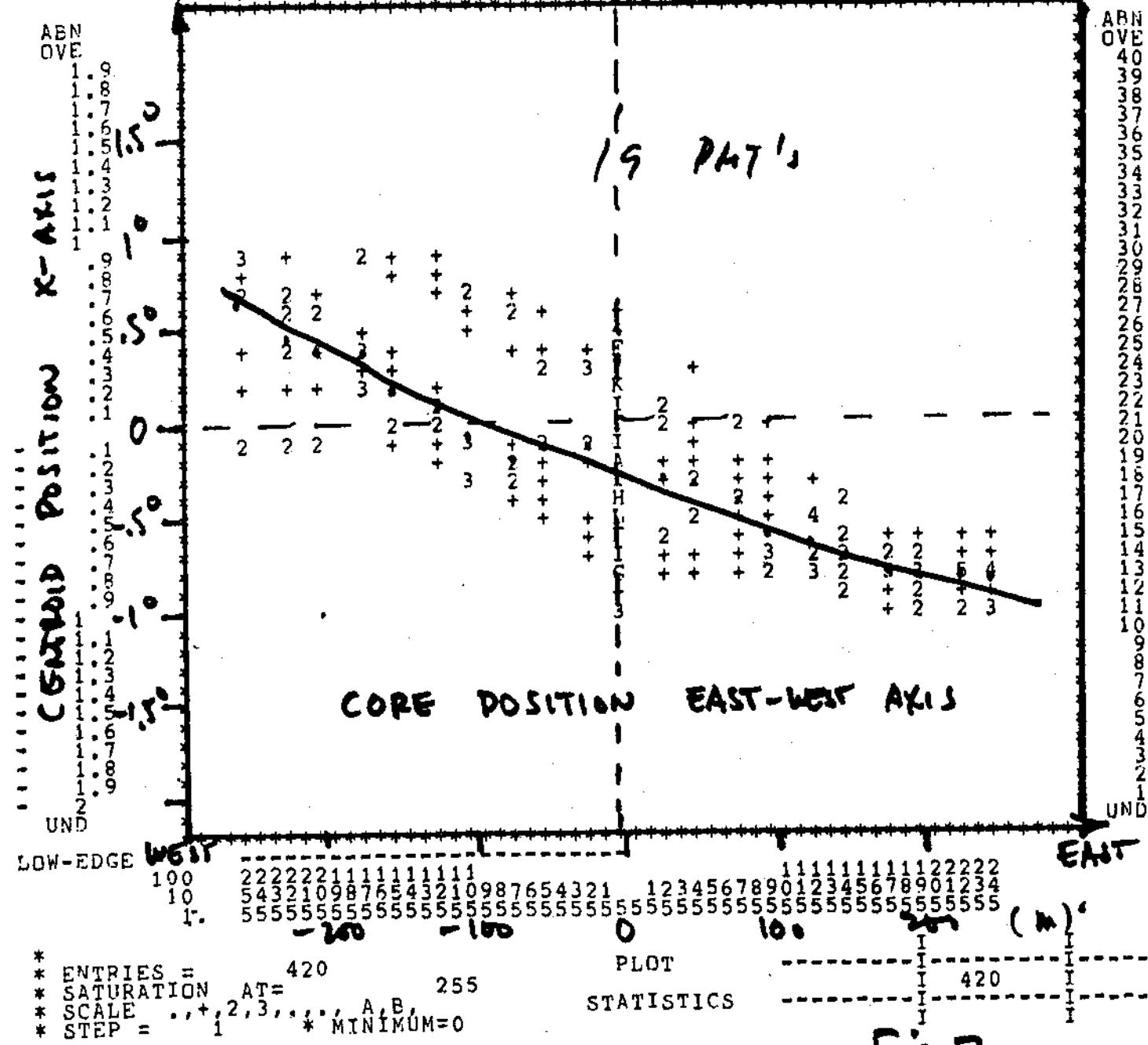


Fig 2

YC VS. YLOC

HBOOK ID =

9

DATE 23-MAY-83

CHANNELS 10 U 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 V B A

ABN
OVE

10

וְאֶת־בְּנֵי־עֲמָקָם

三

- 2
UND
LOW-EDGE

100 2222221111111111
10 543210987654321098
I. 55555555555555555555

* ENTRIES = 420
* SATURATION AT = 255
* SCALE = .,.+,2,3,.*., A,B,
* STEP = 1 MINIMUM=0

PLOT STATISTICS

Fig. 3

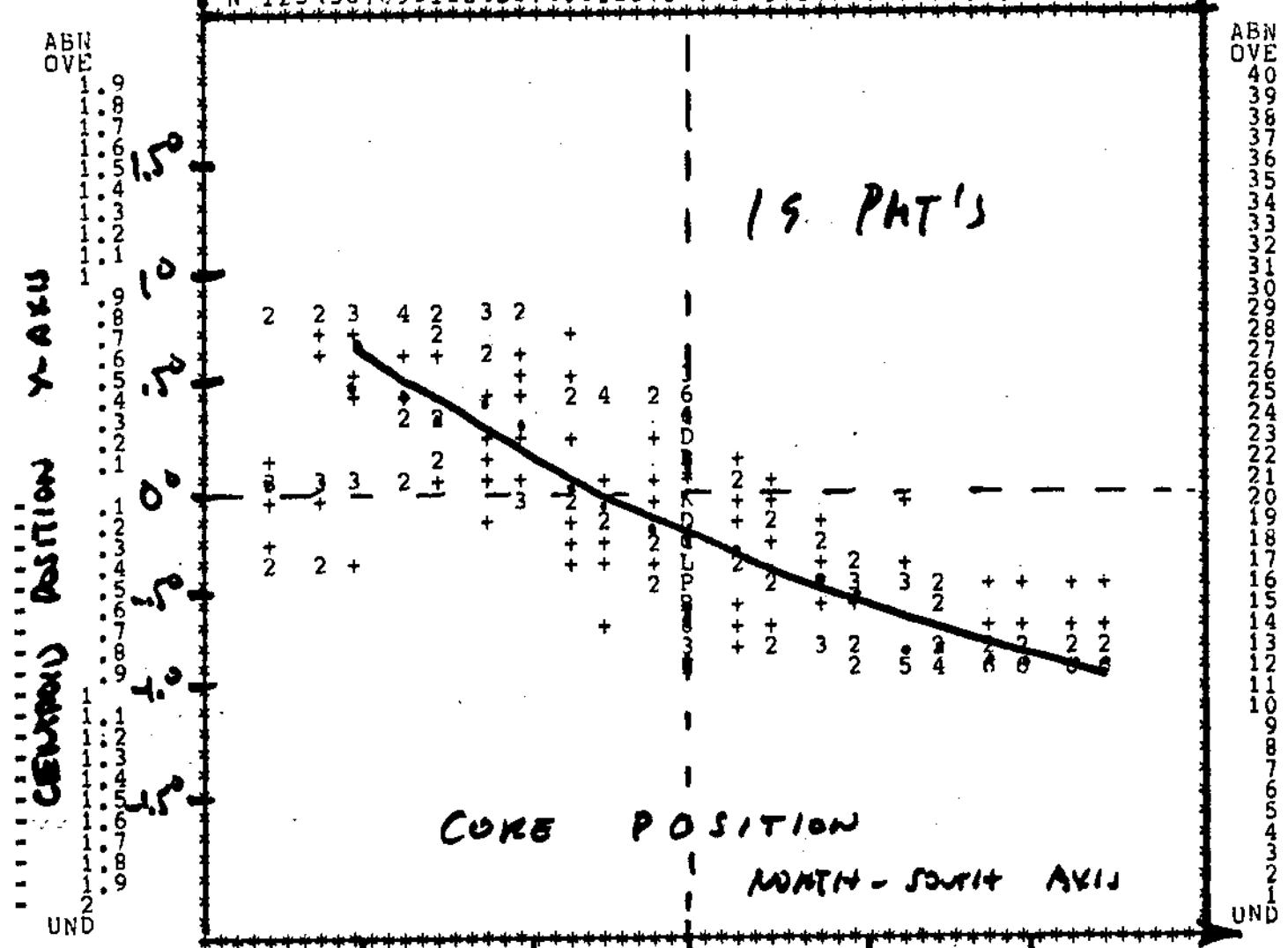


Fig. 3

IMPACT VS. CORE DISTANCE

DATE 23-MAY-83

HBOOK ID = 7

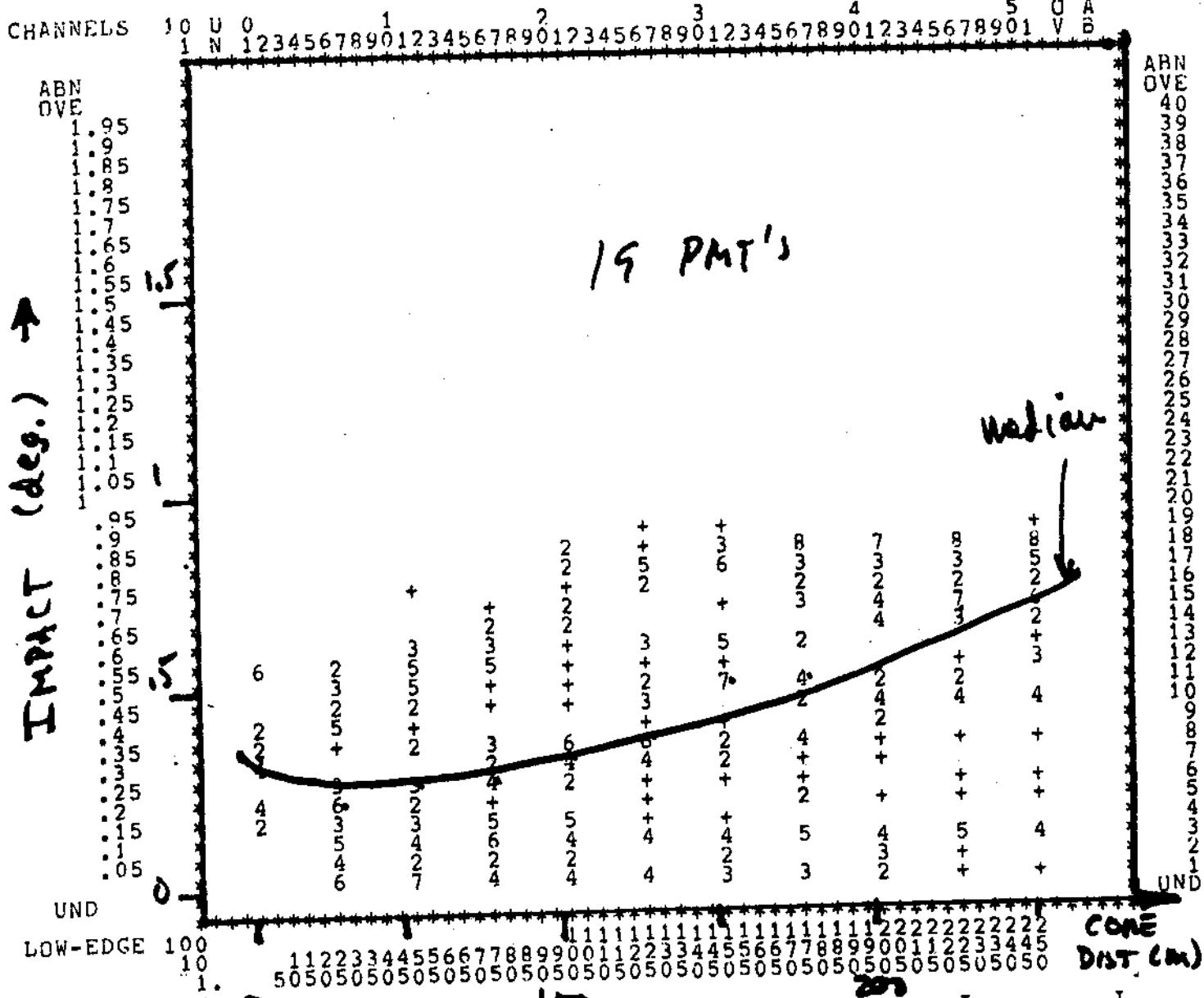
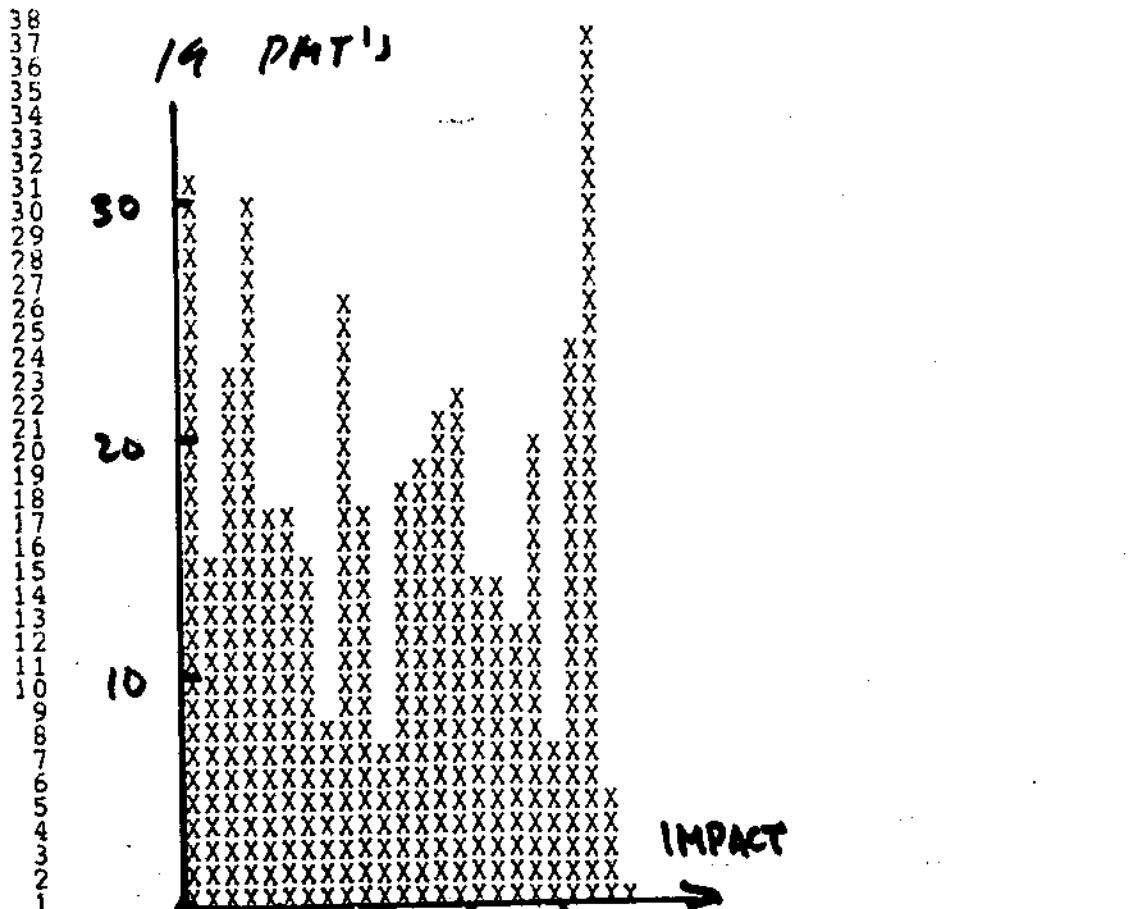


Fig. 4

IMPACT PARAMETER, ALL ZENITHS

HBOOK ID = 16

DATE 23-MAY-83



* ENTRIES = 420
* BIN WID = 0.4000E-01

* ALL CHANNELS = 0.4200E+03
* MEAN VALUE = 0.4399E+00

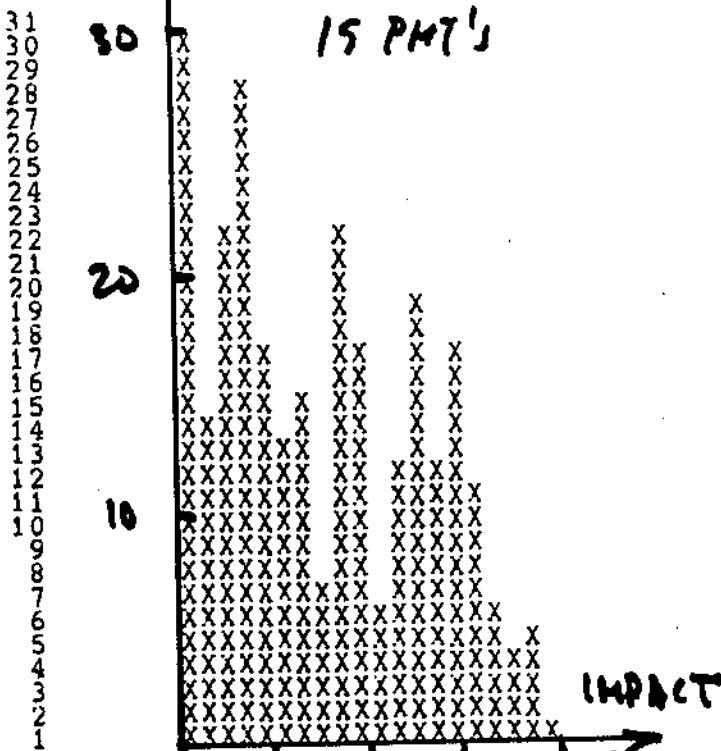
* UNDERFLOW = 0.0
* R . M . S = 0.2

Fig. 5

IMPACT PARAMETER, ZENITH < ZENL = 0.1

HBOOK ID = 19

DATE 23-



CHANNELS 10 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0

CONTENTS 10 3122111 21 11111
1. 04287357276292716451

LOW-EDGE 1. 00011222334445566677888990001122233444556667788899
0 048260482604826048260482604826048260482604826048260482604826

* ENTRIES = 278 * ALL CHANNELS = 0.2780E+03 * UNDERFLOW
* BIN WID = 0.4000E-01 * MEAN VALUE = 0.3071E+00 * R . M . S

1 RUNS PROCESSED

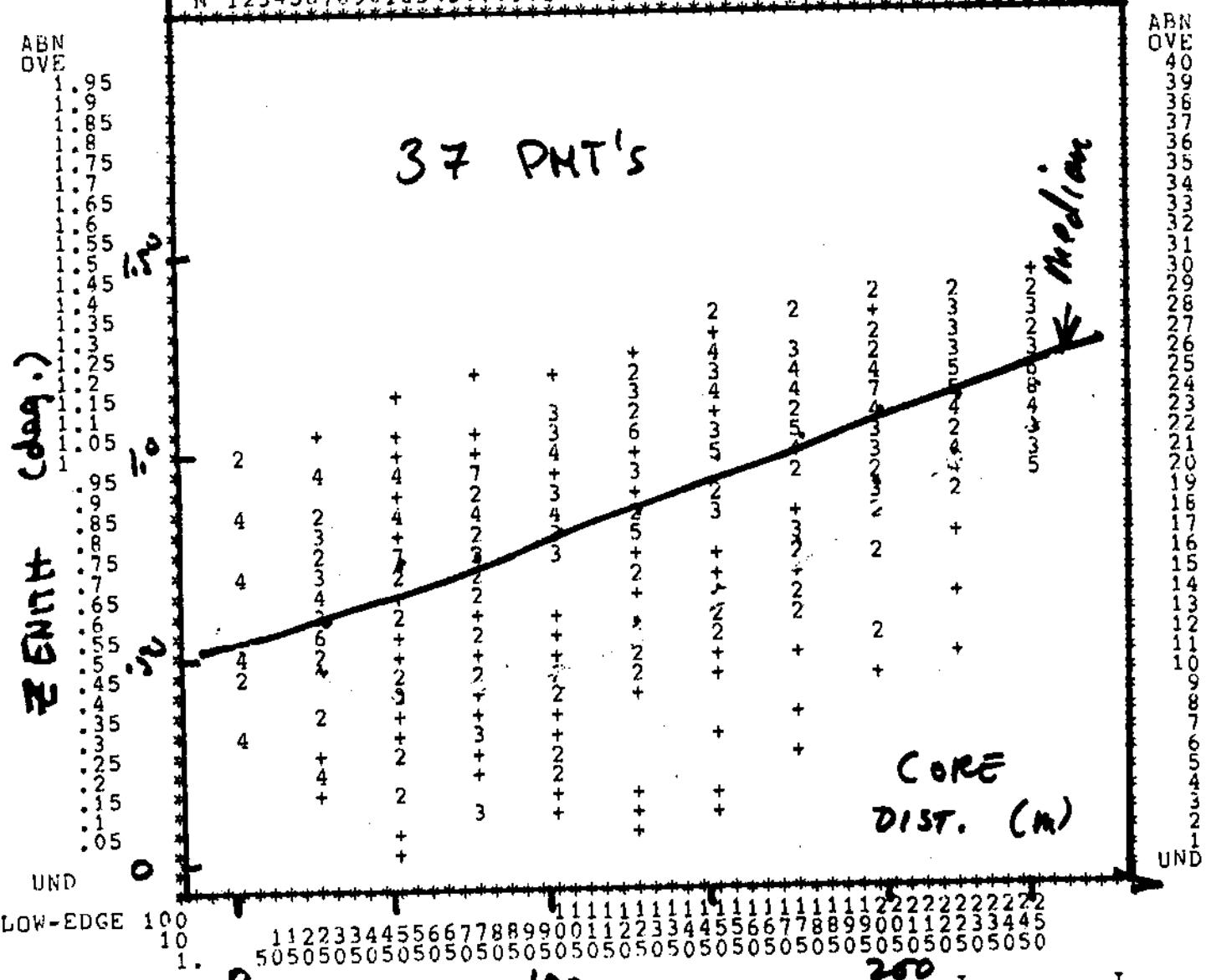
NEV MPRT IPRT MDL1 MDL2 IDIN MRUN DELT PIMPL ZENL FNORM DFS NPMT

Fig. 6

MEASURED ZENITH VS. CORE DISTANCE

HBOOK ID = 6

DATE 23-MAY-83



*
* ENTRIES = 420
* SATURATION AT = 255
* SCALE = . . + 2, 3, . . * . , A, B,
* STEP = 1 MINIMUM=0

PLOT
STATISTICS

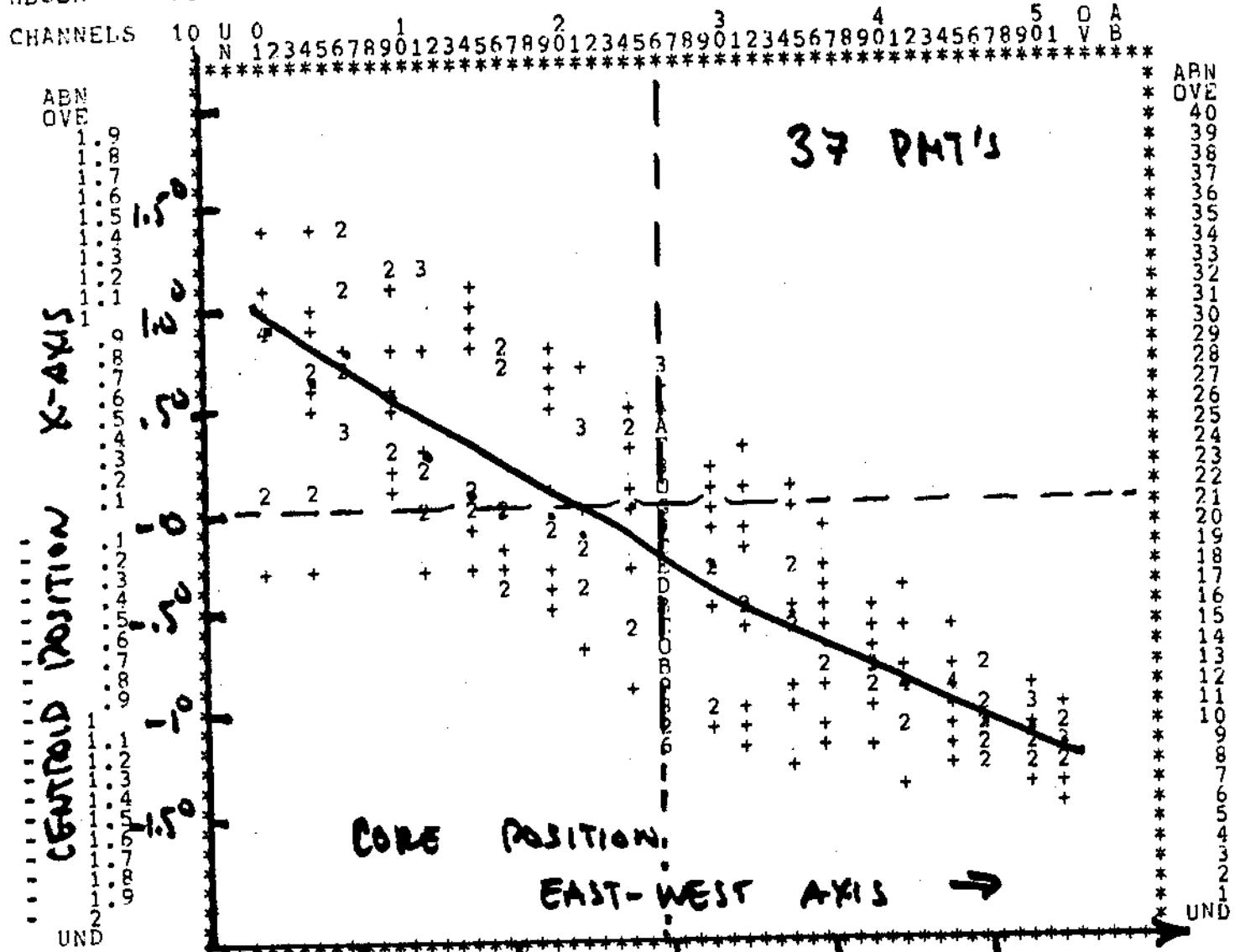
200 I-----I
I-----I 420 I
I-----I I-----I

Fig. 4

XC VS. XLOC

8

DATE 23-MAY83



* ENTRIES = 420
 * SATURATION AT = 255
 * SCALE = .,.+, 2,3,..,* A,B/
 * STEP = 1 MINIMUM=0

PLOT
STATISTICS

Fig. 8

YC VS. YLOC

HBOOK ID =

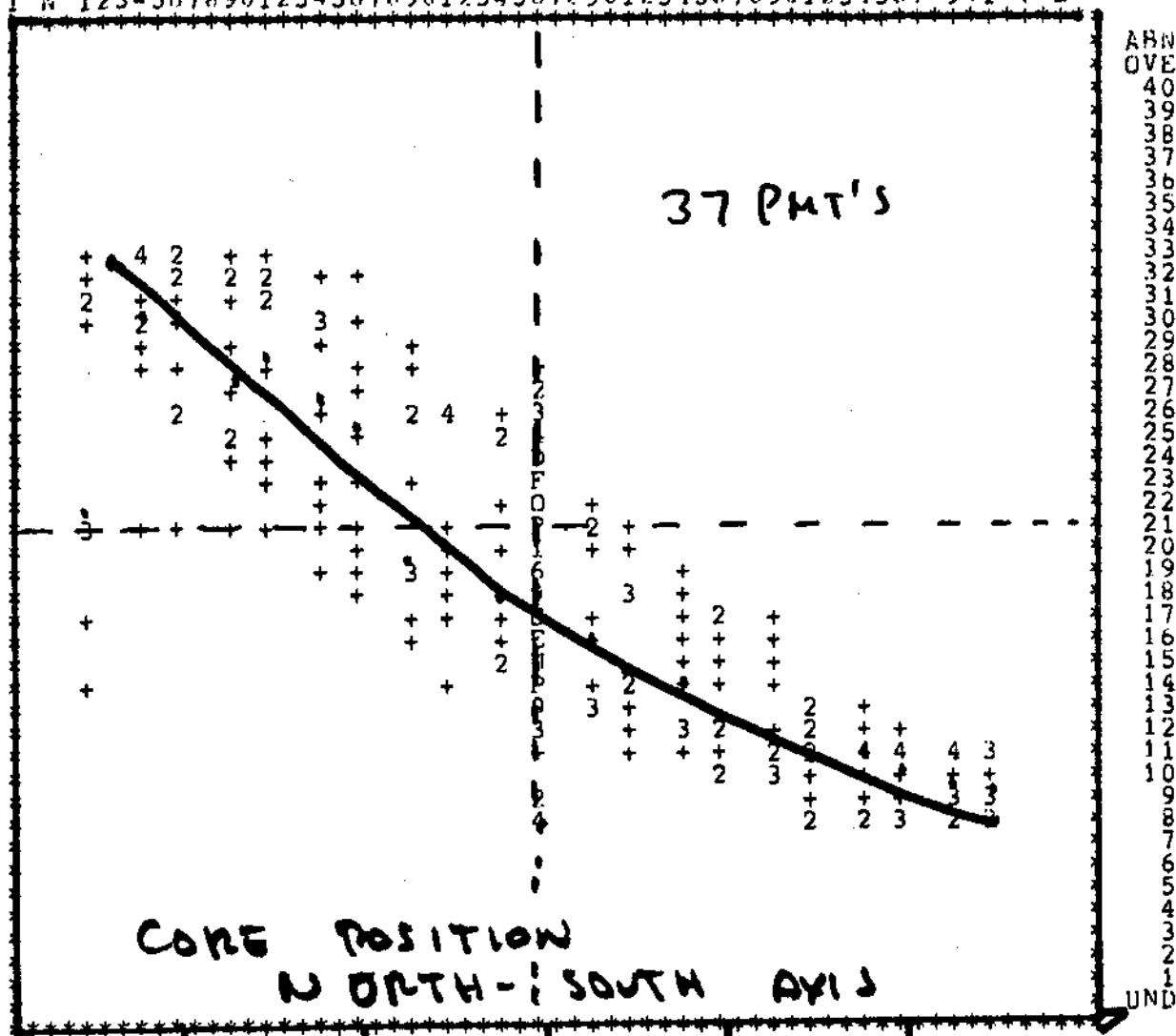
9

DATE 23-MAY-83

CHANNELS 10 U 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 V B A

ESTATE PLANNING

LOW-EDGE



* ENTRIES = 420
* SATURATION AT= 255
* SCALE ..+ 2,3,..., A,B,
* STEP = { * MINIMUM=0

PLOT
STATISTICS

(14)

Fig. 9

IMPACT VS. CORE DISTANCE

HBOOK ID = 7

DATE 23-MAY-83

CHANNELS 10 U 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 V B

ABN
OVE

x	y
0	0
1	95
2	99
3	85
4	85
5	75
6	75
7	70
8	65
9	65
10	55
11	55
12	45
13	45
14	35
15	35
16	30
17	25
18	25
19	20
20	15
21	15
22	10
23	05

UND

LOW-E

*
* ENTRIES = 420
* SATURATION AT =
* SCALE .,+ 2,3,..., A,B
* STEP = 1 * MINIM

PLOT
STATISTICS

200 420

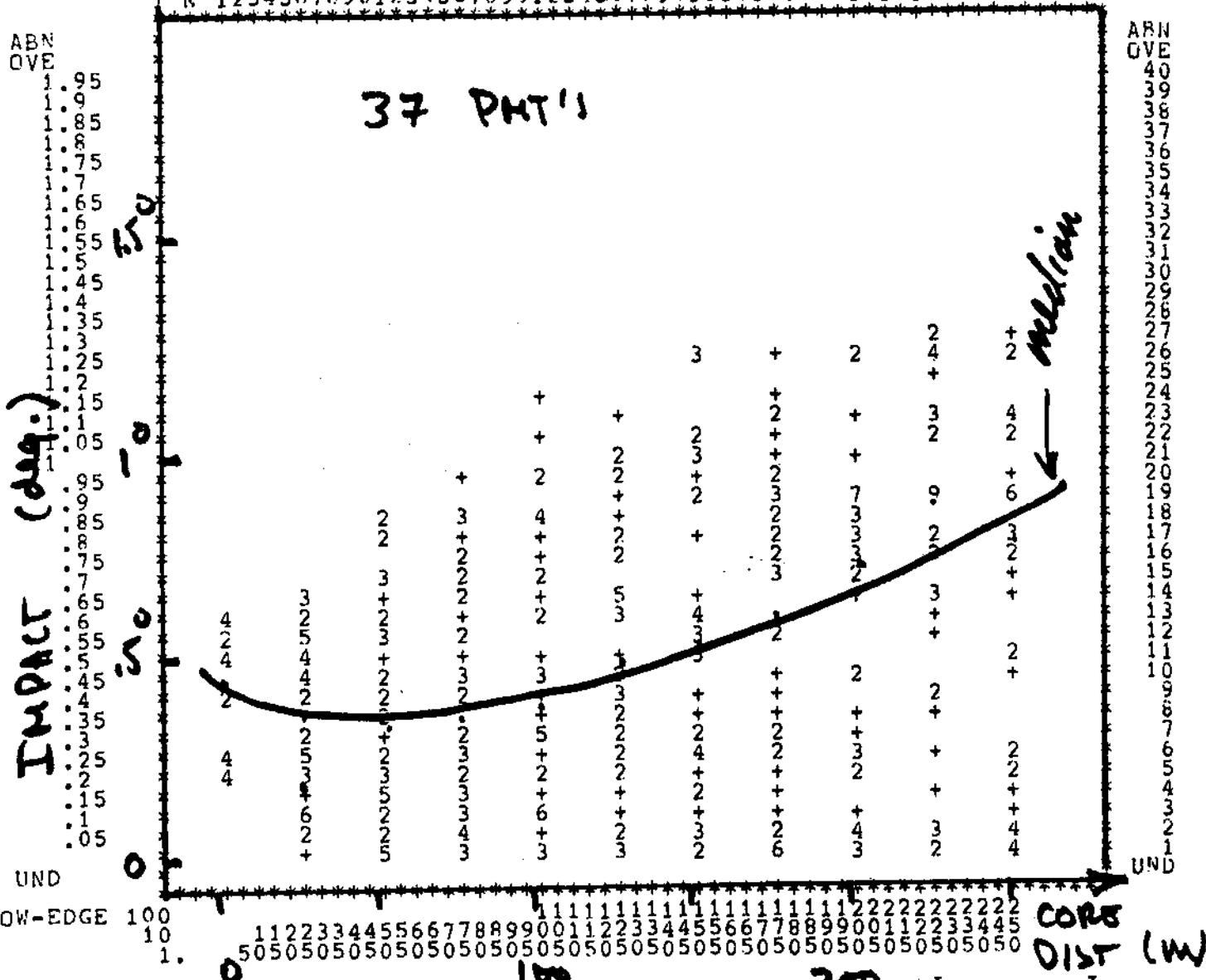


Fig. 10

IMPACT PARAMETER, ALL ZENITHS

HBOOK ID = 16

DATE 23-MAY-83

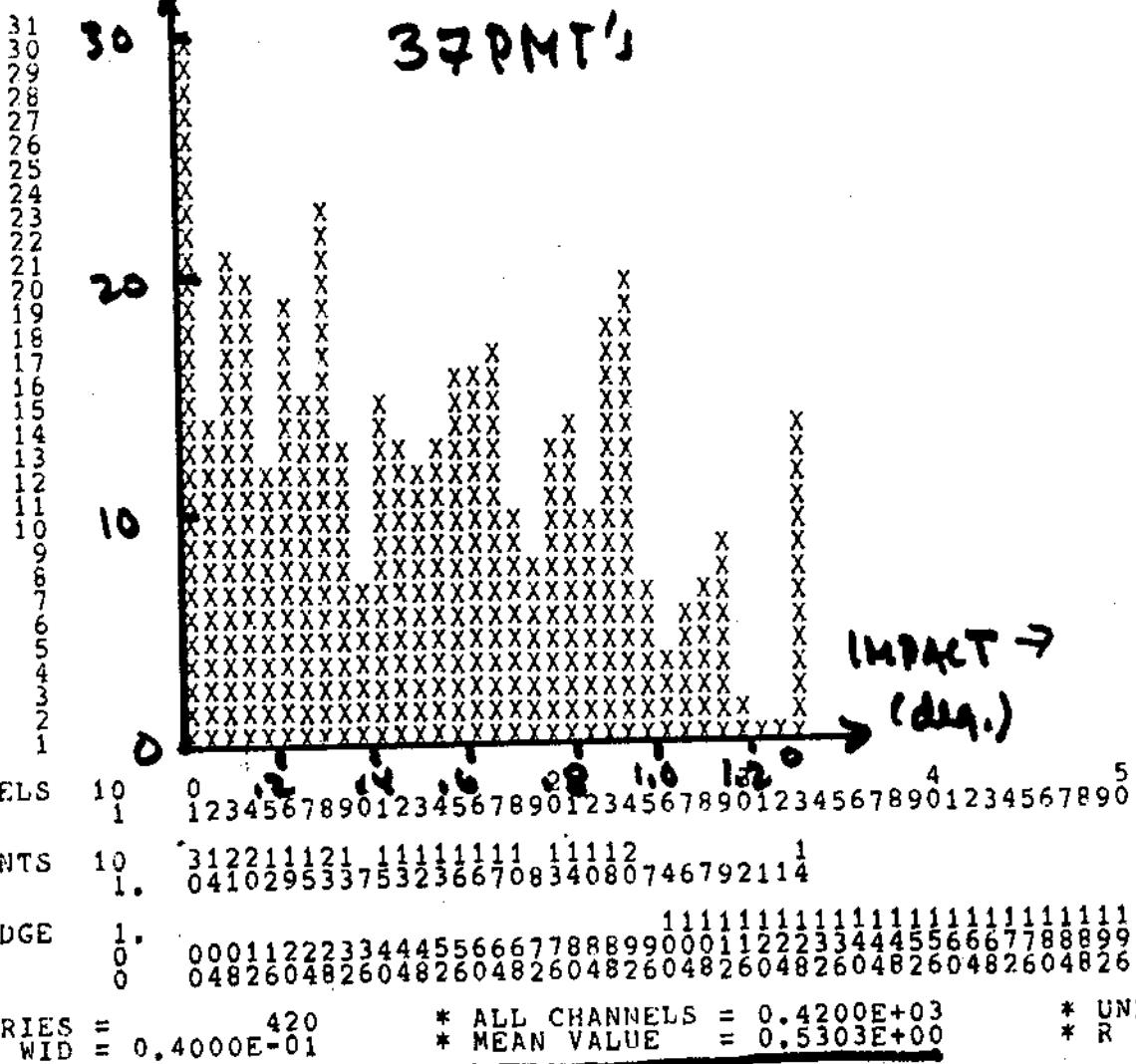
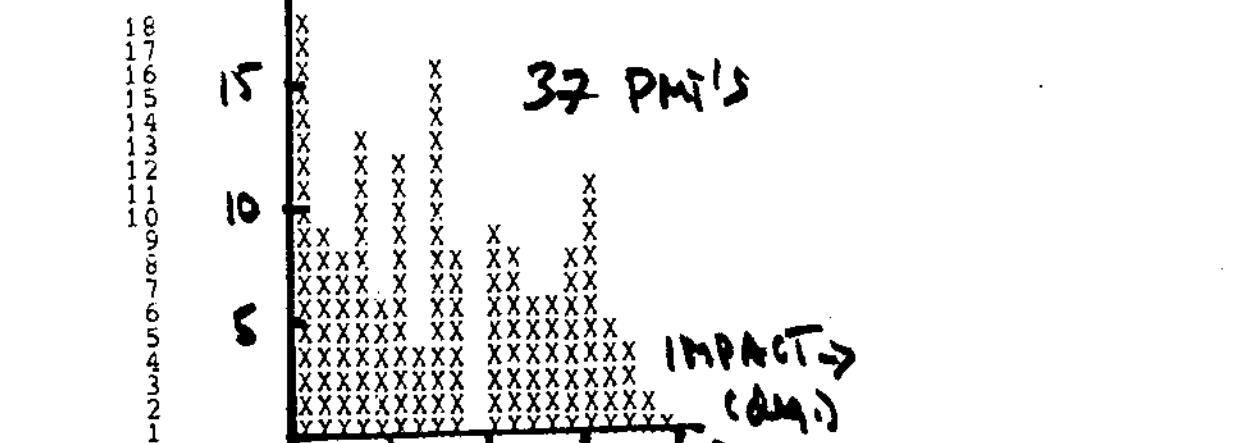


Fig. 11

IMPACT PARAMETER, ZENITH < ZENL $\leq 0.8^\circ$

HBOOK ID = 19

DATE 23-MAY-83



CHANNELS 10 1 123456789012345678901234567890123456789012345678905

CONTENTS 10 1
1. 898362468 9866815421

LOW-EDGE 1. 000112223344455666778899000112223344455666778899
0 048260482604826048260482604826048260482604826048260482604826

* ENTRIES = 154 * ALL CHANNELS = 0.1540E+03 * UNDERFLOW = 0.00
* BIN WID = 0.4000E-01 * MEAN VALUE = 0.3203E+00 * R . M . S = 0.21

1 RUNS PROCESSED

NEV MPRT IPRT MDL1 MDL2 IDIN MRUN DELT PIMPL ZENL FNORM DFS NPMT

Fig. 12