RECENT STUDIES OF THE DEBUNCHER TO ACCUMULATOR TRANSFER EFFICIENCY

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PBAR NOTE # 476

May, 1988

Abstract

We present recent studies of the Debuncher to Accumulator (D/A) transfer efficiency. Based upon a model of the D/A beamline using the computer code *Turtle*, we find that at least 98 % of the Debuncher antiprotons should be able to be injected into the Accumulator. Moreover, we find that the D/A transfer efficiency is extremely sensitive to the beam position and angle through the large quad D6Q6. Finally, we outline some investigations which may be of some importance in future analyses of D/A transfer.

One of the nagging probems which has plagued the operation of the Antiproton Source has been the inability to consistently transfer more than 90% of the Debuncher antiprotons to the Accumulator. The D/A transfer efficiency has typically run betwen 60% and 85%.

At one time, there was some suspicion that the D/A transfer efficiency was not optimized with respect to the beam momentum in the Debuncher. Therefore, studies were undertaken during December, 1986 (See Log Book #10, pp.204-206) to examine this issue. The results are shown in Appendix A, where it is seen that the Debuncher momentum is close to being optimized. But even at the optimal $\frac{\delta p}{p} \simeq 0.15\%$, the D/A transfer efficiency is only $\sim 75\%$. It was further found that the settings of the skew quads, SQ 607 and SQ 100 had little effect on the D/A transfer efficiency.

It has been shown that the D/A transfer efficiency is very sensitive to the vertical beam size (See Log Book, 30Nov.87). For delayed extraction, a plot is shown in Fig. 1 of A:IBEAM/D:IBEM1 vs. settings of the Debuncher vertical scraper, D:TJ308. As is seen, there is a dramatic increase in the D/A transfer efficiency for small scraper settings.

COMPUTER MODEL OF D/A LINE

The computer code *Turtle* was used to model the D/A beamline in order to identify aperture restrictions. A survey of the beamline is contained in Appendix B. During a recent shift, protons were stacked in the Accumulator at a rate of about 1500 microamps per hour. The magnet current settings for that shift were used in the *Turtle* model and are contained in Appendix C. Based uon the survey and magnet settings, the *Turtle* code shown in Apendix D was derived. Note that the code starts just upstream of D6Q10 and ends just downstream of A1Q4. Line 8 of the Turtle code specifies the initial phase space of the beam. Since after beam cooling in the Debuncher, the antiprotons during normal operation should have achieved $(\epsilon_H, \epsilon_V) = (7\pi, 7\pi)$mm-mrad, in the *Turtle* code we have specified $\sigma_H, \sigma_{H'}, \sigma_V, \sigma_{V'}$ via

$$\epsilon_H = 7\pi \times 10^{-6}\text{m} = \frac{6\pi\sigma_H^2}{\beta_H}, \text{etc.},$$

where β_H and β_V are the Design Report values of the beta functions just upstream of D6Q10. Also, from the Design Report we take $\frac{\delta p}{p} = 0.2\%$ and momentum $p = 8.91858$ Gev/c.

All the trims have the same angular deflection per Ampere $= 6.6846 \times 10^{-2}$mrad/Amp.

In the Debuncher, the quadrupoles are on the supplies as designated below:

Straight Section Quads (D:QSS)

D10, 30, 50

plus 2,3,4,5, except D4Q5 and D2Q5, which are on the Dipole Bus

Defocussing Quads (D:QD)

D20, 40, 60

plus 6,8,10,12,14,16,18, except D6Q6, which is on the Dipole Bus

Focussing Quads (D:QF)

7,9,11,13,15,17,19

In the *Turtle* code, the small quad excitations are based upon the curves given in Pbar Note # 418. As an example, consider

D6Q9 (SQC) $l_m = 27.6''$

Current= 244.5Amps

First, use the Pbar Note #418 to enumerate

Amps	$\int$ Gdl
119.06	3.394
258.31	7.398
119.19	3.398
258.34	7.399
229.00	6.577
255.61	7.335
229.03	6.578
255.63	7.335

Then, for each of the data points use the linearity of the small quads to calculate $\int Gdl$ for 244.5 Amps. Finally, average the eight calculated values for 244.5 Amps, obtaining 99.889 kG/m. All small quads in the Debuncher, D/A Line, and Accumulator were handled in this way.

Information about the large quad excitation is contained in Appendix E.

Information about TB1 and TB2 in the D/A Line is contained in Appendix F (See Dave Harding). They have a magnetic length of 60".

The small dipoles D6B7 (SDD-019) and D6B8 (SDD-018R) have a magnetic length of 65.37". Their strengths relative to SDD-001 is contained in Appendix G. Their currents should be such as to produce fields which would bend an 8.91858 Gev/c particle by $\frac{1}{66}360° = 5.455°$. For D6B7 this yields a field of B=17.0685 kG; however, D6B8 has a shunt set to $\Delta I = -12.76$ Amps (See p. C-7). Using

$$\frac{\Delta B/B}{\Delta I/I} = 0.71 \pm 0.01,$$

with I=1183.4 Amps, one gets $\Delta B = -0.130669$ kG, or a total magnetic field in D6B8 of $B + \Delta B = 16.9378$ kG.

Septum excitation data is contained in Pbar Note #396 and in Appendix H below. The data are quite linear. The Debuncher extraction septum and the two Accumulator injection septa are handled identically. The second and third data points in Appendix H are used to predict a septum's excitation. Then the two computed excitations are averaged. Since the Appendix H data are for a nominal magnetic length of 80", we multiply our computed excitations by 80/84 since we take the septa magnetic lengths to be 84".

Information on the Debuncher extraction kicker is contained in Appendix I. We took $\int Bdl = 1.34$ kG-m and a magnetic length of 98.375", giving

B=0.536 kG.

The apertures for the small quadrupoles were taken from the design drawings for the magnets and star chambers. The small dipole beampipe was measured to be $2\frac{9}{32}'' \times 6\frac{3}{8}''$(OD). To get the ID for this and all other devices, a nominal wall thickness of 0.083" was used. For Tor 807, the ceramic gap was taken to be 2.245" as shown in Fig. 2. Finally, the SEM apertures were taken from design drawings.

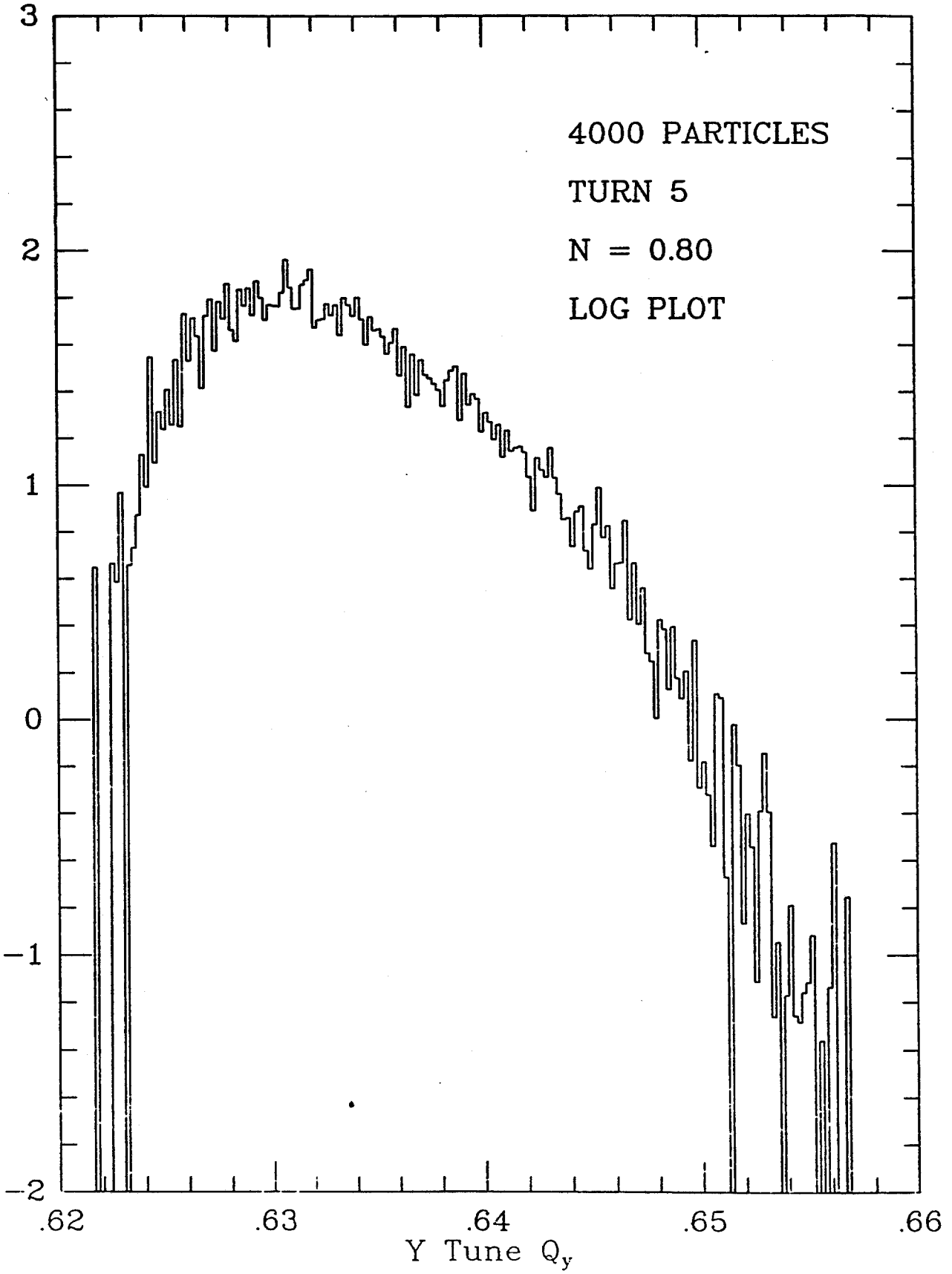

4000 PARTICLES
TURN 5
N = 0.80
LOG PLOT
3
2
1
0
−1
−2
.62
.63
.64
.65
.66
Y Tune Q_y

Figure 28

APPENDIX A

12-DEC-86

14:00 LINAC DOWN TO REPLACE P.A. EST. TIME ≈ 2 HRS.

Comments of scope traces of ~~beam~~ gap monitors (p201, 09:00)

all pictures taken with shutter open.
~~Vacuum~~ Sample of collimated Debuncher beam.

We see no dramatic fall-off in intensity either on the first few turns or on a 100 nsec time scale. Meaning the beam times in had, but under these conditions we rule out ~~[illegible]~~ 20% losses. Highly collimated beam is no better than uncollimated beam. This is quite puzzling since transmission (IBEAM/IBEA) is not 100%. See ~~[illegible]~~ previous pages

1725 Mtingwa/Malamud.

(1) With 1.20 ma A:IBEAM reads 1.24 ma

with 1.20 ma D:IBEAM reads 1.24 ma.

These are scale factors since no beam offsets are much less. Therefore to first order A/D ratio is not affected.

(2) Set up to measure ratios as a function of $P_{Debuncher}$

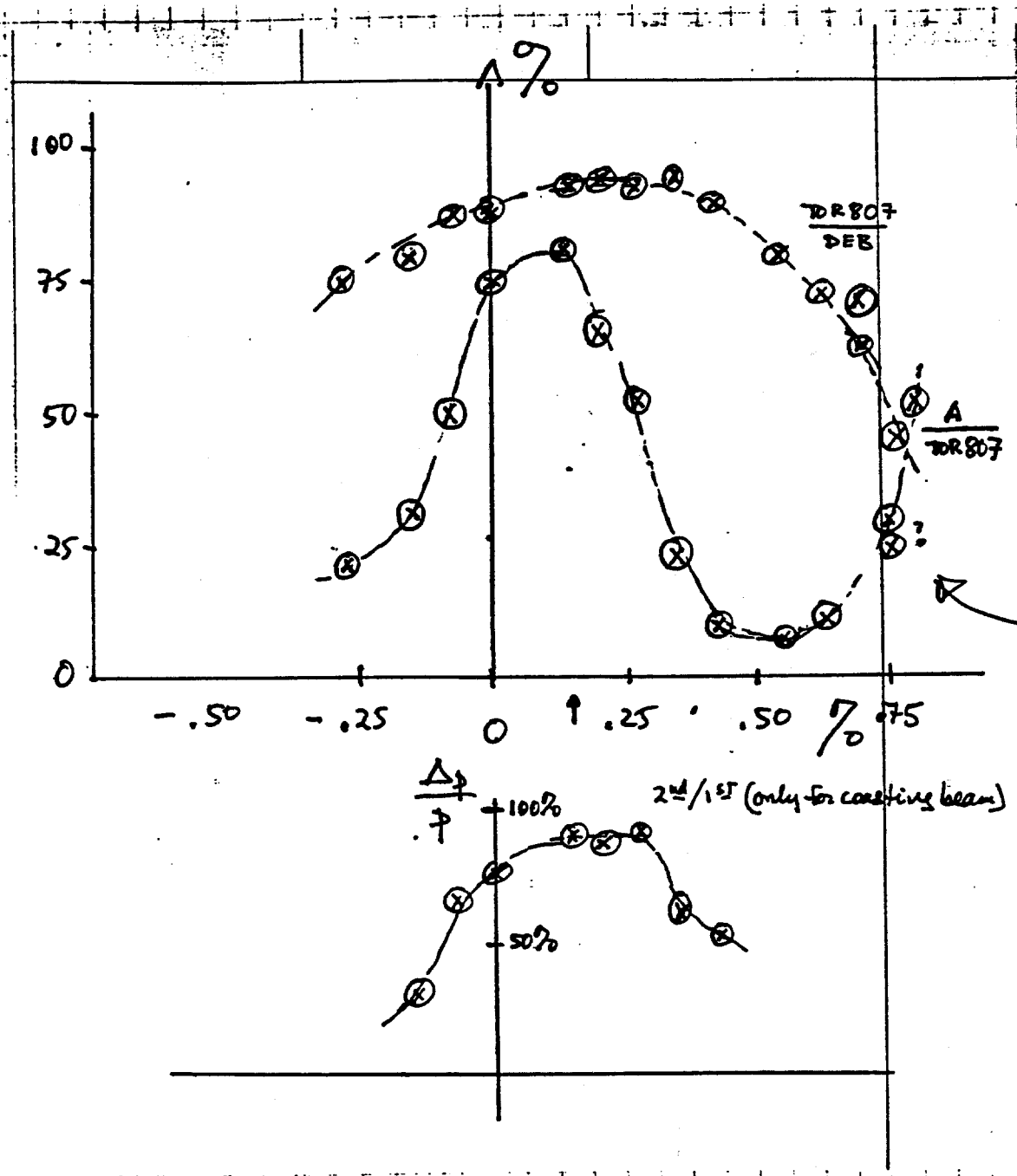
1740 Booster off - Quad in ~~Booster~~ 8 GeV. M:QFB4
1745 Beam back

We have measured three ratios as a function of momentum:
$\frac{TOR\,807}{D:IBEAM}$, $\frac{A:IBEAM}{TOR\,807}$, $\frac{2^{nd}\text{ turn}}{1^{st}\text{ turn}}$ on gap monitor.

Raw data, calculations, and machine settings are in hard copy log.

	D/A acceptance	Accum	$2^{nd}/1^{st}$
peak	+0.25%	+0.10%	+0.20%
FWHM	1.0%	0.4%	

D/A efficiency vs Deb momentum



* Comment added later – maybe hitting the DCT.

Conclusions and questions

1. Curves do not peak at same momentum.
2. D/A looks reasonable. Maximum is ~95%. Why not 100%? Is this a calibration error? Curve might have a plateau.
3. Accumulator: we don't understand rise for p > .50%. D/A transmission drops off smoothly. Coasting beam, and then second turn vanishes, yet Accumulator DCCT shows significant circulating current. [see *]

A-3

2130 Based on momentum scan we will set at

$\nu_{Reb} = 590023\ Hz \rightarrow \Delta p = +.15\%$.

(3) Next we will play with skew Quads.

The nominal settings are supposed to be:

	SQ 607	SQ 100
no coupling on core	10	130
no coupling on injection orbit	30	100

We have done a "2-dimensional scan"

	0 to 40	100 to 170

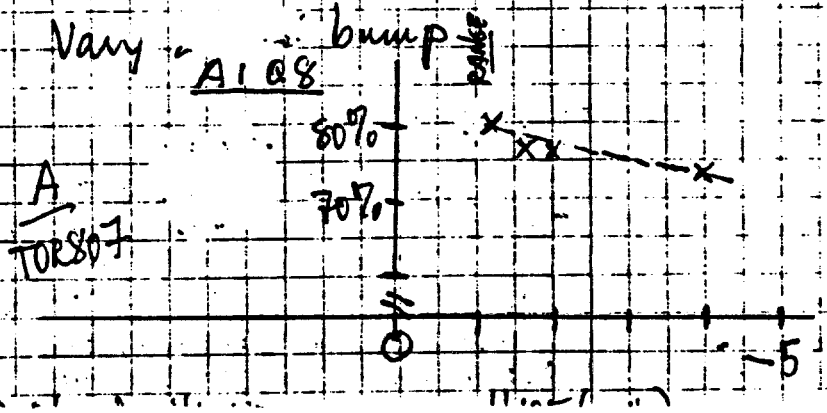
- The gap monitor picture looks about the same for all values.
- The efficiency A:IBEAM/DETOR807 remains at $(80 \pm 2)\%$ for all values.

Data is in hard copy log but probably not useful.

(4) Restored SQ value to 10, 130.

Vary bump

A1Q8



APPENDIX B

MIKE GORMLEY 15-OCT-87

D → A LINE ("SURVEY")

DEVICE	Physical Lengths (INCHES) LENGTH	TRANSVERSE DIMENSIONS	
DRIFT	13.0	CIRCULAR	OD = 5.505"
H-TRIM	18.375	"	"
DRIFT	17.0	(SEE FIGURE-1)	
D:ESEP	84.0	CIRCULAR	OD = 2.62"
DRIFT	~~14.5~~ 14.25	(SEE FIGURE-2)	
D6Q6	29.875		
DRIFT	13.0	CIRCULAR	OD = 2.61"
DRIFT	188.75	"	"
Q1	~~50.125~~ 50.29	STAR CHAMBER	
DRIFT	31.75	CIRCULAR	OD = 5.51"
TRIM	18.375	"	"
DRIFT	47.0	"	"
Q2	~~31.0~~ 31.25	STAR CHAMBER	
DRIFT	17.5	CIRCULAR	OD = 5.51
SEM802	15.75		
DRIFT	99.5	CIRCULAR	OD = 5.51
TRIM	18.5	"	"
DRIFT	36.5	"	"
Q3	31.25	STAR CHAMBER	
DRIFT	26.	CIRCULAR	OD = 5.51
Q4	~~25.75~~ 25.68	STAR CHAMBER	
DRIFT	124.5	CIRCULAR	OD = 5.51
Q5	31.25	STAR CHAMBER	
DRIFT	85.5	CIRCULAR	OD = 5.50
Q6	31.25	STAR CHAMBER	
DRIFT	13.0	CIRCULAR	OD = 5.50
TRIM	18.5	"	"
DRIFT	188.5	"	OD = ~~4.00~~ 5.5
IC	13.0		
DRIFT	13.875	CIRCULAR	OD = ~~5.52~~ 5.5
SEM806	13.0		
DRIFT	16.0	CIRCULAR	OD = 5.52
BEND	60.0	RECTANGULAR	HEIGHT = 2.30" WIDTH = 5.43"
DRIFT	12.75	CIRCULAR	OD = 6.00
BEND	60.0	RECTANGULAR	HEIGHT = 2.30" WIDTH = 5.43"
DRIFT	20.25	CIRCULAR	OD = 5.45
Q7	~~16.75~~ 16.65	STAR CHAMBER	

D → A LINE SURVEY (CONT.)

DEVICE	(INCH) LENGTH	TRANSVERSE DIMENSIONS	
Q7			
DRIFT	79.875	CIRCULAR	OD = 2.51
SEM 807	13.0		
DRIFT	48.75	CIRCULAR	OD = 2.60
A: ISEP1	84.		
DRIFT	3.75	CIRCULAR	OD = 2.62
A: ISEP2	84.		
DRIFT	13.75	(SEE FIGURE-3)	
A: A1Q4	16.75		

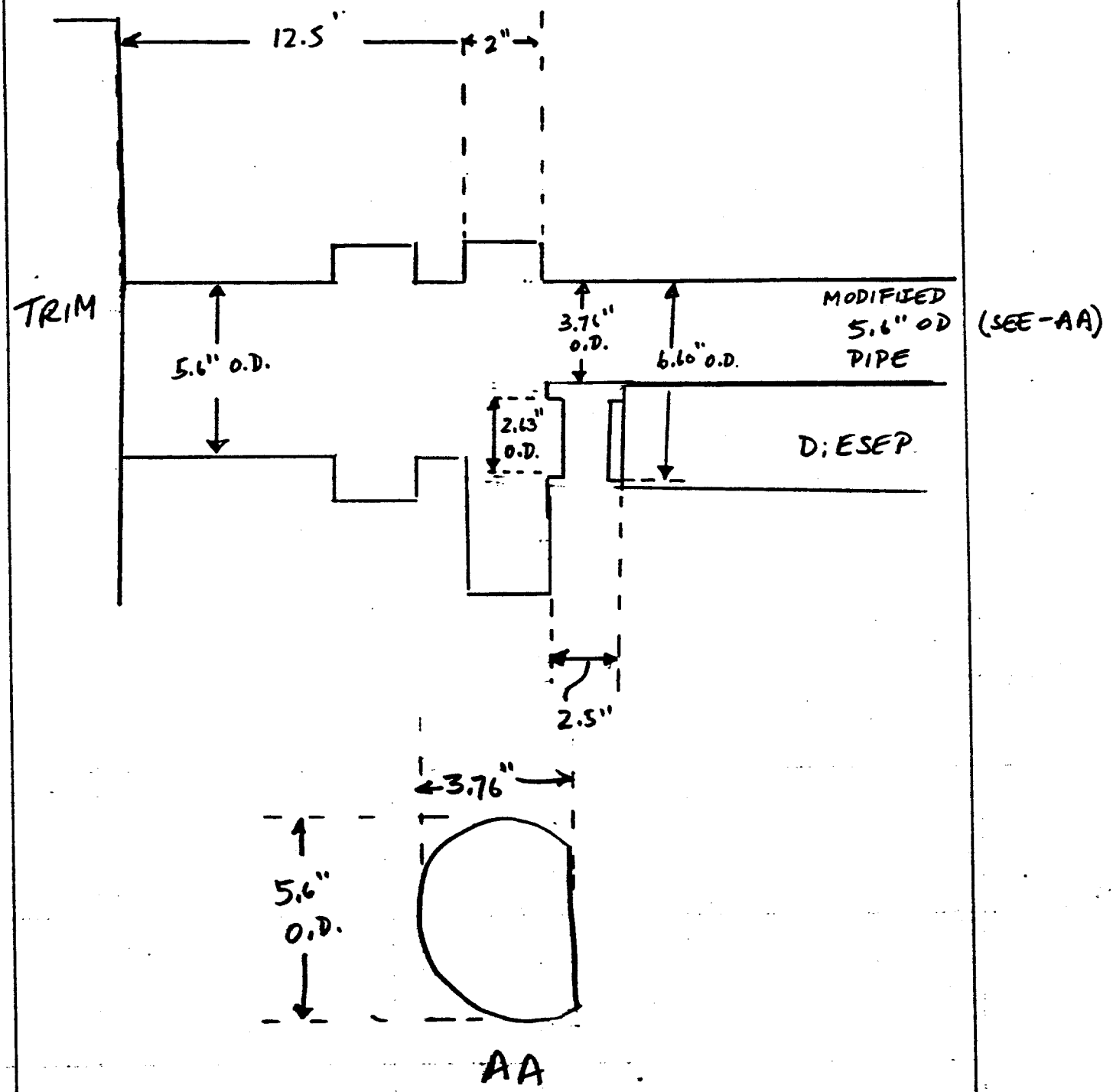
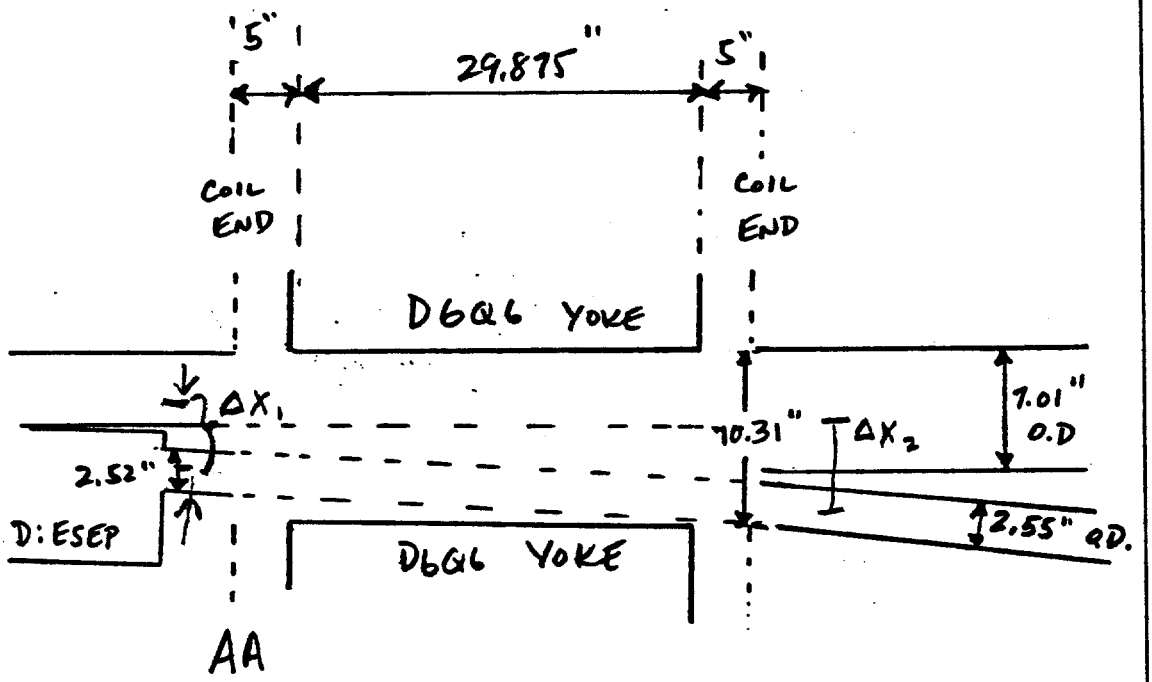


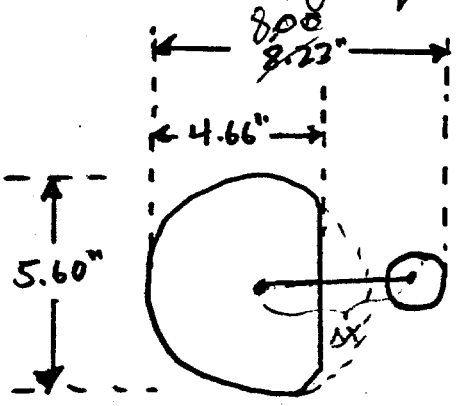
FIGURE - 1

DEBUNCHER EXTRACTION LAYOUT

BIRDS-EYE-VIEW



At split of system



$$\Delta X_1 = 8.00 - \frac{5.60}{2} - \frac{2.52}{2} = 3.94$$

$$\Delta X_2 = 6.25$$

AA
(LOOKING INTO D6Q6)

FIGURE-2
D6Q6 LAYOUT
BIRDS-EYE-VIEW

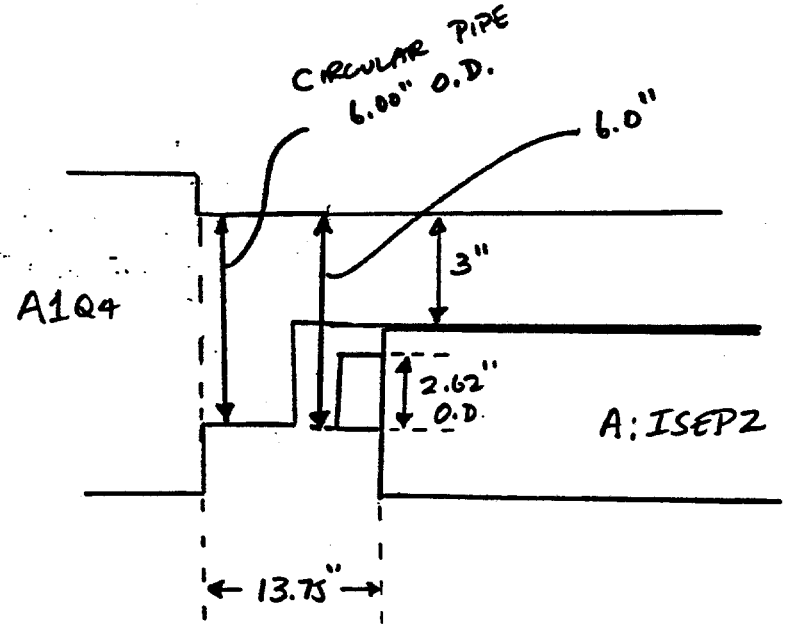


FIGURE - 3
ACCUMULATOR INJECTION LAYOUT
BIRDS-EYE-VIEW

APPENDIX C

STACKING at ≳ 1500 μA/hr

MON 04-JAN-88 11:43

```
D1        Display File <692>  06-Dec-87 2310  Sun                 *COPIES*  *RETURN
CHANNEL   ........ ........ ........ ........ ........ ........ ........ ........
                                                                   *Update Page
linac     booster  mainring switchyd tevatron P-BAR_SR refrig   sequencr system_9

proton    target   injectin d to a  extractn bstr lin rest  1  paux_dev rest 2
DEBUNCH   debunch  accumu   accumu   ap10     ap10/30  ap30/50  ap50     ap0/f2
 bus      shunt    TRIM    inject   extract  bpm      diag     temp     ........ studies
```

	D/A	A/D			D/A	A/D	
	Not Saved	Not Saved					
	Not Saved	Not Saved		-D:V406	-3.7	-3.788	AMP
-D:H103	0	-.038	AMP	-D:H405	0	-.076	AMP
-D:H106	0	.062	AMP	-D:V403	-.038	-.076	AMP
-D:V107	0	-.151	AMP	-D:H403	0	.049	AMP
-D:H109	-10	-9.988	AMP	-D:V401	0	-.026	AMP
-D:V206	0	-.051	AMP	-D:H501	0	.037	AMP
-D:H206	0	-.076	AMP				
-D:V203	0	-.051	AMP	-D:V610	0	.049	AMP
-D:H201	0	.062	AMP	-D:H610	0	-.113	AMP
				-D:H606	7.437	7.762	AMP
-D:V301	0	.012	AMP	-D:H604	-10.39	-10.54	AMP
-D:H302	0	.012	AMP	-D:V603	0	.087	AMP
	Not Saved	Not Saved					
-D:V304	0	-.026	AMP				
	Not Saved	Not Saved					
				-D:BS608	12.73	-12.75	AMP

C-2

WED 16-DEC-87 14:42

D1 Display File <692> 06-Dec-87 2310 Sun ♦COPIES♦ ■RETURN
CHANNEL ....
■Update Page

linac booster mainring switchyd tevatron P-BAR_SR refrig sequencr system_9

proton target injectin d to a extractn bstr lin rest 1 paux_dev mainring
DEBUNCH debunch accumu accumu ap10 ap10/30 ap30/50 ap50 ap0/f2
BUS shunt trim inject extract bpm diag temp ..... studies

	D/A	A/D			D/A	A/D
-D:IB	1183	1183.4	Amp	-D:IBTEST	20 -2	
-D:QF	244.1	244.5	AMP			
-D:QD	238.9	238.5	AMP			
-D:QSS	285.9	286.2	AMP			
-D:QT205	351.8	350.2	AMP			
-D:QT405	351.8	350	AMP			
-D:QT606	348.8	347.3	AMP			
-D:SEXFI	162.8	161	AMP			
-D:SEXFV	162.8	161.3	AMP			
-D:SEXDI	217.5	216.4	AMP			
-D:SEXDV	217.5	216.1	AMP			

D6Q6 current = 1183.4 + 347.3 = 1530.7

C-3

WED 16-DEC-87 14:36

D1 Display File <692> 06-Dec-87 2310 Sun ♦COPIES♦ ■RETURN
CHANNEL ....
■Update Page
linac booster mainring switchyd tevatron P-BAR_SR refrig sequencr system_9

proton debunch times | target debunch lossmon | injectin accumu PW SUP | D TO A accumu | extractn ap10 ..... | bstr lin ap10/30 ..... | rest 1 ap30/50 ..... | paux_dev ap50 ..... | mainring ap0/f2 studies

	D/A	A/D	
-D:Q801	241.9	240.9	AMP
-D:Q804	181	180.7	AMP
-D:Q807	43.1	43.02	AMP
TB1 -D:H807A	624	620	AMP
TB2 -D:H807B	625.5	621.3	AMP
-D:QS802	20	-19.96	AMPS
-D:QS803	15	-15	AMPS
-D:QS804	13	-12.98	AMPS
-D:QS806	2.3	-2.34	AMPS
-D:VT801	4	3.974	AMP
-D:HT804	-.5	-.613	AMP
-D:VT806	-3	-2.976	AMP

(SQE) Q1 = D:Q801 = 240.9 A
(SQD) Q2 = D:Q801 − 19.96 = 220.94 A
(SQD) Q3 = 240.9 − 15 = 225.9 A
(SQC) Q4 = 180.7 − 12.98 = 167.72 A
(SQD) Q5 = 180.7 A
(SQD) Q6 = 180.7 − 2.34 = 178.36 A
(dipole) Q7 = 43.02 A

C-4

MON 04-JAN-88 11:47

D1 Display File <692> 06-Dec-87 2310 Sun ◆COPIES◆ #RETURN
CHANNEL ....
#Update Page
linac booster mainring switchyd tevatron P-BAR_SR refrig sequencr system_9

proton target injectin D TO A extractn bstr lin rest 1 paux_dev rest 2
debunch debunch accumu accumu sp10 sp10/30 sp30/50 sp50 sp0/12
TIMES lessmon pw sup .... studies

	D/A	A/D	
-D:SMA5S	.000274	.000274	SECS
-D:SMA5C	0	0	SECS
-D:EXTRAT	.497	.497	SECS
-D:ESEPON	20	20	USEC
-D:ESEPC	0	0	SECS
-A:ISEP1O	54	54	USEC
-A:ISEP2O	54	54	USEC
-A:ISEP1C	0	0	SECS
-A:ISEP2C	0	0	SECS
-A:SCRES	0	0	SECS

	D/A	A/D	
-D:EXTRAM	.6289308	.6289308	MREV
-D:R1LLMT	.6918239	.6918239	MREV
-D:VAREVT	1	1	SECS
-A:VAREVT	1.4	1.4	SECS
-D:DMPSYN	.6	.6	SECS
-D:SMB5S	0	0	SECS
-D:SMB5C	0	0	SECS

C-5

FRI 18-DEC-87 10:59

[illegible]	Display File <692>	06-Dec-87 2310	Sun				*COPIES*	[illegible]
CHANNEL	.....	.....	.....	.....	.....	.....	.....	.....
								Update Page
linac	booster	mainring	switchyd	tevatron	P-BAR_SR	refrig	sequencr	system_[illegible]
proton	target	injectin	d to a	extractn	bstr lin	rest 1	paux_dev	mainring
DEBUNCH	debunch	accumu	accumu	ap10	ap10/30	ap30/50	ap50	ap0/f2
bus	shunt	trim	inject	EXTRACT	bpm	diag	temp	..... studies

	D/A	A/D		D/A	A/D
-D:ESEPV	695	* 405.5	VOLT		
-D:EKIKP	62	-.123	KV		
-D:EKIKM1	273.192		USEC		
-D:EKIKM2	273.278		USEC		
-D:EKIKM3	273.213		USEC		
-D:EKIKM4	276.309		USEC		
-D:ESEPON	20	20	USEC		

C-6

FRI 18-DEC-87 10:59

01 Display File <692> 06-Dec-87 2310 Sun *COPIES* *RETURN
CHANNEL ....
*Update Page
linac booster mainring switchyd tevatron P-BAR_SR refrig sequencr system_9

proton target injectin d to a extractn bstr lin rest 1 paux_dev mainring
debunch debunch ACCUMU accumu ap10 ap10/30 ap30/50 ap50 ap0/f2
bus shunt trim INJECT extract bpm dampers diag motors studies

	D/A	A/D			D/A	A/D	
-D:EKIKM1	273.192		USEC	-D:H807A	624	620	AMP
-A:IKIKM1	272.368		USEC	-D:H807B	625.5	621.3	AMP
-D:ESEPON	20	20	USEC	-D:VT801	4	3.974	AMP
-A:ISEP1O	54	54	USEC	-D:VT806	-3	-2.976	AMP
-A:ISEP2O	54	54	USEC				
-D:EKIK	62	-.003	KV	-D:EKIKM1	273.192		USEC
-A:IKIK	63	-.083	KV	-D:EKIKM2	273.278		USEC
-A:IKIKP	63	-.043	KV	-D:EKIKM3	273.213		USEC
-A:ISEP1V	661.1	* 448.5	VOLT	-D:EKIKM4	276.309		USEC
-A:ISEP2V	660.2	* 429	VOLT				
-D:ESEPV	695	* 405.5	VOLT	-A:IKIKM1	272.368		USEC
				-A:IKIKM2	272.42		USEC
A:ISEP1I		-21136	AMPS	-A:IKIKM3	272.44		USEC
A:ISEP2I		19049	AMPS	-D:BKIKM1	76.7		USEC
D:ESEPI		*-23086	AMPS				
-A:ISEP1C	0	0	SECS	-D:ESEPC	0	0	SECS
-A:ISEP2C	0	0	SECS				

C-7

FRI 29-JAN-88 14:54

```
P60   DEBUNCHER AP10 QUAD SHUNTS   SET     D/A      A/D     *COPIES*
-<FTP>+ *LX* X-A/D  X=TIME     Y=B:ANODPW,M SMBEAM,T D0SC13,M BGBEAM
*Save   .... Eng-U  I= 0       I= 0      , 0      , 0      , 0
-< 1>+  r_12 15_Hz  F= 40000   F= 10     , 10     , 2000000, 20
acc10 acc30 acc50 DEB10 deb30 deb50 protn  inj  dtoa  ext   bostr
 D:IBEAM       DEB 1ma=10**10pbar                  .0116     mA

-A:IB          ACCUMULATOR DIPOLE BU  1170.245     1170.127  Amp  ...

-D:QS605       D6Q5      50A QUAD MAG S     51      *-50.98  AMPS
-D:QS604       D6Q4      20A QUAD MAG S     2.777   *-2.871  AMPS
-D:QS603       D6Q3      50A QUAD MAG S     26.21   *-26.23  AMPS
-D:QS602       D6Q2      50A QUAD MAG S     30.62   *-30.6   AMPS

-D:QS101       D10Q      20A QUAD MAG S     12.66   *-12.67  AMPS

-D:QS102       D1Q2      50A QUAD MAG S     30.62   *-30.58  AMPS
-D:QS103       D1Q3      50A QUAD MAG S     26.21   *-26.2   AMPS
-D:QS104       D1Q4      20A QUAD MAG S     2.777   *-2.781  AMPS
-D:QS105       D1Q5      50A QUAD MAG S     51      *-50.95  AMPS
-D:QS106       D1Q6      20A QUAD MAG S     4.2     *-4.191  AMPS
-D:BS608       D6B8     25A DIPOLE SHUNT    12.73   *-12.76  AMP

-D:BKIKTG      BSTER TO BEB KICKER T  .4982        .4982     SECS ..
```

C-8

MON 04-JAN-88 11:34

D1 Display File <692> 06-Dec-87 2310 Sun
CHANNEL .... *COPIES* *RETURN

linac	booster	mainring	switchyd	tevatron	P-BAR_SR	refrig	*Update Page sequencr system_9
proton	target	injectin	d to a	extractn	bstr lin	rest 1	paux_dev rest 2
debunch	debunch	ACCUMU	accumu	ap10	ap10/30	ap30/50	ap50 ap0/f2
BUS	shunt	trim	inject	extract	bpm	dampers diag	motors studies

	D/A	A/D		D/A	A/D
-A:ID	1170	1170.322	Amp		
-A:LQ	1271	1270.834	Amp		
-A:QDF	239.3	239.307	Amp		
-A:QT	259.7	259.686	Amp		
-A:QSF1	3.477	-3.59	AMP		
-A:QSD	1.405	-1.4	AMP		
-A:SEX2	39.84	38.47	AMP		
-A:SEX7	43.4	41.92	AMP		
-A:SEX9	262.4	268.9	AMP		
-A:SEX10	397.2	395.2	AMP		
-A:SEX12	408.1	405.9	AMP		
-A:SQ100	44.9	45.22	AMP		
-A:SQ607	.159	.05	AMP		
-A:DCT10	46.7	46.57	AMP		
-A:DCT12	54.6	54.4	AMP		
A:BFIELD		0	Gaus		

(SRA) A:QY = A:QDF − 3.59 = 239.307 − 3.59
= 235.717

```
'DEBUNCHER TO ACCUMULATOR TRANSFER LINE'
(STARTING JUST US OF D6Q10 AND ENDING JUST DS OF A1Q4)
(FEBRUARY 5, 1988)
10000
15.    1.0    'MM'    .10 ;
15.    8.0    'IN'    .02540 ;
13.    10. ;
1.    2.527    0.462    4.115    0.284    9332.0    0.1    8.91858;
(LINE BEGINS JUST UPSTREAM OF D6Q10.)
(CIRCULAR AND HYPERBOLIC QUAD APERTURES)
16.0    100.    70.409 ;
16.0    101.    41.707 ;
5.0    'DQ10'    27.6    -9.7438    100. ;
(CIRCULAR AND HYPERBOLIC DRIFT APERTURES)
16.0    100.    67.8053 ;
16.0    101.    100. ;
5.0    'DRIF'    20.1275    0.0    100. ;
(CIRCULAR DRIFT APERTURE)
16.0    100.    48.6918 ;
5.0    'DRIF'    4.75    0.0    100. ;
(EKIK APERTURE)
16.0    4.0    38.100 ;
16.0    5.0    22.225 ;
2.0    0.129 ;
4.0    'EKIK'    98.375    0.536    0.0 ;
2.0    0.129 ;
(CIRCULAR DRIFT APERTURE)
16.0    100.    48.6029 ;
5.0    'DRIF'    4.75    0.0    100. ;
(CIRCULAR DRIFT APERTURE)
16.0    100.    68.1228 ;
5.0    'DRIF'    18.8975    0.0    100. ;
(CIRCULAR AND HYPERBOLIC QUAD APERTURES)
16.0    100.    70.409 ;
16.0    101.    41.707 ;
5.0    'D6Q9'    27.6    9.9889    100. ;
(CIRCULAR AND HYPERBOLIC DRIFT APERTURES)
16.0    100.    67.7418 ;
16.0    101.    100. ;
5.0    'DRIF'    40.764    0.    100. ;
(D6B8 APERTURE)
16.0    4.0    78.8543 ;
16.0    5.0    26.8637 ;
2.0    2.7088 ;
4.0    'D6B8'    65.37    16.9378    0. ;
2.0    2.7088 ;
5.0    'DRIF'    40.76    0.    100.. ;
(CIRCULAR AND HYPERBOLIC QUAD APERTURES)
16.0    100.    70.409 ;
16.0    101.    41.707 ;
5.0    'D6Q8'    27.6    -9.7438    100. ;
(CIRCULAR AND HYPERBOLIC DRIFT APERTURES)
16.0    100.    67.7418 ;
16.0    101.    100. ;
5.0    'DRIF'    40.76    0.    100. ;
2.0    2.7297 ;
4.0    'D6B7'    65.37    17.0685    0. ;
2.0    2.7297 ;
5.0    'DRIF'    14.76    0.    100. ;
(CIRCULAR SEM APERTURE)
16.0    100.    69.850 ;
5.0    'DRIF'    7.875    0.    100. ;
(OBTAIN SEM 607 PROFILES)
50.    1.0    -10.    10.    1.0 ;
50.    3.0    -10.    10.    1.0 ;
5.0    'DRIF'    7.875    0.    100. ;
```

APPENDIX D
(Not optimized)
(See Appendix J for optimal code)

D-2

```
(CIRCULAR DRIFT APERTURE)
16.    100.    67.7418 ;
5.0    'DRIF'    10.25    0.    100. ;
(CIRCULAR AND HYPERBOLIC QUAD APERTURES)
16.    100.    70.409 ;
16.    101.    41.707 ;
5.0    'D6Q7'    27.6    9.9889    100. ;
(CIRCULAR AND HYPERBOLIC DRIFT APERTURES)
16.    100.    67.8053 ;
16.    101.    100. ;
5.0    'DRIF'    22.1875    0.0    100. ;
7.0    'D6H6'    0.0    0.518859    0.    0.    0.    0. ;
5.0    'DRIF'    9.1875    0.    100. ;
(CIRCULAR DRIFT APERTURE)
16.     100.    69.0118 ;
5.0    'DRIF'    14.5    0.    100. ;
(CIRCULAR DRIFT APERTURE)
16.    100.    31.2928 ;
5.0    'DRIF'    2.5    0.    100. ;
(SEPTUM APERTURE)
16.0    4.0    26.035 ;
16.0:    5.0    19.685 ;
2.0    0.777 ;
4.0    'ESEP'    84.    3.784    0. ;
2.0    0.777 ;
(CIRCULAR DRIFT APERTURE)
16.    100.    29.8958 ;
5.0    'DRIF'    12.8875    0.    100. ;
(SHIFT BEAM HORIZONTALLY)
7.0    115.439    0.    0.    0.    0.    0. ;
(ROTATE BEAM HORIZONTALLY.)
7.0    0.    46.99    0.    0.    0.    0. ;
(REMOVE CIRCULAR QUAD APERTURE)
16.    100.    530.937;
(HYPERBOLIC QUAD APERTURE)
16.    101.    84.1375 ;
5.0    'D6Q6'    32.6    -9.690    100. ;
(ROTATE BEAM BACK.)
7.0    0.    -46.99    0.    0.    0.    0. ;
(SHIFT BEAM BACK.)
7.0    -158.75    0.    0.    0.    0.    0. ;
(CIRCULAR DRIFT APERTURE)
16.0    100.    31.039 ;
5.0    'DRIF'    11.6375    0.    100. ;
5.0    'DRIF'    188.075    0.    100. ;
(HYPERBOLIC QUAD APERTURE)
16.0    101.    41.707 ;
(CIRCULAR QUAD APERTURE)
16.0    100.    70.409 ;
5.0    'Q1'    51.64    9.8659    100. ;
(CIRCULAR AND HYPERBOLIC DRIFT APERTURES)
16.0    100.    67.869 ;
16.0    101.    100. ;
5.0    'DRIF'    40.263    0.    100. ;
7.0    'DBV1'    0.    0.    0.    0.265646    0.    0. ;
5.0    'DRIF'    55.5125    0.    100. ;
(CIRCULAR AND HYPERBOLIC QUAD APERTURES)
16.0    100.    70.409 ;
16.0    101.    41.707 ;
5.0    'Q2'    32.6    -9.0723    100. ;
(CIRCULAR AND HYPERBOLIC DRIFT APERTURES)
16.    100.    67.869 ;
16.    101.    100. ;
5.0    'DRIF'    16.825    0.    100. ;
(CIRCULAR SEM APERTURE)
16.  100.  69.850 ;
```

D-3

```
5.0    'DRIF'    7.875    0.    100.  ;
(OBTAIN SEM 802 PROFILES)
50.    1.0    -10.    10.    1.0 ;
50.    3.0    -10.    10.    1.0 ;
5.0    'DRIF'    7.875    0.0    100.  ;
(CIRCULAR DRIFT APERTURE)
16.0    100.    67.869 ;
5.0    'DRIF'    108.75    0.    100.  ;
7.0    'D8H4'    0.    -0.040977    0.    0.    0.    0.  ;
5.0    'DRIF'    45.075    0.    100.  ;
(CIRCULAR AND HYPERBOLIC QUAD APERTURES)
16.0    100.    70.409 ;
16.0    101.    41.707 ;
5.0    'Q3'    32.6    9.2759    100.  ;
(CIRCULAR AND HYPERBOLIC DRIFT APERTURES)
16.0    100.    67.869 ;
16.0    101.    100.  ;
5.0    'DRIF'    24.365    0.    100.  ;
(CIRCULAR AND HYPERBOLIC QUAD APERTURES)
16.0    100.    70.409 ;
16.0    101.    41.707 ;
5.0    'Q4'    27.6    -6.8517    100.  ;
(CIRCULAR AND HYPERBOLIC DRIFT APERTURES)
16.0    100.    67.869 ;
16.0    101.    100.  ;
5.0    'DRIF'    122.865    0.    100.  ;
(CIRCULAR AND HYPERBOLIC QUAD APERTURES)
16.0    100.    70.409 ;
16.0    101.    41.707 ;
5.0    'Q5'    32.6    7.4200    100.  ;
(CIRCULAR AND HYPERBOLIC DRIFT APERTURES)
16.    100.    67.742 ;
16.    101.    100.  ;
5.0    'DRIF'    84.15    0.    100.  ;
(CIRCULAR AND HYPERBOLIC QUAD APERTURES)
16.    100.    70.409 ;
16.    101.    41.707 ;
5.0    'Q6'    32.6    -7.3239    100.  ;
(CIRCULAR AND HYPERBOLIC DRIFT APERTURES)
16.    100.    67.742 ;
16.    101.    100.  ;
5.0    'DRIF'    21.575    0.    100.  ;
7.0    'D8V6'    0.    0.    0.    -0.198934    0.    0.  ;
5.0    'DRIF'    9.25    0.    100.  ;
(CIRCULAR DRIFT APERTURE)
16.    100.    48.6918 ;
5.0    'DRIF'    188.5    0.    100.  ;
(CIRCULAR DRIFT APERTURE)
16.0    100.    67.742 ;
(ION CHAMBER HAS BEEN REMOVED.)
5.0    'DRIF'    13.    0.    100.  ;
(CIRCULAR DRIFT APERTURE)
16.0    100.    67.996 ;
5.0    'DRIF'    13.875    0.    100.  ;
(CIRCULAR SEM APERTURE)
16.0    100.    69.850 ;
5.0    'DRIF'    6.5    0.    100.  ;
(OBTAIN SEM 806 PROFILES.)
50.0    1.0    -10.    10.    1.  ;
50.0    3.0    -10.    10.    1.  ;
5.0    'DRIF' 6.5    0.    100.  ;
(CIRCULAR DRIFT APERTURE)
16.0    100.    67.996 ;
5.0    'DRIF'    16.0    0.    100.  ;
(TB1 APERTURE)
16.0    4.0    66.8528 ;
```

D-4

```
16.0    5.0    27.1018 ;
20.    180. ;
2.0    1.102 ;
4.0    'TB1'    60.    7.48337    0. ;
2.0    1.102 ;
(CIRCULAR DRIFT APERTURE)
16.0    100.    74.0918 ;
5.0    'DRIF'    12.75    0.    100. ;
2.0    1.104 ;
4.0    'TB2'    60.    7.499    0. ;
2.0    1.104 ;
20.    -180. ;
(CIRCULAR DRIFT APERTURE)
16.0    100.    67.1068 ;
5.0    'DRIF'    19.575    0.    100. ;
(CIRCULAR AND HYPERBOLIC QUAD APERTURES)
16.0    100.    70.409 ;
16.0    101.    41.707 ;
5.0    'Q7'    18.    1.73994    100. ;
(CIRCULAR AND HYPERBOLIC DRIFT APERTURES)
16.0    100.    67.1068 ;
16.0    101.    100. ;
5.0    'DRIF'    9.51    0.    100. ;
(CIRCULAR TOR 807 APERTURE)
16.0    100.    28.5115 ;
5.0    'TOR'    12.    0.    100. ;
(CIRCULAR DRIFT APERTURE)
16.0    100.    29.7688 ;
5.0    'DRIF'    58.365    0.    100. ;
(CIRCULAR SEM APERTURE)
16.0    100.    69.85 ;
5.0    'DRIF'    6.5    0.    100. ;
(OBTAIN SEM 807 PROFILES)
50.    1.0    -10.    10.    1. ;
50.    3.0    -10.    10.    1. ;
5.0    'DRIF'    6.5    0.    100. ;
(CIRCULAR DRIFT APERTURE)
16.0    100.    30.9118 ;
5.0    'DRIF'    48.75    0.    100. ;
(SEPTUM APERTURE)
16.0    4.0    26.035 ;
16.0    5.0    19.685 ;
20.0    180. ;
2.0    0.859 ;
4.0    'SEP1'    84.0    4.18526    0. ;
2.0    0.859 ;
20.0    -180. ;
(CIRCULAR DRIFT APERTURE)
16.0    100.    31.1658 ;
5.0    'DRIF'    3.75    0.    100. ;
20.0    180. ;
2.0    0.822 ;
4.0    'SEP2'    84.0    4.003    0. ;
2.0    0.822 ;
20.0    -180. ;
5.0    'DRIF'    13.075    0.    100. ;
(SHIFT BEAM HORIZONTALLY)
7.0    -42.926    0.    0.    0.    0.    0. ;
(CIRCULAR QUAD APERTURES)
16.0    100.    74.0918 ;
(REMOVE HYPERBOLIC QUAD APERTURES.)
16.0    101.    100. ;
5.0    'A1Q4'    18.0    9.6741    100. ;
(SHIFT BEAM BACK.)
7.0    42.926    0.    0.    0.    0.    0. ;
(OBTAIN BEAM PROFILE.)
```

```
50.0,   1.0    -10.    10.    1. ;
50.0    3.0    -10.    10.    1. ;
SENTINEL
11.22.43.UCLP, GG, TB10,        0.322KLNS.          ** END OF LISTING **
```

D-5

APPENDIX E

TO: all interested parties
FROM: R E Peters
SUBJECT: nominal current for the 3 debuncher LQE's

Steve Holmes recently made the comment that the 3 LQE's in the debuncher at D2Q5(F), D4Q5(F), and D6Q6(D) did not appear to be as strong as expected. I believe, but am not certain, that the basis for this statement was the beta-function measurement we performed a few weeks ago.

At that time, he mentioned that the nominal current for the LQE's had been calculated from the LQD results by applying a correction factor to take into account their (slightly) different effective lengths. "New" data from MDTF indicate that the additional saturation which occurs between 1300-amperes and 1500 amperes significantly changes the predicted current.

The following table summarizes the results of some harmonic (Morgan) coil measurements.

I (amps)	INTEGRATED STRENGTH (Tesla/amp)X10**3	
1200	5.78297	<--
1250	5.71180	!
1300	5.62986	! prototype system
1350	5.54608	!
1400	5.45629	<--
1600	5.12668	<-- MDTF

From this table we find (1300 <= I <= 1600 amperes):

INTEGRATED_STRENGTH [x10**3] = 7.807020 * I - 1.675959E-3 * (I**2)

The nominal strength should be about 8.0 Tesla. Hence, the current be

NOMINAL_CURRENT = 1522 amperes.

If the present value is changed from ~1472 to 1522, the 50 ampere current increase will shift the tunes as follows:

D_NUX = +0.011 D_NUY = +0.003

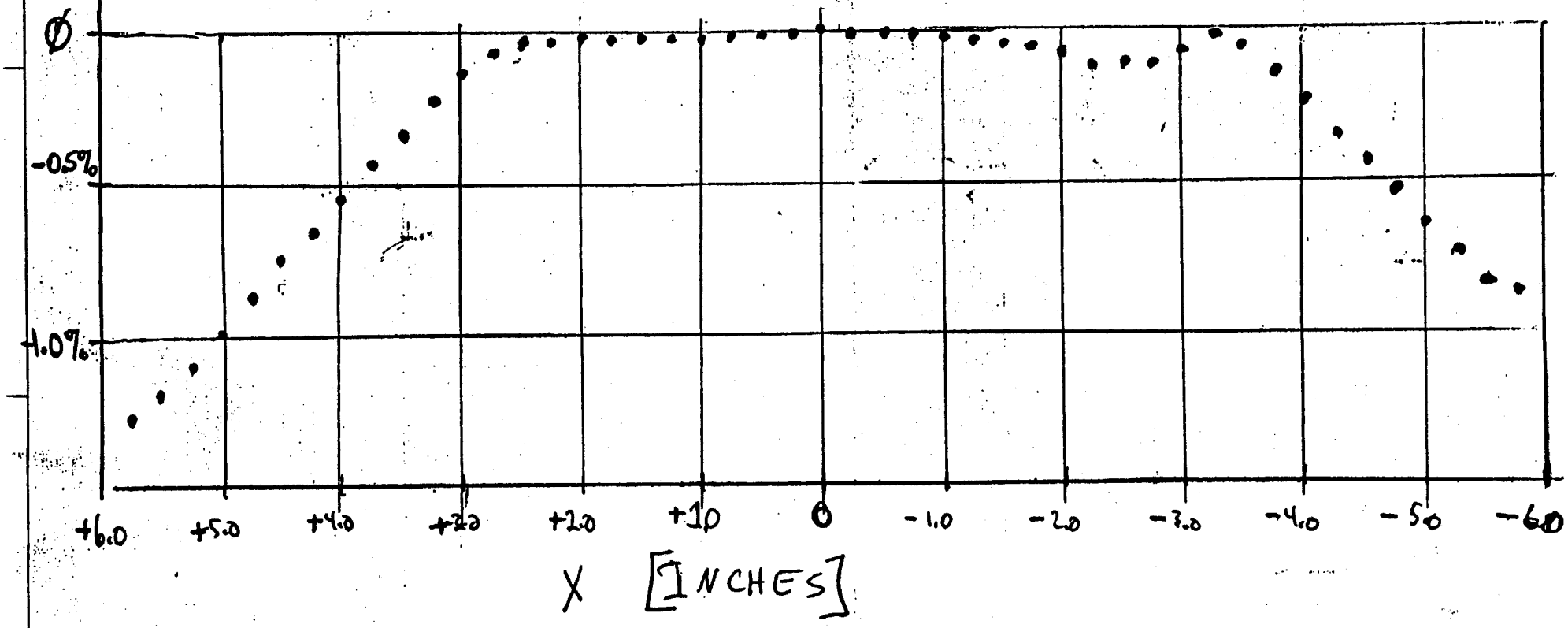
3 Sept 85 E-2

measured 5-OCT-84

David Hartley

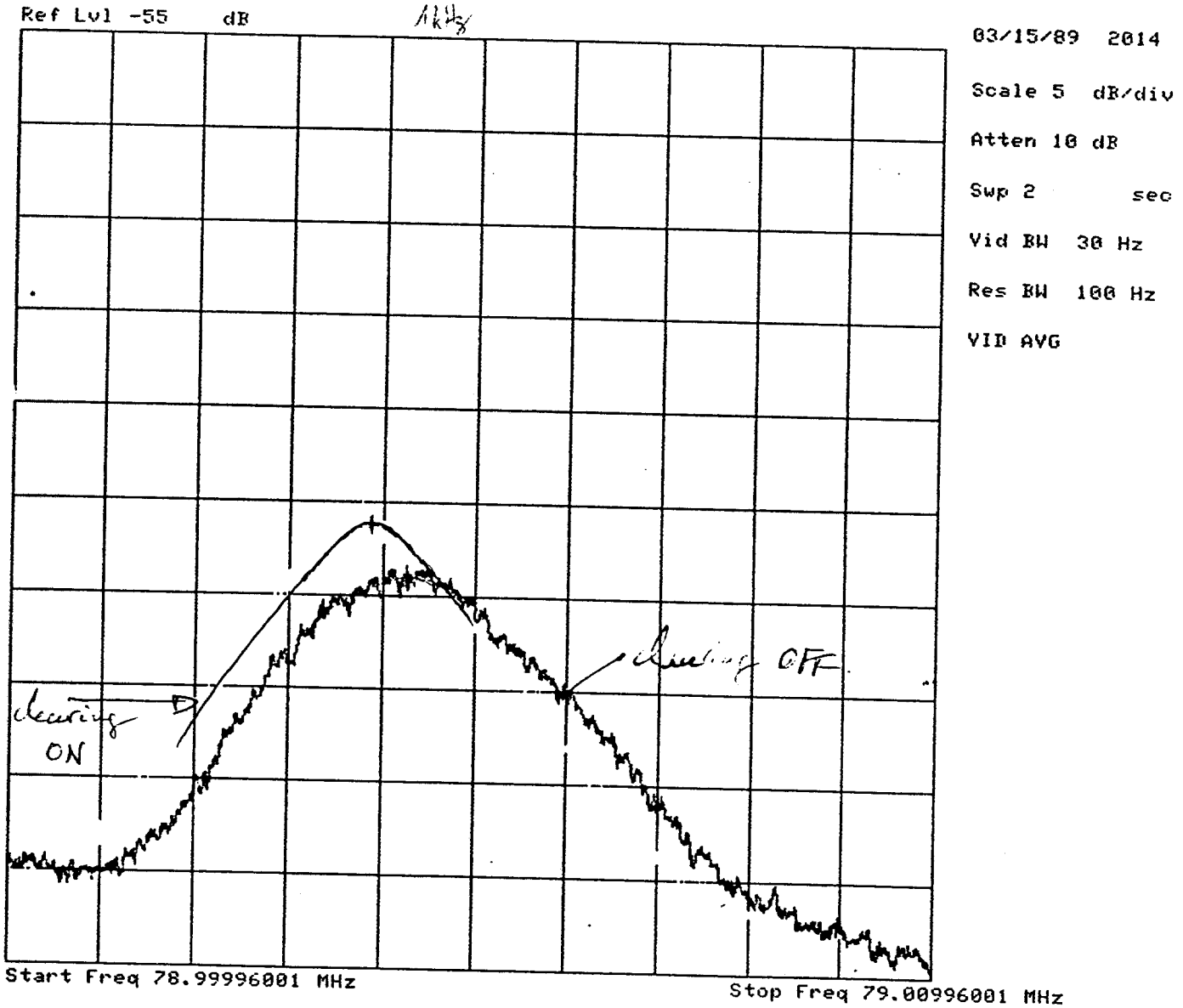
LQEØØ2 at 16ØØ Amp

$$I \equiv \left(\int_{-\infty}^{\infty} \frac{dB_y}{dx}(x)\, dz - \int_{-\infty}^{\infty} \frac{dB_y}{dx}(0)\, dz \right) \Big/ \int_{-\infty}^{\infty} \frac{dB_y}{dx}(x=0)\, dz$$



CONSOLE 08 15-MAR-1989 20:23
P28 GRAPHICS DISPLAY
T | ERSE blue/yellow

(A)



Vertical schottky band

$$\omega_n = (125 + Q_v) f_r$$

$$\Delta\omega_n = \Delta Q f_r$$

$$\Delta\omega_n = 400\,Hz \Rightarrow \Delta Q_v = 6.3 \times 10^{-4}$$

Strengths of SDDUA magnets relative to SDD001

APPENDIX G

FC MAGNET ID	FC RUN DATE TIME	FB SLOPE	parts in ten to the fourth	FC RUN DESCRIPTION
SDD002	5-Feb-1985 23:45	-8.26E-08	+ 5.5	Normal Data Run # 2 1180.0 AMPS
SDD003	19-Oct-1984 05:44	-1.03E-06	+ 68.3	Normal Data Run # 2
SDD004	19-Oct-1984 07:15	-8.92E-07	+ 59.1	Normal Data Run # 2
SDD005	22-Oct-1984 01:45	-1.08E-06	+ 71.8	Normal Data Run # 2
SDD006	12-Oct-1984 21:53	-8.38E-07	+ 55.5	Normal Data Run (1230 AMPS.)
SDD007	15-Oct-1984 01:04	-1.10E-06	+ 73.0	Normal Data Run # 2
SDD008	15-Dec-1984 10:46	-9.80E-07	+ 64.9	Run # 2 Tie Plates Rewelded
SDD009	15-Oct-1984 06:00	-1.02E-06	+ 67.2	Normal Data Run # 2
SDD010	17-Dec-1984 10:20	-9.89E-07	+ 65.5	RUN # 2 TIE PLATES WELDED 1180 AMPS
SDD011	19-Dec-1984 17:29	-8.41E-07	+ 55.7	RUN # 2 TIE PLATES ARE ON 1180 AMPS MAGNET IS SHIMMED
SDD012	21-Dec-1984 13:38	-9.45E-07	+ 62.6	RUN # 2 TIE PLATES REWELDED; SHIMS ADDED 1180 AMPS
SDD013	21-Dec-1984 19:48	-8.78E-07	+ 58.1	RUN #2 1180.0 AMPS TIE PLATES ON SHIMS ADDED
SDD014	21-Dec-1984 07:56	-9.06E-07	+ 60.0	RUN # 2 TIE PLATES WELDED 1180.0 AMPS SDD014R
SDD015	20-Dec-1984 09:25	-9.04E-07	+ 59.9	RUN # 2 TIE PLATES REWELDED; SHIMS ADDED
SDD016	6-Feb-1985 10:16	-9.54E-07	+ 63.2	RUN # 2 RETEST AFTER SITTING IN BUILDING 1180 AMPS
SDD017	17-Dec-1984 15:26	-9.99E-07	+ 66.2	RUN # 2 TIE PLATES WELDED 1180.0 AMPS SDD017R
SDD018	20-Dec-1984 17:54	-9.28E-07	+ 61.5	RUN # 2 1180 AMPS TIE PLATES ON SHIMS ADDED
SDD019	14-Dec-1984 10:03	-9.40E-07	+ 62.2	Run # 2 Tie Plates Rewelded
SDD020	14-Dec-1984 08:34	-7.45E-07	+ 49.3	Run # 2 Tie Plates Rewelded
SDD021	8-Dec-1984 10:43	-9.02E-07	+ 59.8	Normal Data Run # 2 After Rewelding Plates to
SDD022	20-Dec-1984 19:30	-9.11E-07	+ 60.4	RUN # 2 1180 AMPS TIE PLATES ON SHIMS ADDED
SDD023	19-Dec-1984 19:20	-8.76E-07	+ 58.0	RUN # 2 1180 AMPS TIE PLATES ON SHIMS ADDED
SDD024	20-Dec-1984 00:00	-9.59E-07	+ 63.5	RUN # 2 1180 AMPS TIE PLATES ON SHIMS ADDED
SDD025	13-Dec-1984 14:30	-8.80E-07	+ 58.3	RUN # 2 TIE PLATES WELDED 1180.0
SDD026	20-Dec-1984 22:08	-7.16E-07	+ 47.4	RUN # 2 1180 AMPS TIE PLATES ON SHIMS ADDED
SDD027	19-Dec-1984 22:15	-9.67E-07	+ 64.0	RUN # 2 1180 AMPS TIE PLATES ON SHIMS ADDED
SDD028	21-Dec-1984 15:43	-9.92E-07	+ 65.7	RUN # 2 TIE PLATES REWELDED; SHIMS ADDED
SDD029	27-Dec-1984 18:38	-9.62E-07	+ 63.7	Normal Data Run # 2 WITH TIE PLATES ON AT 1180 AMPS
SDD030	21-Dec-1984 18:12	-7.88E-07	+ 52.2	RUN #2 TIE PLATES ON 1180.0 AMP. SHIMS ADDED
SDD031	21-Dec-1984 22:34	-7.43E-07	+ 49.2	RUN # 2 1180.0 AMPS. TIE PLATES ON SHIMS ADDED
SDD032	21-Dec-1984 10:03	-7.37E-07	+ 48.8	RUN # 2 TIE PLATES REWELDED; SHIMS ADDED
SDD033	21-Dec-1984 11:52	-7.78E-07	+ 51.5	RUN # 2 TIE PLATES WELDED 1180.0 AMPS SDD033
SDD034	3-Jan-1985 22:06	-9.27E-07	+ 61.4	RUN # 2 MAG. SHIMMED 1180.0 AMPS
SDD035	3-Jan-1985 08:40	-7.16E-07	+ 47.4	RUN # 2 TIE PLATES WELDED 1180 AMPS
SDD036	28-Dec-1984 13:59	-8.64E-07	+ 57.2	Run # 2 Tie Plates Welded 1180 Amps
SDD037	4-Jan-1985 08:23	-9.68E-07	+ 64.1	RUN # 2 TIE PLATES WELDED 1180 AMPS
SDD038	5-Jan-1985 23:03	-8.12E-07	+ 53.7	RUN # 2 TIE PLATES AND SHIMS IN 1180.0 AMPS
SDD039	7-Jan-1985 09:23	-7.34E-07	+ 48.6	RUN #2 TIE PLATES WELDED 1180.0 AMPS
SDD040	7-Jan-1985 15:10	-6.72E-07	+ 44.5	Normal Data Run
SDD041	7-Jan-1985 23:20	-8.88E-07	+ 58.8	RUN # 2 TIE PLATES AND SHIMS 1180.0 AMPS
SDD042	7-Jan-1985 19:15	-7.07E-07	+ 46.8	RUN # 2 TIE PLATES AND SHIMED 1180.0 AMPS
SDD043	8-Jan-1985 09:27	-8.91E-07	+ 59.0	RUN # 2 TIE PLATES REWELDED 1180 AMPS
SDD044	8-Jan-1985 14:11	-8.59E-07	+ 56.9	RUN # 2 TIE PLATES REWELDED 1180 AMPS
SDD045	9-Jan-1985 11:09	-8.80E-07	+ 58.3	RUN # 2 TIE PLATES WELDED 1180.0 AMPS
SDD046	5-Feb-1985 21:31	-7.92E-07	+ 52.4	Normal Data Run # 2 1180.0 AMPS
SDD047	6-Feb-1985 17:23	-1.26E-06	+ 83.6	Normal Data Run # 2 1180.0 AMPS RE RUN MAGNET
SDD048	25-Jan-1985 14:29	-1.29E-06	+ 85.6	RUN # 2 ALPHA STEEL 1180.0 AMPS
SDD049	26-Jan-1985 21:51	-1.12E-06	+ 74.4	RUN # 2 TIE PLATES ON 1180.0 AMPS
SDD050	30-Jan-1985 14:36	-9.46E-07	+ 62.7	RUN # 2 LAYERED CAKE RECIPE 1180 AMPS
SDD051	31-Jan-1985 14:47	-9.67E-07	+ 64.0	RUN # 2 LAYERED CAKE RECIPE 1180 AMPS
SDD052	1-Feb-1985 08:12	-9.24E-07	+ 61.2	RUN # 2 LAYERED CAKE RECIPE 1180 AMPS BY BETTY CROCI
SDD053	1-Feb-1985 15:30	-6.37E-07	+ 42.2	RUN # 2 LAYERED CAKE RECIPE 1180 AMPS PILLSBURY
SDD054	4-Feb-1985 12:55	-7.02E-07	+ 46.5	RUN # 2 LAYERED RECIPE 1180 AMPS
SDD055	4-Feb-1985 21:24	-7.71E-07	+ 51.0	LAYER CAKE RUN # 2 1180.0 AMPS
SDD056	4-Feb-1985 17:26	-8.11E-07	+ 53.7	Normal Data Run # 2 1180.0 AMPS
SDD057	5-Feb-1985 14:58	-6.74E-07	+ 44.6	RUN # 2 RECIPE LAYER MAGNET 1180 AMPS
SDD058	5-Feb-1985 11:15	-7.43E-07	+ 49.2	RUN # 2 RECIPE MAGNET 1180 AMPS
SDD059	6-Feb-1985 12:23	-8.59E-07	+ 56.9	RUN #2 LAYERED RECIPE @1180 AMPS.
SDD060	6-Feb-1985 14:19	-9.15E-07	+ 60.6	RUN # 2 RECIPE FORMULA @ 1180 AMPS
SDD061	7-Feb-1985 10:49	-9.51E-07	+ 63.0	RUN # 2 RECIPE MAGNET 1180 AMPS
SDD062	7-Feb-1985 14:55	-9.95E-07	+ 65.9	RUN # 2 RECIPE MAG 1180.0 AMPS
SDD063	11-Feb-1985 09:39	-6.59E-07	+ 43.7	RUN # 2 RECIPE MAGNET 1180 AMPS
SDD064	8-Feb-1985 10:42	-9.54E-07	+ 63.2	RUN # 2 RECIPE MAGNET 1180.0 AMPS
SDD065	11-Feb-1985 14:20	-1.01E-06	+ 66.7	RUN # 2 RECIPE 1180 AMPS
SDD066	11-Feb-1985 16:46	-1.25E-06	+ 82.6	Normal Data Run # 2 @ 1180.0 AMP
SDD067	11-Feb-1985 12:48	-1.22E-06	+ 81.1	RUN # 2 RECIPE 1180 AMPS
SDD068	11-Feb-1985 19:13	-1.24E-06	+ 81.9	Normal Data Run RUN # 2 @ 1180.0 AMP
SDD069	11-Feb-1985 23:05	-1.11E-06	+ 73.6	Normal Data Run # 2 @ 1180.0 AMP
SDD070	5-Jan-1985 17:42	-5.86E-07	+ 38.8	Normal Data Run # 2 1180.0 AMPS

APPENDIX H

Single Probe:

$$V = \frac{BA}{RC}$$

$\frac{1}{RC} = 1000$, $A = .11'' \times 80'' = .00568\ m^2$

V_c	V_{peak}	B_{peak} (kG)	
250.3	1.388 ± .03	2.444	± .053
350.1	1.955	3.442	"
449.1	2.490	4.384	"
549.2	3.040	5.352	"
620.1	3.420	6.021	"

$\frac{1}{RC} = 100000$, $V_{peak} = .040 \pm .01$ $\Rightarrow$ $B_{peak} = 0.7$ Gauss

Septum Excitation Data

FERMILAB
ENGINEERING NOTE

SECTION	PROJECT	SERIAL-CATEGORY	PAGE H-2

SUBJECT: Septum Field Measurements

NAME

DATE | REVISION DATE

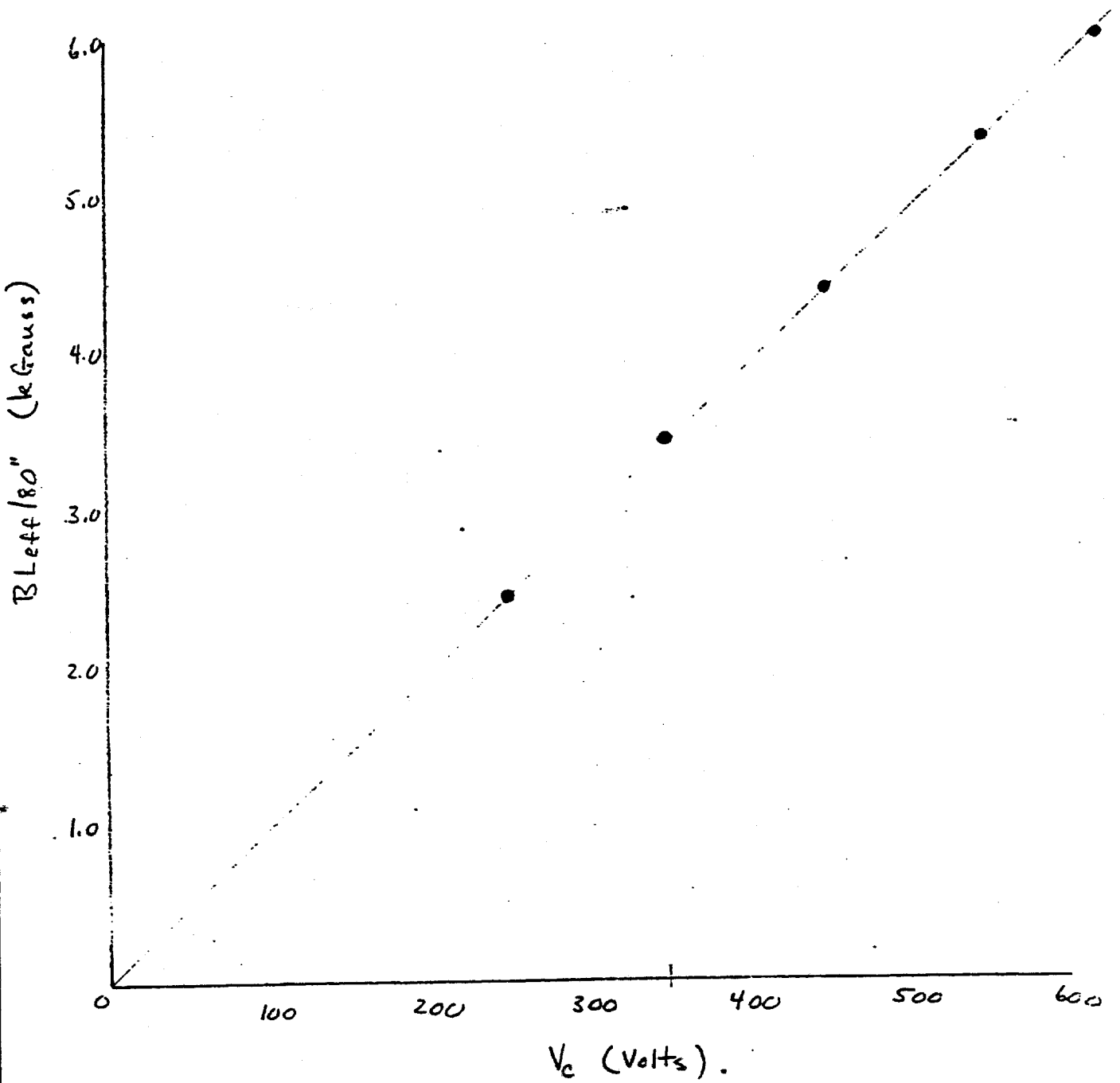


Figure 1

APPENDIX I

KICKER DATA

PARAMETER	DEBUNCHER PROTON INJECTION	DEBUNCHER ANTIPROTON INJECTION	DEBUNCHER EXTRACTION	ACCUMULATOR INJECTION	ACCUMULATOR EXTRACTION	UNITS
FIELD RISE TIME			190		225	nS
FIELD FALL TIME	205	205		75		nS
PULSE WIDTH min	1.49	1.49	1.505	1.505	0.25	uS
PFN LENGTH min	1.695	1.695	1.695	1.58	0.475	uS
TOTAL KICK NEEDED	6.1	6.1	4.6	4	4	uS
BEAM ENERGY	8	8	8	8	8	GeV
DEFLECTION	10	10	6	6.5	6.5	mm
DIRECTION	VERTICAL	VERTICAL	HORIZONTAL	HORIZONTAL	HORIZONTAL	
∫B*dl	1810	1810	1340	1190	1190	gauss-meters
MAGNETIC LENGTH	2.77	2.77	2.34	2.24	2.24	meters
FIELD NEEDED	650	650	574	531	531	gauss
APERTURE (VxH)	56x42	56x42	42x75	30.5x250	30.5x250	mm
BEAM SIZE	32x32	32x32	35x64	25x52	25x52	mm
FERRITE GAP SIZE	65x50	65x50	52x84	30.5x57	30.5x57	mm
FERRITE TYPE	CMD 5005	CMD 5005	CMD 5005	4C6	4C6	
IMPEDANCE	10	10	12.5	25	25	Ω
CURRENT	2530	2530	2420	1400	1400	Amps
VOLTAGE	25.3	25.3	30.2	35	35	KV
# OF MAGNETS	3	3	3	3	3	
INDUCTANCE	1.52	1.52	1.55	1.73	1.73	uH
TOTAL CAPACITANCE	15200	15200	9920	2768	2768	pF
# OF "T" CELLS	12	12	10	9	9	
PROP. DELAY	150	150	125	62	62	nS
FLANGE TO FLANGE	125.125	125.125	107.875	122.8025	122.8025	inches
LOCATION	D202	D402	D609	A20	A20	

CERAMIC TUBES - ALL TYPES USED

DATE: 12/21/84

SIZE & SHAPE	1-5/8" x 2-1/4" ID ELLIPSE 41" LONG	1-3/4" x 3" ID ELONG. ELLIPSE 35" LONG	2-3/4" O.D. x 2-1/2" I.D. ROUND 45" LONG	5-1/4" O.D. x 4-7/8" I.D. LG. ROUND 60" LONG
DRAWING NUMBER	1751-MC-139750	1751-MC-139751	1751-MD-139851	OBSOLETE
FABRICATION LABELS	β (41") E	Σ (35") EE	R (45")	R_L (60")
RAW TUBES ON ORDER	0	0	0	0
TUBES UNFLANGED / W # I.D.	3 # β - 10,11,12	3 # Σ - 6,7,8	2 - 48" Long 3 - 45" Long Old Tubes	4 # R_L - 3,4,5,6 X-GAL
TUBES FLANGED / W # I.D.	9 # β - 1,2,3,4,5,6,7,8,9	5 # Σ - 1,2,3,4,5	4 R - 3(45") R - 6 (45") * R - 3(45") R - 5 (45")	2 # R_L - 1,2 } New Tubes
TUBES FLANGED & COATED / W # I.D., RESISTANCE F.F., STORAGE LOCATION	0	0	0	0
# TUBES TO BE INSTALLED / MAGNET APPLICATION	6 and 1 Spare Debuncher Injection	3 and 1 Spare Debuncher Extraction	2 => 1 Set and 1 Spare Set Booster Fast Kicker (L-2)	0 Proposed Horiz. Injection
# TUBES / MAGNETS IN OPERATION TUNNEL LOCATION	AVERAGE WALL THICKNESS ≈ 1/8"		3 - (in Series => 1 Set) @ Booster L-2 4 - MK01,02,03,04 @ Booster	
BAD TUBES (STATUS)			1 Broken ≈36" usable - no flanges 2 Leaks flange (HOT)	

NOTES: (i) DIMENSIONS GIVEN ARE APERTURE DIMENSIONS (iii) CERAMIC MATERIAL IS 99.95% Al2O3

APPENDIX J

J-1

```
1"DEBUNCHER TO ACCUMULATOR TRANSFER LINE                                                    "
 (STARTING JUST US OF D6Q10 AND ENDING JUST DS OF A1Q4                                       )
 (FEBRUARY 5, 1988                                                                           )
0       10000
   15.                          1.00000   "MM  "        .10000 ;
   15.                          8.00000   "IN  "        .02540 ;
   13.                         10.00000;
    1.000000                    2.52700      .46200     4.11500      .28400  9332.00000      .10000     8.91858;
 (LINE BEGINS JUST UPSTREAM OF D6Q10.                                                        )
 (CIRCULAR AND HYPERBOLIC QUAD APERTURES                                                     )
   16.00                       100.00000    70.40900;
   16.00                       101.00000    41.70700;
    5.00          "DQ10"        27.60000    -9.74380   100.00000;
 (CIRCULAR AND HYPERBOLIC DRIFT APERTURES                                                    )
   16.00                       100.00000    67.80530;
   16.00                       101.00000   100.00000;
    5.00          "DRIF"        20.12750     0.00000   100.00000;
 (CIRCULAR DRIFT APERTURE                                                                    )
   16.00                       100.00000    48.69180;
    5.00          "DRIF"         4.75000     0.00000   100.00000;
 (EKIK APERTURE                                                                              )
   16.00                         4.00000    38.10000;
   16.00                         5.00000    22.22500;
    2.0                           .12900;
    4.000         "EKIK"        98.37500      .53600     0.00000;
    2.0                           .12900;
 (CIRCULAR DRIFT APERTURE                                                                    )
   16.00                       100.00000    48.60290;
    5.00          "DRIF"         4.75000     0.00000   100.00000;
 (CIRCULAR DRIFT APERTURE                                                                    )
   16.00                       100.00000    68.12280;
    5.00          "DRIF"        18.89750     0.00000   100.00000;
 (CIRCULAR AND HYPERBOLIC QUAD APERTURES                                                     )
   16.00                       100.00000    70.40900;
   16.00                       101.00000    41.70700;
    5.00          "D6Q9"        27.60000     9.98890   100.00000;
 (CIRCULAR AND HYPERBOLIC DRIFT APERTURES                                                    )
   16.00                       100.00000    67.74180;
   16.00                       101.00000   100.00000;
    5.00          "DRIF"        40.76400     0.00000   100.00000;
 (D6B8 APERTURE                                                                              )
   16.00                         4.00000    78.85430;
   16.00                         5.00000    26.86370;
    2.0                          2.70880;
    4.000         "D6B8"        65.37000    16.93780     0.00000;
    2.0                          2.70880;
    5.00          "DRIF"        40.76000     0.00000   100.00000;
 (CIRCULAR AND HYPERBOLIC QUAD APERTURES                                                     )
   16.00                       100.00000    70.40900;
   16.00                       101.00000    41.70700;
    5.00          "D6Q8"        27.60000    -9.74380   100.00000;
 (CIRCULAR AND HYPERBOLIC DRIFT APERTURES                                                    )
   16.00                       100.00000    67.74180;
   16.00                       101.00000   100.00000;
    5.00          "DRIF"        40.76000     0.00000   100.00000;
    2.0                          2.72970;
    4.000         "D6B7"        65.37000    17.06850     0.00000;
    2.0                          2.72970;
    5.00          "DRIF"        14.76000     0.00000   100.00000;
 (CIRCULAR SEM APERTURE                                                                      )
   16.00                       100.00000    69.85000;
    5.00          "DRIF"         7.87500     0.00000   100.00000;
 (OBTAIN SEM 607 PROFILES                                                                    )
   50.0                          1.00000   -10.00000    10.00000     1.00000;
   50.0                          3.00000   -10.00000    10.00000     1.00000;
    5.00          "DRIF"         7.87500     0.00000   100.00000;
```

J-2

```
(CIRCULAR DRIFT APERTURE                                                                  )
  16.00                    100.00000    67.74180;
   5.00          "DRIF"     10.25000     0.00000   100.00000;
(CIRCULAR AND HYPERBOLIC QUAD APERTURES                                                   )
  16.00                    100.00000    70.40900;
  16.00                    101.00000    41.70700;
   5.00          "D6G7"     27.60000     9.98890   100.00000;
(CIRCULAR AND HYPERBOLIC DRIFT APERTURES                                                  )
  16.00                    100.00000    67.80530;
  16.00                    101.00000   100.00000;
   5.00          "DRIF"     22.18750     0.00000   100.00000;
   7.            "D6H6"      0.00000      .51886     0.00000     0.00000     0.00000     0.00000;
   5.00          "DRIF"      9.18750     0.00000   100.00000;
(CIRCULAR DRIFT APERTURE                                                                  )
  16.00                    100.00000    69.01180;
   5.00          "DRIF"     14.50000     0.00000   100.00000;
(CIRCULAR DRIFT APERTURE                                                                  )
  16.00                    100.00000    31.29280;
   5.00          "DRIF"      2.50000     0.00000   100.00000;
(SEPTUM APERTURE                                                                          )
  16.00                      4.00000    26.03500;
  16.00                      5.00000    19.68500;
   2.0                        .77700;
   4.000         "ESEP"     84.00000     3.78400     0.00000;
   2.0                        .77700;
(CIRCULAR DRIFT APERTURE                                                                  )
  16.00                    100.00000    29.89580;
   5.00          "DRIF"     12.88750     0.00000   100.00000;
(SHIFT BEAM HORIZONTALLY                                                                  )
   7.                      122.43900     0.00000     0.00000     0.00000     0.00000     0.00000;
(ROTATE BEAM HORIZONTALLY.                                                                )
   7.                        0.00000    42.00000     0.00000     0.00000     0.00000     0.00000;
(REMOVE CIRCULAR QUAD APERTURE                                                            )
  16.00                    100.00000   530.93700;
(HYPERBOLIC QUAD APERTURE                                                                 )
  16.00                    101.00000    84.13750;
   5.00          "D6G6"     32.60000    -9.69000   100.00000;
(ROTATE BEAM BACK.                                                                        )
   7.                        0.00000   -88.00000     0.00000     0.00000     0.00000     0.00000;
(SHIFT BEAM BACK.                                                                         )
   7.                     -170.50000     0.00000     0.00000     0.00000     0.00000     0.00000;
(CIRCULAR DRIFT APERTURE                                                                  )
  16.00                    100.00000    31.03900;
   5.00          "DRIF"     11.63750     0.00000   100.00000;
  50.0                       1.00000   -40.00000    40.00000     4.00000;
  50.0                       3.00000   -10.00000    10.00000     1.00000;
   5.00          "DRIF"    188.07500     0.00000   100.00000;
  50.0                       1.00000   -40.00000    40.00000     4.00000;
  50.0                       3.00000   -10.00000    10.00000     1.00000;
(HYPERBOLIC QUAD APERTURE                                                                 )
  16.00                    101.00000    41.70700;
(CIRCULAR QUAD APERTURE                                                                   )
  16.00                    100.00000    70.40900;
   5.00          "Q1  "     51.64000     9.86590   100.00000;
(CIRCULAR AND HYPERBOLIC DRIFT APERTURES                                                  )
  16.00                    100.00000    67.86900;
  16.00                    101.00000   100.00000;
   5.00          "DRIF"     40.26300     0.00000   100.00000;
   7.            "DBV1"      0.00000     0.00000     0.00000      .26565     0.00000     0.00000;
   5.00          "DRIF"     55.51250     0.00000   100.00000;
(CIRCULAR AND HYPERBOLIC QUAD APERTURES                                                   )
  16.00                    100.00000    70.40900;
  16.00                    101.00000    41.70700;
   5.00          "Q2  "     32.60000    -9.07230   100.00000;
(CIRCULAR AND HYPERBOLIC DRIFT APERTURES                                                  )
  16.00                    100.00000    67.86900;
```

(See J-6) below

J-3

```
  16.00                    101.00000   100.00000;
   5.00          "DRIF"     16.82500     0.00000   100.00000;
(CIRCULAR SEM APERTURE                                                  )
  16.00                    100.00000    69.85000;
   5.00          "DRIF"      7.87500     0.00000   100.00000;
(OBTAIN SEM 802 PROFILES                                                )
  50.0                       1.00000   -10.00000    10.00000     1.00000;
  50.0                       3.00000   -10.00000    10.00000     1.00000;
   5.00          "DRIF"      7.87500     0.00000   100.00000;
(CIRCULAR DRIFT APERTURE                                                )
  16.00                    100.00000    67.86900;
   5.00          "DRIF"    108.75000     0.00000   100.00000;
   7.            "DBH4"      0.00000    -1.40098     0.00000     0.00000     0.00000     0.00000;
   5.00          "DRIF"     45.07500     0.00000   100.00000;
(CIRCULAR AND HYPERBOLIC QUAD APERTURES                                 )
  16.00                    100.00000    70.40900;
  16.00                    101.00000    41.70700;
   5.00          "Q3  "     32.60000     9.27590   100.00000;
(CIRCULAR AND HYPERBOLIC DRIFT APERTURES                                )
  16.00                    100.00000    67.86900;
  16.00                    101.00000   100.00000;
   5.00          "DRIF"     24.36500     0.00000   100.00000;
(CIRCULAR AND HYPERBOLIC QUAD APERTURES                                 )
  16.00                    100.00000    70.40900;
  16.00                    101.00000    41.70700;
   5.00          "Q4  "     27.60000    -6.85170   100.00000;
(CIRCULAR AND HYPERBOLIC DRIFT APERTURES                                )
  16.00                    100.00000    67.86900;
  16.00                    101.00000   100.00000;
   5.00          "DRIF"    122.86500     0.00000   100.00000;
(CIRCULAR AND HYPERBOLIC QUAD APERTURES                                 )
  16.00                    100.00000    70.40900;
  16.00                    101.00000    41.70700;
   5.00          "Q5  "     32.60000     7.42000   100.00000;
(CIRCULAR AND HYPERBOLIC DRIFT APERTURES                                )
  16.00                    100.00000    67.74200;
  16.00                    101.00000   100.00000;
   5.00          "DRIF"     84.15000     0.00000   100.00000;
(CIRCULAR AND HYPERBOLIC QUAD APERTURES                                 )
  16.00                    100.00000    70.40900;
  16.00                    101.00000    41.70700;
   5.00          "Q6  "     32.60000    -7.32390   100.00000;
(CIRCULAR AND HYPERBOLIC DRIFT APERTURES                                )
  16.00                    100.00000    67.74200;
  16.00                    101.00000   100.00000;
   5.00          "DRIF"     21.57500     0.00000   100.00000;
   7.            "DBV6"      0.00000     0.00000     0.00000    -.19893     0.00000     0.00000;
   5.00          "DRIF"      9.25000     0.00000   100.00000;
(CIRCULAR DRIFT APERTURE                                                )
  16.00                    100.00000    48.69180;
   5.00          "DRIF"    188.50000     0.00000   100.00000;
(CIRCULAR DRIFT APERTURE                                                )
  16.00                    100.00000    67.74200;
(ION CHAMBER HAS BEEN REMOVED.                                          )
   5.00          "DRIF"     13.00000     0.00000   100.00000;
(CIRCULAR DRIFT APERTURE                                                )
  16.00                    100.00000    67.99600;
   5.00          "DRIF"     13.87500     0.00000   100.00000;
(CIRCULAR SEM APERTURE                                                  )
  16.00                    100.00000    69.85000;
   5.00          "DRIF"      6.50000     0.00000   100.00000;
(OBTAIN SEM 806 PROFILES.                                               )
  50.0                       1.00000   -25.00000    25.00000     2.00000;
  50.0                       3.00000   -20.00000    20.00000     2.00000;
   5.00          "DRIF"      6.50000     0.00000   100.00000;
(CIRCULAR DRIFT APERTURE                                                )
```

J-4

```
  16.00                    100.00000    67.99600;
   5.00          "DRIF"     16.00000     0.00000   100.00000;
(TB1 APERTURE                                                                  )
  16.00                      4.00000    66.85280;
  16.00                      5.00000    27.10180;
  20.0                     180.00000;
   2.0                       1.10200;
   4.000         "TB1 "     60.00000     7.48337     0.00000;
   2.0                       1.10200;
(CIRCULAR DRIFT APERTURE                                                       )
  16.00                    100.00000    74.09180;
   5.00          "DRIF"     12.75000     0.00000   100.00000;
   2.0                       1.10400;
   4.000         "TB2 "     60.00000     7.49900     0.00000;
   2.0                       1.10400;
  20.0                    -180.00000;
(CIRCULAR DRIFT APERTURE                                                       )
  16.00                    100.00000    67.10680;
   5.00          "DRIF"     19.57500     0.00000   100.00000;
(CIRCULAR AND HYPERBOLIC QUAD APERTURES                                        )
  16.00                    100.00000    70.40900;
  16.00                    101.00000    41.70700;
   5.00          "Q7  "     18.00000     1.73994   100.00000;
(CIRCULAR AND HYPERBOLIC DRIFT APERTURES                                       )
  16.00                    100.00000    67.10680;
  16.00                    101.00000   100.00000;
   5.00          "DRIF"      9.51000     0.00000   100.00000;
(CIRCULAR TOR 807 APERTURE                                                     )
  16.00                    100.00000    28.51150;
   5.00          "TOR "     12.00000     0.00000   100.00000;
(CIRCULAR DRIFT APERTURE                                                       )
  16.00                    100.00000    29.76880;
   5.00          "DRIF"     58.36500     0.00000   100.00000;
(CIRCULAR SEM APERTURE                                                         )
  16.00                    100.00000    69.85000;
   5.00          "DRIF"      6.50000     0.00000   100.00000;
(OBTAIN SEM 807 PROFILES                                                       )
  50.0                       1.00000   -25.00000    25.00000     2.00000;
  50.0                       3.00000   -10.00000    10.00000     1.00000;
   5.00          "DRIF"      6.50000     0.00000   100.00000;
(CIRCULAR DRIFT APERTURE                                                       )
  16.00                    100.00000    30.91180;
   5.00          "DRIF"     48.75000     0.00000   100.00000;
(SEPTUM APERTURE                                                               )
  16.00                      4.00000    26.03500;
  16.00                      5.00000    19.68500;
  20.0                     180.00000;
   2.0                        .85900;
   4.000         "SEP1"     84.00000     4.18526     0.00000;
   2.0                        .85900;
  20.0                    -180.00000;
(CIRCULAR DRIFT APERTURE                                                       )
  16.00                    100.00000    31.16580;
   5.00          "DRIF"      3.75000     0.00000   100.00000;
  20.0                     180.00000;
   2.0                        .82200;
   4.000         "SEP2"     84.00000     4.00300     0.00000;
   2.0                        .82200;
  20.0                    -180.00000;
   5.00          "DRIF"     13.07500     0.00000   100.00000;
(SHIFT BEAM HORIZONTALLY                                                       )
   7.                      -42.92600     0.00000     0.00000     0.00000     0.00000     0.00000;
(CIRCULAR QUAD APERTURES                                                       )
  16.00                    100.00000    74.09180;
(REMOVE HYPERBOLIC QUAD APERTURES.                                             )
  16.00                    101.00000   100.00000;
```

J-5

```
    5.00            "A104"      18.00000      9.67410    100.00000;
 (SHIFT BEAM BACK.                                                                        )
    7.                          42.92600      0.00000      0.00000      0.00000      0.00000      0.00000;
 (OBTAIN BEAM PROFILE.                                                                    )
   50.0                          1.00000    -30.00000     30.00000      2.00000;
   50.0                          3.00000    -10.00000     10.00000      1.00000;
OSENTINEL
1DEBUNCHER TO ACCUMULATOR TRANSFER LINE
OTHE FOLLOWING HISTOGRAMS REFER TO  10000 RAYS PASSING THROUGH THE ABOVE BEAM LINE
 *****************************************************************************
 THE FOLLOWING HISTOGRAMS HAVE BEEN REQUESTED
 -------------------------------------------
OHISTOGRAM NO  1
 DISTRIBUTION OF    X IN MM                      505.359 IN   FROM THE TARGET
OHISTOGRAM NO  2
 DISTRIBUTION OF    Y IN MM                      505.359 IN   FROM THE TARGET
OHISTOGRAM NO  3
 DISTRIBUTION OF    X IN MM                      740.584 IN   FROM THE TARGET
OHISTOGRAM NO  4
 DISTRIBUTION OF    Y IN MM                      740.584 IN   FROM THE TARGET
OHISTOGRAM NO  5
 DISTRIBUTION OF    X IN MM                      928.659 IN   FROM THE TARGET
OHISTOGRAM NO  6
 DISTRIBUTION OF    Y IN MM                      928.659 IN   FROM THE TARGET
OHISTOGRAM NO  7
 DISTRIBUTION OF    X IN MM                     1133.375 IN   FROM THE TARGET
OHISTOGRAM NO  8
 DISTRIBUTION OF    Y IN MM                     1133.375 IN   FROM THE TARGET
OHISTOGRAM NO  9
 DISTRIBUTION OF    X IN MM                     1904.554 IN   FROM THE TARGET
OHISTOGRAM NO 10
 DISTRIBUTION OF    Y IN MM                     1904.554 IN   FROM THE TARGET
OHISTOGRAM NO 11
 DISTRIBUTION OF    X IN MM                     2183.754 IN   FROM THE TARGET
OHISTOGRAM NO 12
 DISTRIBUTION OF    Y IN MM                     2183.754 IN   FROM THE TARGET
OHISTOGRAM NO 13
 DISTRIBUTION OF    X IN MM                     2441.829 IN   FROM THE TARGET
OHISTOGRAM NO 14
 DISTRIBUTION OF    Y IN MM                     2441.829 IN   FROM THE TARGET
O     19658  PLACES LEFT FOR HISTOGRAM STORAGE
1HISTOGRAM NO  1
 DISTRIBUTION OF    X IN MM                      505.359 IN   FROM THE TARGET
O
          INTERVAL                              SCALE FACTOR..  100 X'S EQUAL  1522 ENTRIES
OLESS THAN    -10.000        0

  -10.000 TO   -9.000        0
   -9.000 TO   -8.000        0
   -8.000 TO   -7.000        0
   -7.000 TO   -6.000       14
   -6.000 TO   -5.000      119   XXXXXXX
   -5.000 TO   -4.000      340   XXXXXXXXXXXXXXXXXXXXXX
   -4.000 TO   -3.000      708   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -3.000 TO   -2.000      974   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -2.000 TO   -1.000     1352   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -1.000 TO    0.000     1483   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    0.000 TO    1.000     1522   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    1.000 TO    2.000     1318   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    2.000 TO    3.000     1062   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    3.000 TO    4.000      672   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    4.000 TO    5.000      313   XXXXXXXXXXXXXXXXXXXX
    5.000 TO    6.000      111   XXXXXXX
    6.000 TO    7.000       12
    7.000 TO    8.000        0
    8.000 TO    9.000        0
```

SEM 607

J-6

SEM 607

Just before 188" drift marked with asterisk above

```
    9.000 TO   10.000         0
OGREATER THAN  10.000         0
0          TOTAL NUMBER OF ENTRIES =     10000     INCLUDING UNDERFLOW AND OVERFLOW
           CENTER =    -.011   RMS HALF WIDTH =   2.381
OHISTOGRAM NO  1
 DISTRIBUTION OF     X IN MM                        505.359 IN   FROM THE TARGET
1HISTOGRAM NO  2
 DISTRIBUTION OF     Y IN MM                        505.359 IN   FROM THE TARGET
0
           INTERVAL                               SCALE FACTOR..  100 X'S EQUAL  1494 ENTRIES
OLESS THAN     -10.000        0

  -10.000 TO   -9.000         0
   -9.000 TO   -8.000         0
   -8.000 TO   -7.000         0
   -7.000 TO   -6.000         7
   -6.000 TO   -5.000       130    XXXXXXXX
   -5.000 TO   -4.000       367    XXXXXXXXXXXXXXXXXXXXXXXX
   -4.000 TO   -3.000       689    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -3.000 TO   -2.000      1073    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -2.000 TO   -1.000      1321    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -1.000 TO    0.000      1494    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    0.000 TO    1.000      1480    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    1.000 TO    2.000      1253    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    2.000 TO    3.000      1029    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    3.000 TO    4.000       676    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    4.000 TO    5.000       349    XXXXXXXXXXXXXXXXXXXXXXX
    5.000 TO    6.000       123    XXXXXXXX
    6.000 TO    7.000         9
    7.000 TO    8.000         0
    8.000 TO    9.000         0
    9.000 TO   10.000         0
OGREATER THAN  10.000         0
0          TOTAL NUMBER OF ENTRIES =     10000     INCLUDING UNDERFLOW AND OVERFLOW
           CENTER =    -.039   RMS HALF WIDTH =   2.414
OHISTOGRAM NO  2
 DISTRIBUTION OF     Y IN MM                        505.359 IN   FROM THE TARGET
1HISTOGRAM NO  3
 DISTRIBUTION OF     X IN MM                        740.584 IN   FROM THE TARGET
0
           INTERVAL                               SCALE FACTOR..  100 X'S EQUAL  8456 ENTRIES
OLESS THAN     -40.000        0

  -40.000 TO  -36.000         0
  -36.000 TO  -32.000         0
  -32.000 TO  -28.000         0
  -28.000 TO  -24.000         0
  -24.000 TO  -20.000         0
  -20.000 TO  -16.000         0
  -16.000 TO  -12.000         0
  -12.000 TO   -8.000         0
   -8.000 TO   -4.000         0
   -4.000 TO    0.000       267    XXX
    0.000 TO    4.000      8456    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    4.000 TO    8.000      1277    XXXXXXXXXXXXXXX
    8.000 TO   12.000         0
   12.000 TO   16.000         0
   16.000 TO   20.000         0
   20.000 TO   24.000         0
   24.000 TO   28.000         0
   28.000 TO   32.000         0
   32.000 TO   36.000         0
   36.000 TO   40.000         0
OGREATER THAN  40.000         0
0          TOTAL NUMBER OF ENTRIES =     10000     INCLUDING UNDERFLOW AND OVERFLOW
           CENTER =    2.451   RMS HALF WIDTH =   1.297
```

J-7

```
0HISTOGRAM NO  3
 DISTRIBUTION OF     X IN MM                          740.584 IN    FROM THE TARGET
1HISTOGRAM NO  4
 DISTRIBUTION OF     Y IN MM                          740.584 IN    FROM THE TARGET
0
           INTERVAL                               SCALE FACTOR..  100 X'S EQUAL   861 ENTRIES
0LESS THAN     -10.000          2

  -10.000 TO    -9.000         33    XXX
   -9.000 TO    -8.000        115    XXXXXXXXXXXXX
   -8.000 TO    -7.000        231    XXXXXXXXXXXXXXXXXXXXXXXXXX
   -7.000 TO    -6.000        357    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -6.000 TO    -5.000        521    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -5.000 TO    -4.000        632    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -4.000 TO    -3.000        715    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -3.000 TO    -2.000        779    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -2.000 TO    -1.000        861    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -1.000 TO     0.000        831    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    0.000 TO     1.000        851    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    1.000 TO     2.000        817    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    2.000 TO     3.000        736    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    3.000 TO     4.000        663    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    4.000 TO     5.000        656    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    5.000 TO     6.000        497    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    6.000 TO     7.000        350    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    7.000 TO     8.000        201    XXXXXXXXXXXXXXXXXXXXXXX
    8.000 TO     9.000        118    XXXXXXXXXXXXX
    9.000 TO    10.000         34    XXX
0GREATER THAN  10.000          0
0          TOTAL NUMBER OF ENTRIES =      10000     INCLUDING UNDERFLOW AND OVERFLOW
           CENTER =    -.066   RMS HALF WIDTH =    4.046
0HISTOGRAM NO  4
 DISTRIBUTION OF     Y IN MM                          740.584 IN    FROM THE TARGET
1HISTOGRAM NO  5
 DISTRIBUTION OF     X IN MM                          928.659 IN    FROM THE TARGET
0
           INTERVAL                               SCALE FACTOR..  100 X'S EQUAL  5505 ENTRIES
0LESS THAN     -40.000          0

  -40.000 TO   -36.000          0
  -36.000 TO   -32.000          0
  -32.000 TO   -28.000       1901    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
  -28.000 TO   -24.000       5505    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
  -24.000 TO   -20.000       2352    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
  -20.000 TO   -16.000         78    X
  -16.000 TO   -12.000          0
  -12.000 TO    -8.000          0
   -8.000 TO    -4.000          0
   -4.000 TO     0.000          0
    0.000 TO     4.000          0
    4.000 TO     8.000          0
    8.000 TO    12.000          0
   12.000 TO    16.000          0
   16.000 TO    20.000          0
   20.000 TO    24.000          0
   24.000 TO    28.000          0
   28.000 TO    32.000          0
   32.000 TO    36.000          0
   36.000 TO    40.000          0
0GREATER THAN  40.000          0
0          TOTAL NUMBER OF ENTRIES =       9836     INCLUDING UNDERFLOW AND OVERFLOW
           CENTER = -25.749   RMS HALF WIDTH =    2.438
0HISTOGRAM NO  5
 DISTRIBUTION OF     X IN MM                          928.659 IN    FROM THE TARGET
1HISTOGRAM NO  6
 DISTRIBUTION OF     Y IN MM                          928.659 IN    FROM THE TARGET
```

Just before 188" drift

Just after the 188" drift

```
0
            INTERVAL                                      SCALE FACTOR..  100 X'S EQUAL  3490 ENTRIES
0LESS THAN     -10.000          0

   -10.000 TO    -9.000         0
    -9.000 TO    -8.000         0
    -8.000 TO    -7.000         0
    -7.000 TO    -6.000         0
    -6.000 TO    -5.000         0
    -5.000 TO    -4.000         0
    -4.000 TO    -3.000         0
    -3.000 TO    -2.000         0
    -2.000 TO    -1.000      1518    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    -1.000 TO     0.000      3490    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
     0.000 TO     1.000      3341    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
     1.000 TO     2.000      1487    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
     2.000 TO     3.000         0
     3.000 TO     4.000         0
     4.000 TO     5.000         0
     5.000 TO     6.000         0
     6.000 TO     7.000         0
     7.000 TO     8.000         0
     8.000 TO     9.000         0
     9.000 TO    10.000         0
0GREATER THAN   10.000          0
0          TOTAL NUMBER OF ENTRIES =       9836      INCLUDING UNDERFLOW AND OVERFLOW
           CENTER =    -.013   RMS HALF WIDTH =     .860
0HISTOGRAM NO  6
 DISTRIBUTION OF     Y IN MM                       928.659 IN    FROM THE TARGET
1HISTOGRAM NO  7
 DISTRIBUTION OF     X IN MM                      1133.375 IN    FROM THE TARGET
0
            INTERVAL                                      SCALE FACTOR..  100 X'S EQUAL  3253 ENTRIES
0LESS THAN     -10.000          0

   -10.000 TO    -9.000         0
    -9.000 TO    -8.000        63    X
    -8.000 TO    -7.000       935    XXXXXXXXXXXXXXXXXXXXXXXXXXXX
    -7.000 TO    -6.000      2431    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    -6.000 TO    -5.000      3253    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    -5.000 TO    -4.000      2316    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    -4.000 TO    -3.000       814    XXXXXXXXXXXXXXXXXXXXXXXXX
    -3.000 TO    -2.000        24
    -2.000 TO    -1.000         0
    -1.000 TO     0.000         0
     0.000 TO     1.000         0
     1.000 TO     2.000         0
     2.000 TO     3.000         0
     3.000 TO     4.000         0
     4.000 TO     5.000         0
     5.000 TO     6.000         0
     6.000 TO     7.000         0
     7.000 TO     8.000         0
     8.000 TO     9.000         0
     9.000 TO    10.000         0
0GREATER THAN   10.000          0
0          TOTAL NUMBER OF ENTRIES =       9836      INCLUDING UNDERFLOW AND OVERFLOW
           CENTER =   -5.547   RMS HALF WIDTH =    1.090
0HISTOGRAM NO  7
 DISTRIBUTION OF     X IN MM                      1133.375 IN    FROM THE TARGET
1HISTOGRAM NO  8
 DISTRIBUTION OF     Y IN MM                      1133.375 IN    FROM THE TARGET
0
            INTERVAL                                      SCALE FACTOR..  100 X'S EQUAL  1669 ENTRIES
0LESS THAN     -10.000          0
```

J-8

Just after 188" drift

SEM 802

SEM 802 J-9

```
 -10.000 TO   -9.000        0
  -9.000 TO   -8.000        0
  -8.000 TO   -7.000        0
  -7.000 TO   -6.000        0
  -6.000 TO   -5.000        0
  -5.000 TO   -4.000       34   XX
  -4.000 TO   -3.000      274   XXXXXXXXXXXXXXXX
  -3.000 TO   -2.000      703   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
  -2.000 TO   -1.000     1232   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
  -1.000 TO    0.000     1544   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   0.000 TO    1.000     1669   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   1.000 TO    2.000     1612   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   2.000 TO    3.000     1391   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   3.000 TO    4.000      902   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   4.000 TO    5.000      413   XXXXXXXXXXXXXXXXXXXXXXXX
   5.000 TO    6.000       62   XXX
   6.000 TO    7.000        0
   7.000 TO    8.000        0
   8.000 TO    9.000        0
   9.000 TO   10.000        0
0GREATER THAN  10.000        0
0           TOTAL NUMBER OF ENTRIES =      9836     INCLUDING UNDERFLOW AND OVERFLOW
            CENTER =     .668   RMS HALF WIDTH =    2.027
0HISTOGRAM NO  8
 DISTRIBUTION OF     Y IN MM                         1133.375 IN    FROM THE TARGET
1HISTOGRAM NO  9
 DISTRIBUTION OF     X IN MM                         1904.554 IN    FROM THE TARGET
0
            INTERVAL                               SCALE FACTOR..  100 X'S EQUAL  2575 ENTRIES
0LESS THAN    -25.000        0

 -25.000 TO  -23.000        0
 -23.000 TO  -21.000        0
 -21.000 TO  -19.000        0
 -19.000 TO  -17.000        0
 -17.000 TO  -15.000        0
 -15.000 TO  -13.000        0
 -13.000 TO  -11.000        0
 -11.000 TO   -9.000        0
  -9.000 TO   -7.000        0
  -7.000 TO   -5.000        0
  -5.000 TO   -3.000        0
  -3.000 TO   -1.000        0
  -1.000 TO    1.000        0
   1.000 TO    3.000        0
   3.000 TO    5.000        0
   5.000 TO    7.000        7
   7.000 TO    9.000      171   XXXXXX
   9.000 TO   11.000      799   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
  11.000 TO   13.000     1792   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
  13.000 TO   15.000     2575   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
  15.000 TO   17.000     2497   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
  17.000 TO   19.000     1539   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
  19.000 TO   21.000      456   XXXXXXXXXXXXXXXXX
  21.000 TO   23.000        0
  23.000 TO   25.000        0
0GREATER THAN  25.000        0
0           TOTAL NUMBER OF ENTRIES =      9836     INCLUDING UNDERFLOW AND OVERFLOW
            CENTER =   14.611   RMS HALF WIDTH =    2.678
0HISTOGRAM NO  9
 DISTRIBUTION OF     X IN MM                         1904.554 IN    FROM THE TARGET
1HISTOGRAM NO 10
 DISTRIBUTION OF     Y IN MM                         1904.554 IN    FROM THE TARGET
0
            INTERVAL                               SCALE FACTOR..  100 X'S EQUAL  1350 ENTRIES
0LESS THAN    -20.000        0
```

SEM 806

J-10

SEM 806

```
 -20.000 TO  -18.000        0
 -18.000 TO  -16.000        0
 -16.000 TO  -14.000        0
 -14.000 TO  -12.000        0
 -12.000 TO  -10.000       55   XXXX
 -10.000 TO   -8.000      189   XXXXXXXXXXXXXX
  -8.000 TO   -6.000      401   XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
  -6.000 TO   -4.000      661   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
  -4.000 TO   -2.000      968   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
  -2.000 TO    0.000     1108   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   0.000 TO    2.000     1280   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   2.000 TO    4.000     1350   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   4.000 TO    6.000     1230   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   6.000 TO    8.000      983   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   8.000 TO   10.000      788   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
  10.000 TO   12.000      496   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
  12.000 TO   14.000      242   XXXXXXXXXXXXXXXXX
  14.000 TO   16.000       82   XXXXXX
  16.000 TO   18.000        3
  18.000 TO   20.000        0
0GREATER THAN  20.000       0
0           TOTAL NUMBER OF ENTRIES =      9836     INCLUDING UNDERFLOW AND OVERFLOW
            CENTER =   2.321   RMS HALF WIDTH = .  5.413
0HISTOGRAM NO 10
 DISTRIBUTION OF     Y IN MM                        1904.554 IN    FROM THE TARGET
1HISTOGRAM NO 11
 DISTRIBUTION OF     X IN MM                        2183.754 IN    FROM THE TARGET
0
            INTERVAL                              SCALE FACTOR..  100 X'S EQUAL  2743 ENTRIES
0LESS THAN     -25.000        0

  -25.000 TO  -23.000        0
  -23.000 TO  -21.000        0
  -21.000 TO  -19.000        0
  -19.000 TO  -17.000        0
  -17.000 TO  -15.000        0
  -15.000 TO  -13.000        0
  -13.000 TO  -11.000        0
  -11.000 TO   -9.000        0
   -9.000 TO   -7.000        0
   -7.000 TO   -5.000        0
   -5.000 TO   -3.000        0
   -3.000 TO   -1.000        0
   -1.000 TO    1.000        0
    1.000 TO    3.000        0
    3.000 TO    5.000        0
    5.000 TO    7.000        0
    7.000 TO    9.000        0
    9.000 TO   11.000        0
   11.000 TO   13.000       88   XXX
   13.000 TO   15.000      761   XXXXXXXXXXXXXXXXXXXXXXXXXXX
   15.000 TO   17.000     1917   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   17.000 TO   19.000     2743   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   19.000 TO   21.000     2556   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   21.000 TO   23.000     1510   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   23.000 TO   25.000      261   XXXXXXXXX
0GREATER THAN  25.000        0
0           TOTAL NUMBER OF ENTRIES =      9836     INCLUDING UNDERFLOW AND OVERFLOW
            CENTER =  18.544   RMS HALF WIDTH =   2.483
0HISTOGRAM NO 11
 DISTRIBUTION OF     X IN MM                        2183.754 IN    FROM THE TARGET
1HISTOGRAM NO 12
 DISTRIBUTION OF     Y IN MM                        2183.754 IN    FROM THE TARGET
0
            INTERVAL                              SCALE FACTOR..  100 X'S EQUAL  1281 ENTRIES
```

SEM 807

SEM 807 J-11

```
OLESS THAN     -10.000         0

  -10.000 TO    -9.000         0
   -9.000 TO    -8.000         0
   -8.000 TO    -7.000        30   XX
   -7.000 TO    -6.000       183   XXXXXXXXXXXXXX
   -6.000 TO    -5.000       384   XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -5.000 TO    -4.000       678   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -4.000 TO    -3.000       959   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -3.000 TO    -2.000      1052   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -2.000 TO    -1.000      1220   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -1.000 TO     0.000      1281   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    0.000 TO     1.000      1220   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    1.000 TO     2.000      1031   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    2.000 TO     3.000       858   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    3.000 TO     4.000       556   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    4.000 TO     5.000       278   XXXXXXXXXXXXXXXXXXXXX
    5.000 TO     6.000       101   XXXXXXX
    6.000 TO     7.000         5
    7.000 TO     8.000         0
    8.000 TO     9.000         0
    9.000 TO    10.000         0
OGREATER THAN  10.000          0
0          TOTAL NUMBER OF ENTRIES =      9836     INCLUDING UNDERFLOW AND OVERFLOW
           CENTER =    -.710   RMS HALF WIDTH =    2.747
OHISTOGRAM NO 12
 DISTRIBUTION OF     Y IN MM                        2183.754 IN    FROM THE TARGET
1HISTOGRAM NO 13
 DISTRIBUTION OF     X IN MM                        2441.829 IN    FROM THE TARGET
0
           INTERVAL                               SCALE FACTOR..  100 X'S EQUAL  2881 ENTRIES
OLESS THAN     -30.000         0

  -30.000 TO   -28.000         0
  -28.000 TO   -26.000         0
  -26.000 TO   -24.000         0
  -24.000 TO   -22.000         0
  -22.000 TO   -20.000         0
  -20.000 TO   -18.000         0
  -18.000 TO   -16.000         0
  -16.000 TO   -14.000         0
  -14.000 TO   -12.000         0
  -12.000 TO   -10.000         0
  -10.000 TO    -8.000         0
   -8.000 TO    -6.000         0
   -6.000 TO    -4.000         0
   -4.000 TO    -2.000         0
   -2.000 TO     0.000         0
    0.000 TO     2.000         0
    2.000 TO     4.000         0
    4.000 TO     6.000         0
    6.000 TO     8.000         0
    8.000 TO    10.000         0
   10.000 TO    12.000         0
   12.000 TO    14.000         0
   14.000 TO    16.000       120   XXXX
   16.000 TO    18.000      1094   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   18.000 TO    20.000      2436   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   20.000 TO    22.000      2881   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   22.000 TO    24.000      2328   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   24.000 TO    26.000       883   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   26.000 TO    28.000        84   XX
   28.000 TO    30.000         0
OGREATER THAN  30.000          0
0          TOTAL NUMBER OF ENTRIES =      9826     INCLUDING UNDERFLOW AND OVERFLOW
           CENTER =   20.874   RMS HALF WIDTH =    2.363
```

End of Beamline

J-12

```
OHISTOGRAM NO 13
 DISTRIBUTION OF     X IN MM                          2441.829 IN    FROM THE TARGET
1HISTOGRAM NO 14
 DISTRIBUTION OF     Y IN MM                          2441.829 IN    FROM THE TARGET
0
           INTERVAL                                  SCALE FACTOR..  100 X'S EQUAL  3034 ENTRIES
OLESS THAN    -10.000        0

  -10.000 TO   -9.000        0
   -9.000 TO   -8.000        0
   -8.000 TO   -7.000        0
   -7.000 TO   -6.000        5
   -6.000 TO   -5.000      971   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -5.000 TO   -4.000     2683   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -4.000 TO   -3.000     3034   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -3.000 TO   -2.000     2498   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   -2.000 TO   -1.000      635   XXXXXXXXXXXXXXXXXXXXX
   -1.000 TO    0.000        0
    0.000 TO    1.000        0
    1.000 TO    2.000        0
    2.000 TO    3.000        0
    3.000 TO    4.000        0
    4.000 TO    5.000        0
    5.000 TO    6.000        0
    6.000 TO    7.000        0
    7.000 TO    8.000        0
    8.000 TO    9.000        0
    9.000 TO   10.000        0
OGREATER THAN  10.000        0
0          TOTAL NUMBER OF ENTRIES =      9826     INCLUDING UNDERFLOW AND OVERFLOW
           CENTER =   -3.590   RMS HALF WIDTH =    1.043
OHISTOGRAM NO 14
 DISTRIBUTION OF     Y IN MM                          2441.829 IN    FROM THE TARGET
12.13.41.UCLP, GG, TB10,       0.814KLNS.             ** END OF LISTING **
```

End of Beamline

APPENDIX K

D/A LINE STUDIES

S. MTINGWA

11 JANUARY 1988

PRELIMINARY SETUP

1. Setup for delayed extraction of positive secondaries from the Debuncher.

2. Reduce the number of bunches to get clean Rf capture.

3. Minimize the Debuncher injection oscillations to 0.5 ` 0.8 mm in each plane.

4. Set the tunes to nominal values.

5. Do Debuncher aperture scans with heated beam.

PREVIOUS RESULTS

1. The D/A transfer efficiency is most sensitive to the vertical beam size.

2. After blowing up the beam in the Accumulator, the transfer efficiency into the Debuncher is almost 100%.

PROPOSED NEW STUDIES (About 1 Shift)

1. Vary cooling gate time (1 plane at a time) and monitor the Debuncher Profile Monitor, D/A Sems, D:Tor807/D:IBEAM, A:IBEAM/D:IBEAM, SEM 607 and the Gap Monitors.

2. Vary D6H6 and redo Step #1.

3. Vary the Debuncher momentum and redo the above.

4. Reset D6H6 and the Debuncher momentum ; vary the current in D6Q6 by varying D:QT606 and monitor the D/A efficiency vs. the Debuncher tune.

5. Vary the current in A1Q4 and monitor the D/A transfer efficiency vs. Accumulator tune.

6. From the knowledge gained above, tune the D/A transfer as best as possible and study the transfer efficiency vs. Debuncher and Accumulator bumps with particular attention on the position and angle of the beam near D6Q6 and A1Q4.

SEM PROFILES TAKEN AT INDICATED SETTINGS OF D:TJ308

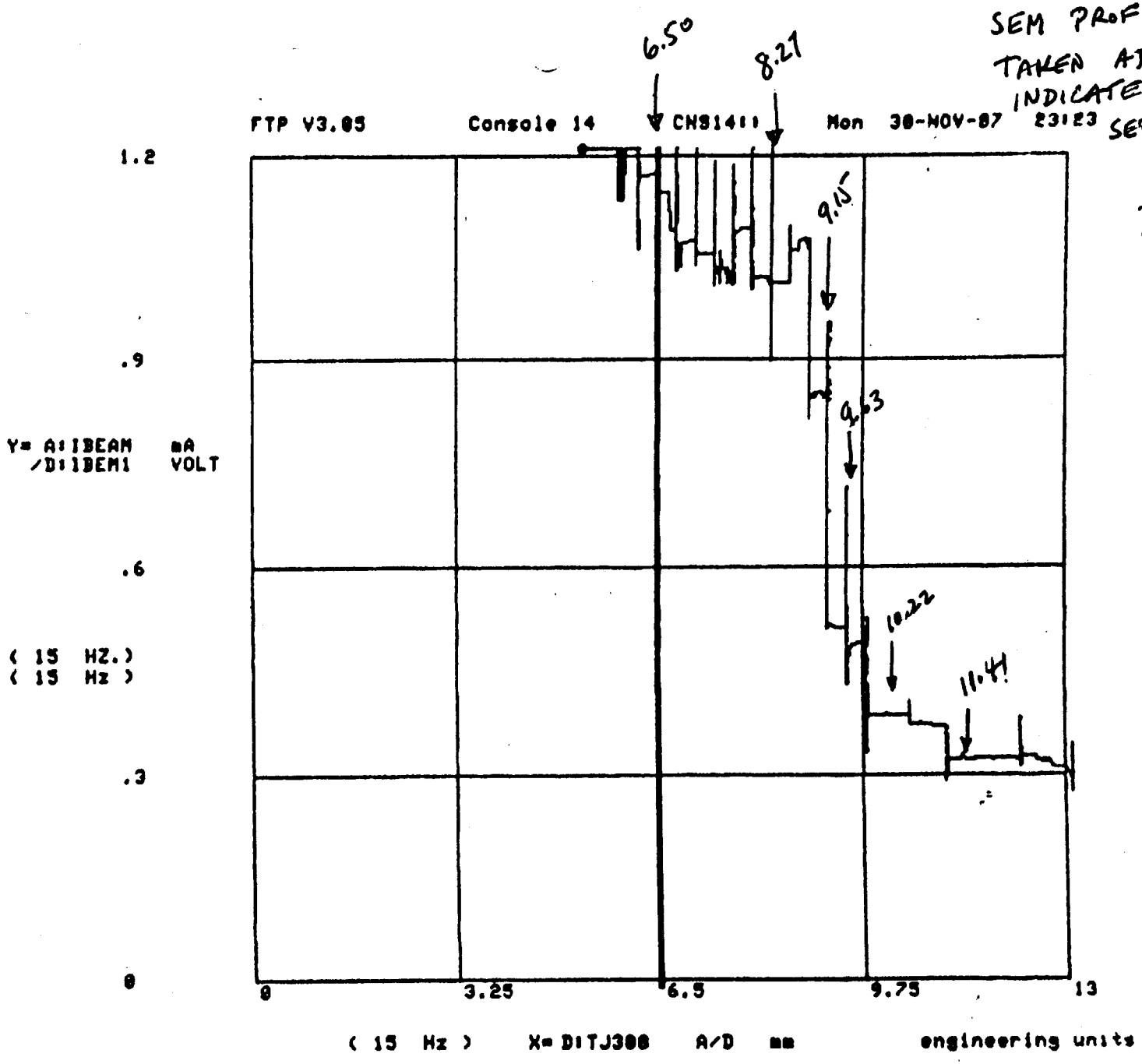
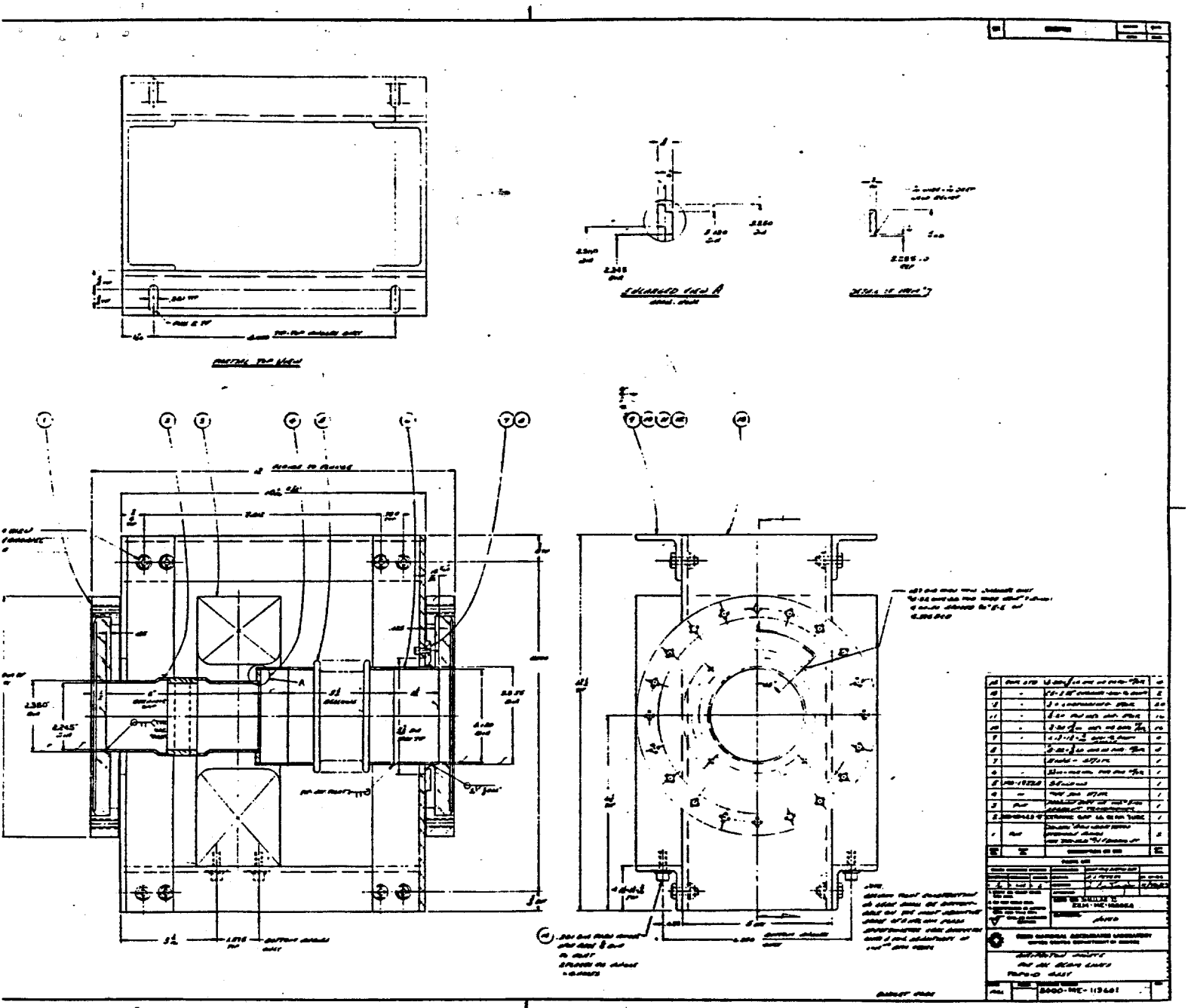


FIG. 1



Ceramic gap
2.245"

FIG. 2

Reverse Protons

NORMAL

D:SM607 12/08/87 0944

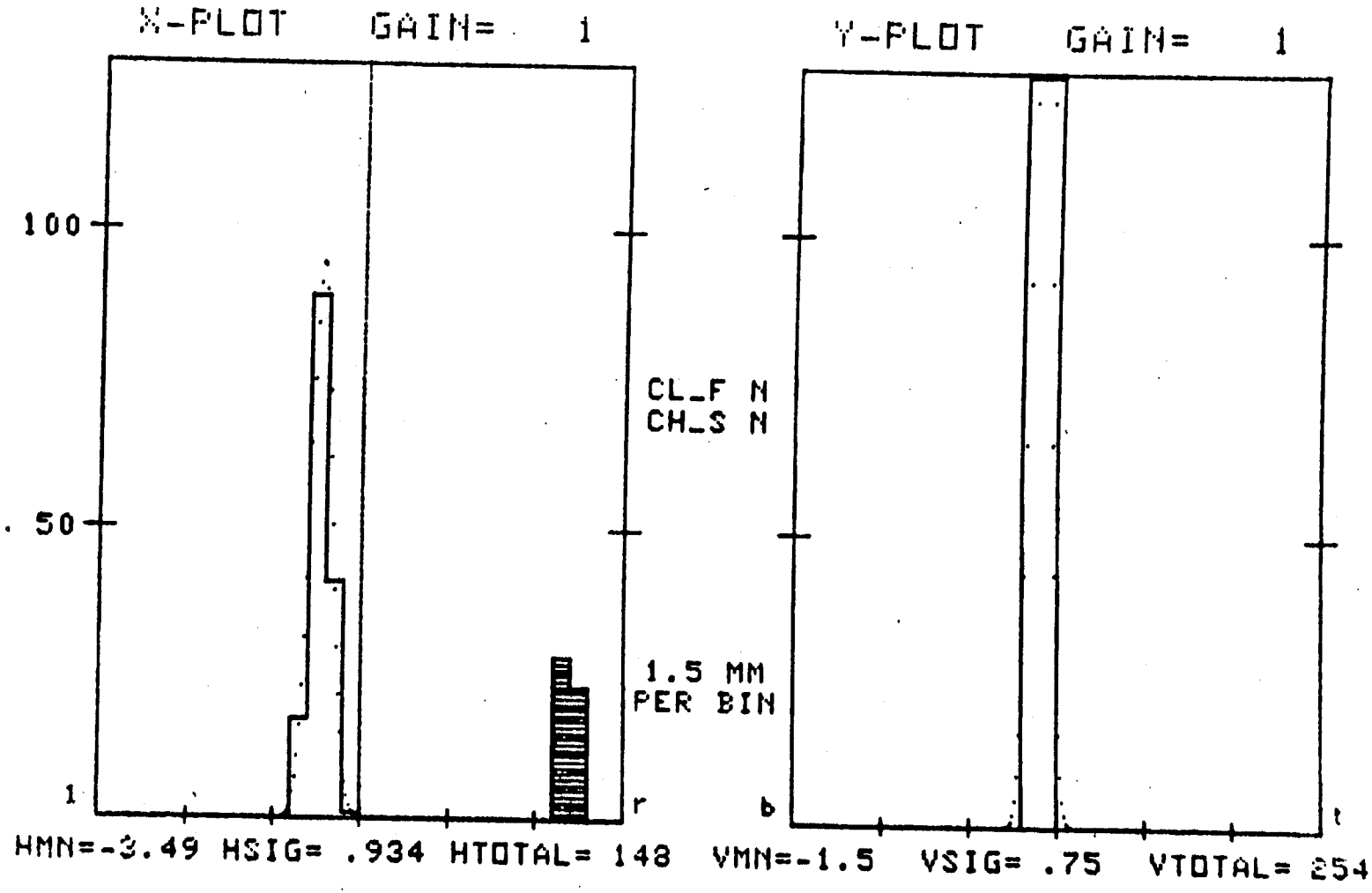


FIG. 3

Reverse Protons

NORMAL

D:SM802 12/08/87 0942

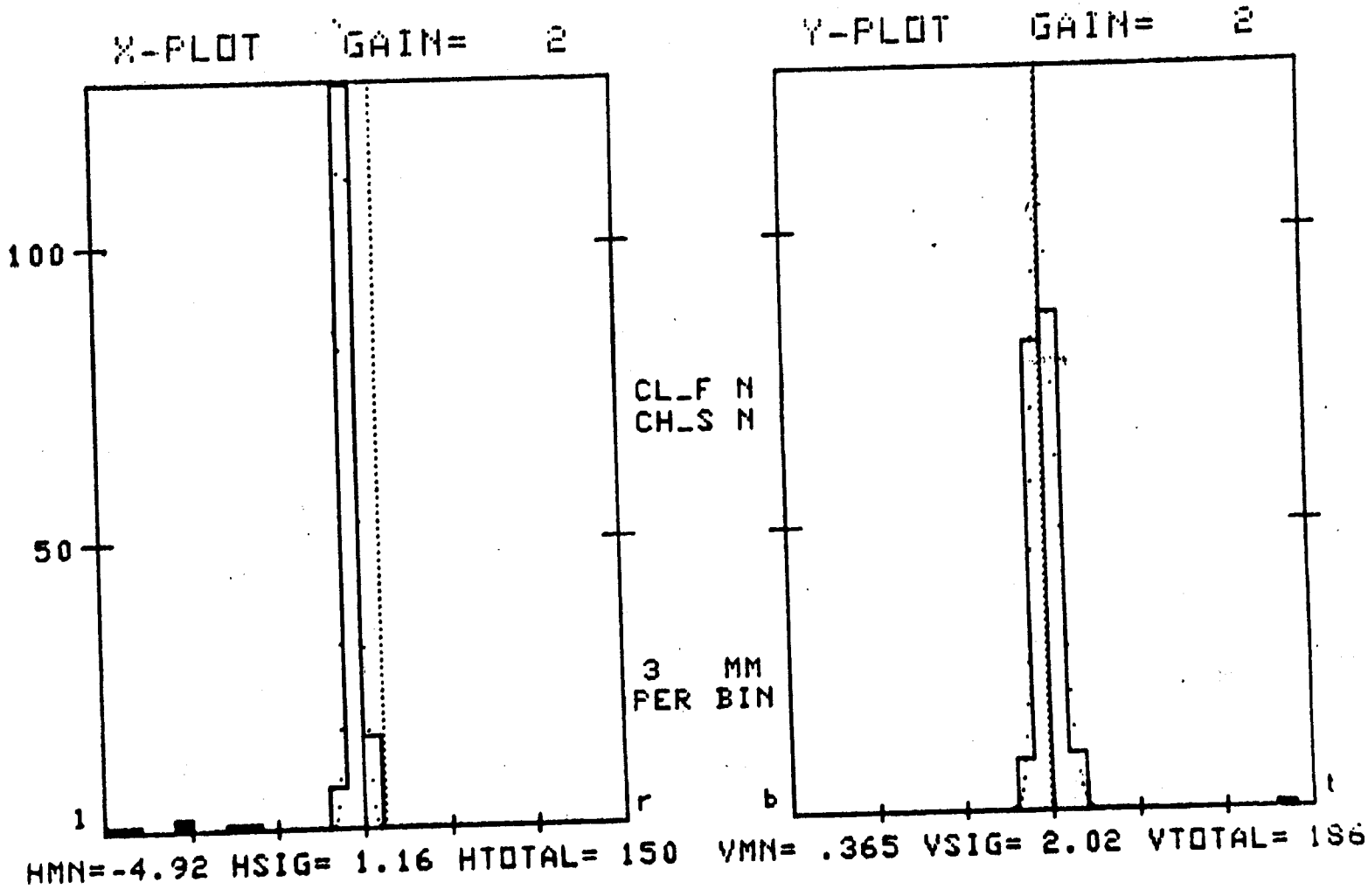


FIG. 4

Reverse Protons

NORMAL X

D:SM806 12/08/87 0940

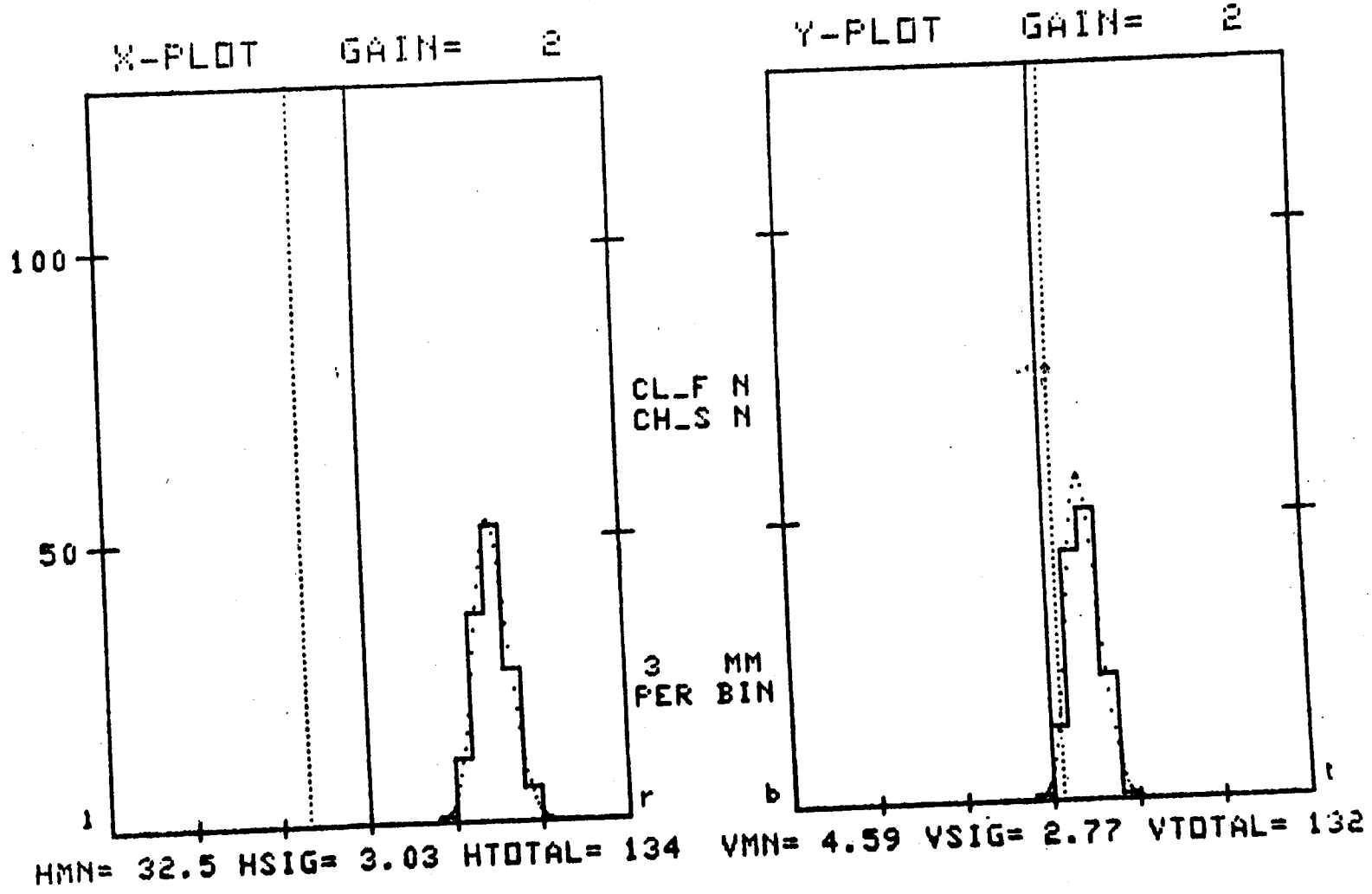


FIG. 5

REVERSE PROTONS
ACC → DEB.

NORMAL

D:SM807 12/08/87 0941

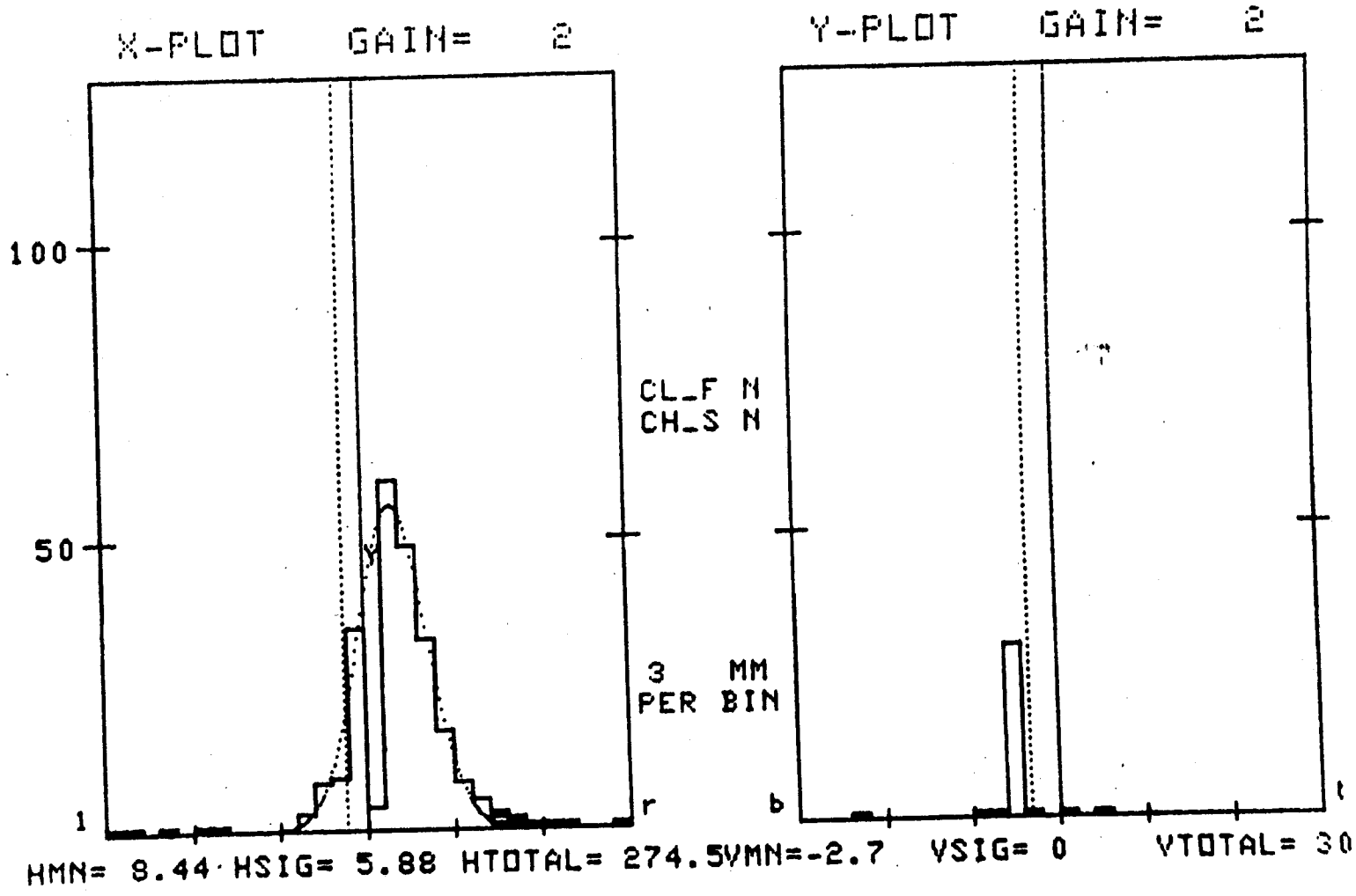


FIG. 6

Immediate D To Acc. Xtraction

NORMAL_X

A:SM104 03/28/88 1558

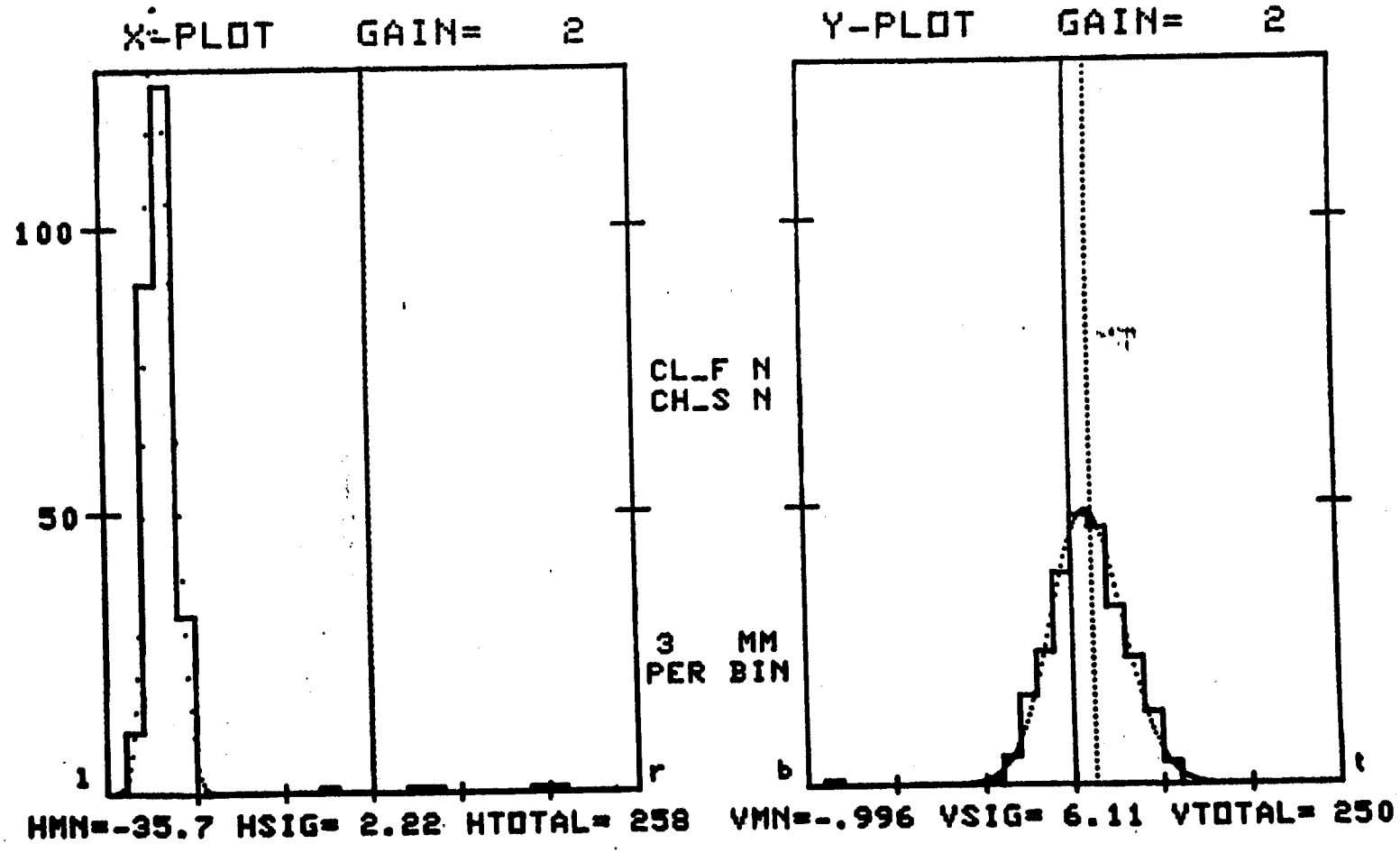


FIG. 7