Alternating Gradient Synchrotron Department
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Upton, New York 11973

EP&S Division Technical Note
No. 112

B5 Tunes for Experiment 766

Gerry M. Bunce

June 3, 1985

The following plots were made for a beam at the B-target which is (1.4 mm x 1 mrad)_x . (1.3 mm x 2 mrad)_y. These are half sizes, taken from calculations for the switchyard; however, they appear to be consistent with the observed spot size on B. After the beam traverses the target, the multiple-scattering blow-up should be ± 2 mrad. The plots do not have this additional spread folded in. A $\Delta p/p$ of $\pm .3\%$ was used and it is assumed the servo system holds the beam steady at B. These sizes are Transport half sizes, which nominally contain 90% of the beam.

Tune A This is the "standard" tune where the upstream quads are set for B1 at 10 GeV/c. The "wavy hole" aperture (vertical) is shown as $\pm 1/2"$. This tune appears to give poor transmission, as is observed. Q6/7, however, are at opposite polarity from what is now used!

Tune B The polarities of the upstream quads remain the same and the beam is squeezed through the apertures.

Tune C The upstream quad polarities are interchanged. The transmission should be quite high.

Tune D Again, the upstream quad polarities have been inverted, but with their settings chosen to get optimum (but poor compared with Tune A) momentum selection and transmission for B1. This solution would seem to have no better transmission for B5 than Tune A, so it has little going for it.

Note: B and C are not ideal for the B1 line! Tune A has been found to give more transmission (x1.5 to 2) and a smaller spot at B' than the previous E766 tune.

Tune A

June 5, 1985

Q1-5 are set for 10 gaw 81 running.

D:bulk	Pol.	A	B
950		1.094	1.094
1043		1.835	1.835

D:bulk	Pol.	A	B
2560		1.60 kA	1.60 kA
2976		7.855	7.855

Tune B

3" 2wads
11cc

(3)

A 1.70 kA
B -2.45 kA

±.625 to 90%
d: back off.

A 2.17 kA
B -1.80 kA

EXP. 766, B5 LINE 5/24/85

Tune C

4

REVERSED Q1-5, 10.69 GEV TUNE FOR B1

Tune D

11-Jun-85 09:28

Dibuk pd. current
920 B 920amps -1.056
899 A 562 .719

2464 A 1540
3019 B 1887

A B

2464 3019

Tune A June 5, 1985

"EXP. 766, B5 LINE 5/24/85					
DRIFFT 3:	"D1	5.690000	0.000000	0.000000	0.000000
QUAD* 5:	"Q1	0.932000	1.009400	2.540000	23.838000
DRIFFT 3:	"D2	0.249000	0.000000	0.000000	0.000000
QUAD* 5:	"Q2	0.932000	1.009400	2.540000	23.838000
DRIFFT 3:	"L2	0.249000	0.000000	0.000000	0.000000
QUAD* 5:	"Q3	0.932000	1.009400	2.540000	23.838000
DRIFFT 3:	"L3	0.435000	0.000000	0.000000	0.000000
QUAD* 5:	"Q4	1.321000	-0.835000	2.540000	-21.672000
DRIFFT 3:	"L4	0.253000	-0.835000	2.540000	-21.672000
QUAD* 5:	"Q5	1.321000	0.000000	0.000000	0.000000
DRIFFT 3:	"L5	5.480000	0.000000	0.000000	0.000000
ROTAT 2:		0.600000	0.000000	0.000000	0.000000
BEND* 4:	"D1	1.981000	9.883000	0.000000	1.179000
ROTAT 2:		0.600000	0.000000	0.000000	0.000000
DRIFFT 3:		0.508000	0.000000	0.000000	0.000000
ROTAT 2:		0.600000	0.000000	0.000000	0.000000
BEND* 4:	"D2	1.981000	9.883000	0.000000	1.179000
ROTAT 2:		0.600000	0.000000	0.000000	0.000000
DRIFFT 3:		2.350000	0.000000	0.000000	0.000000
BEND* 4:	"D3	1.981000	0.000000	0.000000	0.000000
DRIFFT 3:		11.960000	0.000000	0.000000	0.000000
BEND* 4:	"D4	1.070000	0.000000	0.000000	0.000000
DRIFFT 3:		0.500000	0.000000	0.000000	0.000000
QUAD* 5: 0 1	"Q6	1.000000	6.825000	2.540000	3.709000
DRIFFT 3:		0.910000	0.000000	0.000000	0.000000
QUAD* 5: 0 1	"Q7	1.000000	-7.855000	2.540000	-2.913000
DRIFFT 3:		8.430000	0.000000	0.000000	0.000000
FIT 10:		1.00010	0.10000	0.01000	0.11500
FIT 10:		3.00030	0.10000	0.01000	0.10390
0:		0.00000	0.00000	0.00000	0.00000

Parameter	Value	Unit
"D1	5.69000	
"Q1	0.93200	
"D2	0.24900	
"Q2	0.93200	
"L2	0.24900	
"Q3	0.93200	
"L3	0.43500	
"Q4	1.32100	
"L4	0.25300	
"Q5	1.32100	
"L5	5.48000	
"D1	1.98100	
"Q1	0.60000	
"D2	0.50800	
"Q2	1.98100	
"D3	1.98100	
"Q3	1.98100	
"D4	1.98100	
"Q4	1.98100	
"Q6	1.98100	
"Q7	1.98100	
"Q8	1.98100	
"Q9	1.98100	
"Q10	1.98100	
"Q11	1.98100	
"Q12	1.98100	
"Q13	1.98100	
"Q14	1.98100	
"Q15	1.98100	
"Q16	1.98100	
"Q17	1.98100	
"Q18	1.98100	
"Q19	1.98100	
"Q20	1.98100	
"Q21	1.98100	
"Q22	1.98100	
"Q23	1.98100	
"Q24	1.98100	
"Q25	1.98100	
"Q26	1.98100	
"Q27	1.98100	
"Q28	1.98100	
"Q29	1.98100	
"Q30	1.98100	
"Q31	1.98100	
"Q32	1.98100	
"Q33	1.98100	
"Q34	1.98100	
"Q35	1.98100	
"Q36	1.98100	
"Q37	1.98100	
"Q38	1.98100	
"Q39	1.98100	
"Q40	1.98100	
"Q41	1.98100	
"Q42	1.98100	
"Q43	1.98100	
"Q44	1.98100	
"Q45	1.98100	
"Q46	1.98100	
"Q47	1.98100	
"Q48	1.98100	
"Q49	1.98100	
"Q50	1.98100	
"Q51	1.98100	
"Q52	1.98100	
"Q53	1.98100	
"Q54	1.98100	
"Q55	1.98100	
"Q56	1.98100	
"Q57	1.98100	
"Q58	1.98100	
"Q59	1.98100	
"Q60	1.98100	
"Q61	1.98100	
"Q62	1.98100	
"Q63	1.98100	
"Q64	1.98100	
"Q65	1.98100	
"Q66	1.98100	
"Q67	1.98100	
"Q68	1.98100	
"Q69	1.98100	
"Q70	1.98100	
"Q71	1.98100	
"Q72	1.98100	
"Q73	1.98100	
"Q74	1.98100	
"Q75	1.98100	
"Q76	1.98100	
"Q77	1.98100	
"Q78	1.98100	
"Q79	1.98100	
"Q80	1.98100	
"Q81	1.98100	
"Q82	1.98100	
"Q83	1.98100	
"Q84	1.98100	
"Q85	1.98100	
"Q86	1.98100	
"Q87	1.98100	
"Q88	1.98100	
"Q89	1.98100	
"Q90	1.98100	
"Q91	1.98100	
"Q92	1.98100	
"Q93	1.98100	
"Q94	1.98100	
"Q95	1.98100	
"Q96	1.98100	
"Q97	1.98100	
"Q98	1.98100	
"Q99	1.98100	
"Q100	1.98100	
"Q101	1.98100	
"Q102	1.98100	
"Q103	1.98100	
"Q104	1.98100	
"Q105	1.98100	
"Q106	1.98100</	

Tune C

"EXP: 766, B5 LINE 5/24/85

DRIFT	3:	"D1	5.690000	0.000000	0.000000	0.000000
QUAD*	5:	"Q1	0.932000	-2.733000	2.540000	-9.326000
DRIFT	3:	"D2	0.249000	0.000000	0.000000	0.000000
QUAD*	5:	"Q2	0.932000	-2.733000	2.540000	-9.326000
DRIFT	3:	"L2	0.249000	0.000000	0.000000	0.000000
QUAD*	5:	"Q3	0.932000	-2.733000	2.540000	-9.326000
DRIFT	3:	"L3	0.435000	0.000000	0.000000	0.000000
QUAD*	5:	"Q4	1.321000	1.884000	2.540000	9.925000
DRIFT	3:	"L4	0.253000	0.000000	0.000000	0.000000
QUAD*	5:	"Q5	1.321000	1.884000	2.540000	9.925000
DRIFT	3:	"L5	5.480000	0.000000	0.000000	0.000000
ROTAT	2:	"D1	0.600000	0.000000	0.000000	0.000000
BEND*	4:	"D1	1.981000	9.883000	0.000000	1.179000
ROTAT	2:	"D2	0.600000	0.000000	0.000000	0.000000
DRIFT	3:	"D3	0.508000	0.000000	0.000000	0.000000
ROTAT	2:	"D2	0.600000	0.000000	0.000000	0.000000
BEND*	4:	"D3	1.981000	9.883000	0.000000	1.179000
ROTAT	2:	"D4	0.600000	0.000000	0.000000	0.000000
DRIFT	3:	"D4	2.350000	0.000000	0.000000	0.000000
BEND*	4:	"D4	1.981000	9.883000	0.000000	1.179000
DRIFT	3:	"Q6	1.070000	0.000000	0.000000	0.000000
BEND*	4:	"Q6	0.500000	0.000000	0.000000	0.000000
QUAD*	5: 0 1	"Q6	1.000000	5.883000	2.540000	4.275000
DRIFT	3:	"Q7	0.910000	0.000000	0.000000	0.000000
QUAD*	5: 0 1	"Q7	1.000000	-7.163000	2.540000	-3.209000
DRIFT	3:		8.430000	0.000000	0.000000	0.000000
FIT	10:		1.00010	0.100000	0.010000	0.000000
FIT	10:		3.00030	0.100000	0.010000	0.227000

$\frac{G}{I}$
 $\times 10^{-3}$

16 X 10 TO THE CUBED FT LBS
 10 X 25 CM
 KNUFF & SONS CO.

B5 Q1-3 N8Q52

10 X 10 TO THE CENTIMETER 45 1510
HUFFEL & ESSER CO.

Panby

B5 Q4-5

Multiply by kamps to get gradient

Fig. 6. Gradient, G point, vs I for 8 inch quadrupoles.

Dawby

B5 Q4-5

Fig. 7. Magnet length, L_B , vs I for 8 inch quadrupoles. ($L_B = \Delta L_B + L_{\text{core}}$).

B5Q6/7

N3Q36-1

GAP
3" x 36"
H. x D.

$G\left(\frac{KG}{IN}\right) \times Lb (IN)$
 $I (KA)$
Multiply by kamps to get gradient x length
at a 1" radius.

ABSOLUTE ACCURACY ~2%

B5D1

Danby

Multiply by kamps to get $\int B ds$ in kgauss-inches

Fig. 2. $\int B_s ds$ vs I for 18D72 magnets.

Fig. 3. Magnet length, L_B , vs I for 18D72 magnets.

300-162

$$\begin{aligned}
 (\sin \theta_0 - \sin \theta_1) \times \left[\frac{\text{Bew/c}}{1} \right] &= \frac{(B_{15}) - B_0 [KG-IN]}{313.22} \\
 &= \frac{B_{15} [KG-IN]}{313.22}
 \end{aligned}$$

746.0
742.0
738.0
734.0
730.0
726.0
722.0

$\frac{B_{15}}{I} \left[\frac{KG-IN}{KA} \right]$

1×10^{-3}

B502

30D72

K&E 10 X 10 TO THE CM. 359-14L
KLUFFEL & FISHER CO. NAT'L IN. 1 A

3^u quadrants

(2)

① E7761.201

"EXP. 766, BS LINE 5/24/85

DRI FT	3.	"D1	5.690000	0.000000	0.000000	0.000000
QUAD*	5.	"Q1	0.932000	1.094000	2.540000	0.000000
DRI FT	3.	"D2	0.249000	0.000000	0.000000	23.838000
QUAD*	5.	"Q2	0.932000	1.094000	2.540000	0.000000
DRI FT	3.	"L2	0.249000	0.000000	0.000000	23.838000
QUAD*	5.	"Q3	0.932000	1.094000	2.540000	0.000000
DRI FT	3.	"L3	0.435000	0.000000	0.000000	0.000000
QUAD*	5.	"Q4	1.321000	-1.340000	2.540000	-13.423000
DRI FT	3.	"L4	0.253000	0.000000	0.000000	0.000000
QUAD*	5.	"Q5	1.321000	-1.340000	2.540000	-13.423000
DRI FT	3.	"L5	5.480000	0.000000	0.000000	0.000000
ROTAT	2.	"D1	0.600000	0.000000	0.000000	0.000000
BEND*	2.		1.981000	9.883000	0.000000	1.179000
ROTAT	2.		0.600000	0.000000	0.000000	0.000000
DRI FT	3.		0.508000	0.000000	0.000000	0.000000
ROTAT	2.		0.600000	0.000000	0.000000	0.000000
BEND*	2.	"D2	1.981000	9.883000	0.000000	1.179000
ROTAT	2.		0.600000	0.000000	0.000000	0.000000
DRI FT	3.	"D3	2.350000	0.000000	0.000000	0.000000
BEND*	3.		1.981000	0.000000	0.000000	0.000000
DRI FT	3.	"D4	1.960000	0.000000	0.000000	0.000000
BEND*	4.		1.070000	0.000000	0.000000	0.000000
DRI FT	3.		0.500000	0.000000	0.000000	0.000000
QUAD*	5.	"Q6	1.000000	6.817000	2.540000	3.714000
DRI FT	3.		0.910000	0.000000	0.000000	0.000000
QUAD*	5.	"Q7	1.000000	-7.630000	2.540000	-3.003000
DRI FT	3.		8.430000	0.000000	0.000000	0.000000
FIT	10.		1.000100	0.100000	0.010000	0.100300
FIT	10.		3.000300	0.100000	0.010000	0.106300

RUN PLTR

ENTER UP TO 55 CHARACTERS OF DESCRIPTION:

2

3" 2x4s
11x

(3)

DE 762.71

→ : requested sizes

.TECO FOR05.DAT4HARACTERS OF DESCRIPTION:

L2K Core1
*S04#0LT#
5.0 1.321 -1.395 2.54 'Q4' ;
*FS1.395#2.101#EX#
CPU TIME: 4.36 ELAPSED TIME: 6.63
TY FOR05.DAT
EXP. 766, BS LINE 5/24/85
ORUN PLTR
1. .13 1. .13 2. 0. .3 28.5 ;
16. .3 1836.15 ;
3.0 5.69 'D1' *CTERS OF DESCRIPTION:
5.0 .932 2.489 2.54 'Q1' ;
3.0 .249 'D2' *
5.0 .932 2.489 2.54 'Q2' ;
3.0 .249 'L2' *

DRIFF 3. "D1 5.690000 0.000000 0.000000 0.000000
 QUAD* 5. "Q1 0.932000 2.489000 2.540000 10.566000
 DRIFF 3. "D2 0.249000 0.000000 0.000000 0.000000
 QUAD* 5. "Q2 0.932000 2.489000 2.540000 10.566000
 DRIFF 3. "L2 0.249000 0.000000 0.000000 0.000000
 QUAD* 5. "Q3 0.932000 2.489000 2.540000 10.566000
 DRIFF 3. "L3 0.435000 0.000000 0.000000 0.000000
 QUAD* 5. "Q4 1.321000 -2.101000 2.540000 -8.483000
 DRIFF 3. "L4 0.253000 0.000000 0.000000 0.000000
 QUAD* 5. "Q5 1.321000 -2.549000 2.540000 -6.955000
 DRIFF 3. "L5 5.480000 0.000000 0.000000 0.000000
 ROTAT 2. "D1 0.600000 9.883000 0.000000 0.000000
 BEND* 4. 1.981000 0.000000 0.000000 1.179000
 ROTAT 2. 0.600000 0.000000 0.000000 0.000000
 DRIFF 3. 0.508000 0.000000 0.000000 0.000000
 ROTAT 2. 0.600000 0.000000 0.000000 0.000000
 BEND* 4. 1.981000 9.883000 0.000000 1.179000
 ROTAT 2. 0.600000 0.000000 0.000000 0.000000
 DRIFF 3. 2.350000 0.000000 0.000000 0.000000
 BEND* 4. 1.981000 0.000000 0.000000 0.000000
 DRIFF 3. 11.960000 0.000000 0.000000 0.000000
 BEND* 4. 1.070000 0.000000 0.000000 0.000000
 DRIFF 3. 0.500000 0.000000 0.000000 0.000000
 QUAD* 5. 0 1 "Q6 1.000000 7.215000 2.540000 3.519000
 DRIFF 3. 0.910000 0.000000 0.000000 0.000000
 QUAD* 5. 0 1 "Q7 1.000000 -8.819000 2.540000 -2.578000
 DRIFF 3. 8.430000 0.000000 0.000000 0.000000
 FIT 10. 1.000100 0.100000 0.010000 0.150800
 FIT 10. 3.000300 0.100000 0.010000 0.127000
 FIT 0. 0.000000 0.000000 0.000000 0.000000

5.01 1.0 6. 2.54 'Q6' ;
 .^C\$\$\$

. TECO FOR05.DAT4HARACTERS OF DESCRIPTION:

LEK Core1
 *SQ4\$0LT\$#
 5.0 1.321 -1.395 2.54 'Q4' ;
 *FS1.395\$2.101\$EX\$#
 CPU TIME: 4.36 ELAPSED TIME: 6.63
 .TY FOR05.DAT
 .EXP. 766, BS LINE 5/24/85
 ORUN PLTR
 1. 13 1. 13 2. 0. .3 28.5 ;
 16. 3. 1836.15 ;
 3.0 5.69 'D1' *CTERS OF DESCRIPTION:
 5.0 .932 2.489 2.54 'Q1' ;
 3.0 .249 'D2' *
 5.0 .932 2.489 2.54 'Q2' ;
 3.0 .249 'L2' *
 5.0 .932 2.489 2.54 'Q3' ;

④
F7763.20

*S884\$I \$0TT\$
 5.0 1.321 1.884 2.54 'Q4' ;
 *S10. \$0LT\$
 10. 1. 1. 2. .1 ;ARACTERS OF DESCRIPTION:
 *4K\$EX\$

Q1-3 } reversed polarity
 Q4.5 }

.RUN TT\TRANS125,64

STOP

END OF EXECUTION
 CPU TIME: 3.88 ELAPSED TIME: 12.13
 EXIT

.RUN PLTR

ENTER UP TO 55 CHARACTERS OF DESCRIPTION:

"EXP: 766, BS LINE 5/24/85

DRIFT	3.	"D1	5.690000	0.000000	0.000000
QUAD*	5.	"Q1	0.932000	-2.733000	-9.326000
DRIFT	3.	"D2	0.249000	0.000000	0.000000
QUAD*	5.	"Q2	0.932000	-2.733000	-9.326000
DRIFT	3.	"L2	0.249000	0.000000	0.000000
QUAD*	5.	"Q3	0.932000	-2.733000	-9.326000
DRIFT	3.	"L3	0.435000	0.000000	0.000000
QUAD*	5.	"Q4	1.321000	1.884000	9.925000
DRIFT	3.	"L4	0.253000	0.000000	0.000000
QUAD*	5.	"Q5	1.321000	1.884000	9.925000
DRIFT	3.	"L5	5.480000	0.000000	0.000000
ROTAT	2.	"D1	0.600000	0.000000	0.000000
BEND*	4.		1.981000	9.883000	1.179000
ROTAT	2.		0.600000	0.000000	0.000000
DRIFT	3.		0.508000	0.000000	0.000000
ROTAT	2.	"D2	0.600000	0.000000	0.000000
BEND*	4.		1.981000	9.883000	1.179000
ROTAT	2.		0.600000	0.000000	0.000000
DRIFT	3.	"D3	2.350000	0.000000	0.000000
BEND*	4.		1.981000	0.000000	0.000000
DRIFT	3.	"D4	11.960000	0.000000	0.000000
BEND*	4.		1.070000	0.000000	0.000000
DRIFT	3.	"Q6	0.500000	0.000000	0.000000
QUAD*	5.	"Q6	1.000000	5.883000	4.275000
DRIFT	3.	"Q7	0.910000	-7.163000	0.000000
QUAD*	5.		1.000000	-7.163000	-3.209000
DRIFT	3.		8.430000	0.000000	0.000000
FIT	10.		1.000100	0.100000	0.000000
FIT	10.		3.000300	0.100000	0.227000

*S884\$I \$0TT\$

5.0 1.321 1.884 2.54 'Q4' ;

*S10. \$0LT\$

10. 1. 1. 2. .1 ;RACTERS OF DESCRIPTION:

**4K\$EX\$

.RUN TT\TRANS125,64

STOP

END OF EXECUTION

CPU TIME: 3.88 ELAPSED TIME: 12.13

EXIT

.RUN PLTR

ENTER UP TO 55 CHARACTERS OF DESCRIPTION:

4