AA INJECTION AND EJECTION BEAM LINES

T. Sherwood

Contents

- 1. Text
- Appendix I. Non standard TRANSPORT elements and correspondence between BEATCH and TRANSPORT beam parameters
- 3. Data lists
- 4. Beam envelope graphs
- 5. Momentum vector graphs
- 6. List of magnet elements parameters and operating requirements

Introduction

This note gives a summary of the beam optics calculated for the AA beam lines. A non-standard version of TRANSPORT has been used, but users of the standard CERN version should be able to follow the appended data lists. Appendix I explains the relevant differences as well as giving some correspondences between TRANSPORT and BEATCH data conventions. Data files are stored on the permanent data file base for the CDC-MFB computer under the names AADn, ID = PS 321 TRS.

Names of beam line magnets follow the system described in PS/AA/Mem.79-41 (Blechschmidt, Sherwood, 28.3.79) and differ from those used in previous (informal) notes.

Lists of beam elements are given showing beam size and required currents against apertures and maximum nominal current available. The geometrical layout is given in PS/ML/BS/nc, (Mayoud, Szeless, 25.5.79).

When reading the geometry and beam optic lists, the following points should be noted:

- Distances are given along the beam axis, whether sloping or horizontal.
- Magnetic lengths are usually used, but in any case, the centre of the element and the integral of the field or gradient are always well defined.
- 3. The length of a bending magnet is defined as the arc length of the central trajectory (TRANSPORT convention). For a rectangular magnet block, of length L, oriented symmetrically to the incoming and outgoing beams and which gives a deflection angle 0, we have the related lengths:
 - a) arc-length, s, where

 $s = L\theta/(2 \sin \frac{\theta}{2})$

and L', the distance from entry (or exit) to the intersection point of the entering and exiting beams where

$$L' = (L/2) \sec \frac{\theta}{2}$$

Usually s, 2L' and L are only slightly different.

4. Tilt angles are defined in the geometry memo. In TRANSPORT a a tilted magnet is treated by rotating the beam reference axis about the beam longitudinal direction so as to align it with the magnet element system. The angle is introduced via a TRANSPORT type 20 element. When the incoming beam X axis is horizontal, tilt and rotation angles are identical. Since beam envelopes are given in the beam reference system, the presence of tilted magnets introduces the discontinuities seen in the graphs. A vertical bending magnet is treated as a tilted magnet with tilt angle 90°.

The injection line is treated in two parts:

- a) From the PS to the antiproton production target and
- b) From the target to the end of the injection/ejection straight section.

The ejection line is taken from the start of the ejection straight section to a point just beyond the crossing with TT2.

The interpretation of the accompanying beam envelope and momentum vector graphs differ in these three sections.

Injection line PS to target

A small beam waist is required at the target for 26 GeV/c incident protons. The lower limit to beam size (apart from power density in the target itself) is given by the emittance and momentum spread of the PS beam as well as the apertures in the final vertical bending magnet and pulsed quadrupoles. The momentum vector ($^{\alpha}p,^{\alpha}p'$) should be zero at the target in both transverse planes, ($^{\alpha}p'$ does not affect beam size at the target but does use aperture in the upstream magnets). Such solutions were not found, in particular the condition ($^{\alpha}'p$)v was not possible and allowance had to be made for this.

The aperture required to pass this fraction of the beam is then

$$A = 2 \left[w^2 + \left(\frac{\Delta p}{p} \alpha p \right)^2 \right]^{\frac{1}{2}} + 2 \frac{d p}{p} \alpha p$$

where w is the half-width of one component. Values of $A_{\rm H}$, $A_{\rm V}$ are given in the table comparing required aperture with that available. No special allowance has been made for steering errors or poor magnetic field quality regions. In the calculations the starting point has been taken as magnet QD102. The beam parameters at this point were obtained from a BEATCH run for normal operation of TT2 when the beam is going to the ISR.

Injection line - Target to AA ring

The antiproton beam is matched to the AA ring using the lattice parameters given in the 7th edition of the parameter list (Jan. 1979) using an acceptance of 100π mm.mR., a momentum spread of $\pm 0.75\%$. The septum magnets and the small effect of the kicker on the momentum vector are included.

It is assumed that the antiproton beam is a waist of radius 22 mm at the exit of the magnetic horn. The beam envelope is for $\frac{dp}{p} = 0$ and the required apertures are given by:

$$A = 2(w + \frac{dp}{p} \alpha p)$$

Even to get $(\alpha p, \alpha p')_H = 0$ requires changing two quadrupoles, QF 107, in the TT2 line to run at currents a little higher than for normal ISR operation.

Solutions are given for the following beam sizes at the centre of the target:

horizontal 1.4 mm, vertical 1.5 mm
 " 2.0 mm, " 2.0 mm
 " 3.0 mm, " 3.0 mm

Two solutions are given for case 3). Beam envelopes are for zero momentum spread.

PS beam assumptions

The characteristics of the PS beam have been given in PS/DL/Note.78-7 (P. Lefèvre). If the beam is combined into five bunches at 26 GeV/c, we can consider it as a double beam, each component matched to the PS lattice but separated by a distance:

$$\delta x = {}^{\alpha} p \; \frac{dp}{p}$$

Each component is expected to have an emittance of 2π mm.mR and a momentum spread $\frac{\Delta p}{p} = \pm 10^{-3}$ (contains 95% of the beam) but separated in momentum by $\frac{dp}{p} = \pm 2.10^{-3}$.

The envelopes calculated are for a component emittance 2.46 mm mR giving nearer to $97\frac{1}{2}\%$ of the beam (assuming a Gaussian model).

Ejection Line - AA ring to junction with TTL2

The hande-over point is at the end of EJ 2575(D8 is the TTL2 name). This is the second quadrupole magnet after the ejection line crosses TT2. At this point the matching conditions requested are:

 $(\alpha_p)_H = 0$, $(\alpha_p')_H = 0$ $(\alpha_p)_V = -0.508$, $(\alpha_p')_V = -0.0135$ $L_H = 10$ mn, $L_V = 75$ m $S_H = 0$, $S_V = 0$

The ejected beam is matched to the AA lattice with an initial horizontal momentum vector (-0.0745 m, 0.0039 rad) due to the ejection kicker. The emittances used are 1.4π mn mR for the horizonzal and $1.\pi$ mm mR for the vertical Beam envelopes are for $\frac{dp}{D} = 0$. Required apertures are given by:

A = 2
$$\left[(w^2 + (\frac{dp}{p} = \alpha p)^2 \right]^{\frac{1}{2}}$$
.

using a value of $\frac{dp}{p} = 3 \times 10^{-4}$

The effect of momentum spread on aperture requirement is small for the above values.

APPENDIX I

Non-Standard TRANSPORT

The beam optic calculations were made using a non-standard version of TRANSPORT. The attached data lists are for this version. They differ from that required for the CERN version of TRANSPORT (CERN 73-16) in format and the presence of both non-standard element types and modified standard types. These differences are noted below. The purpose of these notes is to enable a person familiar with the standard version of TRANSPORT to be able to construct a standard data list.

1. Format. The data is given in a fixed format (1X, AlO, 7F 10.5). The first word is any lable (or blank). The rest of the words on each line conform to the data requirement for the element type (word 2).

2. No indicator word is used.

3. Beam momentum (4th word) is entered via the type 16. element, not with a type 1 element.

4. The initial beam description is entered by the combination of the special type 24 emittance element and the modified type 1 element. The type 24 element gives three independent emittances for the horizontal, vertical and longitudinal planes in that order. The following type 1 element gives (in TRANSPORT notation)

$$\sigma_{11}^{\frac{1}{2}}, r_{12}, \sigma_{33}^{\frac{1}{2}}, r_{34}, \sigma_{55}^{\frac{1}{2}}, r_{56}$$

5. The special type 22 element is used to obtain plots of beam envelopes.

Relations between some BEATCH and TRANSPORT parameters

1. Quadrupole strengths. TRANSPORT expect two parameters (words 4 and 5) viz field and a radius.

The fields are given in KG and an arbitary radius of 1 cm is used. Consequently word 4 can be interpreted as gradient, G, in KG/am. BEATCH requires the parameter $K(m^{-2})$. G and K are related by

$$K = - \frac{G}{(B_{\rho})}$$

where G is in T/m , $B_{\rm P}$ is in T.m

In TRANSPORT G is positive for a horizontally focussing magnet.

2. Bending magnet lengths. BEATCH uses the straight length of a straight magnet while TRANSPORT uses the arc length of the reference trajectory.

3. BEATCH uses the parameters L, S. TRANSPORT uses the sigma matrix
Horizontal beam size ,
$$\sigma_{11}^{\frac{1}{2}} = \left[(\epsilon/L_H) (S_H^2 + L_H^2) \right]^{\frac{1}{2}}$$

" divergence , $\sigma_{22}^{\frac{1}{2}} = (\epsilon/L_H)^{\frac{1}{2}}$

Distance to beam waist is $r_{12} \cdot (\sigma_{11} / \sigma_{22})^{\frac{1}{2}} = S_{H}$

giving
$$r_{12} = S_H / (L^2 + S^2)^{\frac{1}{2}}$$

 ε is the emittance (ellipe area / $\pi)$

ERRATUM

Please note that all magnetic elements in the ejection line should have names of the form xyz 25 nn <u>NOT</u> xyz 24 nn as in the data lists and diagrams.

DIOHNFILE	START 20102, APH=0 /	FTER BTI11	. SMALL SPO	DT ON TARGET	22/05/79	17.47.
EMIT	24.00000 246000	245000	.000100	0.000000		
PLOT	22.000000 400000	0.0000002	00.0000000	0.000000 1	.000000	0.000000
ALPHAIN	14.00000 1.00000	2.000000		1 EC 170		
ALPHAPIN	14 00000 2 00000	0.00000	· • • • • • • • • •	1,30470		
P0.000000	3.000000 0.00000	-0-00000	0.00000	-1_/1000		
D4	3.000000 700000	300300	1.000000			
EDGIO	2.000000 050500	and a second	ng n			
EDGIO	2. 000000 2. 200030	6.953090	0.000000			
05	20.000000 90.000000		n en altra anti-anti-anti-anti- anti-anti-anti-anti-anti-anti-anti-anti-			
0F103 05	5.000000 1.200000 3.000000 2.371000	.872132	1.000000			
EDGE11 HB102	2.000000 378000	6.188080	0.000000			
	2.000000 378000 3.000000 8.094900					
DB104	5.000000 1.200000 3.000000 8.515000	687576	1.000000			
QF105 D9	5 010000 1 200000 3 000000 700000	.779320	1.000000			
EDG12	2.000000 = 244000 4.000000 = 1.400000	-5.286640	0,000000			
EDG12 D10	2 000060 244000					
ZRDT2 EDG13	20.000000 90.000000					
VB102 E0G13	4.000000 2.200030	6.953090	0.00000			
ZROTZ	20.00000-90.000000					
00106	5.000000 1.200000	745900	1.000000			
	5.010000 1.200000	.784521	1.000000			
00208	5.000000 320000	-1.019570	1.000000			
DF209	-5.000000 -500000	1.005040	1.000000			
00210	5.000000 .800000	-1.021560	1.000000			
QF211	-5.000000 - 800000	1.006040	1.000000			
00212	3.000000 8.430000 5.000000 .600900	-1.021560	1.000000			
018 0F213	3.000000 8.430000 5.000000 \$600000	1.006040	1.000000			
D19 D214	3.000000 8.420000 5.000000 820000	-1.019570	1.000000			
020 95215	3.000000 8.420000 -5.000000 800000	1.006040	1.000000			
D21 TLT1	3.000000 590000 20.000000 14.085500					
E05000 BTI00	2.000000 1.150000	13.952518	0.000000			
ED6000 D22	2-000000-1-150000					
EDGON1 BTI01	2.000000 1.150000	13,952518	0.000000			
EDGOR1 TLBT1	2.000000 1.150000					
023 01N05	3 000000 3 229000	=1.114765	1 000000			
D24 TLT2	3 000000 1 019000					
ÉÖĠÖ10 81110	2.006000 1.037000	16 024625	0 000000			
EDG010	2.000000 1.037000	10.024025	0.00000			
EDG011	2.000000 1.037000	16 024625	0 00000			
Eggoil	2.000000 1.037000	10.024025	a.000000			
ÇÜND10	10.000000-21.000000 20.000000-21.000000	6.000000	0.00000	.001000		
026 026	10.00000-22.000000 	6.000000	0.000000	.001000		
QIN15 D27	5.010000 800000 3.000000 6.906100	1.226398	1.000000			
GIN30 D28	5.010000 21.200000	-1.616533	1.000000			
QIN35 D29	5.010000 - 300000 3.000000 - 902840	030079	1.000000			
ZRÚT	20 000000 90 000000					
BVI40 FDGV01	4.000000 1.960100	10.402290	0.000000			
ZROTR	20.000000-00.000000					
01450 031	5.000000 1.060000	3.122869	1.000000			
01N52	5.010000 1.060000	-5.158794	1.000000			
0Ĭĥ55	5.020000 450000	4.165266	1.000000			
01156	5.020000 450000	4.165266	1.000000			
č olioj		1.000000	• 07 9000	.001000		
C01.02	10.000000 2.000000	1.000000	0.000000	601000		
C01013	10.000000 4.000000 10.000000023.000000	5.000000 6.000000	0.000000 0.000000	.001000		
SENTINEL.						

.

LIST 1 Data list AAD10. Injection line from TT2 to target. Beam diameter on target 1.5 mm

DIIMMFILE	START 30102. APH=0 A	FTER BTI11	. 2MM SPOT	UN TARGET 22/05/79	17.47.
		26.000000	_000100	0.00000	
BEAH BLOT	1 000000 5 94620	728385			0.000000
INTRO	0000000 0 000000	2.000000		0.000000 11.00000	
ALPHAIN 1.00000	14_00000 1_00000 0_00000 0_00000	0.00000	0.00000	1,56470	
ALFHAPIN 0.00000	1400000 200000	0.00000	0,00000	-1-71600	
D0	3.000000 0.000000	- 086960	1 000000		
D4	3.000000 .700000		1.000000		
EDGIO	2,000000 .050500	· .			
VB101 EDG10	4,000000 2,200030	6.953090	0.000000		
ŽŽOTI	20.000000 90.00000				
QF103	2.000000 1.200000	.872132	1.000000		
D5 EDGE11	3.000000 2.371000 ~~2.000000 _378000				
HB102	4.000000 1.850000	6.188080	0.000000		
b7	3.000000 8.094900				
	3.000000 8.515000	00/0/0	1.000000		
QF105	5.010000 1.200000	.780143	1.000000		
ÉPG12	2.000000 - 244000	-5 286640	0 00000		
EDGIZ	2.000000 - 244000	-3.200040			
23012	50.000000 1.223000 3.0000000 1.223000				
EDG13 VB102	2.000000 _050500 4.000000 2.200030	6.953090	0.000000		
	2.0000000 .050500		•••••		
011	3.000000 1.966000	745040			
012	3.000000 7.966000	745900	1.000000		
QF107 D13		.784202	1.000000		
00208	5.00000 820000	-1.019570	1.000000		
0F209	5.000000 .300000	1.006040	1.000000		
015 07210	5.000000 8.430000 5.000000 860000	-1.021560	1.000000		
D16 0F211	3.000000 8.430000 5.000000 .800000	1.006040	1.000000		
D17	3.000000 8.430000	-1 021560	1 006000		
018	3.000000 8.430000	-1.021500	1.000000		
D19	3.000000 8.420000	1.005040	1.000000		
00214 D20	5.000000 8.420000 3.000000 8.420000	-1.019570	1.000000		
0F215	5.00000 590000 3.000000 590000	1.005040	1.000000		
TLT1	20.00000-14.085600	•			
BILOO	~ 4.000000 2.500200	13.952516	0.000000		
025 FULLOO	3.000000 750000				
E00001 87101	2.000000 1.150000 ***4.000000 2.500200	13.952518	0.000000		
EDCOO1	2.000000 1.150000				
D23	3.000000 3.229000	1 101001	1 00000		
D24	3.000000 1.019000	-1.101001	-1-00000		
EDG010	2.000000-14.041900	• *			
- BTI10 FDG010	-4.000000 - 1.960100	16.024625	0.000000		
D25	3.000000 033000				
61111	4.000000 1.960100	10.024625	0.00000		
E00011 TILIBL	Jorgogeon 13 47486			,	
C34010	10.000000-21.000000	00000000000000000000000000000000000000	0.00000.0	.001000	
020	3.000000 11.170840	1 016346	1.000000		
D27	3.000000 6.900100	1.215340	1.000000		
01430 026	5.010000 .800000 3.000000 21.200000	-1.531/06	1.000000		
01N35	5.616000 -800000 3.000060 -902840	.699012	1.000000		
ŽŘÚT	20.000000 90.000000	•			
BVI40	4.000000 1.960100	10.402290	0.00000		
ZRUTE	20.00000 -90.00000				
030 0150	3.068	2.096061	1.000000		
031	3.000000 547500	-4.800000	1.000000		
032	3.000000 1.250000	A 886109	1 000000		
033	3.000000 .150000	M.000136			
011656 034	5.020000 1.760000 3.000000 1.760000	4.680198	1.000000		
COND1 COND3	10.000000 1.000000	1.0000000	100000 166000	.UO1000 .GOU100	
ČAND?	16.000060 2.000000	1.0000000	0.000000	001000	
ζ21.013	10.000000-23.000000	6.000000	0.000000	. 301000	
SENTINEL					

LIST 2 Data list AAD11. Injection line from TT2 to target. Beam diameter 2 mm on target.

DIZMNFILE	START SDIDZ. APHEU	AFTEP STILL SHM-E	3 SFOT ON TARGET 22/05/79 17.47.
EMIT	24.000000 -240000 1.000000 -594620	246000 000 246000 000 228385 772	
PLOT	22.000000 40000		
ALPHAIN 1.00000		0.00000 0.00	Microsoft and some single state strategies and where are added to be with the strategies of the str
ALPHAPIN 0.00000	14 00000 2 00000 1.00000 0 0.00000	0.00000 0.00	
00102	3 000000 0 0 00000 5 000000 1 20000	-986960 1.000	n mining and the sufficient and an and an and an and an and and and
ZROT1	3.000000 .700000	ېچې، د د مېرېدو به هم به چې رو وموم د د و د چې د د و د مېرېدو به هم به چې رو وموم د د و د	
E0G10 V8101	2.000000 .050500 4.000000 2.200030	6.953090 0.000	en e
23011	2.000000 .050500 20.000000 90.000000	م الم الم الم الم الم الم الم الم الم ال	
QF103	5.000000 2.316000	.872132 1.000	
EDGE11	-2.000000 -378000	6 480000 0 000	
EgGII	2.000000 1.00000 3.000000 378000	0.102020 0.000	A model of the second s
20104		687576 1.000	
05105		.773379 1.000	
ÉDG12 H8103	-2.000000 = 244000	-5-286640 0.000	
EDG12 -	2.000000 .244000		
ZROT2	20.000000 90.00000	ارد به در و چرو دومیتر مرد کالار اماده استان میشود.	na na na na na na na manana ana ana ana
V8102 E0G13	4.000000 2.200030	6.953090 0.000	000 Construction of the second s
ZRUT2	20 00000 - 90 000000 3 000000 - 1 960000	n na angela angela kanalisi Na angela kanalisi kanalisi kanalisi kanalisi kanalisi kanalisi kanalisi kanalisi k	на практи и управляют по служите на напазите с учана в селена и селена и прогода стоја с на селена селена на се Осност на царити селена селена и селена и селена и селена си селена на селена практи и селена на селена селена н
00106 012	5.000000 1.200000 3.000000 7.966000	745900 1.000	
GF107	-5.010000 1.200000 -3.000000 13.680000	.786792 1.000	
07208 014	5.000000 1820000 3.000000 7.940000	-1.019570 1.000	000 est avec and online est of the statement of the state
015 CT	-5.000000 .800000 -3.000000 .8.430000	1.005040 1.000	
09210 D16	5.006000 .800000 3.000000 8.430000	-1.021560 1.000	
017	5.000000 6.00000 5.000000 8.430000	1.005040 1.000	
D18	3.000000 8.430000 3.000000 8.430000	=1.021560 1.000	
D19	-3.000000 8.420000	1.006040 1.000	
0214	5.000000 8.420000 3.000000 8.420000		
021	3.000000 590000	1.005040 1.000	
EDGORO	2.000000 1.150000	17 050519 0 000	needen en miljine in een en e
E20000	-2.000000 -2.000000 3.000000 -2.000000 -2.000000 -2.000000 -2.0000000	12.425210 0.000	
ĚDČ001	2.000000 1.150000	13 952518 0 000	n an
EDGO01	2.000000 1.150000		The construction of the second sec The construction of the second seco
023 01N05	3.000000 3.229000 5.010000 800000) =1.214061 1.00	an a
D24 TLT2	3.000000 1.019000		an a
EDC010 BIII0	2. 000000 1. 037000 4. 000000 1. 960100) 16.024625 0.000	a service service and the service of the
EDG010 025	2.000000 1.03700 3.000000 633000)	and a stand of the second s I want the second sec
EDG011 BTI11		0 16.024625 0.000	
IIITEL	2.000000 1.037000	р 	
CONDIG CONDII	10.00000-21.00000	0 0.000000 0.0000000000000000000000000	000 .001000
D26 01H15	- 3.000000 11.170840 - 5.010000 80000		
D27 QIN30	3.000000 6.900100 5.010000 80000	0 -1.452392 1.000	000
D28 D1135	3.000000 21.20000 5.010000 .80000	1.091484 1.000	
ZRUT -	3.000000 90.00000		The second se
6YT40	2.000000 1.052000 4.000000 1.960100) 16.402290 0.000	n na senta la matricessa zona de la subsenza deun deba da subsenza la subsenza da 000
ZRUTB	20.00000-90.000000) to strategy of the off	د. به موسیق کار در در این است. محمد این این این این در این در میرو بازی در میرو این در در این این در میرو این این
01.50	- 5.000000 1.060000	0.812070 1.000	on a service second
01152	5.010000 1.060000	-4.050000 1.0000	00
01N55		4.880198 1.000	000
QIN56 D34		4.880198 1.000	د. این این موجود می محمد این می مصرفین مربق و درخت بر مربق می می این این این این این این این این این ای
COND1 COND3		1-000000 .150	000 •001000
COND2 COND2			
CONDIS SENTINEL	10.000000-23.000000	6.000000 0.000	000 .001000

LIST 3 Data list AAD12. Injection line from TT2 to target. Beam diameter on target 3 mm. Solution 1.

•

D3HNFILE START 00102. APH=0	AFTER BTILL 3MH SPOT	ON TARGET 22/05/79	17.47.52.
EMIT 24.000000 10.0000 EMIT 24.000000 2460		0.00000	nen en fan de fan de fan de fan en
BEAM 1.000000 5946 PLOT 22.000000 4000	20 -7723385 7772111 00 0.000000200.000000		0 0.000000 The state state of a
INTR: 6.000000 0.0000	2.000000	المراجع المراجع المحاطة المراجع	-
1 00000 0 00000 0 000	ŭõ o,oonoo o,nonoo	1,56470	and the state of the state of the state
	00 0 .000 00 - 0.0000 0	-1.71600	
00 3.000000 0.0000 00102 5.000000 1.2000	00)	• An and a first and a second of the first second states of the first second s second second se second second s
D4 3.00000 7000	00		
E0G10 2.000000 0505	00		
EDG10 4.000000 2.2000 EDG10 2.000000 .0505	ου 20 0 °323030 0°0 00000	1 : . <u>† 12</u>	
ZRUT1~ 20.000000 90.0000 D5	V 0 0 0	ور رهبه بر البلغان و الترفيق من الرواني و معارد الم	
0F103 5.000000 1.2000 .06 3.000000 2.3710	00 .872132 1.00000		
EDGE11 2.000000 3780			anne an a chaine ann an 1970 ann an tharaichte ann an thar ann an tharaichte ann an tharaichte ann an tharaicht An 1986 ann an 1977 ann an tharaichte ann an tharaichte ann an tharaichte ann an tharaichte ann ann ann an thar
E9G11 2.000000 .3750			
. 00104	çü - 687576 1.000000		
QF105 5.016000 1.2060	60 60 .848603 1.000000)	
D9 3.000000 .7000 EDG12 2.000000 -2440	00 00	n an sin synan ar yn yn yn yn yn yn yn yn gywr i raegy. T	n de la companye de La companye de la comp
HB103 - 4.000000 1.4000 ED612 2.000000 - 2440	00 -5. 286640 0.00000)	n later di en di di bar bala bi banda di la di termendan dan endade a fan di antisa a di. Na
	ŭů	· · · · · · · · · · · · · · · · · · ·	
EQC13 2.000000 0.0000	00		
¥8102 4.000000 2.2000 EDG13 2.000000 .0505	30 5.953090 0.00000 un		
272012		موریمان دی و پیرونان پر میران مانو ارتباط این پر مارومان پر محمد میروند. این این این مارونان میرین از دیدان در این در میرون با این اور این این ا	in the life sector of the sector of the
	00 7 45900 1.00000)	ې د دېږې کې د وې وې د وې د وې د وې د وې د وې د
OF107 5.010000 1.2000	on .752495 1.00000		
00508 2.000000 13.5000	60 =1.019570 1.00000		
014 3.000000 7.9400 GF209 5.000000 8000	00 09 1.006040 1.006000) از مورد و در مورد از معرب مربع و مربع مربع مربع مربع از از از از مورد و مربع مربع مربع مربع مربع مربع مربع مربع	an and the first of the state of the first of the state o
D15 3.000000 8.4300 00210 5.000000 .6000	00 = 1.021560 = 1.000000	n na la constanta e anteres de la constant Alexandre de la constante en la constante	n an tha an an ann an tha an an an ann an tha an tha an tha an tha an
016 3.00000 8.4300 05211 5.000000 5000		· · · · · · · · · · · · · · · · · · ·	
D17 3.00000 8.4300		ى كەلىمە ئىلەر ئىلەر ئەلىرى ئەلىرى ئەلىرى كۈلۈك ئەرىپى ئەلىرى ئەلىرى ئەلىرى ئەلىرى ئەلىرى ئەلىرى ئەلىرى ئەلىرى م	a anna 400 anna 400 anna 1986. Ta tha anna 1980 anna 1980 anna 1987 anna 1987 anna 1987
D16 3.000000 8.4300			 이 가지가 많이 되어 있는 것을 통하게 하는
D19 3.000000 8.4200		ى يوم مەنىيە بەت بىلىر بىلىم مەمىيەردىن ،	ు ప్రాసాధిని కథ విరికించింది. సంగార్థిక ఉప్రారం ఉపారం! పుర్తుల్లో కారి కోరించి ప్రాసాకు తొల్లి ప్రాసా ఉపార్టిత సి. స్. సి. సి. ఈ రెడ్డి సి. సి. సి. సి. సి. సి. సి. సి. సి. సి
02214 5.000000 .5200 D20 3.000000 8.4200	60 -1.019570 1.00000	• •	
0F215 5.000000 58000	0 1.005040 1.00000) A service of the se	
111 20.000000-14.0855		ار. مربق به محمد رواز محرین محریه در از مربق ا مربق به محمد رواز محرین محرور محرور محرور محرور م	د. مراجع المحمد معرف المحمد ال محمد المحمد ا
BII00 4.000000 2.5002	00 13.952518 0.000000	المحادية والمحادثة والمحادية والمحاد	د مسر که گرا، «میشان کانکنانی کاری و در می میکند که خرد زد در میشود. مردوم که بخر که در در مردوک و دخت که در
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0.0		
EDG001 2.000000 1.1500 BJI01	00 00 13.952518 0.000000	n an an ann an ann an an an an an an an	د د موجوع میشوند موجوع در این میشود به در میشود. مربق میشوند موجوع میشوند میشوند به در میشوند میشوند میشوند میشوند میشوند میشوند.
EDG001 2.000000 14.0419	00	e o de las estas de las de las desentes en el estas de las desentes de las desentes de las de las de las de las En compositivos de las desentes de las de	1.5 Surahim menerata penyata <u>di penyang</u> an penyatan penyatan penyatan penyatan penyatan penyatan penyatan di p Penyatan penyatan peny
023 3.000000 3.2290 01805 5.010000 8000		no observatore de la situação de la serva. A la servação de la servação de la servação de la servação de la serv	a na sana ana ana ina sina na sina na ana ang ang ang ang ang ang ang an
D24 3.000000 1.0190			
E90010 2.000000 1.0370			n an in die 1955 abere die 1955 van die 1955 and 1955 aber 1955 aber 1955. Als die eerste die 1955 aber 19 Als die eerste die 1955 aber 19
E_{2}^{0} E_{2	09 10.024625 0.000000	a an ann a' an an ann ann an thairt an t I an thairt ann an thairt an tha	
D25 3.000000	UO	· . ·	and a state of the second state Second state of the second state
BTT1j - 4.000000 1.9601 EDG011 - 2.000000 1.0370	00 15.024625 0.00000 00) en la sub-tradición de la seconda de la	ام، معنى دونغ ومريومة الأفري الريد المراجع الذي الذي ال ا
TITET 20.00000 13 4279		0 001000	
	un	0 001000	
QIN15 5.010000 11.1200	00 .984065 1.00000	°,	
027 - 3_000000 6_9001 QIN30 - 5_010000 _8000	60 60991106 1.00000	0.	الماسي بالمراجرة المحيومة فاحتر
00000 21.2000 028 3.000000 21.2000	00 3.000000 2.00000 00	0 .001000	and share for the standard state of the state
Q1N35 5.010000 3000	00 1.284056 1.0000C	0	
Ç ƏHDS 10.200000 1.0000	00 1.000000 1.40000	.001000	
E26V01 2.000000 40.0000	00 09	-	
BV140 4.000000 1.9601 EPGV01 2.000000 1.0620	00 16.402290 0.00000		na se en en ante aporte de la companya de la companya de la companya. La companya de la com
ŽROTĖ 20.00000-90.0000 D30 3.000000 3.0000	ΰ0 00	•	· · · · ·
01150 - 5000000 1.0600	00 U.000000 1.00000	0	et no te sono de la proprie e estato
Q1N52 5.010000 1.0600	0 -2.97235 1.000000		
QIN55 5.626000 1.2560	0 5.489062 1.00000	0 says may read .	المجرج جيري جرجي الارباط محرج والمراجع
D33 3.000000 1500 Q1456 5.020000 4500	00 5.489062 1.00000	0	· · · · · · · · · · · · · · · · · · ·
D34 3.000000 1.7600 C3601 10.00000 1.0000	00 02 1.000000 .1500m	0 001000	and a second
	0 3 00000 15000		and a state of the state of th
	00 3.000000 0.00000	0 001000	
LURUYS 10.00000-23.0000 SENTINEL	UU D.UUUUUU Q.UUUUU 	• • • • • • • • • • • • • • • • • • •	

LIST 4 Data list AAD3. Injection line from TT2 to target. Beam diameter on target 3 mm. Solution 2.

.

.

DISULI AADI FINAL VERSION	25/4/79 TARGET TO AA	RING 16/05/79 12.21.22.
P 16.000000 16.000000 *EMITT* 24.000000 10.000000 *BEAN* 1.000000 2.200000 *SP_CH* 22.00000 250000 *SI_TT* 0.00000 4.000000	3.575200 10.000000 75.000000 0.000000 2.200000 0.00000000.000000 2.000000	0.000000 0.000000100.000000 0.000000 1.000000 0.000000 1.000000
D 3.000000 2.81000 Q60 5.01000 1.16000 D 3.00000 34000	457392 1.000000	an na shi sa shekara shekara shi na shekara ta shekara shekara shekara shekara shekara shekara shi na sase shin An ana shekara s
Q65 5.010000 1.16000 D 3.000000 459600	.440517 1.000000	
BHZ70 4.000000 2.250000 EG 2.000000 1.140300 EG 2.000000 2.250000	8.213910 0.000000	
Q75 5.010000 2.84900 D 3.00000 1.16000 D 3.00000 84000	234131 1.000000	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$.151600 1.000000	(a) A STATES AND STATES AND
D 3.000000 3.92000 Q90 5.010000 1.10000 D 3.000000 3.42000	203178 1.000000	an an ann an an ann an ann an ann an ann an a
Q95 5.010000 1.16000 D 3.000000 8.05220 EG maximum 2.000000 6.500000	.148980 1.000000	
S4H2A 4.000000 900000 EG 2.00000 -3.549270 D 3.000000 575000	6.820000 0.000000	
EG 2.000000 3.649270 QDW1 4.000000 750000 EG 2.000000 -2.614410 D 3.000000 575000	2.548112334.312000	
EG 2.000000 2.014410 6 2.00000 336000 2.000000 2.014410	5.820000 0.000000	
CONDI 10200000000000000000000000000000000000	1.000000 4.318970 2.000000 4.050810 3.000000 2.816190 4.000000 3.713300	
COND6 10.000000-21.00000 COND6 10.000000-22.00000 SENTINEL	6.000000	

LIST 5 Data list AAD1. Injection line. Target to AA ring

D7SOL1 AA EJECTION	FINAL	14/06/79 08.5	8.16.
P 16.000000 16.000000 EMIT 24.000000 140000 BEAM 1.000000 511027 PLOT 22.000000 500000 INTR2 6.000000 0.00000	3.575200 100000 000010 -826547 251819 0.00000200.000000 2.000000	0.000000 294713100.000000 0.00000 1.000000	00000
INTAP 14.00000 1.00000 1.00000 0.00000 0.00000	0.00000 0.00000	•.07450	alasi ni kara Kanal
INTAPP 14.00000 2.00000 0.00000 1.00000 0.00000	0.00000 0.00000	.03890	n 1977 - Maria Mandra, ang
D0 3.000000 0.00000 D1 3.000000 3.920500 FDC1 2.000000 3.920500			··· ·
SMH1 4 000000 -200000 EDG2 2 000000 -2.736000	-6.824000 0.000000	مې د د د و د استې استان درون په د سېږې کې د وې د و د و د و د و د و د و و و و و و	مىلىيە بىلەت بىلەت يېتىپەت تەرىپى تەرىپەت بىلەت بىلەت بەت بەت بەت بەت
D2 3.00000 575000 EDG3 2.00000 2.736000 QDw1 4.00000 -750000	-2.259410425.200000		an a
D3 3.000000 575000 EDG5 2.00000 3.549000	n san sa		
ŠMH24	-6.824000 0.000000	an an ann an	
QEJ2410 5.010000 2.160000 DEJ2410 5.010000 500000	.831380 1.000000		
QEJ2415 5.010000 500000 D6 3.000000 612900	908389 1.000000		
ŘOTZ1 20.00000−17.559700 EDG7 2.000000 −6.859600 BTT2420 4.000000 1.964700	-14.534070 0.000000		and a state of the
EDG8 2.000000 +6.859600 RJTZ1B 20.000000 17.043200 DZ 3.000000 3.092900			aline and a second s Second second second Second second
0EJ2430 5.01000 50000 08 3.000000 4.090000	.951020 1.000000	n na alakaber dalam dalam dalam dan dari di kalamatika sekarat dalam dalam dalam dan dalam dan dalam dan dalam Terretari dalam dan dari dari dalam dala	alexanendi daeren 44. En 1998 militari eta 1
GEJ2435 5.010000 500000 COND10 0.00000 3.000000 D9 0.00000 5.300000	-686993 $1.0000003.000000$ $.800000$.100000	
DEJ2440 5.010000 5.0000 CONDP 19.200000 1.000000	.836143 1.000000 1.000000 750000	.100000	
$\begin{array}{c} 010 \\ 0212445 \\ 010000 \\ 000000$	985792 1.000000	an a	angeneration and an announced by the second s Second second s
QEJ2450 5.010000 50000 D12 3.000000 635500	1.056610 1.000000	ation and a statement and a statement of the statement of t	
R0TZ2 20.000000-15.316947 EDG9 2.00000 7.580000 BT12455 4.00000 1.964690 EDC1 2.00000 7.580000	16.056152 0.000000	y na akazar na katar katar Katar katar kat Katar katar kat	na zani tari si manani na marina Manani amin'ny tariha amin'ny tariha amin'ny tariha amin'ny tariha amin'ny tariha amin'ny tariha amin'ny tariha Manani amin'ny tariha
$\begin{array}{c} \text{ROTZ2B} & = 22.000000 \\ \text{ROTZB} & = 22.000000 \\ \text{ROTZB} & = 22.000000 \\ \text{ROTZB} & = 25.000000 \\ \text{ROTZB} & = 25.00000 \\ \text{ROTZB} & = 25.0000 \\ \text{ROTZB} & = 25.0000 \\ \text{ROTZB} & = 25.0000 \\ \text{ROTZB} & = 25.00000 \\ \text{ROTZB} & = 25.00000 \\ \text{ROTZB} & = 25.0000 \\ \text{ROTZB} & = 25.00000 \\ \text{ROTZB} & = 25.00000 \\ \text{ROTZB} & = 25.0000 \\ \text{ROTZB}$	n an		
014 5.000000 500000 014 3.000000 1.713000	-1.050000 1.000000	ى ئىڭى (دەك ئىكى بىكى بىكى بىكى ئىكى يەر يېكى ئىكى ئىكى) دەك بىكى بىكى بىكى بىكى بىكى بىكى بىكى بى	de la la dela dela dela dela dela dela d
015 5.010000 5.752200	.660174 1.000000	ම් කිරීම මේ මේ මේ මේ මේ කර්ගන්න කිරීම කරන්නේ මේ කරන්නේ. මේ මේ මේ මේ මේ මේ කර්ගන්න කරන්නේ කරන්නේ මේ මේ මේ මේ මේ මේ මේ මේ ම	lokielisteisetteilen totottas attackiel
QEJ2470 5.010000 500000 D16 3.000000 3.850000	.361335 1.000000		
QEJ2475 5.010000 .500000 CONDI 10.000000-21.000000 CONDI 10.000000-21.000000	■.339440 1.000000 b.000000 0.000000	.001000	ander an en
COND3 10.000000-23.000000 COND3 10.000000-23.000000 COND4 10.00000-24.000000	-6.00000 = 507626		
CDND5 10 COUNCO 1 000000 CDND6 10 000000 2 000000	1.000000 374160 1.000000 0.000000		
COND710.000000 3.00000 COND810.000000 4.000000	3.000000 0.000000 3.000000 0.000000	.001000	
SENTINEL 3.000000 1.000000	دید. ۱۹۰۵ - میلی این این این این این این این این این ای		na se an anna an anna an an an an an an an an

LIST 6 Data list AAD7. Ejection line.







Fig. 2. Beam Envelopes from TT2 to target. Beam diameter on target 2.0 mm l.IST 2. Data set AAD11



Solution 1 Data set ADD12 щ. LIST : Beam Envelopes from TT2 to target. Beam diameter on target 3.0 mm .. т Fig.



Solution 2 Fig. 4. Beam envelopes from TT2 to target. Beam diameter on target 3.0 mm LIST 4. Data set AAD3



Fig. 7. Momentum Vectors dp/p = 0.2% See Fig. 1



Fig. 8. Momentum Vectors dp/p = 0.2% See Fig. 2



Fig. †∮ Momentum &stctors dp/p = 0.2% See Fig. 4









.

Name	Origen	Pole tip Diameter (mm)	Vacuum tube 70	Plane	Reguived Aperature		Required Strengths GrinKc/cm, Kinme	Required Curvent	Available Current
			· · · · · · · · · · · · · · · · · · ·	·····				· · · · · · · · · · · · · · · · · · ·	• • •
agoonito	Q100 PS	300 300	152	Z)	, 77 72	ΥY	- 0.4574 0,3835	ż30.2	430
QIN 00 65	Q 100	20 g	125/	I>	4 4 0 4	- у У	0.4405 0.3694	4.122	430
GTN0075	Q 100 PS	0 0 K	25/	オン	17 5 0 17	υŽ	-0.2341 0.1963	1-	<i>350</i>
Q1N0050	Q 100	0 0 0	152	I >	10 <i>t</i> 1-8	<u>ب</u> ى	0.1516 -0.1271	16.3	
Q7N0055	Q 100 PS	200	, <u>5</u> 2	τ>	142 98	よシ	0.1279	64.4	15 0
ObOONID	9 0 0 0 8	200	1251	I >	(02 14 7	5K	-0.2032 -0.1704	102.3	150
QTN0095	Q 100 PS	0 0 4	. /52	Ξ>	132	よ と	0.1490 -0.1249	0.5t	150

Quadrupole Magnet - Operating Requirements - Injection line Target to AA Ring

Available Current	150	150	150	051	051	051	051	ISO	150	051
Keguirod	80.4	6.48	0.76	85.8	80.9	95 H	102	101.5	63 <i>K</i>	34.9
Required Stienarth 7 in Klifen, Kin me	0, 8314 - 0. 6971	-0.9084 0-7617	0.9570	-0.8870	0.8361	ntzs.o - 0.9868	- 0,8860 -	-1.0500	0.6602 - 0.5536	0.3613
	JY	らと	とと	6 X	5 X	ΥĽ	Υۍ	らべ	জ স	Ċ
Required	é t	- 9 Ñ	જ્ઞ	5.4	, 3 3	98	\$ 4	51	<i>6-</i> 9	ž,
Rune	$\prec \succ$	エン	τ>	ΞŻ	エン	IN	±>	エン	τ>	Ŧ
Vacuum tube 7.D.	5 Z	St	52	St.	SŁ	St	75	75	75	75
Pole tip diameter (mm)	08	8	<i>0</i> 8 	80	80	8.0	80	60	30	20
01 5										

Rea	uived.	ADer	446		Dativitade	-troneths	עש ג' ש	I'm K	0	1 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	(0) ++		Aurilahle
U/ ONE	HADH	AAD 12	A AO		APD 10	A A D II	AAD12	м Сан	APD/0	AADI.	HAD12	RAD3	current
							· · · · ·				• • • •	• • • • •	
		,		ም ት	0.27793 -0.5955-0	9663. 0- 2032. 0	0.7734	0.8486 -0.9786	5 .	182.5	180	198.5	300
				いとい	- theb.o- Stat.o	24842	5. 709 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	0.7525	183.5	183.4	1.4.81	0 9 1 /	300
23	27	2.4	27	5 Z	- 1.11 48	-1.1010	-1.2141	0.0520	250.5	247.4	272.8	t ./	500
4 I 15	41 15	9/ 79	25	にと	1.2264 -1.4143	1.2163 -1.4026	1.2092 -1.3944	0.9841	275.6	275.3	<i>た.1</i> た 7	227.2	500
22 34	23 34	24 34	16 67	U X e	1798.1 5919.1-	-1.5317 1 7663	-1.4524 1.6749	1.90.9911 1920-	3697	9 975	328.1	222.7	500
3 Ct	31.	31	77 77 77 77	5 X	-0.0321	0.6990	1.0915	- 1.4808	6·S	1.721	245.3	288.6	200
38	23	15 29	36	জ হ	3.1229	2.0961 - 2.4172-	0.8121	0.0	1882.9	1331.9	t.287	<i>o</i>	3500
36	15	32	800	チビッ	-5.1588	-4.800	4029.71 0050.7-	1724-2-	3.515.2	3181.9	2500.9	S.obtl	3500
17 23	23	8 16	\$ rt	みどう	4.1653	4.6802	8620.2- 2088.4	5.4841	C. E821	15 12.4	1512.4	1722.3	3 5 0 0
s's	1, 4	2 de 1	\$ 2	ら い で	4.1653	-5-6278-	18812	5.4891	1283.0	1512-4	1512.4 11	1722.3	3500

Available Curront	· · · · · · · · · · · · · · · · · · ·		007	004	430	200	430	12 CE #
Reguired	777 69	99 <i>†</i> †	376	376	007	375	340	376
Till Angle	60. 771	t	14.04	13.99	60.09	00.0	17.56	15.36
Bending Angle	70.77	16.22 :	8.12	36.22	12-12 12-12	<i>ts:</i> 8t	239.44	264.52
AAD7			· · · · · · · · · · · · · · · · · · ·				5	90
A A D1				· · · · ·		6 00		
HAD3	1 18	18/	14 23	16 25	31	- <u>.</u>		
A ADIZ	8	18/	91	7 10	% It-	· · · · ·		
AADII	18	18	16	20 16	2 N 0 N 0 N		· · · ·	
AAD 10	2 %	t 2	16	20 16	5 m	· · · · · · ·	· · · · · · · ·	· .: .
Availulle Agarture	र्षे हैं। इस्ट्रे	1 日 14 10 10 10 10 10 10 10 10 10 10 10 10 10		100 48	48 100	· · ·	· · · ·	
Plane		· -1>	τ >	=>	<۲ <	< ד	- E >	· I >