

THE EFFECT OF NEW LOW ASSEMBLY PRESSURE COLLARS ON IRON SATURATION

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A new collar has been designed for the SSC dipole that reduces assembly pressure to 10 kpsi as well as reduces the out-of-roundness for both stainless and aluminum collars. The main features of the new collar (Fig. 1) are the elimination of the O.D. pole notch and the introduction of a large tapered key along the midplane. Leaving the coil cross-section unchanged, the new collar requires a modification of the iron laminations. We summarize below the effect of such iron modifications on sextupole saturation.

If we subtract the low field sextupole (same as $\mu = \infty$) of a smooth circular I.D. iron from the sextupole computed with the large key collars, the difference is -0.48 units. The effect of saturation on b_2 is plotted in Fig. 2 showing the new collar reduces b_2 by a factor of four compared to the old collar.

Figure 3 is a flux plot at $B_0 = 6.5$ tesla. Note that the collar keys made from 9% nickel steel are ferromagnetic.

The effect of iron saturation on the decapole is negligible and does not exceed 0.1 units up to 7 tesla.

We have revised the coil cross-section, calling it - NC9 - (Fig. 4, Table I). This cross-section incorporates all of the latest revisions in dimension including the low assembly prestress. As a result, we now believe that the sextupole will reach a value of ~ 1 unit with no sextupole offset built into the wedges.

Effect of iron saturation on b_2

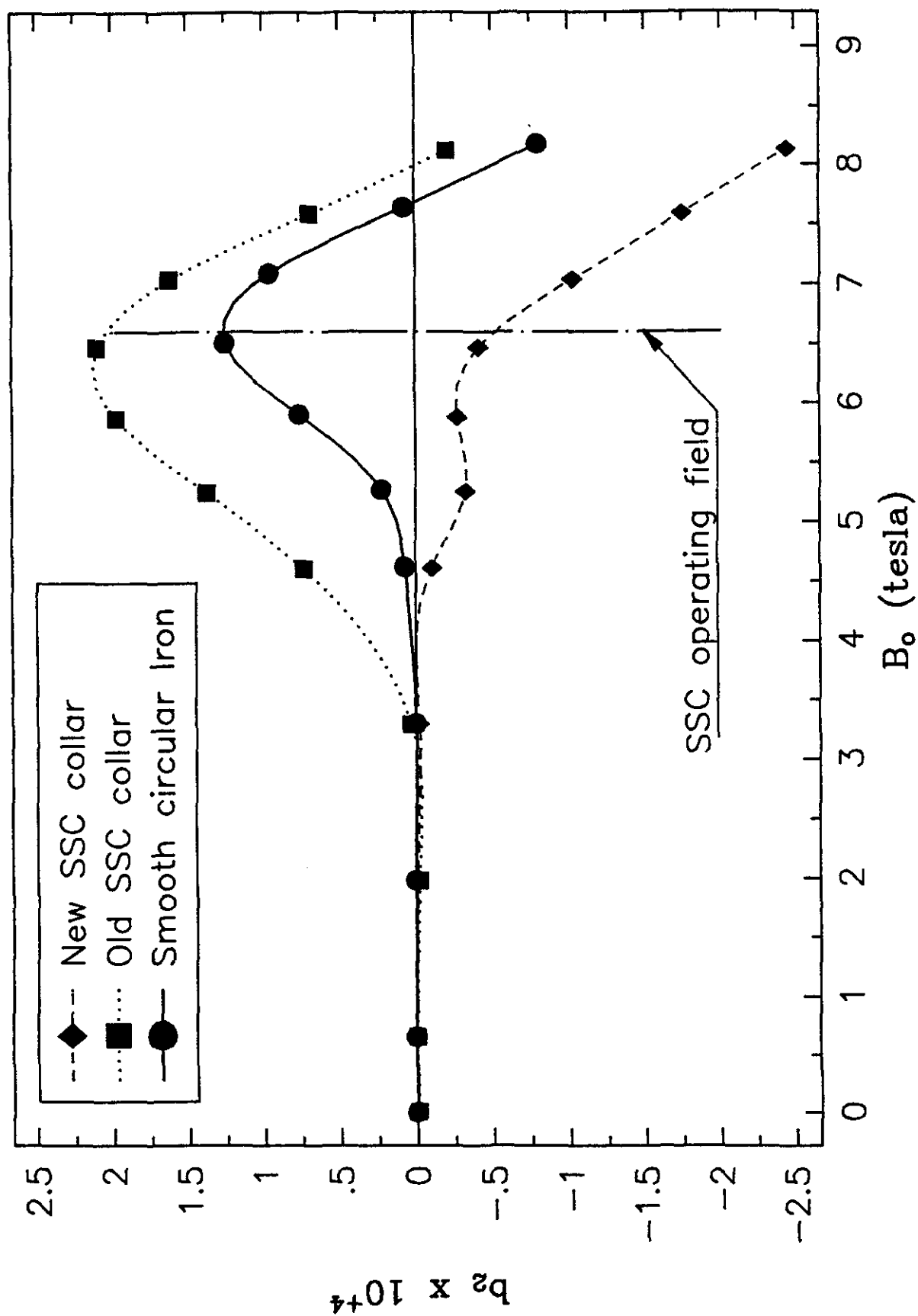
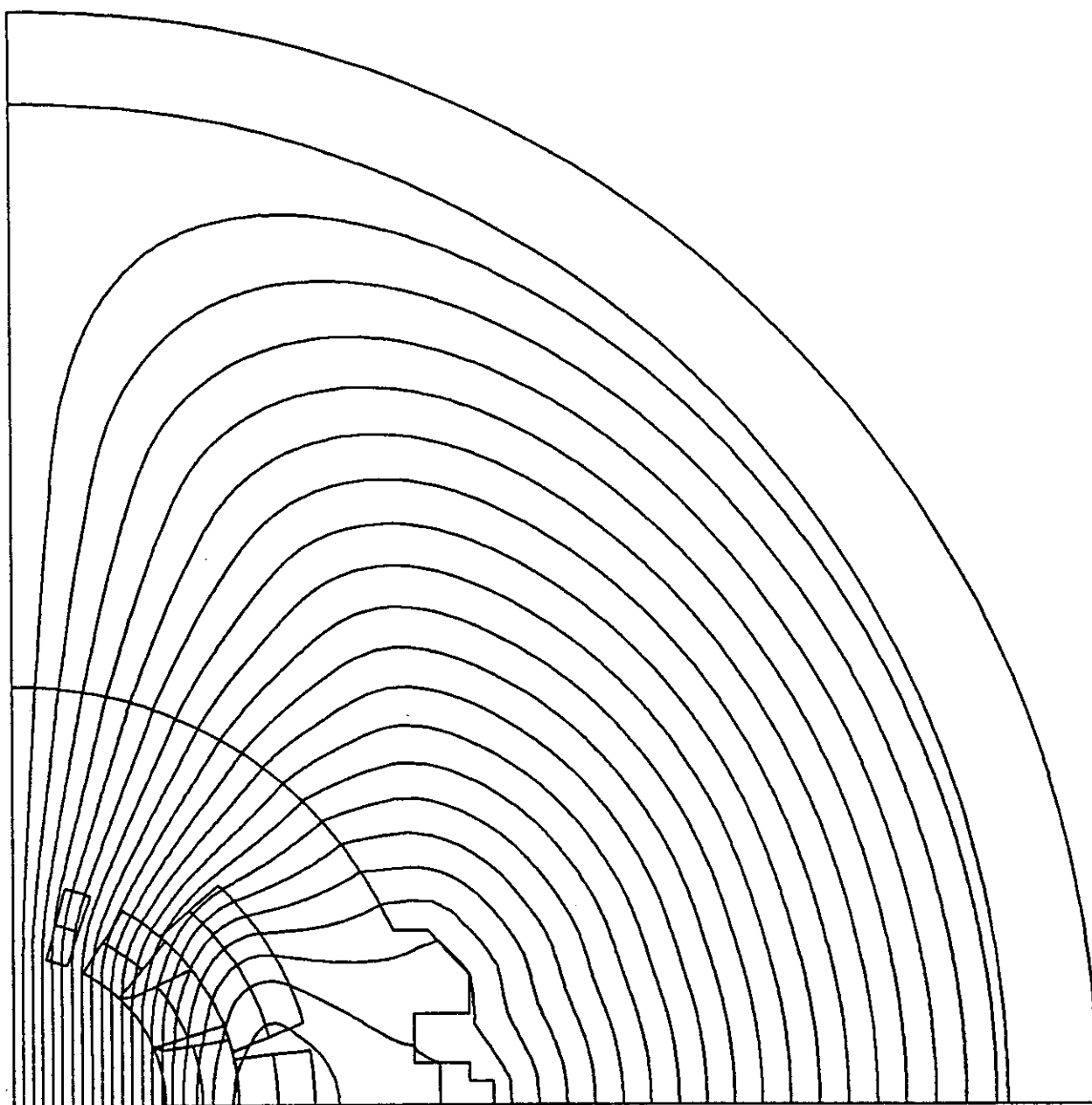


Fig. 2 Iron saturation effect on b_2 for old and new collars.



NC9

Fig. 3 Flux plot at 6.5 tesla.

TABLE I. Cross-section design with pk peak.

input

MC9 revised 25 November 86

1 N1	.5000E+01	.1000E+01	.1000E+01	.1200E+02
2 W2	.8669E+00	.9418E-05	.7200E+00	.1200E+02
3 N3	.5000E+01	.1000E+01	.1000E+01	.1000E+02
4 W4	.3466E+01	.8345E-05	.3500E+00	.1200E+02
5 N5	.4000E+01	.1000E+01	.3000E+01	.7000E+01
6 W6	.5641E+01	.1049E-04	.3500E+00	.1200E+02
7 N7	.2000E+01	.1000E+01	.1000E+01	.4000E+01
11 N11	.5000E+01	.2000E+01	.5000E+01	.9000E+01
12 W12	.9030E+00	.1013E-05	.7200E+00	.1200E+02
13 N13	.1500E+02	.1000E+01	.1200E+02	.1600E+02

\$FCNIN RFE=5.588 ,ROPT=1.00\$

1	4						
2	0.0	1.					
4	0.0	1.					
6	0.0	1.					
8	0.0	1.					
2							
1	4.0	7.	2.0244	2.9692	1.	63.3	10.7
2	4.0	3.	3.0302	4.0106	1.	53.00	8.3

\$TWIST pb(5) = 16.0 pb(3) = 17.0 pb(7)=13.8672 \$

\$KEY \$

\$WIDTH \$

FIX 1

FIX 3

FIX 5

FIX 7

FIX 11

FIX 13

SIMPLEX

CALL FCM 3

PUNCH

EXIT

END

nc9 revised output

SUMMARY MINIMIZATION 1 -----

IL,IB,IC,CXY,ANG	1	1	1	2.0240	.0102	2.0218	.1573	2.9664	.1845	2.9689	.0102	.29	4.45	3.56	.20
IL,IB,IC,CXY,ANG	1	1	2	2.0160	.1572	2.0097	.3042	2.9530	.3586	2.9605	.1843	4.46	8.61	6.92	3.56
IL,IB,IC,CXY,ANG	1	1	3	1.9986	.3036	1.9880	.4504	2.9294	.5318	2.9419	.3579	8.64	12.77	10.29	6.94
IL,IB,IC,CXY,ANG	1	1	4	1.9717	.4490	1.9569	.5954	2.8956	.7039	2.9131	.5304	12.83	16.92	13.66	10.32
IL,IB,IC,CXY,ANG	1	1	5	1.9354	.5929	1.9164	.7389	2.8515	.8743	2.8740	.7014	17.03	21.09	17.05	13.72
PHIEND,RI,RO=				21.0855	2.0377	2.9692									
IL,IB,WANG=	1	2		.8669E+00											
IL,IB,IC,CXY,ANG	1	3	1	1.8813	.7591	1.8167	.8913	2.6594	1.3187	2.7360	1.1620	21.97	26.13	26.37	23.01
IL,IB,IC,CXY,ANG	1	3	2	1.8181	.8920	1.7496	1.0223	2.5797	1.4737	2.6608	1.3194	26.13	30.30	29.74	26.37
IL,IB,IC,CXY,ANG	1	3	3	1.7464	1.0206	1.6742	1.1489	2.4910	1.6240	2.5765	1.4720	30.30	34.46	33.10	29.74
IL,IB,IC,CXY,ANG	1	3	4	1.6665	1.1444	1.5907	1.2706	2.3935	1.7689	2.4833	1.6195	34.48	38.62	36.47	33.11
IL,IB,IC,CXY,ANG	1	3	5	1.5787	1.2631	1.4992	1.3870	2.2874	1.9083	2.3814	1.7615	38.66	42.77	39.84	36.49
PHIEND,RI,RO=				42.7730	2.0308	2.9692									
IL,IB,WANG=	1	4		.3466E+01											
IL,IB,IC,CXY,ANG	1	5	1	1.4027	1.4656	1.2894	1.5596	1.8824	2.2952	2.0166	2.1839	46.26	50.42	50.64	47.28
IL,IB,IC,CXY,ANG	1	5	2	1.2903	1.5607	1.1744	1.6515	1.7460	2.4039	1.8833	2.2964	50.42	54.58	54.01	50.64
IL,IB,IC,CXY,ANG	1	5	3	1.1722	1.6485	1.0537	1.7358	1.6034	2.5043	1.7438	2.4009	54.58	58.74	57.37	54.01
IL,IB,IC,CXY,ANG	1	5	4	1.0485	1.7285	.9275	1.8124	1.4549	2.5964	1.5982	2.4970	58.76	62.90	60.74	57.38

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PHIEND,R1,RO=      62.8984      2.0275      2.9692
IL,IB,WANG=      1      6      .5641E+01
IL,IB,IC,CXY,ANG  1  7  1      .7409  1.8856      .6019  1.9341      .9003  2.8306      1.0650  2.7732      68.55 72.71 72.36 68.99
IL,IB,IC,CXY,ANG  1  7  2      .6012  1.9319      .4609  1.9763      .7334  2.8811      .8996  2.8284      72.71 76.87 75.72 72.36
PHIEND,R1,RO=      76.8741      2.0250      2.9692
IL,IB,IC,CXY,ANG  2  1  1      3.0301      .0102      3.0287      .1342      4.0090      .1553      4.0105      .0102      .19  2.54  2.22      .15
IL,IB,IC,CXY,ANG  2  1  2      3.0262      .1342      3.0222      .2582      4.0018      .3003      4.0065      .1553      2.54  4.88  4.29  2.22
IL,IB,IC,CXY,ANG  2  1  3      3.0176      .2580      3.0109      .3819      3.9894      .4451      3.9972      .3001      4.89  7.23  6.37  4.29
IL,IB,IC,CXY,ANG  2  1  4      3.0042      .3815      2.9948      .5052      3.9717      .5894      3.9826      .4447      7.24  9.57  8.44  6.37
IL,IB,IC,CXY,ANG  2  1  5      2.9860      .5044      2.9740      .6279      3.9488      .7331      3.9628      .5886      9.59 11.92 10.52  8.45
PHIEND,R1,RO=      11.9222      3.0333      4.0106
IL,IB,WANG=      2      2      .9030E+00
IL,IB,IC,CXY,ANG  2  3  1      2.9702      .6762      2.9241      .7914      3.8304      1.1654      3.8843      1.0306      12.83 15.14 16.92 14.86
IL,IB,IC,CXY,ANG  2  3  2      2.9370      .7967      2.8884      .9109      3.7865      1.3043      3.8433      1.1707      15.18 17.50 19.01 16.94
IL,IB,IC,CXY,ANG  2  3  3      2.8992      .9156      2.8482      1.0287      3.7376      1.4413      3.7973      1.3090      17.53 19.86 21.09 19.02
IL,IB,IC,CXY,ANG  2  3  4      2.8570      1.0328      2.8035      1.1448      3.6839      1.5764      3.7464      1.4454      19.87 22.21 23.17 21.10
IL,IB,IC,CXY,ANG  2  3  5      2.8103      1.1481      2.7544      1.2589      3.6253      1.7093      3.6906      1.5797      22.22 24.56 25.24 23.17
IL,IB,IC,CXY,ANG  2  3  6      2.7592      1.2613      2.7010      1.3709      3.5620      1.8400      3.6300      1.7118      24.57 26.91 27.32 25.25
IL,IB,IC,CXY,ANG  2  3  7      2.7038      1.3724      2.6433      1.4808      3.4939      1.9682      3.5648      1.8415      26.91 29.26 29.39 27.32
IL,IB,IC,CXY,ANG  2  3  8      2.6442      1.4813      2.5813      1.5883      3.4213      2.0939      3.4949      1.9688      29.26 31.60 31.47 29.39
IL,IB,IC,CXY,ANG  2  3  9      2.5804      1.5877      2.5153      1.6933      3.3442      2.2169      3.4204      2.0934      31.60 33.95 33.54 31.47
IL,IB,IC,CXY,ANG  2  3 10      2.5126      1.6916      2.4452      1.7958      3.2627      2.3371      3.3415      2.2152      33.95 36.29 35.61 33.54
IL,IB,IC,CXY,ANG  2  3 11      2.4408      1.7929      2.3711      1.8956      3.1768      2.4543      3.2582      2.3342      36.30 38.64 37.69 35.62
IL,IB,IC,CXY,ANG  2  3 12      2.3650      1.8913      2.2932      1.9925      3.0867      2.5685      3.1707      2.4501      38.65 40.99 39.76 37.69
IL,IB,IC,CXY,ANG  2  3 13      2.2854      1.9869      2.2114      2.0865      2.9923      2.6794      3.0789      2.5628      41.00 43.33 41.84 39.77
IL,IB,IC,CXY,ANG  2  3 14      2.2021      2.0793      2.1260      2.1774      2.8939      2.7869      2.9829      2.6722      43.36 45.68 43.92 41.86
IL,IB,IC,CXY,ANG  2  3 15      2.1150      2.1687      2.0369      2.2650      2.7915      2.8909      2.8830      2.7782      45.72 48.04 46.00 43.94
PHIEND,R1,RO=      48.0362      3.0371      4.0106
Bpeak = 6.96503      at ( .483205      , 2.05054      )
Bpeak = 5.61959      at ( 2.18901      , 2.39122      )
CUR,CRI,CRO,BPI,BPO,BC =      .6500E+04      .4077E+05      .3394E+04      .8321E+11      .5620E+01      .4853E+05

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0 CORRECTED Y ARRAY

0	K	PHIST	TURNS	RIN	ROUT	I/L	THICK	PHIEND	
	1	4.0000	7.0000	2.0244	2.9692	1.0000	63.3000	10.7000	0.0000
	2	4.0000	3.0000	3.0302	4.0106	1.0000	53.0000	8.3000	0.0000

TRANSFER FUNCTION = 10.333643

0	N	BN/BO	BPR	BEFF	AN/BO	APR	AEFF
	0	.1000E+01	10000.00	15.03	.0000E+00	0.00	0.00
	2	-.6056E-07	-.00	-.00	.0000E+00	0.00	0.00
	4	-.3692E-06	-.00	-.00	.0000E+00	0.00	0.00
	6	-.1558E-05	-.02	-.00	.0000E+00	0.00	0.00
	8	-.1807E-05	-.02	-.00	.0000E+00	0.00	0.00
	10	.4476E-05	.04	.00	.0000E+00	0.00	0.00
	12	.1041E-05	.01	.00	.0000E+00	0.00	0.00
	14	.5077E-07	.00	.00	.0000E+00	0.00	0.00
	16	-.1961E-06	-.00	-.00	.0000E+00	0.00	0.00
	18	.2029E-07	.00	.00	.0000E+00	0.00	0.00

DB EVALUATED AT R = 1.00000

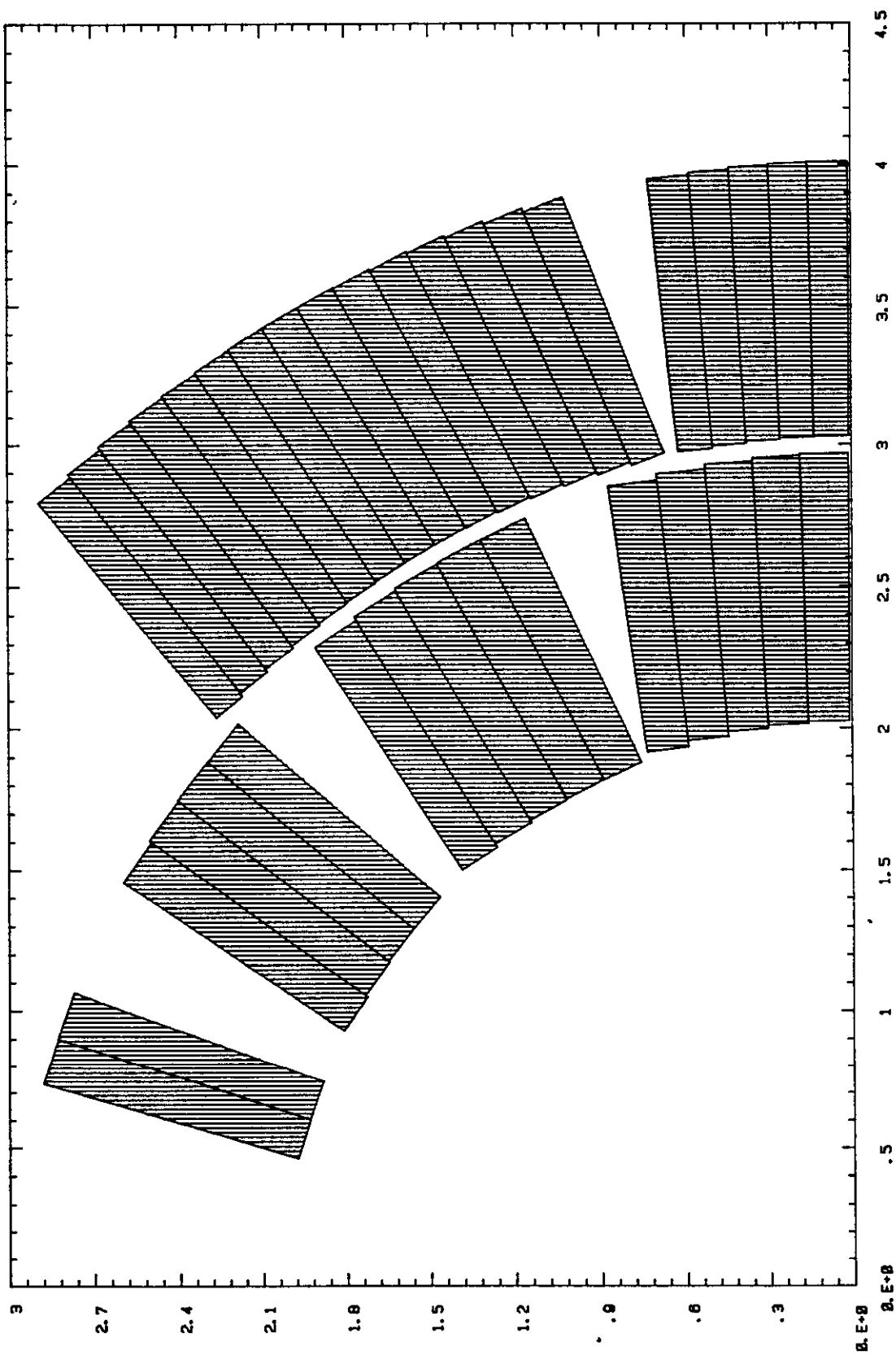


Fig. 4 NC9 cross-section.