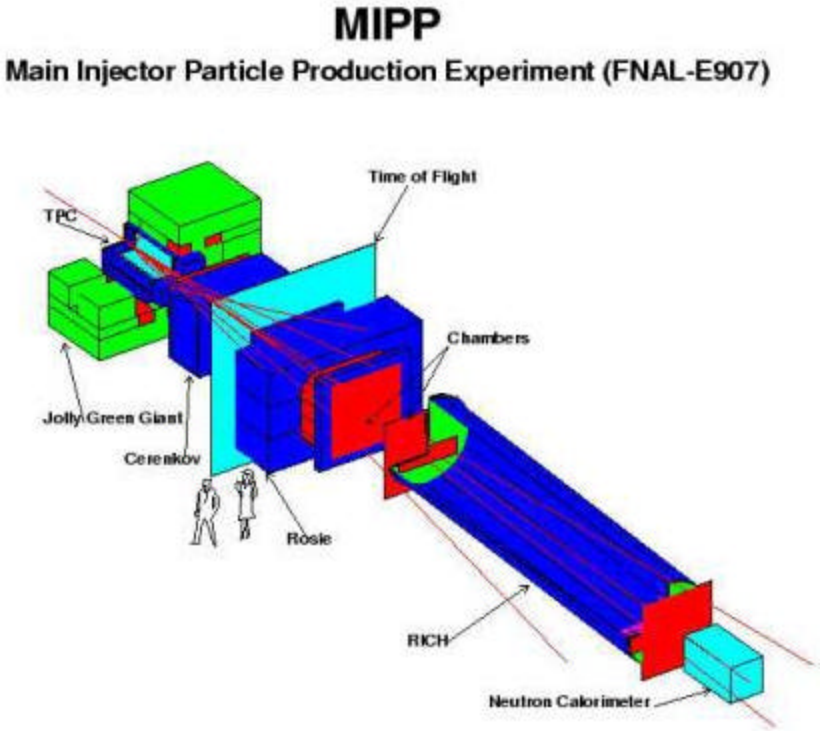
MIPP

Main Injector Particle Production Experiment

FNAL-E907

Cutaway View

This is a cutaway view of the experiment, with tracks from a simulated event. The beam particles enter from the upper left, where they hit a target just in front of the TPC, which sits inside the Jolly Green Giant magnet. Following the TPC there is a Cerenkov counter, a Time of Flight wall, a second magnet called Rosie, a Ring Imaging Cerenkov counter, and a Neutral Calorimeter. Interspersed between these detectors are a set of Drift Chambers, in red.



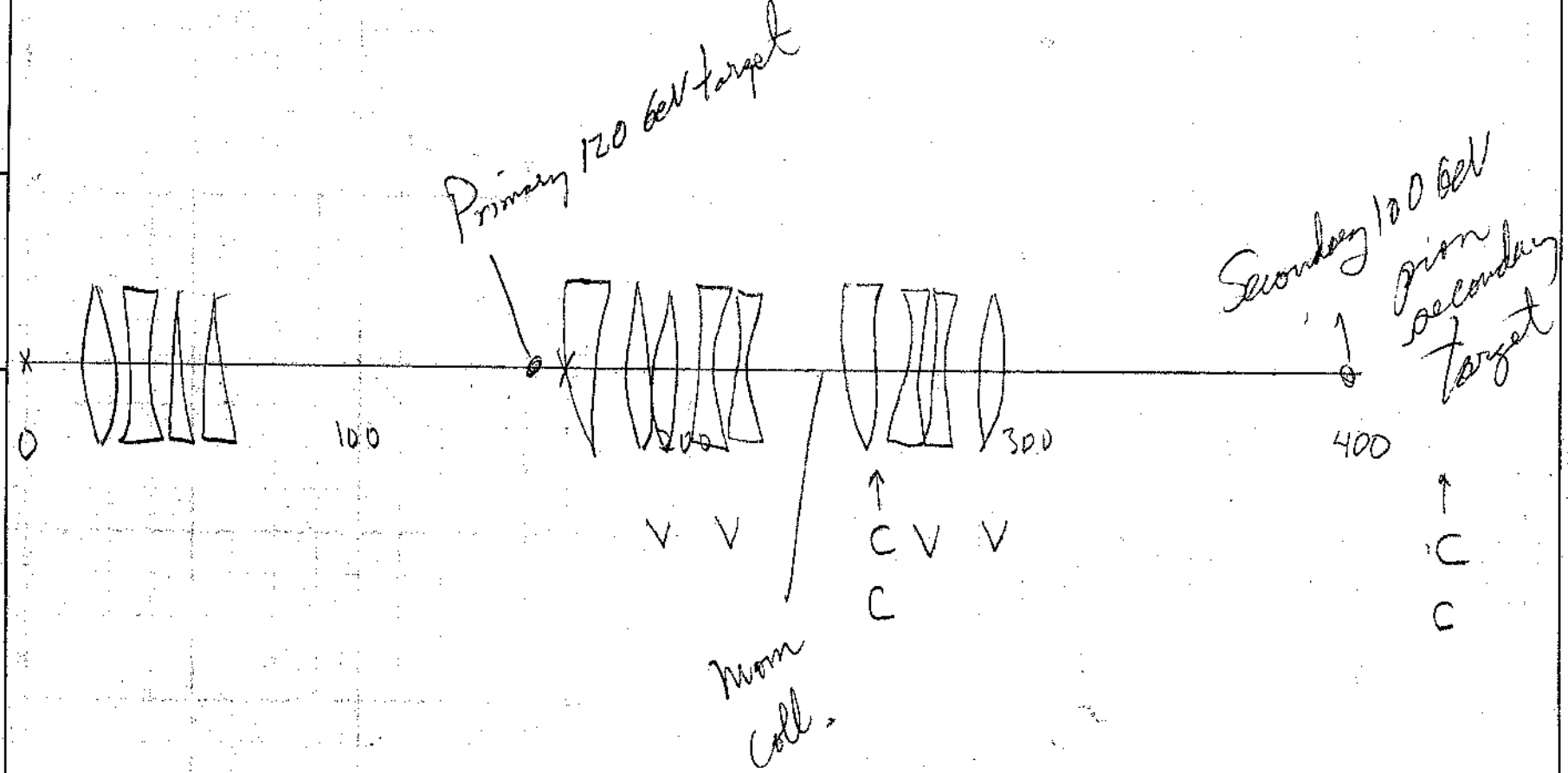
For more Monte Carlo plots and other file formats, see the Monte Carlo page.

Live Pictures From the Experimental Hall

As we build the experiment, you can watch our progress on our MIPPCam:

FERMILAB
ENGINEERING NOTE

SUBJECT | NAME | DATE | REVISION DATE | SERIAL-CATEGORY | PROJECT | SECTION | PAGE



Layout of total beam

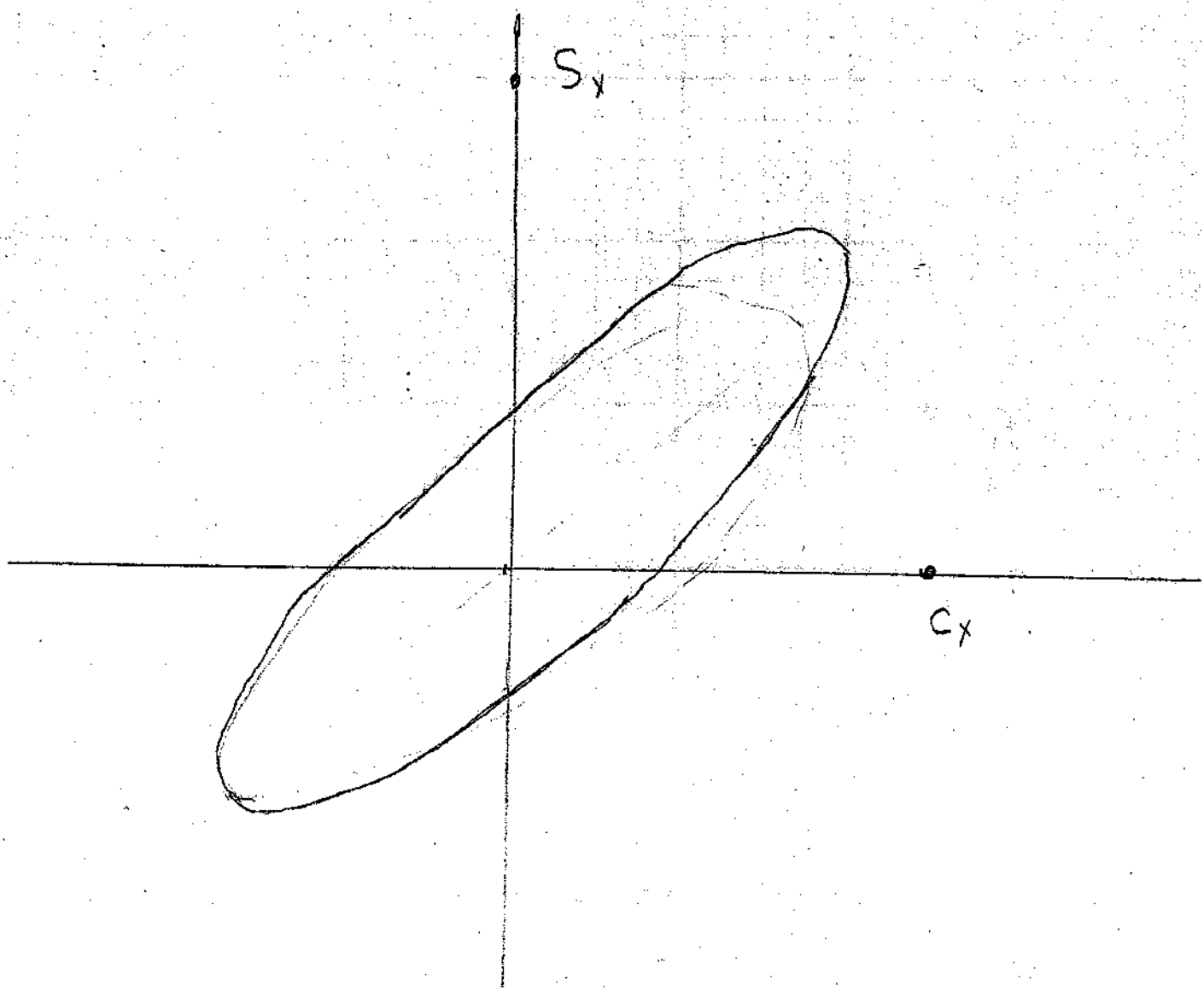
-0.6353	60.5263	0.0698	-8.2236	-0.7186	32.7382	-0.1193
-0.3089	24.9609	0.1368	-14.2951	-1.2636	53.0213	-0.2506
-0.1838	11.8895	0.1368	-14.2951	-1.4927	61.9139	-0.2506
0.2232	-32.2085	0.1395	-15.6411	-1.9034	77.0457	-0.0094
0.2658	-36.9759	0.1395	-15.6411	-1.9063	77.0018	-0.0094
0.7785	-96.0359	0.2086	-24.4521	-1.5485	61.0598	0.2360
2.2006	-262.7036	0.2086	-24.4521	0.0598	-6.7581	0.2360
2.2006	-262.7036	0.2086	-24.4521	0.0598	-6.7581	0.2360
2.3914	-285.0626	0.2086	-24.4521	0.2755	-15.8561	0.2360
3.0272	-359.5817	0.2086	-24.4439	0.9947	-46.1824	0.2360
3.0908	-367.0322	0.2086	-24.4439	1.0666	-49.2150	0.2360
4.4598	-528.5455	0.7216	-85.2971	1.5148	-67.2371	0.0475
4.6798	-554.5440	0.7216	-85.2971	1.5293	-67.6791	0.0475
8.0800	-956.7558	1.5886	-187.9878	1.3476	-57.7869	-0.1624
10.6447	*********	1.5886	-187.9878	1.0854	-45.3441	-0.1624
12.8501	*********	-0.1956	23.2340	0.8036	-30.5519	-0.0293
5.4519	-642.4088	-0.1956	23.2340	-0.3027	58.5684	-0.0293
5.4519	-642.4088	-0.1956	23.2340	-0.3027	58.5684	-0.0293

2 FT

TERS = 4 *
= 4 *

.0283	-0.97E-03	-0.0013	-0.0042
.0038	0.43E-04	-0.0092	0.0412
.0038	-0.43E-04	0.0092	-0.0412
6E-03	-0.26E-03	-0.0045	0.0234
.0022	0.22E-03	-0.82E-03	0.0029
.0022	-0.22E-03	0.82E-03	-0.0029
.0021	0.20E-03	-0.66E-03	0.0024

Transfer matrix elements for combined primary and secondary beams



Characteristic trajectories

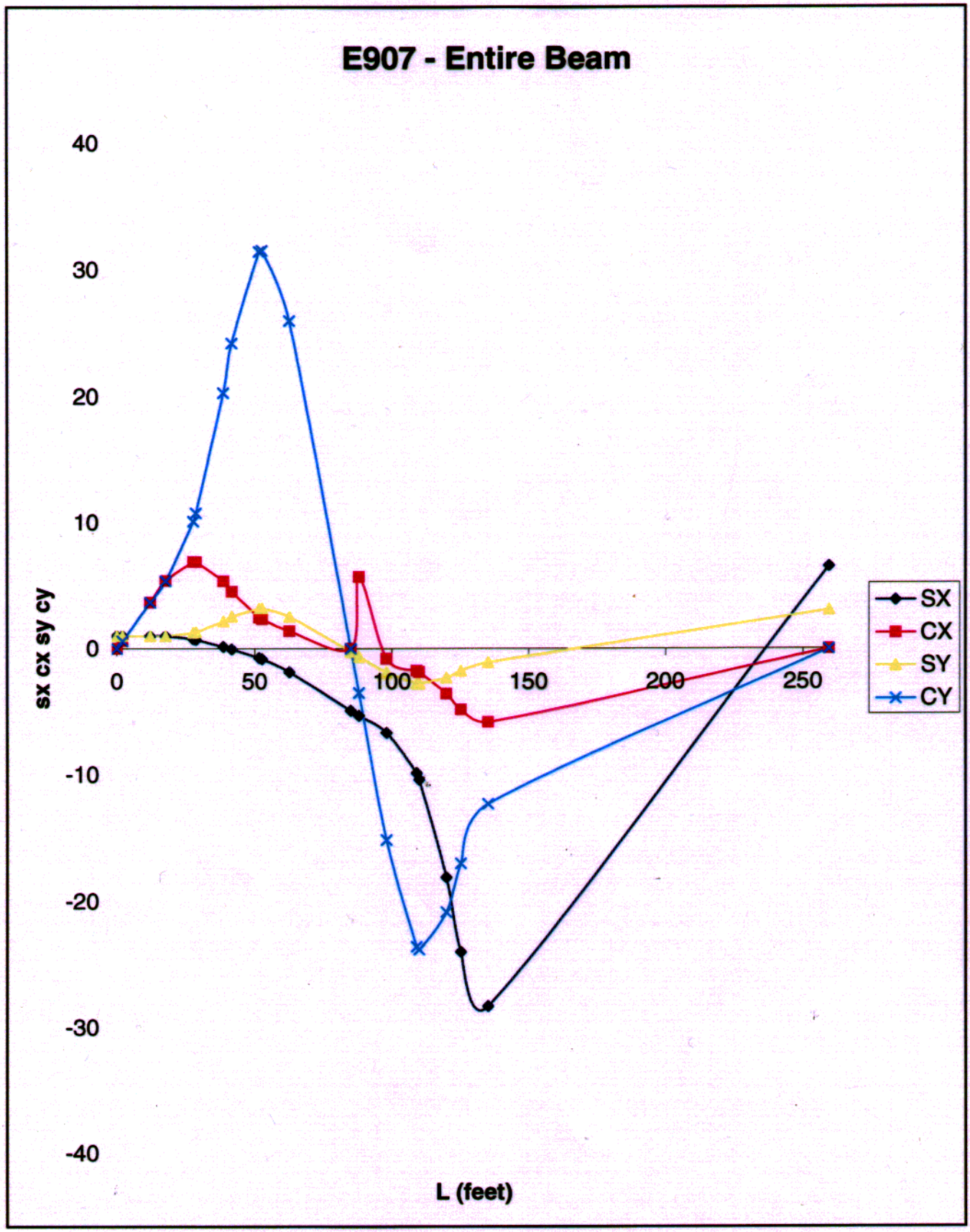
vs Beam Envelope

1E907 SECONDARY BEAMLINE MC05, MC06, MC07 7/12/02 CNB

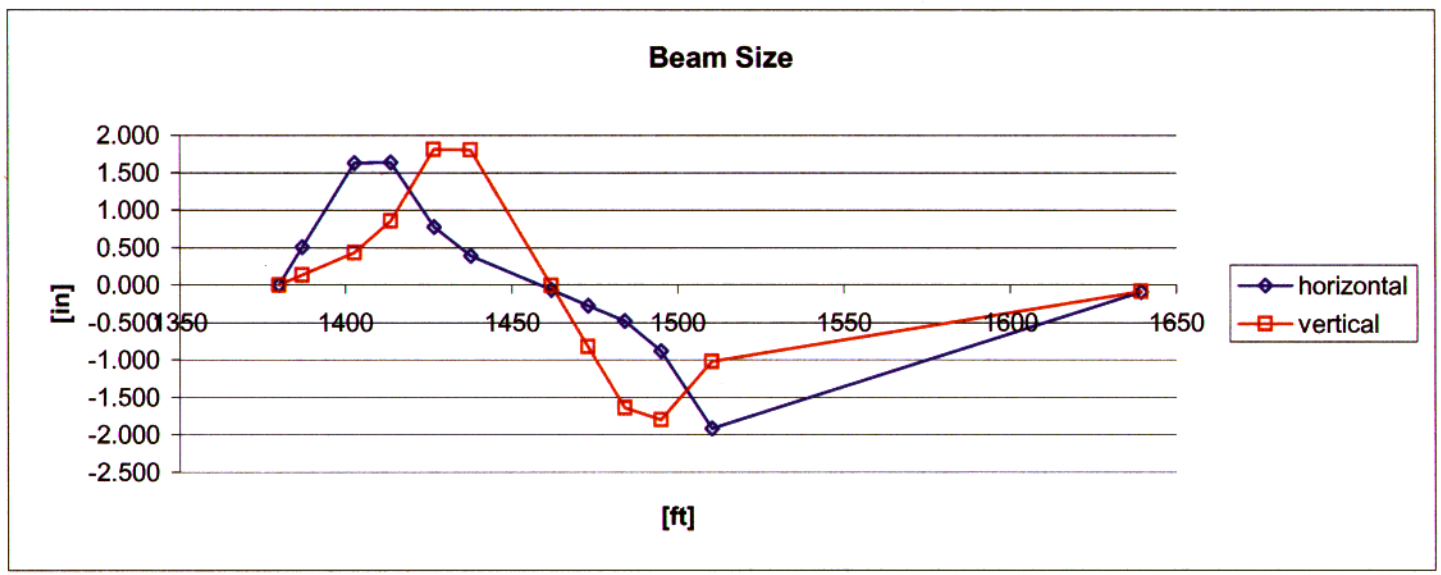
```
(   3)  *LEVEL COORDS*
          0.000 M
(  11)  *XBEGIN*                    0.00000E+00
(  12)  *YBEGIN*                    0.74593E+03
(  13)  *ZBEGIN*                    0.12200E+04
(  15)  *BEAM*                     120.00000 GEV/C
          0.000 M                    1.100 MM     0.010 MR     2.460 MM     0.021 MR     0.010 MM     0.000 PM       0.997    0.989
(  20)  *MARKER*          MC5BEG
          0.000 M                    1.100 MM     0.010 MR     2.460 MM     0.021 MR     0.010 MM     0.000 PM       0.997    0.989
(  21)  *DRIFT*                      1.29540 M
          1.295 M                    1.113 MM     0.010 MR     2.487 MM     0.021 MR     0.010 MM     0.000 PM       0.997    0.989
(  22)  *MARKER*          M1224C
          1.295 M                    1.113 MM     0.010 MR     2.487 MM     0.021 MR     0.010 MM     0.000 PM       0.997    0.989
(  23)  *DRIFT*                      0.58522 M
          1.881 M                    1.119 MM     0.010 MR     2.499 MM     0.021 MR     0.010 MM     0.000 PM       0.997    0.989
(  24)  *MARKER*          MC5WC1
          1.881 M                    1.119 MM     0.010 MR     2.499 MM     0.021 MR     0.010 MM     0.000 PM       0.997    0.989
(  25)  *DRIFT*                      0.24700 M
          2.128 M                    1.121 MM     0.010 MR     2.504 MM     0.021 MR     0.010 MM     0.000 PM       0.997    0.989
(  26)  *QAPA  *                     0.36576E+02
(  27)  *QUAD*            MC5Q1$1    3.04800 M          0.02495 M   **-2              (   13.67279 M   )
          5.176 M                    1.023 MM     0.073 MR     2.866 MM     0.221 MR     0.010 MM     0.000 PM      -1.000    1.000
(  28)  *DRIFT*                      0.30480 M
          5.480 M                    1.001 MM     0.073 MR     2.933 MM     0.221 MR     0.010 MM     0.000 PM      -1.000    1.000
(  29)  *QUAD*            MC5Q1$2    3.04800 M          0.00000 M   **-2              (   INFINITE M   )
          8.528 M                    0.778 MM     0.073 MR     3.607 MM     0.221 MR     0.010 MM     0.000 PM      -1.000    1.000
(  30)  *DRIFT*                      0.30480 M
          8.833 M                    0.755 MM     0.073 MR     3.675 MM     0.221 MR     0.010 MM     0.000 PM      -1.000    1.000
(  31)  *QAPA  *                     0.36576E+02
(  32)  *QUAD*            MC5Q2$     3.04800 M         -0.02776 M   **-2              (  -11.32632 M   )
         11.881 M                    0.622 MM     0.016 MR     3.856 MM     0.105 MR     0.010 MM     0.000 PM      -0.996   -1.000
(  33)  *DRIFT*                      0.30480 M
         12.186 M                    0.617 MM     0.016 MR     3.824 MM     0.105 MR     0.010 MM     0.000 PM      -0.996   -1.000
(  34)  *HWIDTH*                     0.72136E+02
(  35)  *HGAP  *                     0.37846E+02
(  36)  *SROT*                     -90.00000 DEG
(  36)  *      *           MC5U$1     4.45208 MR
(  36)  *RBEND*            MC5U$1     3.04800 M         11.69330 KG        0.00000      (   342.313 M   ,   8.90416 MR  )
(  36)  *      *           MC5U$1     4.45208 MR
(  36)  *SROT*                      90.00000 DEG
         15.234 M       -            0.568 MM     0.016 MR     3.506 MM     0.105 MR     0.034 MM     0.000 PM      -0.996   -1.000
(  37)  *DRIFT*                      0.30480 M
         15.539 M                    0.563 MM     0.016 MR     3.474 MM     0.105 MR     0.034 MM     0.000 PM      -0.996   -1.000
(  38)  *HWIDTH*                     0.72136E+02
(  39)  *HGAP  *                     0.37846E+02
(  40)  *SROT*                     -90.00000 DEG
(  40)  *      *           MC5U$2     4.45208 MR
(  40)  *RBEND*            MC5U$2     3.04800 M         11.69330 KG        0.00000      (   342.313 M   ,   8.90416 MR  )
(  40)  *      *           MC5U$2     4.45208 MR
(  40)  *SROT*                      90.00000 DEG
         18.587 M                    0.514 MM     0.016 MR     3.156 MM     0.105 MR     0.063 MM     0.000 PM      -0.995   -1.000
(  41)  *DRIFT*                     27.74810 M
         46.335 M                    0.082 MM     0.016 MR     0.265 MM     0.105 MR     0.063 MM     0.000 PM      -0.765   -0.961
(  42)  *MARKER*          MC5END
         46.335 M                    0.082 MM     0.016 MR     0.265 MM     0.105 MR     0.063 MM     0.000 PM      -0.765   -0.961
(  43)  *MARKER*          MC6BEG
         46.335 M                    0.082 MM     0.016 MR     0.265 MM     0.105 MR     0.063 MM     0.000 PM      -0.765   -0.961
(  44)  *DRIFT*                      2.43840 M
         48.773 M                    0.057 MM     0.016 MR     0.073 MM     0.105 MR     0.063 MM     0.000 PM      -0.402    0.000
(  45)  *MARKER*          MC6T1
         48.773 M                    0.057 MM     0.016 MR     0.073 MM     0.105 MR     0.063 MM     0.000 PM      -0.402    0.000
0       *LENGTH*          48.77334 M
```

Beam Envelope Dimensions

for Primary Beam


E907 - Entire Beam
40
30
20
10
0
-10
-20
-30
-40
sx cx sy cy
0
50
100
150
200
250
L (feet)
SX
CX
SY
CY

	p (GeV)	z (ft)	z (in)	b(kg/in)	x (in)	xp	y (in)	yp	B (kg)
	110 GeV secondary beam								
MCT1	110	1380	0		0.000	0.0060	0.000	0.0016	
MCD1	110	1387	84		0.504	0.0060	0.134	0.0016	11.09
MC6Q1	110	1402.64	271.68	-4.4	1.630	0.0000	0.435	0.0032	
MC6Q2	110	1413.64	403.68	-4.1	1.636	-0.0055	0.856	0.0061	
MC6Q3	110	1426.64	559.68	4.1	0.773	-0.0029	1.808	-0.0001	
MC6Q4	110	1437.64	691.68	4.1	0.391	-0.0016	1.801	-0.0062	
MC6C	110	1462	984		-0.066	-0.0016	-0.008	-0.0062	
MC6D2	110	1473	1116		-0.273	-0.0016	-0.824	-0.0062	-11.09
MC6Q5	110	1484	1248	3.65	-0.479	-0.0030	-1.641	-0.0012	
MC6Q6	110	1495	1380	3.65	-0.877	-0.0057	-1.801	0.0042	
MC6Q7	110	1510.3	1563.6	-4.3	-1.920	0.0012	-1.021	0.0006	
MCT2	110	1639.4	3112.8		-0.092	0.0012	-0.086	0.0006	



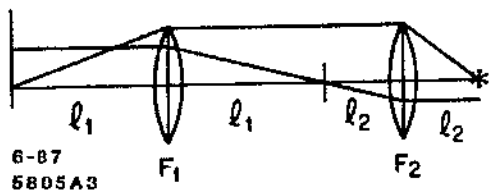


Fig. 3. A Thin Lens Telescopic Transformer.

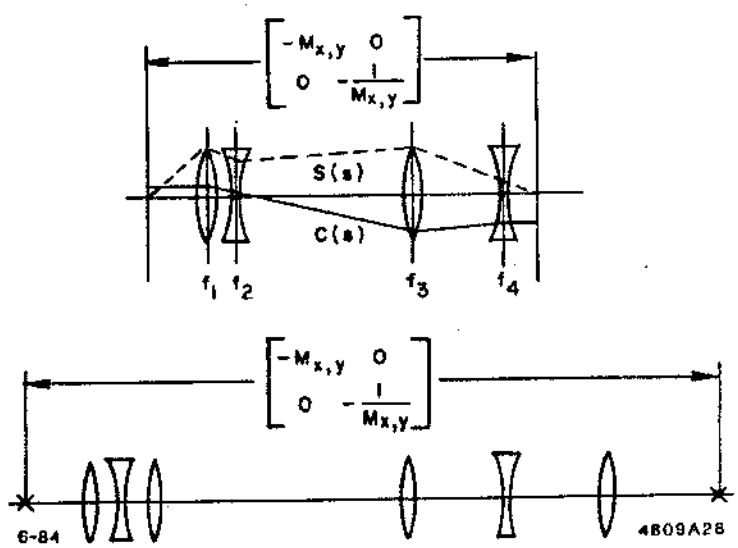
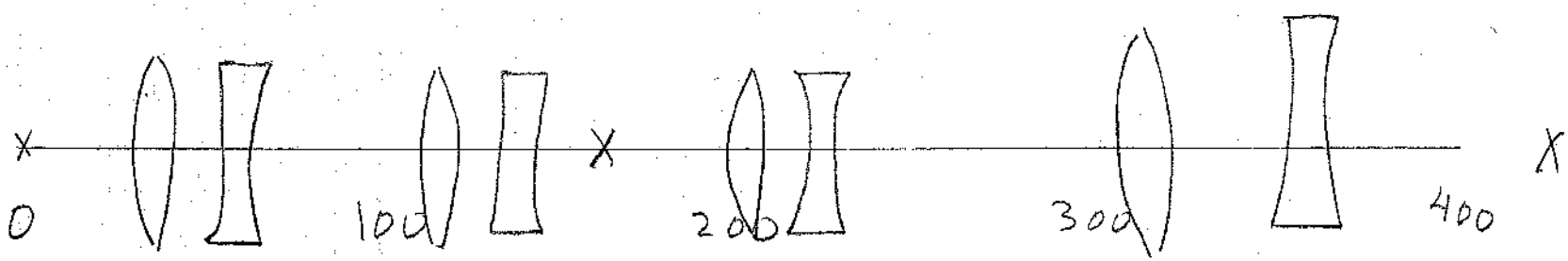


Fig. 4. Telescopic Transformers using Doublets and Triplets.



Layout of beam line
with magnifying telescope

Matrix elements for present Secondary channel

0.00000	0.00000	0.00000	0.00000						
0.00000	0.00000	0.00000	0.00000						
1.00000	0.00000	0.00000	0.00000						
0.00000	1.00000	0.00000	0.00000						
0.00000	0.00000	1.00000	0.00000						
0.00000	0.00000	0.00000	1.00000						
R11	R12	R21	R22	R33	R34	R43	R44	R16	I
100.00000 GEV/C									
1.0000	0.6100	0.0000	1.0000	1.0000	0.6100	0.0000	1.0000	0.0000	(
1.0000	3.6580	0.0000	0.9999	1.0000	3.6580	0.0000	1.0000	0.0000	(
0.9999	5.3779	0.0000	0.9999	1.0000	5.3780	0.0000	1.0000	0.0000	(
0.7613	6.8964	-0.1500	-0.0452	1.2592	10.0788	0.1771	2.2114	0.0000	(
0.7156	6.8826	-0.1500	-0.0452	1.3131	10.7529	0.1771	2.2114	0.0000	(
0.1445	5.3574	-0.2115	-0.9203	2.1773	20.3161	0.4097	4.2821	0.0000	(
-0.0488	4.5159	-0.2115	-0.9203	2.5519	24.2316	0.4097	4.2821	0.0000	(
-0.7502	2.4933	-0.2647	-0.4531	3.1970	31.4700	-0.0013	0.3000	0.0000	(
-0.8309	2.3552	-0.2647	-0.4531	3.1966	31.5614	-0.0013	0.3000	0.0000	(
-1.8765	1.3880	-0.4452	-0.2036	2.5442	26.0076	-0.4117	-3.8156	0.0000	(
-4.9109	0.0000	-0.4452	-0.2036	-0.2621	0.0000	-0.4117	-3.8156	0.0000	(
-4.9109	0.0000	-0.4452	-0.2036	-0.2621	0.0000	-0.4117	-3.8156	0.0000	0
-5.3180	-0.1862	-0.4452	-0.2036	-0.6385	-3.4890	-0.4117	-3.8156	0.0000	0
-6.6747	-0.8069	-0.4450	-0.2036	-1.8934	-15.1189	-0.4117	-3.8156	0.0000	0
-6.8103	-0.8689	-0.4450	-0.2036	-2.0189	-16.2819	-0.4117	-3.8156	0.0000	0
-9.8543	-1.7390	-1.6264	-0.3885	-2.7464	-23.5482	-0.0477	-0.7729	0.0000	0
-10.3500	-1.8575	-1.6264	-0.3885	-2.7609	-23.7838	-0.0477	-0.7729	0.0000	0
-18.0931	-3.5640	-3.6427	-0.7728	-2.2997	-20.8341	0.3389	2.6356	0.0000	0
-23.9739	-4.8117	-3.6427	-0.7728	-1.7526	-16.5793	0.3389	2.6356	0.0000	0
-28.3073	-5.7980	0.9210	0.1533	-1.0952	-12.2512	0.1106	0.3239	0.0000	0
6.5227	0.0000	0.9210	0.1533	3.0869	0.0000	0.1106	0.3239	0.0000	0

2 FT

C06, MC07 7/12/02 CNB

R11	R12	R21	R22	R33	R34	R43	R44	R16
1.0000	0.0000	0.0000	1.0000	1.0000	0.0000	0.0000	1.0000	0.0000

100.00000 GEV/C

1.0000	0.0000	0.0000	1.0000	1.0000	0.0000	0.0000	1.0000	0.0000
1.0000	5.4100	0.0000	1.0000	1.0000	5.4100	0.0000	1.0000	0.0000
0.6541	6.2262	-0.2129	-0.4977	1.3911	10.9615	0.2722	2.8634	0.0000
0.0537	4.8228	-0.2129	-0.4977	2.1585	19.0363	0.2722	2.8634	0.0000
-0.6349	4.3855	-0.2569	0.1993	2.4259	22.6963	-0.1038	-0.5587	0.0000

26.8350875385

-7.5284	9.7346	-0.2569	0.1993	-0.3589	7.7042	-0.1038	-0.5587	0.0000
-7.7008	9.5632	0.1453	-0.3103	-0.7125	6.5760	-0.1313	-0.1914	0.0000

23.7306473671

-4.2525	2.1994	0.1453	-0.3103	-3.8291	2.0340	-0.1313	-0.1914	0.0000
-4.0260	1.3530	0.0046	-0.2499	-4.0241	1.3554	0.0045	-0.2500	0.0000
-4.0012	0.0008	0.0046	-0.2499	-3.9997	0.0028	0.0045	-0.2500	0.0000

73 M

Matrix elements for magnifying telescopic section

Maximum Absolute Values

	Existing Design	Telescopic
C_x	-28.3	-7.70
S_x	-5.8	9.6
C_y	3.08	-4.0
S_y	31.6	22.7

Dispersion in Existing Design

Two bends down, each 8.904 mr

Sine like trajectories at magnet longitudinal midpoints: 2.134 m and 6.078 m

Both very close to the preceding focus, (makes dispersion small)

Value of dispersion:

At collimator .005 m

At secondary target .197 m

Dispersion cannot be eliminated without rearranging elements.

```
*TRANSFORM 1*
   -18.09309  -3.56404   0.00000   0.00000   0.00000   0.00000
    -3.64271  -0.77282   0.00000   0.00000   0.00000   0.00000
     0.00000   0.00000  -2.29971 -20.83412   0.00000  -0.09748
     0.00000   0.00000   0.33892   2.63556   0.00000   0.01540
     0.00000   0.00000   0.00237   0.06384   1.00000   0.00044
     0.00000   0.00000   0.00000   0.00000   0.00000   1.00000
*DRIFT*                    5.29659 FT
   125.304 FT
*TRANSFORM 1*
   -23.97388  -4.81168   0.00000   0.00000   0.00000   0.00000
    -3.64271  -0.77282   0.00000   0.00000   0.00000   0.00000
     0.00000   0.00000  -1.75257 -16.57928   0.00000  -0.07262
     0.00000   0.00000   0.33892   2.63556   0.00000   0.01540
     0.00000   0.00000   0.00237   0.06384   1.00000   0.00044
     0.00000   0.00000   0.00000   0.00000   0.00000   1.00000
*QUAD*          MC6Q7$      10.00000 FT        0.18288 KG  /MM
   135.304 FT
*TRANSFORM 1*
   -28.30732  -5.79804   0.00000   0.00000   0.00000   0.00000
     0.92097   0.15331   0.00000   0.00000   0.00000   0.00000
     0.00000   0.00000  -1.09520 -12.25117   0.00000  -0.04091
     0.00000   0.00000   0.11058   0.32395   0.00000   0.00629
     0.00000   0.00000   0.00237   0.06384   1.00000   0.00044
     0.00000   0.00000   0.00000   0.00000   0.00000   1.00000
*DRIFT*                  124.07677 FT
   259.380 FT
*TRANSFORM 1*
     6.52265   0.00000   0.00000   0.00000   0.00000   0.00000
     0.92097   0.15331   0.00000   0.00000   0.00000   0.00000
     0.00000   0.00000   3.08694   0.00000   0.00000   0.19708
     0.00000   0.00000   0.11058   0.32395   0.00000   0.00629
     0.00000   0.00000   0.00237   0.06384   1.00000   0.00044
     0.00000   0.00000   0.00000   0.00000   0.00000   1.00000
*FIT*                      R12          0.0      /0.01000        (
*FIT*                      R34          0.0      /0.01000        (
*MARKER*        MC6T2
   259.380 FT
*TRANSFORM 1*
     6.52265   0.00000   0.00000   0.00000   0.00000   0.00000
     0.92097   0.15331   0.00000   0.00000   0.00000   0.00000
     0.00000   0.00000   3.08694   0.00000   0.00000   0.19708
     0.00000   0.00000   0.11058   0.32395   0.00000   0.00629
     0.00000   0.00000   0.00237   0.06384   1.00000   0.00044
     0.00000   0.00000   0.00000   0.00000   0.00000   1.00000
*LENGTH*        259.38032 FT
```

Full matrix elements for original

Secondary beam