

Booster Coordinates

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BOOSTER COORDINATES

*Booster Technical Note
No. 3*

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ABSTRACT

THIS NOTE DESCRIBES THE COORDINATES OF THE AGS - BOOSTER IN THE BOOSTER CENTERED FRAME OF REFERENCE WITH AXES IN THE NORTH (X) AND EAST (Y) DIRECTIONS. TRANSFORMATION FROM THE BOOSTER CENTERED FRAME TO THE AGS AND BNL GRIDS ARE DISCUSSED, AND THE COORDINATES OF THE MACHINE WITH RESPECT TO THESE FRAMES ARE GIVEN.

I. INTRODUCTION

In this note we describe the coordinates of the AGS - Booster with respect to three reference frames. In section II we give the coordinates of the Machine in the Booster reference frame with axes in the North (X) and East (Y) directions, with the unit of length expressed in meters.

In section III, the transformation from the Booster centered reference frame to the AGS and BNL grids are discussed. Then in Section IV, the coordinates of the Booster with respect to these frames are tabulated, (in inches and feet units respectively).

Layout of the Booster lattice [1,2] showing relative position of magnets and the labeling convention of the lattice and its superperiods are also included (see Figures 1-3).

II. BOOSTER CENTERED COORDINATE SYSTEM

The coordinates of the Booster lattice in the Booster centered coordinate system (with East (X) and North (Y) axes where the length is measured in meters) using Tape 5 [3] of program SYNCH, were generated assuming that:

1. The magnets have sharp edges where the field becomes zero.
2. The values listed in Table I correspond to the coordinates of an on-axis point of the downstream end of that element when viewed in a clockwise direction.

We note that, the effect of the earth's curvature for the Booster is negligible.

III. TRANSFER OF COORDINATES TO AGS AND BNL GRID

We can use the following transformation from the Booster centered frame of reference to that of AGS and BNL grids assuming that the axes of the Booster centered coordinate system are parallel to those of 1) AGS and 2) BNL grids. Here X_{BST} and Y_{BST} are the x and y distances expressed in the Booster coordinate system, with E and N as the East and North coordinates and EO and NO are the the coordinates of the Booster in the 1) AGS [E(inch),N(inch)] and 2) BNL [E(feet),N(feet)] grids respectively, (see Table II [4]):

1. AGS GRID

$$E(\text{inch}) = EO_{AGS}(\text{inch}) + X_{BST}(\text{inch})$$

$$N(\text{inch}) = NO_{AGS}(\text{inch}) + Y_{BST}(\text{inch})$$

$$EO_{AGS}(\text{inch}) = 1153.6786$$

$$NO_{AGS}(\text{inch}) = 15452.8$$

2. BNL GRID

$$E(\text{feet}) = EO_{BNL}(\text{feet}) + X_{BST}(\text{feet})$$

$$N(\text{feet}) = NO_{BNL}(\text{feet}) + Y_{BST}(\text{feet})$$

$$EO_{BNL}(\text{feet}) = 99,180.5694 \text{ feet, and}$$

$$NO_{BNL}(\text{feet}) = 105,920.3314 \text{ feet .}$$

where the values for EO and NO were obtained from Fig.3, [5], (using the conversion factor of 2.54 cm/inch). Note that the origins of the two systems are different.

AKNOWLEDGEMENT:

We thank E. Courant, and other members of the Booster Design study group for discussions and their efforts. We also thank Ms. K. Brown for our drawings.

REFERENCES:

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1. Booster Lattice, Booster Tech. Note No. 1, E. Courant and Z. Parsa, (January 1986).
 2. Booster Parameters, Booster Tech. Note No. 2, Z. Parsa, (January 1986).
 3. Using DUAO:[PARSA1.BOOSTER]SYNBOOST.DAT, a tape 5 [BSTR5, E. Courant] was generated.
 4. Obtained from Y.Y. LEE, private communication.
 5. Construction map for the Booster; J. Feldman, P. Mohn and M. Schaeffer.

TABLE I

| ELEMENT | X (M) | Y (M) | E-AGS (IN) | N-AGS (IN) | ANGLE | S (ORBIT) |
|---------|----------|-----------|------------|-------------|--------|-----------|
| 0 | | | | | | |
| 1 | 31.86063 | -5.55399 | 2408.03542 | 15234.13914 | 99.89 | 0.000 |
| 2 | 31.82006 | -5.80257 | 2406.43829 | 15224.35226 | 100.33 | .252 |
| 3 | 31.77174 | -6.09866 | 2404.53601 | 15212.69543 | 100.87 | .552 |
| 4 | 31.18098 | -8.42167 | 2381.27751 | 15121.23823 | 105.11 | 2.952 |
| 5 | 30.85098 | -9.36565 | 2368.28561 | 15084.07355 | 106.89 | 3.952 |
| 6 | 30.76787 | -9.60342 | 2365.01327 | 15074.71270 | 107.33 | 4.204 |
| 7 | 30.68475 | -9.84118 | 2361.74094 | 15065.35184 | 107.78 | 4.456 |
| 8 | 30.58575 | -10.12438 | 2357.84336 | 15054.20244 | 108.32 | 4.756 |
| 9 | 29.60057 | -12.30951 | 2319.05684 | 14968.17347 | 112.58 | 7.156 |
| 10 | 29.11167 | -13.18185 | 2299.80873 | 14933.82943 | 114.36 | 8.156 |
| 11 | 28.98853 | -13.40157 | 2294.96062 | 14925.17902 | 114.81 | 8.408 |
| 12 | 28.86539 | -13.62129 | 2290.11250 | 14916.52862 | 115.26 | 8.659 |
| 13 | 27.05645 | -16.84895 | 2218.89450 | 14789.45565 | 121.91 | 12.359 |
| 14 | 26.93331 | -17.06867 | 2214.04638 | 14780.80524 | 122.36 | 12.611 |
| 15 | 26.81016 | -17.28839 | 2209.19827 | 14772.15483 | 122.82 | 12.863 |
| 16 | 26.66349 | -17.55009 | 2203.42383 | 14761.85162 | 123.35 | 13.163 |
| 17 | 25.31384 | -19.53095 | 2150.28779 | 14683.86484 | 127.65 | 15.563 |
| 18 | 24.68088 | -20.30514 | 2125.36832 | 14653.38496 | 129.44 | 16.563 |
| 19 | 24.52146 | -20.50014 | 2119.09173 | 14645.70783 | 129.90 | 16.815 |
| 20 | 24.36203 | -20.69514 | 2112.81514 | 14638.03071 | 130.35 | 17.067 |
| 21 | 24.17215 | -20.92740 | 2105.33930 | 14628.88675 | 130.88 | 17.367 |
| 22 | 22.49902 | -22.64380 | 2039.46825 | 14561.31174 | 135.18 | 19.767 |
| 23 | 21.74125 | -23.29632 | 2009.63459 | 14535.62213 | 136.98 | 20.767 |
| 24 | 21.55038 | -23.46067 | 2002.12024 | 14529.15156 | 137.43 | 21.019 |
| 25 | 21.35952 | -23.62502 | 1994.60589 | 14522.68099 | 137.88 | 21.271 |
| 26 | 18.55575 | -26.03933 | 1884.22134 | 14427.62945 | 144.53 | 24.971 |
| 27 | 18.36489 | -26.20368 | 1876.70699 | 14421.15888 | 144.98 | 25.223 |
| 28 | 18.17402 | -26.36804 | 1869.19264 | 14414.68832 | 145.42 | 25.474 |
| 29 | 17.94669 | -26.56379 | 1860.24254 | 14406.98143 | 145.96 | 25.774 |
| 30 | 16.00093 | -27.96359 | 1783.63794 | 14351.87143 | 150.22 | 28.174 |
| 31 | 15.14136 | -28.47460 | 1749.79557 | 14331.75266 | 152.00 | 29.174 |
| 32 | 14.92486 | -28.60331 | 1741.27277 | 14326.68525 | 152.45 | 29.426 |
| 33 | 14.70835 | -28.73203 | 1732.74898 | 14321.61784 | 152.89 | 29.678 |
| 34 | 14.45048 | -28.88533 | 1722.59657 | 14315.58221 | 153.42 | 29.978 |
| 35 | 12.29121 | -29.92598 | 1637.58601 | 14274.61170 | 157.67 | 32.378 |
| 36 | 11.35596 | -30.27997 | 1600.76518 | 14260.67508 | 159.44 | 33.378 |
| | 11.12040 | -30.36913 | 1591.49093 | 14257.16479 | 159.89 | 33.630 |

TABLE I

| | ELEMENT | X (M) | Y (M) | E-AGS(IN) | N-AGS(IN) | ANGLE | S (ORBIT) |
|----|---------|------------|------------|-------------|--------------|---------|-----------|
| 37 | GD | 10. 88483 | -30. 45830 | 1582. 21648 | 14253. 65450 | 160. 33 | 33. 882 |
| 38 | S30 | 10. 60426 | -30. 56449 | 1571. 17043 | 14249. 47352 | 160. 87 | 34. 182 |
| 39 | BEND | 8. 29709 | -31. 21438 | 1480. 33693 | 14223. 88737 | 165. 11 | 36. 582 |
| 40 | S100 | 7. 31458 | -31. 40059 | 1441. 65542 | 14216. 55635 | 166. 89 | 37. 582 |
| 41 | GF | 7. 06711 | -31. 44749 | 1431. 91251 | 14214. 70984 | 167. 33 | 37. 834 |
| 42 | GF | 6. 81964 | -31. 49439 | 1422. 16961 | 14212. 86334 | 167. 78 | 38. 086 |
| 43 | S30 | 6. 52488 | -31. 55025 | 1410. 56515 | 14210. 66404 | 168. 32 | 38. 386 |
| 44 | BEND | 4. 13991 | -31. 78963 | 1316. 66862 | 14201. 23967 | 172. 58 | 40. 786 |
| 45 | S100 | 3. 13999 | -31. 80240 | 1277. 30175 | 14200. 73700 | 174. 36 | 41. 786 |
| 46 | GD | 2. 88814 | -31. 80562 | 1267. 38622 | 14200. 61039 | 174. 81 | 42. 037 |
| 47 | GD | 2. 63628 | -31. 80883 | 1257. 47069 | 14200. 48378 | 175. 26 | 42. 289 |
| 48 | S370 | -1. 06341 | -31. 85607 | 1111. 81327 | 14198. 62389 | 181. 91 | 45. 989 |
| 49 | GF | -1. 31527 | -31. 85929 | 1101. 89774 | 14198. 49728 | 182. 36 | 46. 241 |
| 50 | GF | -1. 56712 | -31. 86251 | 1091. 98221 | 14198. 37067 | 182. 82 | 46. 493 |
| 51 | S30 | -1. 86710 | -31. 86634 | 1080. 17215 | 14198. 21987 | 183. 35 | 46. 793 |
| 52 | BEND | -4. 25741 | -31. 68793 | 986. 06560 | 14205. 24364 | 187. 65 | 49. 193 |
| 53 | S100 | -5. 24435 | -31. 52687 | 947. 20951 | 14211. 58459 | 189. 44 | 50. 193 |
| 54 | GD | -5. 49294 | -31. 48630 | 937. 42263 | 14213. 18171 | 189. 90 | 50. 445 |
| 55 | GD | -5. 74152 | -31. 44574 | 927. 63576 | 14214. 77884 | 190. 35 | 50. 697 |
| 56 | S30 | -6. 03761 | -31. 39742 | 915. 97893 | 14216. 68113 | 190. 88 | 50. 997 |
| 57 | BEND | -8. 36062 | -30. 80665 | 824. 52173 | 14239. 93962 | 195. 18 | 53. 397 |
| 58 | S100 | -9. 30460 | -30. 47666 | 787. 35705 | 14252. 93153 | 196. 98 | 54. 397 |
| 59 | GF | -9. 54237 | -30. 39354 | 777. 99619 | 14256. 20386 | 197. 43 | 54. 649 |
| 60 | GF | -9. 78013 | -30. 31042 | 768. 63534 | 14259. 47620 | 197. 88 | 54. 901 |
| 61 | S370 | -13. 27287 | -29. 08945 | 631. 12602 | 14307. 54625 | 204. 53 | 58. 601 |
| 62 | GD | -13. 51064 | -29. 00633 | 621. 76517 | 14310. 81858 | 204. 98 | 58. 852 |
| 63 | GD | -13. 74840 | -28. 92321 | 612. 40431 | 14314. 09092 | 205. 42 | 59. 104 |
| 64 | S30 | -14. 03160 | -28. 82421 | 601. 25491 | 14317. 98849 | 205. 96 | 59. 404 |
| 65 | BEND | -16. 21673 | -27. 83903 | 515. 22594 | 14356. 77501 | 210. 22 | 61. 804 |
| 66 | S100 | -17. 08907 | -27. 35013 | 480. 88190 | 14376. 02312 | 212. 00 | 62. 804 |
| 67 | GF | -17. 30879 | -27. 22699 | 472. 23149 | 14380. 87124 | 212. 45 | 63. 056 |
| 68 | GF | -17. 52851 | -27. 10385 | 463. 58109 | 14385. 71936 | 212. 89 | 63. 308 |
| 69 | S30 | -17. 79021 | -26. 95718 | 453. 27787 | 14391. 49379 | 213. 42 | 63. 608 |
| 70 | BEND | -19. 77108 | -25. 60752 | 375. 29109 | 14444. 62983 | 217. 67 | 66. 008 |
| 71 | S100 | -20. 54527 | -24. 97457 | 344. 81121 | 14469. 54930 | 219. 44 | 67. 008 |
| 72 | GD | -20. 74027 | -24. 81514 | 337. 13409 | 14475. 82589 | 219. 89 | 67. 260 |

TABLE I

| | ELEMENT | X (M) | Y (M) | E-AGS (IN) | N-AGS (IN) | ANGLE | S (ORBIT) |
|-----|---------|-----------|-----------|------------|-------------|--------|-----------|
| 73 | GD | -20.93527 | -24.65572 | 329.45697 | 14482.10248 | 220.33 | 67.512 |
| 74 | S30 | -21.16752 | -24.46583 | 320.31300 | 14489.57832 | 220.87 | 67.812 |
| 75 | BEND | -22.88393 | -22.79271 | 252.73799 | 14555.44937 | 225.11 | 70.212 |
| 76 | S100 | -23.53644 | -22.03493 | 227.04838 | 14585.28303 | 226.89 | 71.212 |
| 77 | GF | -23.70080 | -21.84407 | 220.57781 | 14592.79738 | 227.33 | 71.464 |
| 78 | GF | -23.86515 | -21.65320 | 214.10724 | 14600.31174 | 227.78 | 71.716 |
| 79 | S30 | -24.06090 | -21.42587 | 206.40036 | 14609.26183 | 228.32 | 72.016 |
| 80 | BEND | -25.46070 | -19.48011 | 151.29036 | 14685.86643 | 232.58 | 74.416 |
| 81 | S100 | -25.97171 | -18.62054 | 131.17159 | 14719.70780 | 234.36 | 75.416 |
| 82 | GD | -26.10043 | -18.40404 | 126.10418 | 14728.23160 | 234.81 | 75.667 |
| 83 | GD | -26.22914 | -18.18753 | 121.03677 | 14736.75940 | 235.26 | 75.919 |
| 84 | S370 | -28.11990 | -15.00712 | 46.59735 | 14861.98848 | 241.91 | 79.619 |
| 85 | GF | -28.24861 | -14.79062 | 41.52994 | 14870.49227 | 242.36 | 79.871 |
| 86 | GF | -28.37732 | -14.57411 | 36.46252 | 14879.01607 | 242.82 | 80.123 |
| 87 | S30 | -28.53063 | -14.31624 | 30.42689 | 14889.16848 | 243.35 | 80.423 |
| 88 | BEND | -29.57128 | -12.15697 | -10.54362 | 14974.17903 | 247.65 | 82.823 |
| 89 | S100 | -29.92527 | -11.22172 | -24.48024 | 15010.99987 | 249.44 | 83.823 |
| 90 | GD | -30.01443 | -10.98616 | -27.99053 | 15020.27411 | 249.90 | 84.075 |
| 91 | GD | -30.10359 | -10.75059 | -31.50081 | 15029.54836 | 250.35 | 84.327 |
| 92 | S30 | -30.20979 | -10.47002 | -35.68180 | 15040.59461 | 250.88 | 84.627 |
| 93 | BEND | -30.85968 | -8.16285 | -61.26795 | 15131.42812 | 255.18 | 87.027 |
| 94 | S100 | -31.04589 | -7.18034 | -68.59897 | 15170.10963 | 256.98 | 88.027 |
| 95 | GF | -31.09279 | -6.93287 | -70.44547 | 15179.85253 | 257.43 | 88.279 |
| 96 | GF | -31.13969 | -6.68540 | -72.29197 | 15189.59944 | 257.88 | 88.531 |
| 97 | S370 | -31.82866 | -3.05011 | -99.41675 | 15332.71703 | 264.53 | 92.231 |
| 98 | GD | -31.87556 | -2.80264 | -101.26325 | 15342.45993 | 264.98 | 92.482 |
| 99 | GD | -31.92246 | -2.55517 | -103.10975 | 15352.20284 | 265.42 | 92.734 |
| 100 | S30 | -31.97832 | -2.26041 | -105.30906 | 15363.80729 | 265.96 | 93.034 |
| 101 | BEND | -32.21770 | 1.2456 | -114.73342 | 15457.70382 | 270.22 | 95.434 |
| 102 | S100 | -32.23047 | 1.12448 | -115.36271 | 15497.07069 | 272.00 | 96.434 |
| 103 | GF | -32.23368 | 1.37633 | -115.36271 | 15506.98622 | 272.44 | 96.686 |
| 104 | GF | -32.23690 | 1.62818 | -115.48932 | 15516.90175 | 272.89 | 96.938 |
| 105 | S30 | -32.24073 | 1.92816 | -115.64012 | 15528.71181 | 273.42 | 97.238 |
| 106 | BEND | -32.06233 | 4.31847 | -108.61635 | 15622.81837 | 277.67 | 99.638 |
| 107 | S100 | -31.90127 | 5.30541 | -102.27540 | 15661.67446 | 279.44 | 100.638 |
| 108 | GD | -31.86070 | 5.55400 | -100.67827 | 15671.46133 | 279.89 | 100.890 |

TABLE I

| | ELEMENT | X (M) | Y (M) | E-AGS(IN) | N-AGS(IN) | ANGLE | S (ORBIT) |
|-----|---------|-----------|----------|-----------|-------------|--------|-----------|
| 109 | GD | -31.82013 | 5.80258 | -99.08114 | 15681.24821 | 280.33 | 101.142 |
| 110 | S30 | -31.77182 | 6.09867 | -97.17886 | 15692.90503 | 280.87 | 101.442 |
| 111 | BEND | -31.18105 | 8.42168 | -73.92036 | 15784.34224 | 285.11 | 103.842 |
| 112 | S100 | -30.85105 | 9.36566 | -60.92846 | 15821.52692 | 286.89 | 104.842 |
| 113 | GF | -30.76794 | 9.60343 | -57.65612 | 15830.88777 | 287.33 | 105.094 |
| 114 | GF | -30.68482 | 9.84120 | -54.38379 | 15840.24862 | 287.78 | 105.346 |
| 115 | S30 | -30.58582 | 10.12439 | -50.48621 | 15851.39803 | 288.32 | 105.646 |
| 116 | BEND | -29.60064 | 12.30953 | -11.69969 | 15937.42699 | 292.58 | 108.046 |
| 117 | S100 | -29.11174 | 13.18186 | 7.54842 | 15971.77104 | 294.36 | 109.046 |
| 118 | GD | -28.98860 | 13.40158 | 12.39653 | 15980.42145 | 294.81 | 109.297 |
| 119 | GD | -28.86546 | 13.62131 | 17.24465 | 15989.07185 | 295.26 | 109.549 |
| 120 | S370 | -27.05652 | 16.84896 | 88.46265 | 16116.14482 | 301.91 | 113.249 |
| 121 | GF | -26.93338 | 17.06868 | 93.31077 | 16124.79523 | 302.36 | 113.501 |
| 122 | GF | -26.81024 | 17.28840 | 98.15888 | 16133.44563 | 302.82 | 113.753 |
| 123 | S30 | -26.66357 | 17.55010 | 103.93332 | 16143.74885 | 303.35 | 114.053 |
| 124 | BEND | -25.31391 | 19.53096 | 157.06936 | 16221.73563 | 307.65 | 116.453 |
| 125 | S100 | -24.68096 | 20.30515 | 181.98883 | 16252.21551 | 309.44 | 117.453 |
| 126 | GD | -24.52153 | 20.50015 | 188.26542 | 16259.89263 | 309.90 | 117.705 |
| 127 | GD | -24.36211 | 20.69515 | 194.54201 | 16267.56975 | 310.35 | 117.957 |
| 128 | S30 | -24.17222 | 20.92741 | 202.01785 | 16276.71372 | 310.88 | 118.257 |
| 129 | BEND | -22.49909 | 22.64381 | 267.88890 | 16344.28873 | 315.18 | 120.657 |
| 130 | S100 | -21.74132 | 23.29633 | 297.72256 | 16369.97833 | 316.98 | 121.657 |
| 131 | GF | -21.55045 | 23.46068 | 305.23691 | 16376.44890 | 317.43 | 121.909 |
| 132 | GF | -21.35959 | 23.62503 | 312.75126 | 16382.91947 | 317.88 | 122.161 |
| 133 | S370 | -18.55582 | 26.03934 | 423.13581 | 16477.97101 | 324.53 | 125.861 |
| 134 | GD | -18.36496 | 26.20370 | 430.65016 | 16484.44158 | 324.98 | 126.112 |
| 135 | GD | -18.17409 | 26.36805 | 438.16451 | 16490.91215 | 325.42 | 126.364 |
| 136 | S30 | -17.94676 | 26.56380 | 447.11461 | 16498.61903 | 325.96 | 126.664 |
| 137 | BEND | -16.00100 | 27.96360 | 523.71921 | 16553.72904 | 330.22 | 129.064 |
| 138 | S100 | -15.14143 | 28.47461 | 557.56058 | 16573.84780 | 332.00 | 130.064 |
| 139 | GF | -14.92493 | 28.60333 | 566.08438 | 16578.91522 | 332.44 | 130.316 |
| 140 | GF | -14.70842 | 28.73204 | 574.60817 | 16583.98263 | 332.89 | 130.568 |
| 141 | S30 | -14.45055 | 28.88534 | 584.76058 | 16590.01826 | 333.42 | 130.868 |
| 142 | BEND | -12.29129 | 29.92599 | 669.77114 | 16630.98877 | 337.67 | 133.268 |
| 143 | S100 | -11.35604 | 30.27998 | 706.59197 | 16644.92539 | 339.44 | 134.268 |
| 144 | GD | -11.12047 | 30.36915 | 715.86622 | 16648.43568 | 339.89 | 134.520 |

TABLE I

| ELEMENT | X (M) | Y (M) | E-AGS(IN) | N-AGS(IN) | ANGLE | S (ORBIT) |
|---------|-----------|----------|------------|-------------|--------|-----------|
| 145 | | | | | | |
| 146 | | | | | | |
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| 179 | | | | | | |
| 180 | | | | | | |
| GD | -10.88490 | 30.45831 | 725.14047 | 16651.94596 | 340.33 | 134.772 |
| S30 | -10.60433 | 30.56450 | 736.18671 | 16656.12695 | 340.87 | 135.072 |
| BEND | -8.29716 | 31.21439 | 827.02022 | 16681.71310 | 345.11 | 137.472 |
| S100 | -7.31465 | 31.40060 | 865.70173 | 16689.04412 | 346.89 | 138.472 |
| GF | -7.06718 | 31.44750 | 875.44464 | 16690.89062 | 347.33 | 138.724 |
| GF | -6.81971 | 31.49440 | 885.18754 | 16692.73712 | 347.78 | 138.976 |
| S30 | -6.52496 | 31.55027 | 896.79200 | 16694.93643 | 348.32 | 139.276 |
| BEND | -4.13998 | 31.78964 | 990.68853 | 16704.36080 | 352.58 | 141.676 |
| S100 | -3.14006 | 31.80241 | 1030.05540 | 16704.86347 | 354.36 | 142.676 |
| GD | -2.88821 | 31.80563 | 1039.97093 | 16704.99008 | 354.81 | 142.927 |
| GD | -2.63636 | 31.80884 | 1049.88646 | 16705.11669 | 355.26 | 143.179 |
| S370 | 1.06334 | 31.85609 | 1195.54388 | 16706.97658 | 1.91 | 146.879 |
| GF | 1.31520 | 31.85930 | 1205.45941 | 16707.10319 | 2.36 | 147.131 |
| GF | 1.56705 | 31.86252 | 1215.37494 | 16707.22980 | 2.82 | 147.383 |
| S30 | 1.86703 | 31.86635 | 1227.18500 | 16707.38060 | 3.35 | 147.683 |
| BEND | 4.25733 | 31.68794 | 1321.29155 | 16700.35683 | 7.65 | 150.083 |
| S100 | 5.24428 | 31.52688 | 1360.14764 | 16694.01588 | 9.44 | 151.083 |
| GD | 5.49286 | 31.48632 | 1369.93452 | 16692.41875 | 9.90 | 151.335 |
| GD | 5.74145 | 31.44575 | 1379.72139 | 16690.82163 | 10.35 | 151.587 |
| S30 | 6.03753 | 31.39743 | 1391.37822 | 16688.91934 | 10.88 | 151.887 |
| BEND | 8.36055 | 30.80667 | 1482.83542 | 16665.66085 | 15.18 | 154.287 |
| S100 | 9.30453 | 30.47667 | 1520.00010 | 16652.66894 | 16.98 | 155.287 |
| GF | 9.54230 | 30.39355 | 1529.36095 | 16649.39660 | 17.43 | 155.539 |
| GF | 9.78006 | 30.31044 | 1538.72181 | 16646.12427 | 17.88 | 155.791 |
| S370 | 13.27280 | 29.08946 | 1676.23113 | 16598.05422 | 24.53 | 159.491 |
| GD | 13.51056 | 29.00634 | 1685.59198 | 16594.78188 | 24.98 | 159.742 |
| GD | 13.74833 | 28.92322 | 1694.95284 | 16591.50955 | 25.42 | 159.994 |
| S30 | 14.03152 | 28.82422 | 1706.10224 | 16587.61198 | 25.96 | 160.294 |
| BEND | 16.21666 | 27.83905 | 1792.13121 | 16548.82545 | 30.22 | 162.694 |
| S100 | 17.08900 | 27.35014 | 1826.47525 | 16529.57734 | 32.00 | 163.694 |
| GF | 17.30872 | 27.22700 | 1835.12566 | 16524.72923 | 32.44 | 163.946 |
| GF | 17.52844 | 27.10386 | 1843.77606 | 16519.88111 | 32.89 | 164.198 |
| S30 | 17.79014 | 26.95719 | 1854.07928 | 16514.10668 | 33.42 | 164.498 |
| BEND | 19.77101 | 25.60753 | 1932.06606 | 16460.97064 | 37.67 | 166.898 |
| S100 | 20.54519 | 24.97458 | 1962.54594 | 16436.05117 | 39.44 | 167.898 |
| GD | 20.74019 | 24.81515 | 1970.22306 | 16429.77458 | 39.89 | 168.150 |

TABLE I

| | ELEMENT | X (M) | Y (M) | E-AGS(IN) | N-AGS(IN) | ANGLE | S (ORBIT) |
|-----|---------|-----------|-----------|-------------|--------------|--------|-----------|
| 181 | QD | 20. 93519 | 24. 65573 | 1977. 90018 | 16423. 49799 | 40. 33 | 168. 402 |
| 182 | S30 | 21. 16745 | 24. 46584 | 1987. 04415 | 16416. 02215 | 40. 87 | 168. 702 |
| 183 | BEND | 22. 88385 | 22. 79272 | 2054. 61916 | 16350. 15110 | 45. 11 | 171. 102 |
| 184 | S100 | 23. 53637 | 22. 03494 | 2080. 30877 | 16320. 31744 | 46. 89 | 172. 102 |
| 185 | QF | 23. 70072 | 21. 84408 | 2086. 77934 | 16312. 80309 | 47. 33 | 172. 354 |
| 186 | QF | 23. 86508 | 21. 65321 | 2093. 24990 | 16305. 28873 | 47. 78 | 172. 606 |
| 187 | S30 | 24. 06083 | 21. 42588 | 2100. 95679 | 16296. 33863 | 48. 32 | 172. 906 |
| 188 | BEND | 25. 46062 | 19. 48012 | 2156. 06679 | 16219. 73404 | 52. 58 | 175. 306 |
| 189 | S100 | 25. 97164 | 18. 62055 | 2176. 18556 | 16185. 89266 | 54. 36 | 176. 306 |
| 190 | QD | 26. 10035 | 18. 40405 | 2181. 25297 | 16177. 34887 | 54. 81 | 176. 557 |
| 191 | QD | 26. 22907 | 18. 18754 | 2186. 32038 | 16168. 84507 | 55. 26 | 176. 809 |
| 192 | S370 | 28. 11983 | 15. 00713 | 2260. 75980 | 16043. 63199 | 61. 91 | 180. 509 |
| 193 | QF | 28. 24854 | 14. 79063 | 2265. 82721 | 16035. 10820 | 62. 36 | 180. 761 |
| 194 | QF | 28. 37725 | 14. 57412 | 2270. 89463 | 16026. 58440 | 62. 82 | 181. 013 |
| 195 | S30 | 28. 53056 | 14. 31625 | 2276. 93026 | 16016. 43199 | 63. 35 | 181. 313 |
| 196 | BEND | 29. 57121 | 12. 15698 | 2317. 90077 | 15931. 42143 | 67. 65 | 183. 713 |
| 197 | S100 | 29. 92520 | 11. 22174 | 2331. 83739 | 15894. 60060 | 69. 44 | 184. 713 |
| 198 | QD | 30. 01436 | 10. 98617 | 2335. 34767 | 15885. 32635 | 69. 90 | 184. 965 |
| 199 | QD | 30. 10352 | 10. 75060 | 2338. 85796 | 15876. 05211 | 70. 35 | 185. 217 |
| 200 | S30 | 30. 20972 | 10. 47003 | 2343. 03895 | 15865. 00586 | 70. 88 | 185. 517 |
| 201 | BEND | 30. 85961 | 8. 16286 | 2368. 62510 | 15774. 17235 | 75. 18 | 187. 917 |
| 202 | S100 | 31. 04581 | 7. 18035 | 2375. 95612 | 15735. 49084 | 76. 98 | 188. 917 |
| 203 | QF | 31. 09271 | 6. 93288 | 2377. 80262 | 15725. 74793 | 77. 43 | 189. 169 |
| 204 | QF | 31. 13962 | 6. 68541 | 2379. 64912 | 15716. 00503 | 77. 88 | 189. 421 |
| 205 | S370 | 31. 82859 | 3. 05012 | 2406. 77390 | 15572. 88344 | 84. 53 | 193. 121 |
| 206 | QD | 31. 87549 | 2. 80265 | 2408. 62040 | 15563. 14054 | 84. 98 | 193. 372 |
| 207 | QD | 31. 92239 | 2. 55518 | 2410. 46690 | 15553. 39763 | 85. 42 | 193. 624 |
| 208 | S30 | 31. 97825 | 2. 26043 | 2412. 66621 | 15541. 79318 | 85. 96 | 193. 924 |
| 209 | BEND | 32. 21763 | -1. 12455 | 2422. 09057 | 15447. 89665 | 90. 22 | 196. 324 |
| 210 | S100 | 32. 23040 | -1. 12446 | 2422. 59325 | 15408. 52978 | 92. 00 | 197. 324 |
| 211 | QF | 32. 23361 | -1. 37632 | 2422. 71986 | 15398. 61425 | 92. 44 | 197. 576 |
| 212 | QF | 32. 23683 | -1. 62817 | 2422. 84647 | 15388. 69872 | 92. 89 | 197. 828 |
| 213 | S30 | 32. 24066 | -1. 92815 | 2422. 99727 | 15376. 88865 | 93. 42 | 198. 128 |
| 214 | BEND | 32. 06225 | -4. 31845 | 2415. 97350 | 15282. 78210 | 97. 67 | 200. 528 |
| 215 | S100 | 31. 90119 | -5. 30540 | 2409. 63255 | 15243. 92601 | 99. 44 | 201. 528 |
| 216 | QD | 31. 86063 | -5. 56399 | 2408. 03542 | 15234. 13914 | 99. 89 | 201. 780 |

TABLE II

| APEX AGS COORD (INCHES) | | | APEX LAB COORD (FEET) | | |
|---------------------------------------|----------|----------|--------------------------|-------------|--|
| | NORTH | EAST | NORTH | EAST | |
| F7 | 15495.25 | 2421.487 | 102441.2714 | 98623.24061 | |
| F8 | 15329.52 | 2423.603 | 102427.4606 | 98623.41695 | |
| A1 | 15165.94 | 2396.908 | 102413.8290 | 98621.19241 | |
| A2 | 15009.49 | 2342.214 | 102400.7909 | 98616.63457 | |
| A3 | | | | | |
| A4 | 14720.53 | 2180.268 | 102376.7111 | 98603.13907 | |
| A5 | 14592.21 | 2075.361 | 102366.0181 | 98594.39678 | |
| A6 | | | | | |
| A7 | 14376.07 | 1824.352 | 102348.0062 | 98573.47937 | |
| A8 | 14291.37 | 1681.884 | 102340.9481 | 98561.60708 | |
| B1 | 14232.70 | 1526.874 | 102336.0588 | 98548.68953 | |
| B2 | 14201.84 | 1364.030 | 102333.4870 | 98535.11921 | |
| B3 | | | | | |
| B4 | 14197.61 | 1032.813 | 102333.1345 | 98507.51775 | |
| B5 | 14224.30 | 869.2342 | 102335.3590 | 98493.88619 | |
| B6 | | | | | |
| B7 | 14333.61 | 556.5451 | 102344.4681 | 98467.82876 | |
| B8 | 14414.65 | 411.9614 | 102351.2208 | 98455.78012 | |
| C1 | 14519.55 | 283.6453 | 102359.9631 | 98445.08711 | |
| C2 | 14645.15 | 175.4957 | 102370.4294 | 98436.07464 | |
| C3 | | | | | |
| C4 | 14929.88 | 6.224075 | 102394.1567 | 98421.96867 | |
| C5 | 15084.89 | -52.4471 | 102407.0743 | 98417.07940 | |
| C6 | | | | | |
| C7 | 15410.34 | -114.127 | 102434.1952 | 98411.93939 | |
| C8 | 15576.07 | -116.243 | 102448.0060 | 98411.76304 | |
| D1 | 15739.65 | -89.5489 | 102461.6375 | 98413.98758 | |
| D2 | 15896.10 | -34.8548 | 102474.6757 | 98418.54542 | |
| D3 | | | | | |
| D4 | 16185.06 | 127.0910 | 102498.7555 | 98432.04092 | |
| D5 | 16313.38 | 231.9985 | 102509.4485 | 98440.78321 | |
| D6 | | | | | |
| D7 | 16529.52 | 483.0075 | 102527.4604 | 98461.70062 | |
| D8 | 16614.22 | 625.4750 | 102534.5185 | 98473.57291 | |
| E1 | 16672.89 | 780.4856 | 102539.4077 | 98486.49046 | |
| E2 | 16703.75 | 943.3294 | 102541.9796 | 98500.06078 | |
| E3 | | | | | |
| E4 | 16707.98 | 1274.546 | 102542.3321 | 98527.66224 | |
| E5 | 16681.29 | 1438.125 | 102540.1075 | 98541.29381 | |
| E6 | | | | | |
| E7 | 16571.98 | 1750.814 | 102530.9984 | 98567.35123 | |
| E8 | 16490.94 | 1895.398 | 102524.2458 | 98579.39987 | |
| F1 | 16386.04 | 2023.714 | 102515.5035 | 98590.09288 | |
| F2 | 16260.44 | 2131.864 | 102505.0372 | 98599.10535 | |
| F3 | | | | | |
| F4 | 15975.71 | 2301.135 | 102481.3099 | 98613.21132 | |
| F5 | 15820.70 | 2359.807 | 102468.3923 | 98618.10059 | |
| F6 | | | | | |
| CENTER | | | 15452.8 NORTH (INCHES) | | |
| COORD | | | 1153.68 EAST (INCHES) | | |
| CIRCUMFERENCE= | | | 201.78 METERS | | |
| ANGLE BETWEEN FA JUNCTION AND EAST IS | | | 0.161764 RADIANS | | |

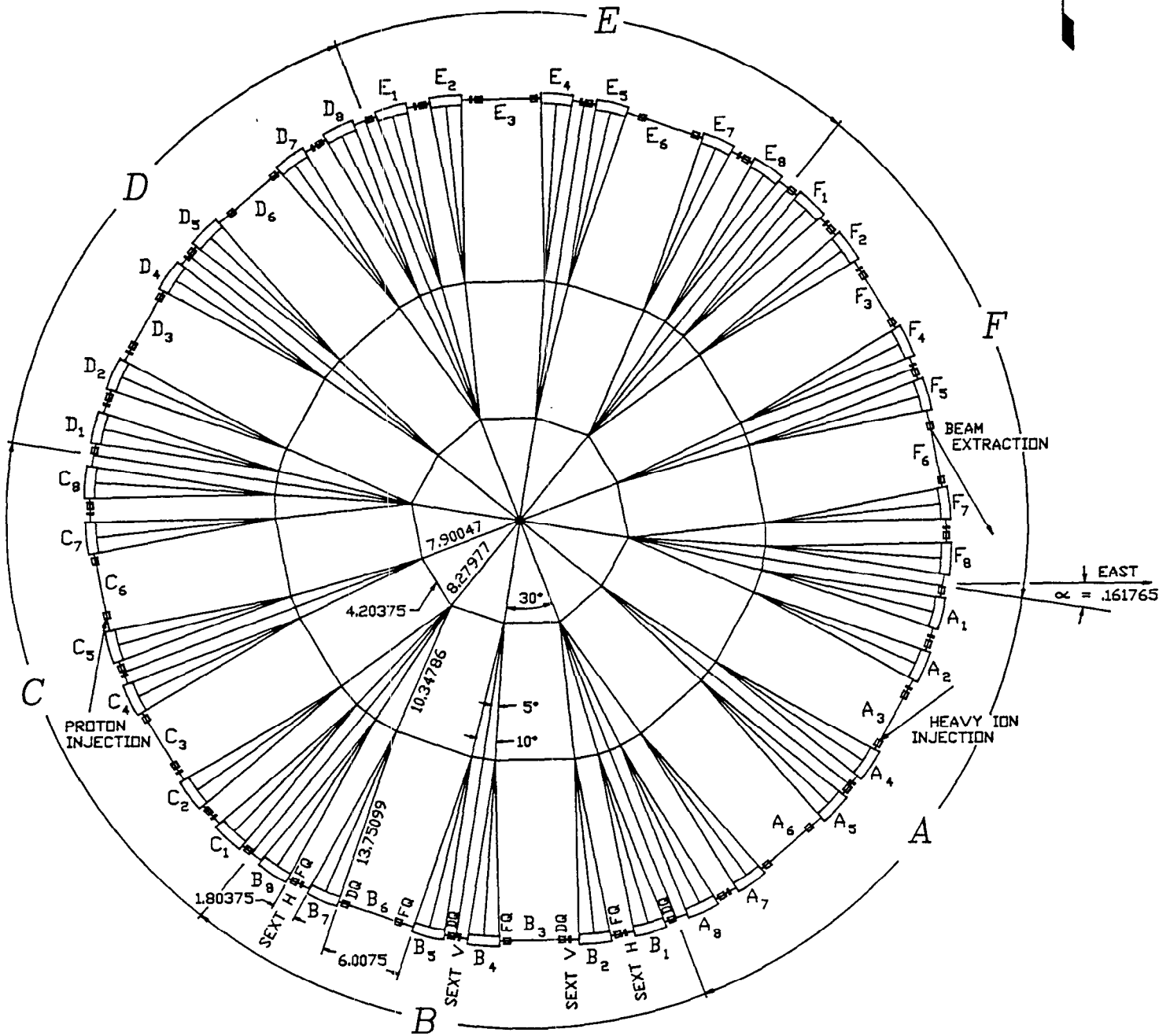


FIG. 1 Overall Layout of the AGS Booster

0 5
METERS

NOTE: ALL DIMENSIONS ARE IN METERS

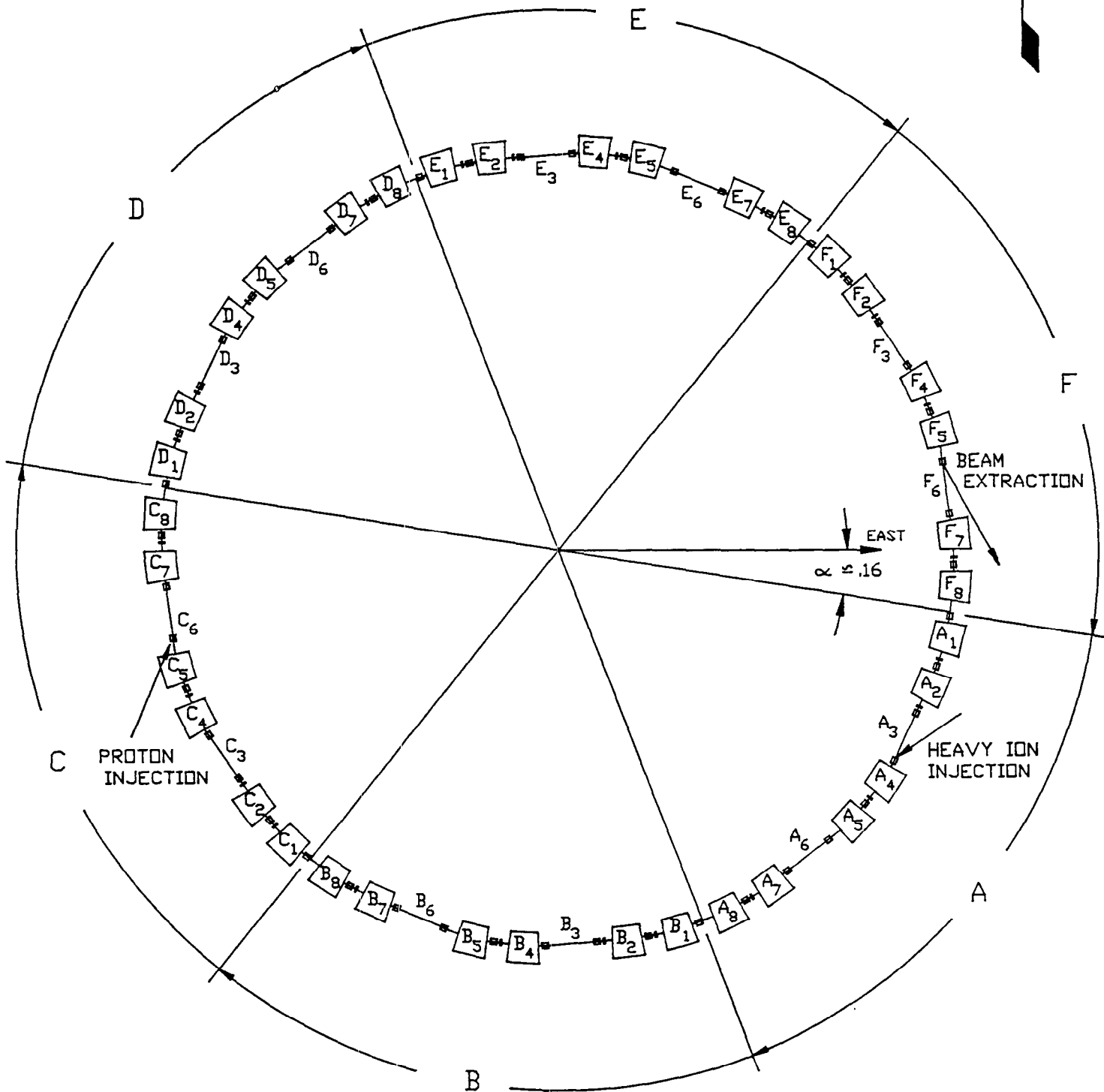
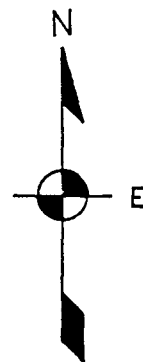


Fig.2 Layout of the AGS Booster showing the relative position of magnets (e.g. Dipole Apex locations) and labeling convention of the Booster Superperiods. (A to F, with the Beam in the Clockwise direction).

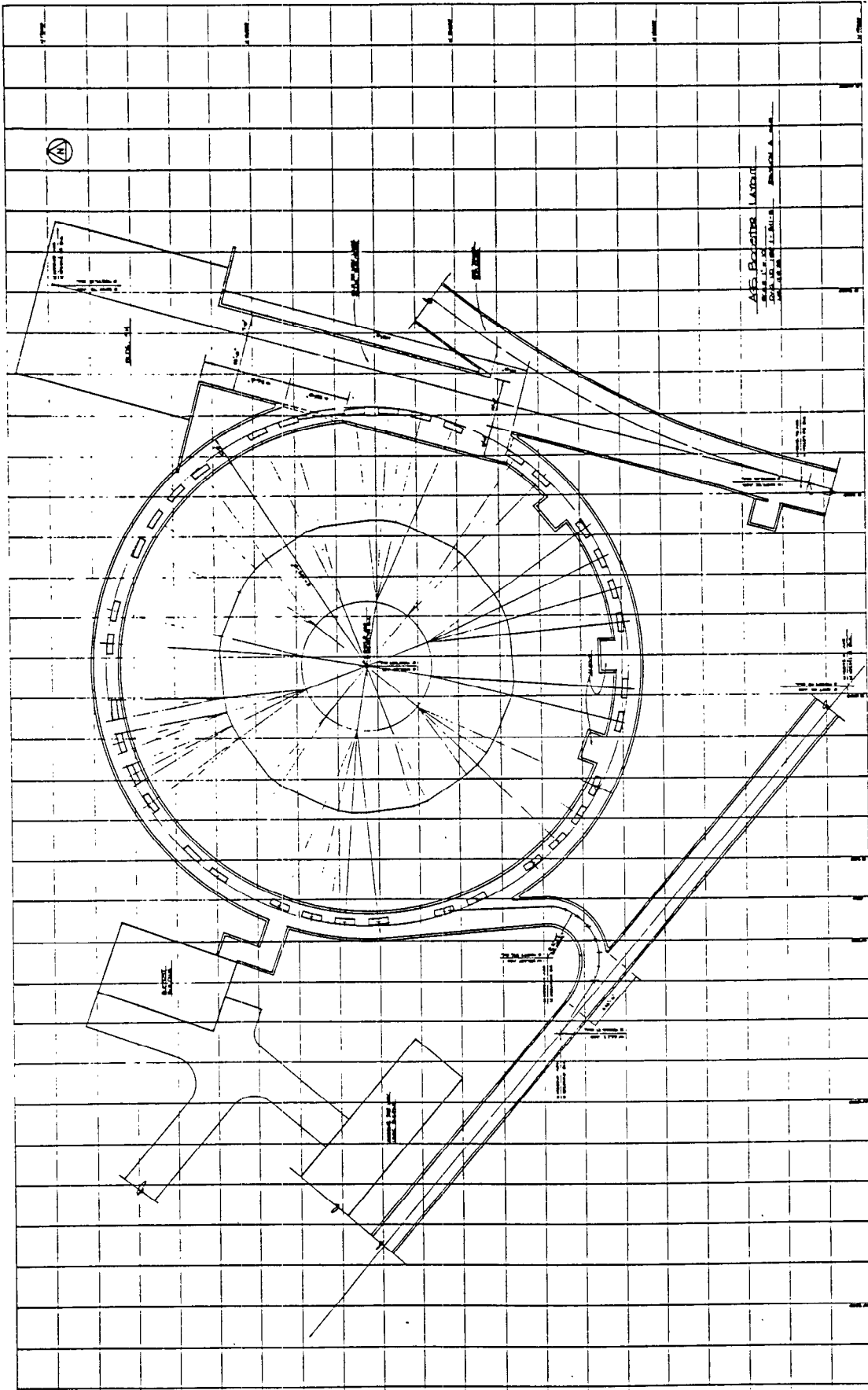


Fig. 3 Construction map of AGS Booster