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LAWRENCE RADIATION LABORATORY
UNIVERSITY of CALIFORNIA BERKELEY

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ABSTRACT

Starting from an energy-independent phase-shift analysis carried out at 26 momenta between 385 and 1700 MeV/c, we attempt to find the proper energy continuation through these momenta. We compare several path-finding schemes which are designed to take into consideration both the continuity and the smoothness of the partial-wave amplitudes as viewed on an Argand diagram. While differing in detail, the various methods yield essentially the same results for the important partial waves. These results agree in general with paths found by other methods, but contain some evidence for additional resonances between 1500 and 1700 MeV.

I. INTRODUCTION

In a typical energy-independent phase-shift analysis there exist many possible solutions at a given energy. The hope is that the tremendous ambiguities which result when each energy is considered separately will be reduced or removed by imposing certain theoretical assumptions on the behavior of each partial-wave amplitude as a function of energy. We assume that each partial-wave amplitude is continuous and maintains a certain amount of "smoothness" when plotted on an Argand diagram. We investigate several criteria for continuity, and in addition impose certain demands for smoothness. We hope that these added theoretical assumptions will be enough to enable us to select one solution at each energy which will make up the proper energy-continued path. This work is a continuation of earlier work on pion-nucleon scattering carried out at Berkeley.[1]

In Section II we discuss briefly the methods used in obtaining the energy-independent phase-shift solutions. In Section III we examine various methods for selecting an energy continuation and compare these paths with the one found by Lovelace[2] using a more complicated method in which continuity is applied through partial-wave dispersion relations.

II. PION-NUCLEON PHASE-SHIFT ANALYSIS

An energy-independent phase-shift analysis of pion-nucleon scattering was carried out at Berkeley several years ago.[1] Solutions were found at some 26 momenta from $p_{lab} = 385$ to $p_{lab} = 1700$ MeV/c. For completeness we shall briefly mention the method used to obtain the solutions.

At each of the 26 momenta initial guesses for the parameters $\eta_{I,j,\ell}$ and $\delta_{I,j,\ell}$ are made. Then by use of a variable-metric minimization scheme called ORPHEUS these parameters are varied in an attempt to get a good fit to the data by minimizing χ^2. The data include the π^+,π^- and charge-exchange differential cross sections as well as the π^+ and π^- polarizations. The parameters η and δ are related to the transition matrix in the usual way:

$$T_{I,j,\ell} = [\eta_{I,j,\ell} \exp(2i\, \delta_{I,j,\ell}) - 1]/2i$$

where I is the isospin, j the total angular momentum, and ℓ the orbital angular momentum. The analysis includes waves through G waves ($\ell = 4$) and involves both $I = 1/2$ and $I = 3/2$.

The initial guesses for the η's and δ's are obtained by one of three methods. One consists of starting with a rather coarse survey conducted with a ravine-following minimization method using starting points chosen randomly in the general vicinity of the solutions published by other groups, and then to use the minima found here as initial guesses in ORPHEUS. A second method used to obtain initial guesses is to use the first method to obtain solutions at momenta

k_{n-1} or k_{n+1} and then to use these as initial guesses at momenta k_n. This method is particularly useful when one is trying to continue to k_n a path that stops at k_{n-1}. The third method consists of simply using solutions obtained by other groups as starting points.

At each momenta solutions with intolerable χ^2 are removed. In the earlier work done at Berkeley[1] solutions that were approximately equal were also edited out. In this work, however, we have included all solutions that are not exactly equal. In Table I we list at each momentum the degrees of freedom (number of data points), the best χ^2, the worst χ^2, and the number of solutions remaining after editing. We feel it is important when carrying out energy-continuation procedures to have many solutions at each energy. We must require, however, that the χ^2 of each solution remain reasonably good. The χ^2 value alone is not a very good way of deciding which solution at each energy is the right one. For example, an energy continuation made up of the best χ^2 at each energy has very discontinuous and rough behavior and hence is unsatisfactory. On the other hand, a method that imposes smoothness while ignoring χ^2 may give a poor fit to the data. The best method is one that keeps only reasonable χ^2, but has enough solutions at each energy to allow the smoothing program freedom to find a smooth and continuous path.

III. ENERGY CONTINUATION

The problem is to define a procedure by which a computer can pick out one solution at each energy in such a way that the resultant path is both continuous and smooth when viewed on an Argand diagram. We attempt to find a proper energy continuation through the 26 momenta listed in Table I, using a criterion of continuity based on a method of "minimal path." We define a "distance" D_i for the path i as

$$D_i^{sum} = \sum_{\ell,j,I} \sum_{k=k_{min}}^{k_{max}} d(\ell,j,I,k,i), \qquad (1)$$

where a path consists of one solution at each momentum k, and where ℓ is the orbital angular momentum, j the total angular momentum, and I the isospin. We investigate various choices for the function $d(\ell,j,I,k,i)$, the simplest being just the geometric distance between two points on the Argand diagram,

$$d_0(\ell,j,I,k,i) = \left|\underset{\sim}{T}(\ell,j,I,k,i) - \underset{\sim}{T}(\ell,j,I,k-1,i)\right| , \qquad (2)$$

where $\underset{\sim}{T}$ is the appropriate partial-wave amplitude (see Fig. 1). The proper energy-continued path is assumed to be that path i_{min} for which the "distance" D is minimum. Another definition of "distance" we shall investigate is

$$D_i^{Euc} = \sum_{k=k_{min}}^{k_{max}} \left(\sum_{\ell,j,I} d^2(\ell,j,I,k,i)\right)^{\frac{1}{2}} . \qquad (3)$$

In this definition of distance we are considering the ℓ, j, and I variables as making up a many-dimensional Euclidian space, whereas D_i^{sum} is just the sum over ℓ, j, and I of each path length

$$\sum_{k=k_{min}}^{k_{max}} d(\ell,j,I,k,i),$$

which is the length of a path viewed on an Argand diagram for a given ℓ, j, and I.

The problem with using just the geometric distance [Eq. (2)] for d is that although it does incorporate the idea of continuity (i.e., the solution does not change much when the energy is changed slightly), it does not produce paths that are smooth. Indeed, the computer would select path 1,2,3,4b over path 1,2,3,4a in Fig. 2. To correct this we define

$$d(\ell,j,I,k,i) = [1/(a + \cos\Theta)]\ d_0(\ell,j,I,k,i),$$

where Θ is the angle between the vectors

$$\underset{\sim}{A} = \underset{\sim}{T}(\ell,j,I,k-1,i) - \underset{\sim}{T}(\ell,j,I,k-2,i)$$

and

$$\underset{\sim}{B} = \underset{\sim}{T}(\ell,j,I,k,i) - \underset{\sim}{T}(\ell,j,I,k-1,i),$$

and where $d_0(\ell,j,I,k,i)$ is defined in Eq. (2) (see Fig. 3). For fixed d_0 the parameter a determines the ratio of the distance d in the forward direction $\Theta = 0$ to the distance in the backward direction $\Theta = 180°$. This ratio is $(a - 1)/(a + 1)$. For example if $a = 1.5$ for fixed d_0 the distance d in the backward direction is five times that in the forward direction. Figure 4 shows a line of constant $d(\ell,j,I,k,i)$ for $a = 1.5$. We do not want to bias too much in the forward direction, for this would tend to wash out resonance loops. However, by suitably choosing the value of a we can be assured the computer will select the path 1,2,3,4a as the "shortest" in Fig. 2. We found the best value of a to be $a \approx 1.5$.

We also try weighting the function $d(\ell,j,I,k,i)$ with a factor $(j + 1/2)$, however, this tends to force the computer to work hard at smoothing the high partial waves at the expense of the smoothness of the low partial waves.

In Figures 5-17 we compare the resultant minimum paths found by the following methods:

Path A--We exhibit CERN experimental solution found by Lovelace;[2]

Path B--We use D^{sum} and $d(\ell,j,I,k,i) = d_0(\ell,j,I,k,i)$;

Path C--We use D^{Euc} and $d(\ell,j,I,k,i) = d_0(\ell,j,I,k,i)$;

Path D--We use D^{sum} and

$$d(\ell,j,I,k,i) = [1/(1.5 + \cos\Theta)]\, d_0(\ell,j,I,k,i);$$

Path E--We use D^{Euc} and

$$d(\ell,j,I,k,i) = [1/(1.5 + \cos\Theta)]\, d_0(\ell,j,I,k,i);$$

Path F--We use D^{Euc} and

$d(\ell,j,I,k,i) = [1/(1.5 + \cos\Theta)]\, d_0(\ell,j,I,k,i)$ and weight with a factor $(j + 1/2)$.

We compare our five paths (B,C,D,E,F) with path A, which is the path found by Lovelace using a sophisticated smoothing technique.[2]

We have not bothered to show the G37, G39, F17, G17, and G19 waves, since they are not interesting at these energies. In Table II we list the total χ^2's for each of our five paths, where the total number of degrees of freedom is 2069. To get the total χ^2 for a path we add the χ^2's for each solution along the path. We see that the two methods D and E, which use the smoothing function, give better total χ^2. In addition paths D and E are indeed smoother than paths B and C, as can be seen by comparing Fig. 5C with Fig. 5E, or Fig. 7B with Fig. 7D.

In general our paths, although not as smooth, agree with Lovelace's path. There are, however, several differences between Lovelace's path and our paths that are worth noting. Firstly, we are better able to exhibit the complicated structure of the S11 wave[3] (Fig. 12). Secondly, we are unable to produce the same structure Lovelace has for the P11. For reasons not understood all our paths have P11 waves that are very messy above $p_{lab} = 707$ MeV/c (Fig. 13). Finally, there appears to be additional resonance-like structure in the following waves:

Partial wave	Mass region	Figure
P31	1570-1680 MeV	6D
D35	1570-1680 MeV	9F
P13	1470-1680 MeV	14D.

Whether this behavior actually corresponds to resonances or is just caused by inadequacies of our method is a question requiring further study. As mentioned earlier, the methods we use require as many solutions with reasonable χ^2 at each energy as can be found. Hence, the next step in improving our results would be to search for more solutions at each energy. Perhaps two or three times as many solutions can be found. It remains to be seen if the resonance-like structure in the above partial waves will then persist.

It is reassuring that a method based on very simple ideas of continuity and smoothness can select an energy-continued path that is reasonably well behaved.

ACKNOWLEDGMENTS

I am grateful to Professor Herbert Steiner, without whose encouragement this work would never have been accomplished, and to C. H. Johnson for introducing me to this subject. Also, I thank Professor Owen Chamberlain for the generous use of computer time.

FOOTNOTES AND REFERENCES

* This work was supported by the U.S. Atomic Energy Commission.

1. C. H. Johnson, Measurement of the Polarization Parameter in π^+p Scattering from 750 to 3750 MeV/c, (Ph.D. Thesis), Lawrence Radiation Laboratory Report UCRL-17683, 1967.

2. A. Donnachie, R. G. Kirsopp, and C. Lovelace, Phys. Letters 26B, 161 (1968); C. Lovelace, in Proceedings of the 1967 Heidelberg Conference (North Holland Publishing Company, Amsterdam, 1967), p. 79; C. Lovelace, invited paper at the Conference on πN Scattering, Irvine, 1967; CERN preprint TH-839, 1967.

3. This double loop behavior is seen by many other groups. See, for example, P. Bareyre, C. Bricman, A. V. Stirling, and G. Villet, Phys. Letters 18, 342 (1965).

Table I. Number of fits at each momenta.

	p_{lab}(MeV/c)	Number of fits	Degrees of freedom	Best χ^2	Worst χ^2
1.	385	1	-	-	-
2.	427	3	100	117.4	-
3.	490	3	90	86.0	-
4.	532	27	67	77.6	97.0
5.	614	30	60	64.5	97.2
6.	658	33	65	71.9	99.6
7.	675	37	77	68.5	153.9
8.	707	56	71	65.0	126.5
9.	726	48	55	53.8	92.8
10.	745	57	98	73.4	114.5
11.	777	30	57	74.4	99.2
12.	826	43	92	68.7	148.5
13.	875	41	114	86.5	119.9
14.	899	72	106	88.7	117.7
15.	925	60	74	46.6	112.9
16.	975	80	54	48.9	71.1
17.	1000	75	71	46.8	119.5
18.	1030	73	54	41.1	110.8
19.	1080	37	86	52.9	78.9
20.	1121	56	77	47.8	188.8
21.	1180	53	100	75.8	158.8
22.	1280	60	99	73.6	178.2

Table I continued next page

Table I (Continued).

	p_{lab} (MeV/c)	Number of fits	Degrees of freedom	Best χ^2	Worst χ^2
23.	1360	80	104	79.3	196.5
24.	1440	69	94	99.7	179.0
25.	1579	59	86	86.3	152.3
26.	1700	60	118	79.6	179.6

Table II. List of total χ^2 for our five paths, where the total number of data points is 2069.

Path	Total χ^2
B	2393
C	2417
D	2353
E	2315
F	2447

FIGURE CAPTIONS

Fig. 1. Argand diagram illustrating the function $d_0(\ell,j,I,k,i)$, which is just the geometric distance between the two points k and k-1.

Fig. 2. Argand diagram illustrating two possible paths.

Fig. 3. Argand diagram illustrating the vectors $\underset{\sim}{A}$ and $\underset{\sim}{B}$ and the angle θ used in defining the function $d(\ell,j,I,k,i) = [1/(1.5 + \cos\theta)]\, d_0$.

Fig. 4. Shows a line of constant $d(\ell,j,I,k,i)$, where $d(\ell,j,I,k,i) = [1/(1.5 + \cos\theta)]\, d_0$ and $|\underset{\sim}{B}| = d_0$.

Fig. 5. Argand diagram of the S31 partial wave.

Fig. 6. Argand diagram of the P31 partial wave.

Fig. 7. Argand diagram of the P33 partial wave.

Fig. 8. Argand diagram of the D33 partial wave.

Fig. 9. Argand diagram of the D35 partial wave.

Fig. 10. Argand diagram of the F35 partial wave.

Fig. 11. Argand diagram of the F37 partial wave.

Fig. 12. Argand diagram of the S11 partial wave.

Fig. 13. Argand diagram of the P11 partial wave.

Fig. 14. Argand diagram of the P13 partial wave.

Fig. 15. Argand diagram of the D13 partial wave.

Fig. 16. Argand diagram of the D15 partial wave.

Fig. 17. Argand diagram of the F15 partial wave.

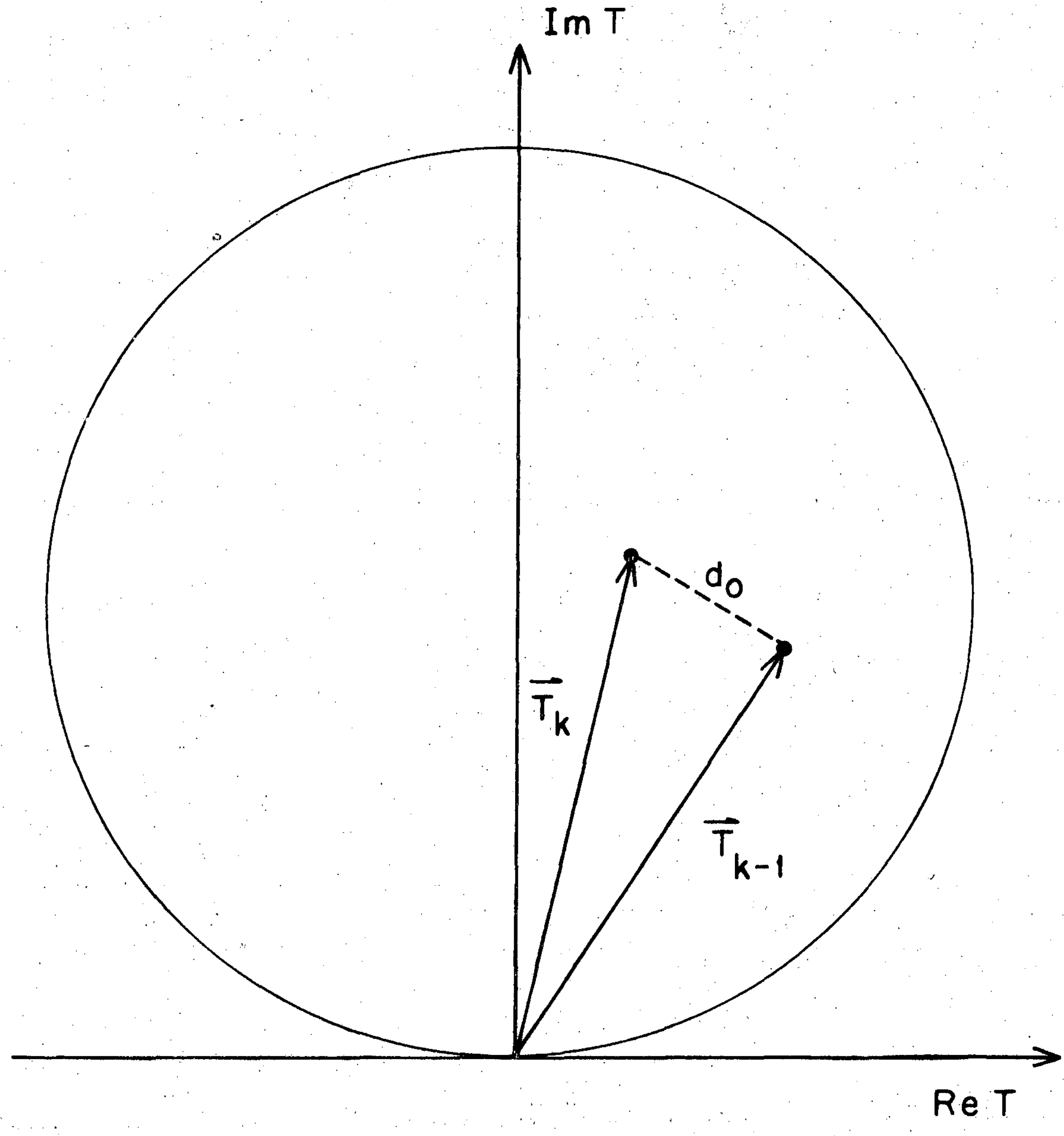


Fig. 1.

XBL711-2651

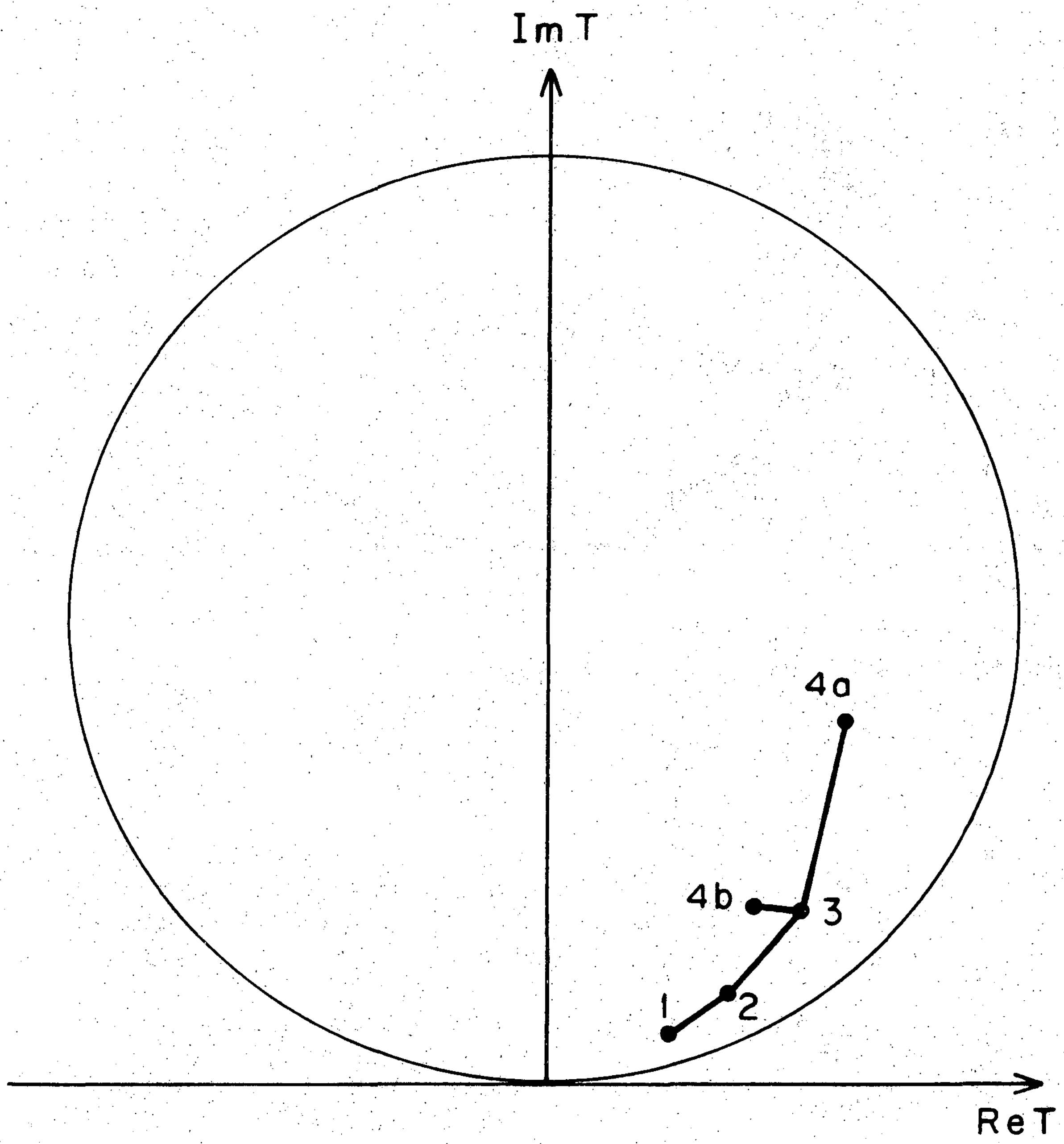


Fig. 2.

XBL711-2652

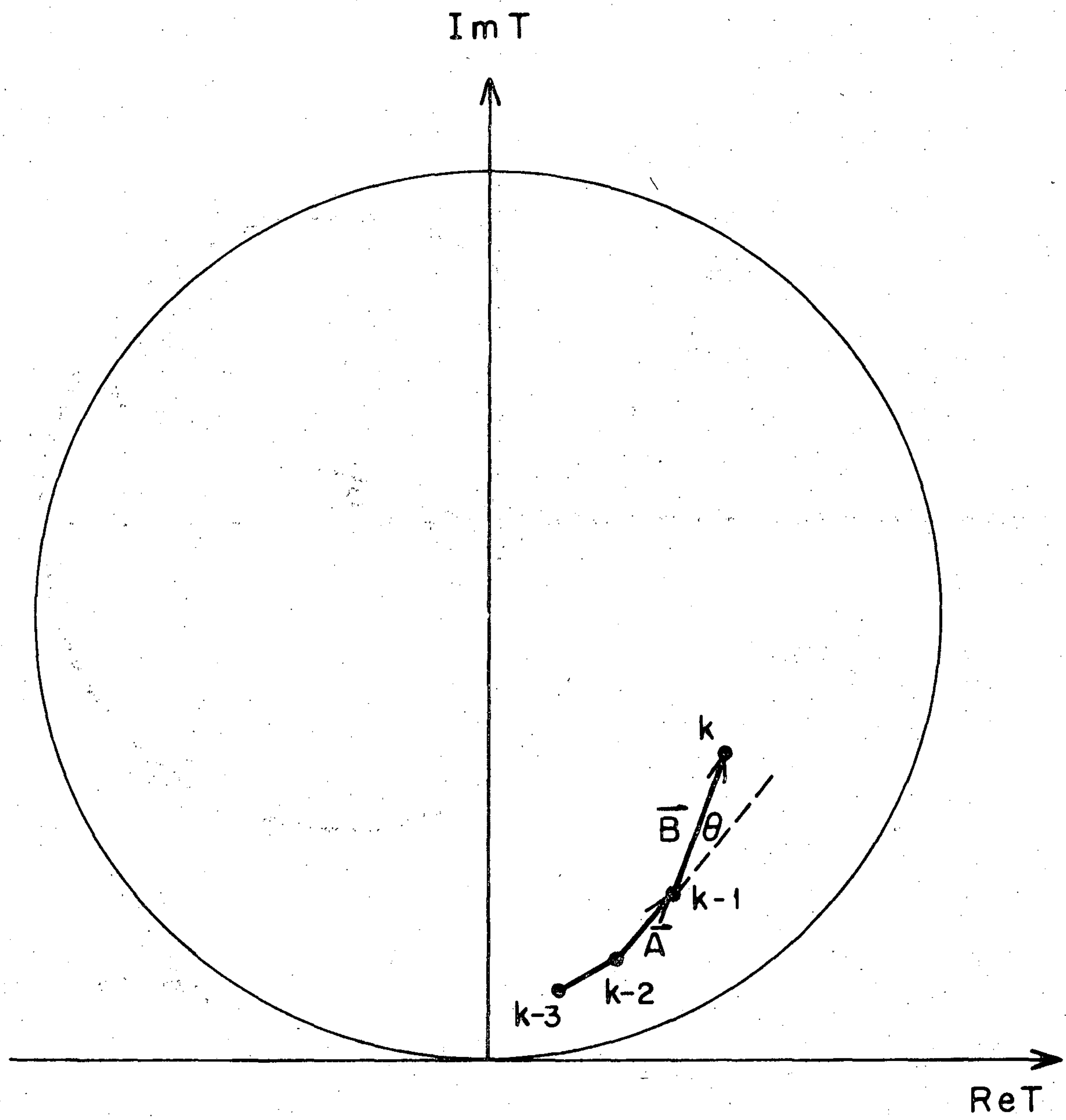


Fig. 3.

XBL711-2653

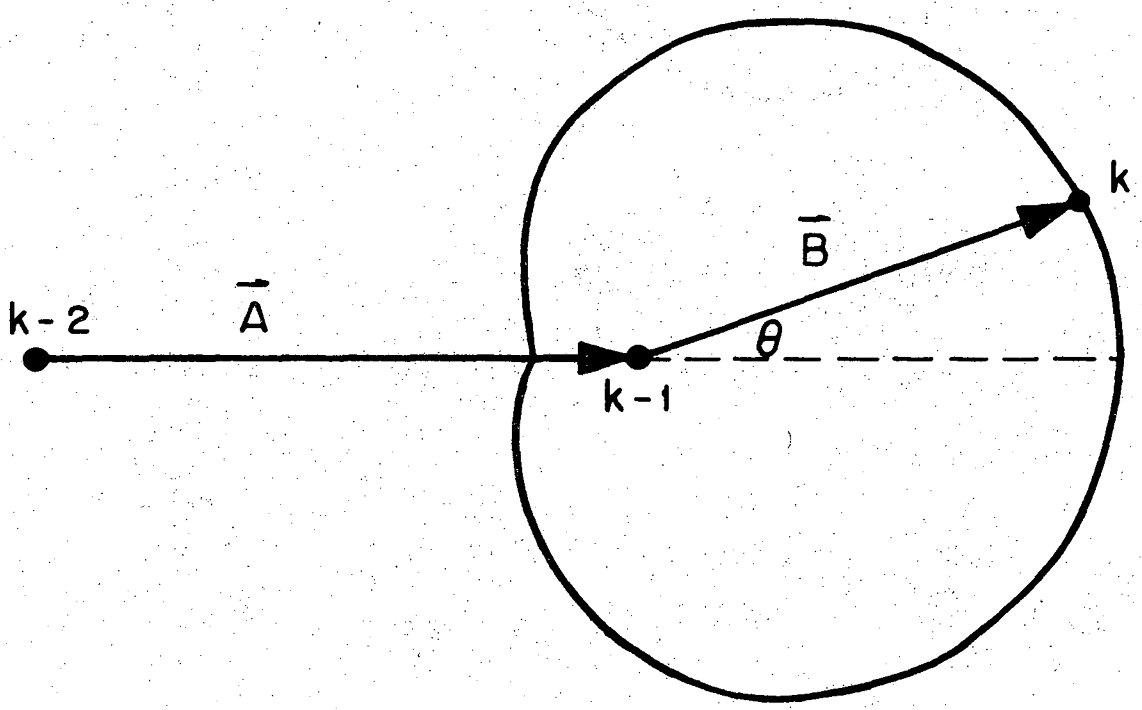
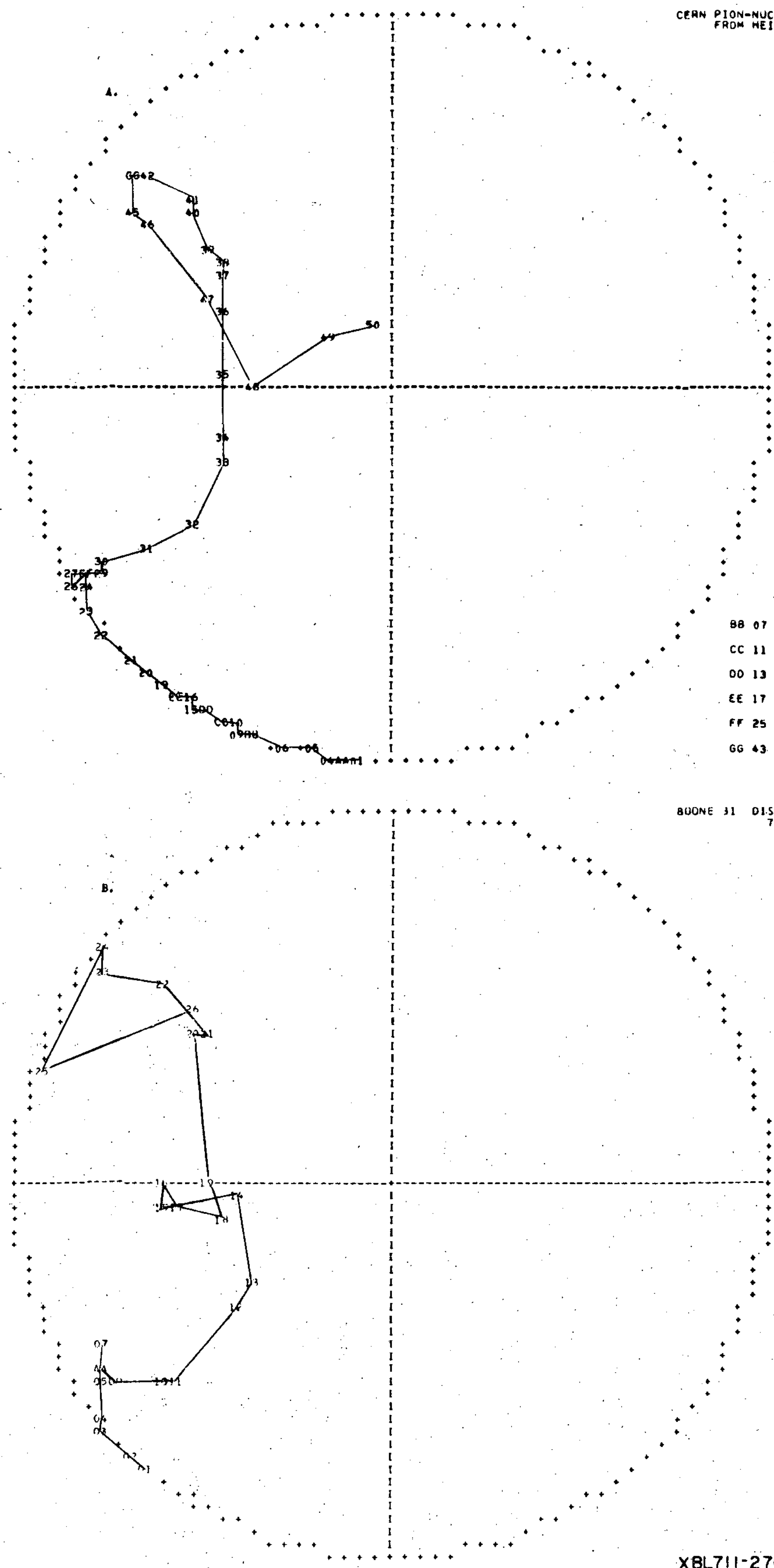


Fig. 4. XBL711-2654



CERN PION-NUCLEON EXPERIMENTAL FITS.
FROM HEIDELBERG, 9/67.
ORIGIN AT BOTTOM SCALE=1.0

*** S31 ***

	P	T	M
01	80	21	1096
02	98	31	1104
03	108	37	1109
04	115	41	1113
05	140	58	1127
06	192	98	1160
07	219	120	1178
08	231	130	1186
09	245	142	1195
10	255	151	1202
11	271	165	1213
12	276	170	1217
13	297	189	1231
14	303	194	1235
15	321	210	1248
16	328	217	1252
17	331	220	1255
18	337	225	1259
19	361	247	1275
20	385	270	1292
21	427	310	1320
22	490	370	1362
23	532	410	1390
24	573	450	1417
25	614	490	1443
26	658	533	1470
27	675	550	1481
28	707	581	1501
29	726	600	1512
30	745	618	1524
31	777	650	1543
32	826	698	1572
33	875	746	1601
34	904	775	1617
35	925	796	1629
36	975	845	1658
37	1000	870	1672
38	1030	900	1688
39	1080	949	1716
40	1121	990	1738
41	1180	1049	1769
42	1280	1148	1821
43	1360	1228	1862
44	1444	1311	1903
45	1505	1372	1933
46	1579	1446	1968
47	1700	1566	2025
48	1880	1746	2107
49	2010	1875	2163
50	2070	1935	2189

BB 07 08
CC 11 12
DD 13 14
EE 17 18
FF 25 28
GG 43 44

AA 02 03

BOONE 31 DIST=00 SUM WT=1
7 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST

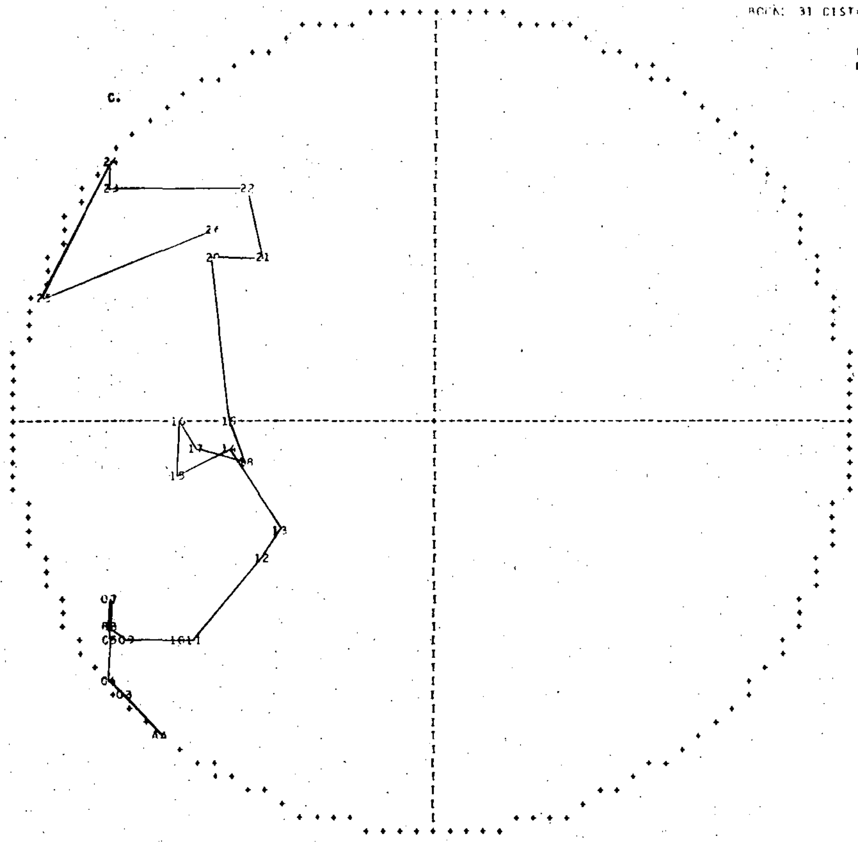
*** S31 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 06 08

XBL711-2707

Fig. 5A,B



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8 JAN 71

PLOTS TO FIT 17-26
LEAST TOTAL DIST

*** S31 ***

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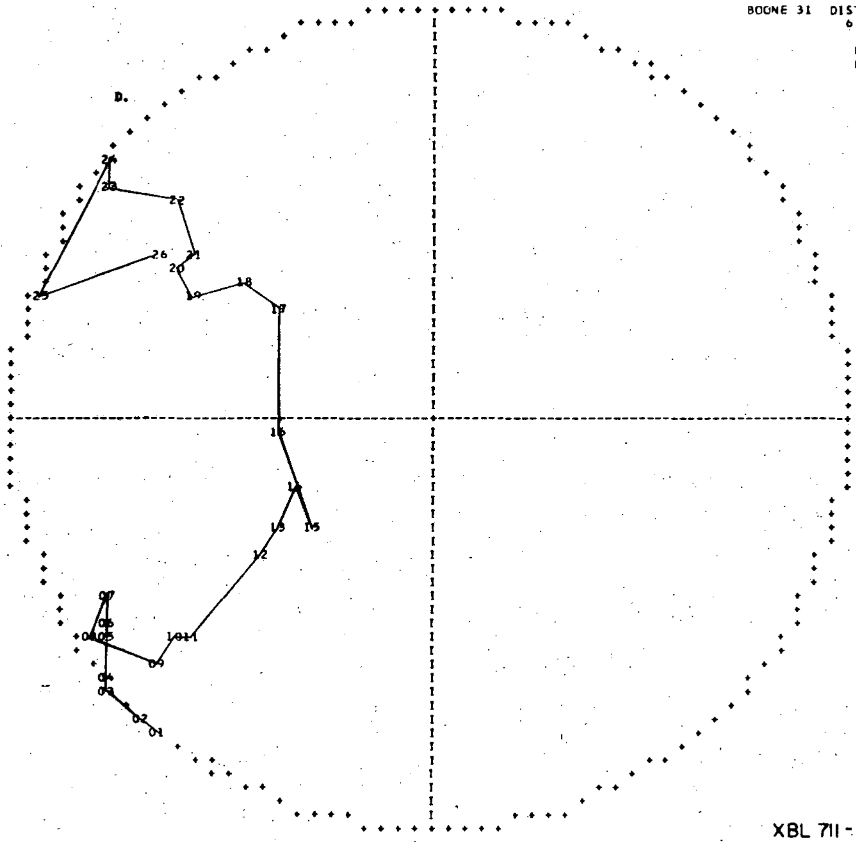
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA C1 02

BB C6 C8



BOONE 31 DIST=DO/(1.5+COS) SUM WT=1
6 JAN 71

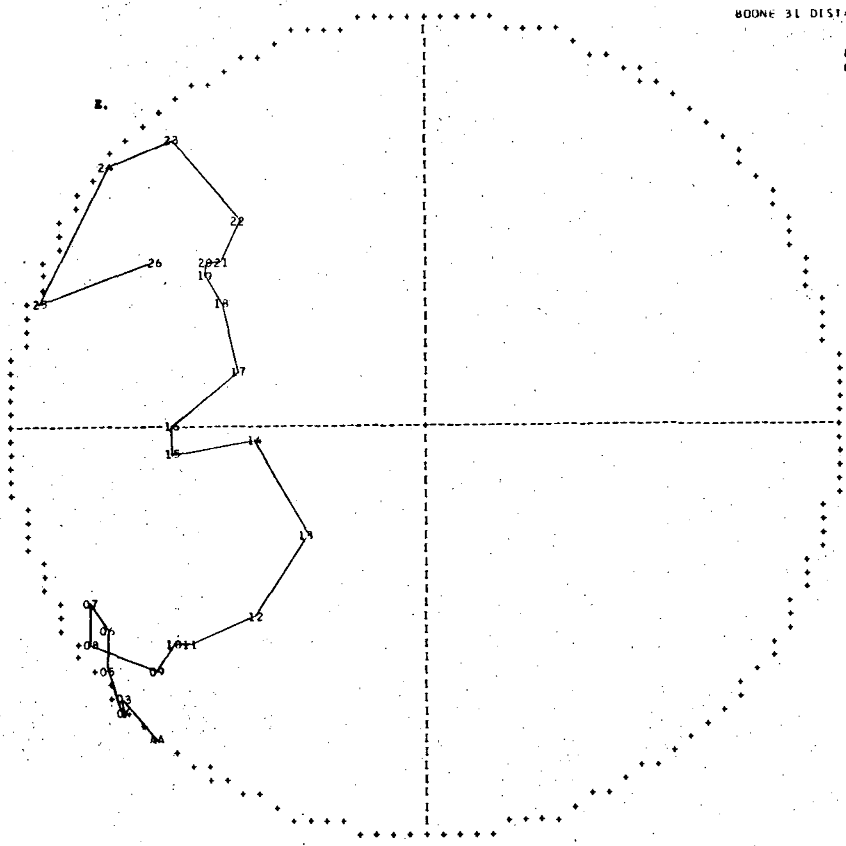
PLOTS TO FIT 7-NE
LEAST TOTAL DIST

*** S31 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

XBL 711-2708

Fig. 5C,D



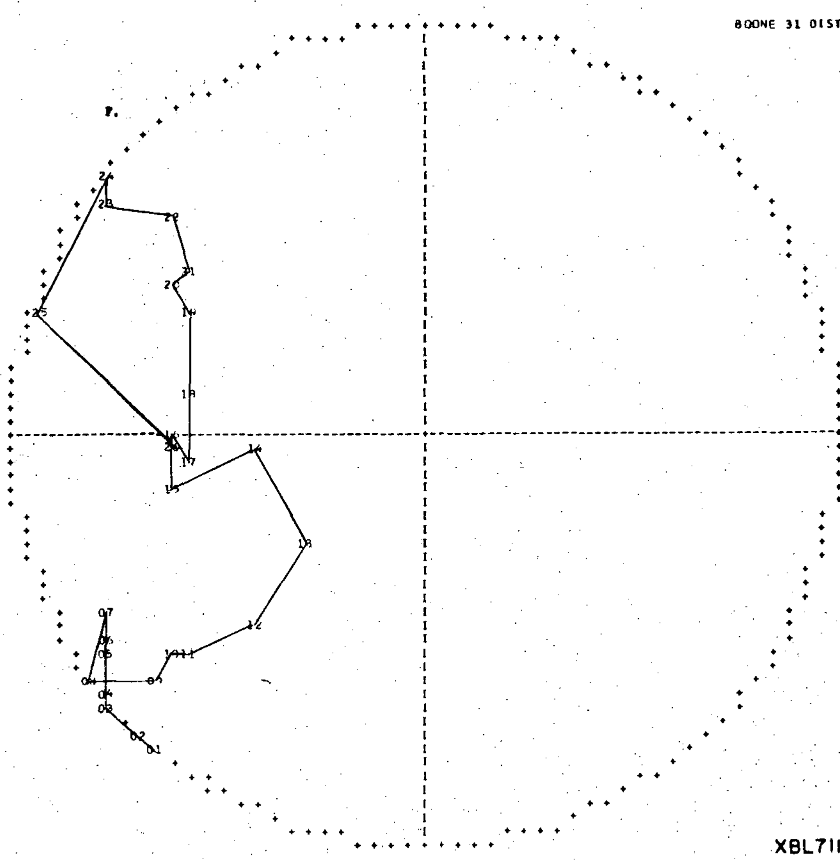
BOONE 31 DIST=DO/(1.5+COS) EUC WT=1
9 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

*** S31 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 02



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10 JAN 71

PLOTS TO FIT 41-HZ
LEAST TOTAL DIST

*** S31 ***

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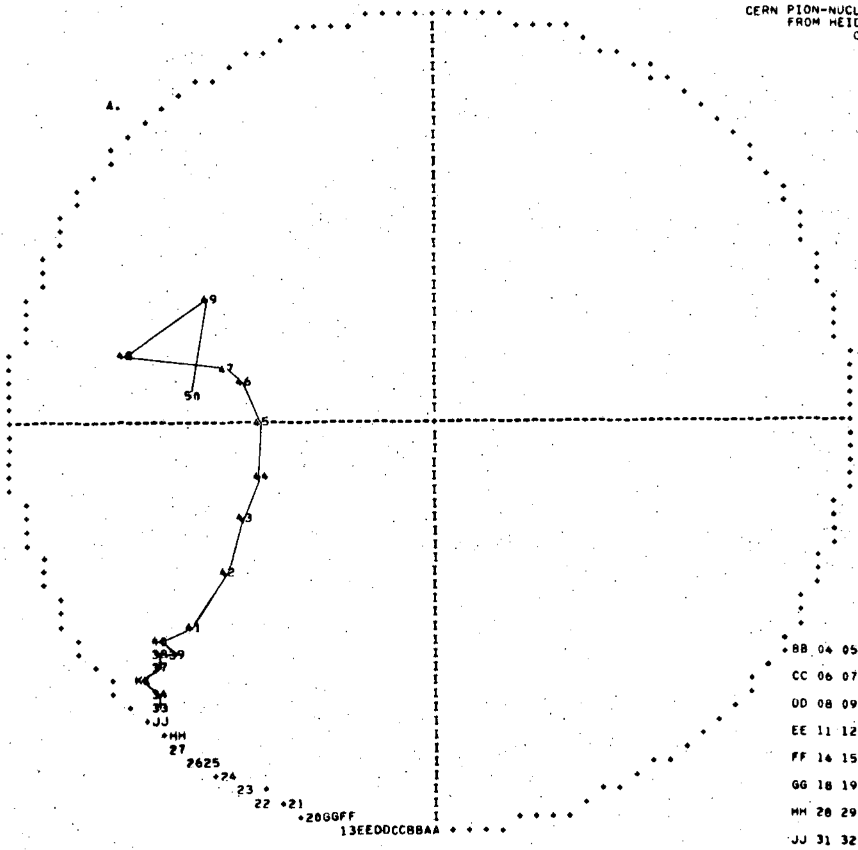
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1290	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

XBL711-2709

Fig. 5E,F

CERN PION-NUCLEON EXPERIMENTAL FITS.
FROM HEIDELBERG, 9/67.
ORIGIN AT BOTTOM SCALE=1.0

A.



*** P31 ***

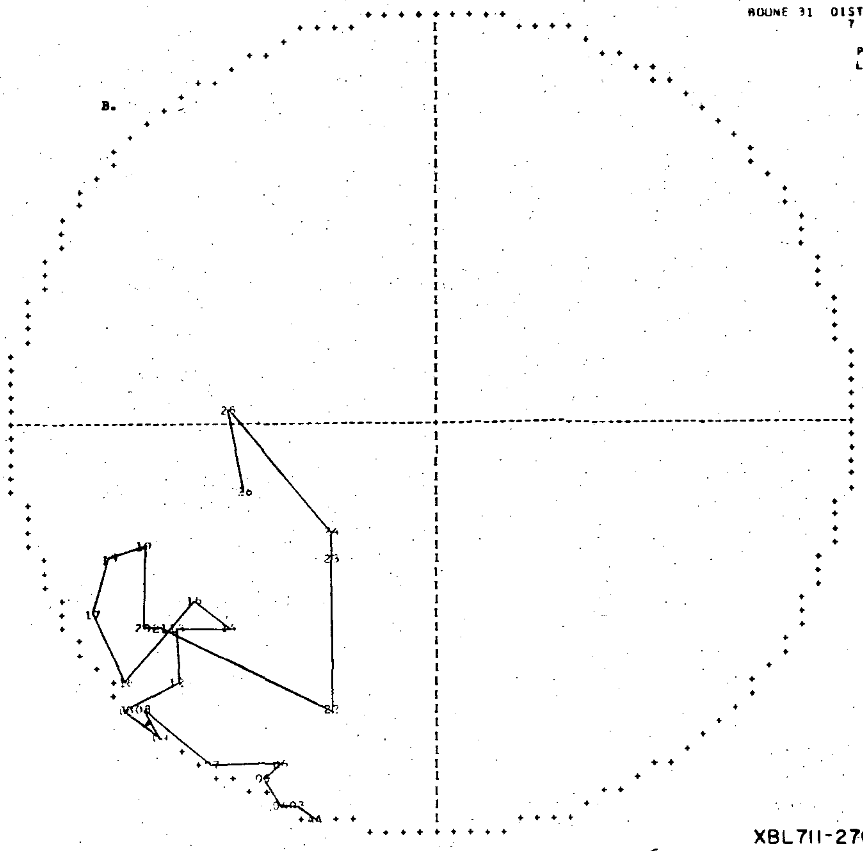
	P	T	M
01	80	21	1096
02	98	31	1104
03	108	37	1109
04	115	41	1113
05	140	58	1127
06	192	98	1160
07	219	120	1178
08	231	130	1186
09	245	142	1195
10	255	151	1202
11	271	165	1213
12	276	170	1217
13	297	189	1231
14	303	194	1235
15	321	210	1248
16	328	217	1252
17	331	220	1255
18	337	225	1259
19	361	247	1275
20	385	270	1292
21	427	310	1320
22	490	370	1362
23	532	410	1390
24	573	450	1417
25	614	490	1443
26	658	533	1470
27	675	550	1481
28	707	581	1501
29	726	600	1512
30	745	618	1524
31	777	650	1543
32	826	698	1572
33	875	746	1601
34	904	775	1617
35	925	796	1629
36	975	845	1658
37	1000	870	1672
38	1030	900	1688
39	1080	949	1716
40	1121	990	1738
41	1180	1049	1769
42	1280	1148	1821
43	1360	1228	1862
44	1444	1311	1903
45	1505	1372	1933
46	1579	1446	1968
47	1700	1566	2025
48	1880	1746	2107
49	2010	1875	2163
50	2070	1935	2189

BB 04 05
CC 06 07
DD 08 09 10
EE 11 12
FF 14 15 16 17
GG 18 19
HH 28 29 30
JJ 31 32 AA 01 02 03
KK 35 36

ROUNE 31 DIST=DO SUM WT=1
7 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST

B.



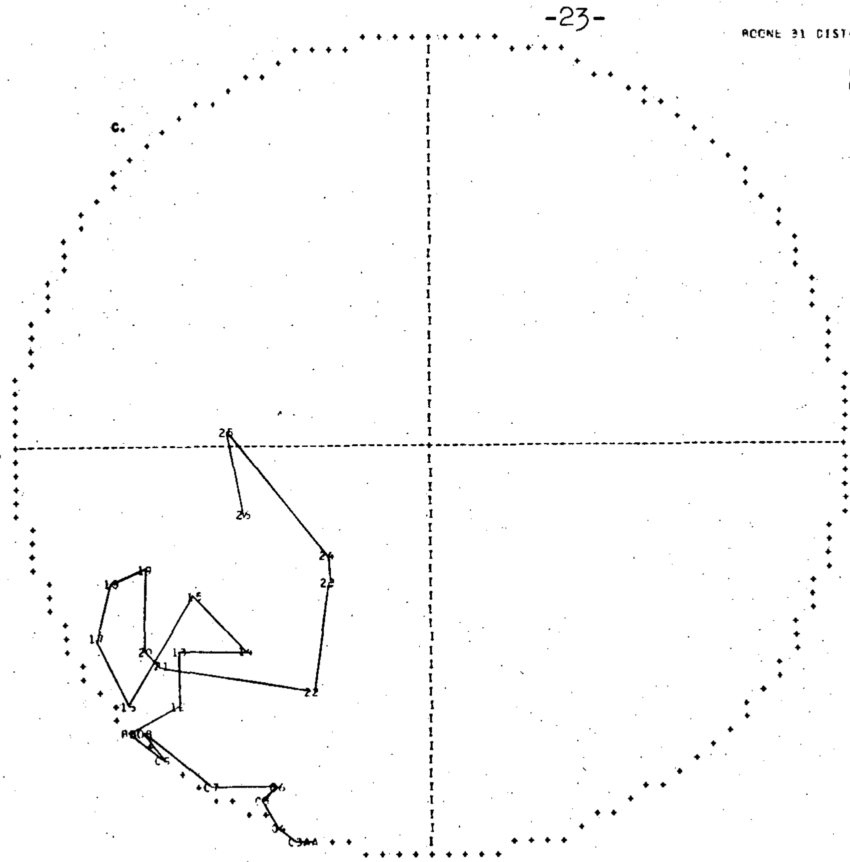
*** P31 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 02
BB 10 11

XBL711-2704

Fig. 6A,B



BOONE 31 DIST=D0 EUC WT=1
8 JAN 71

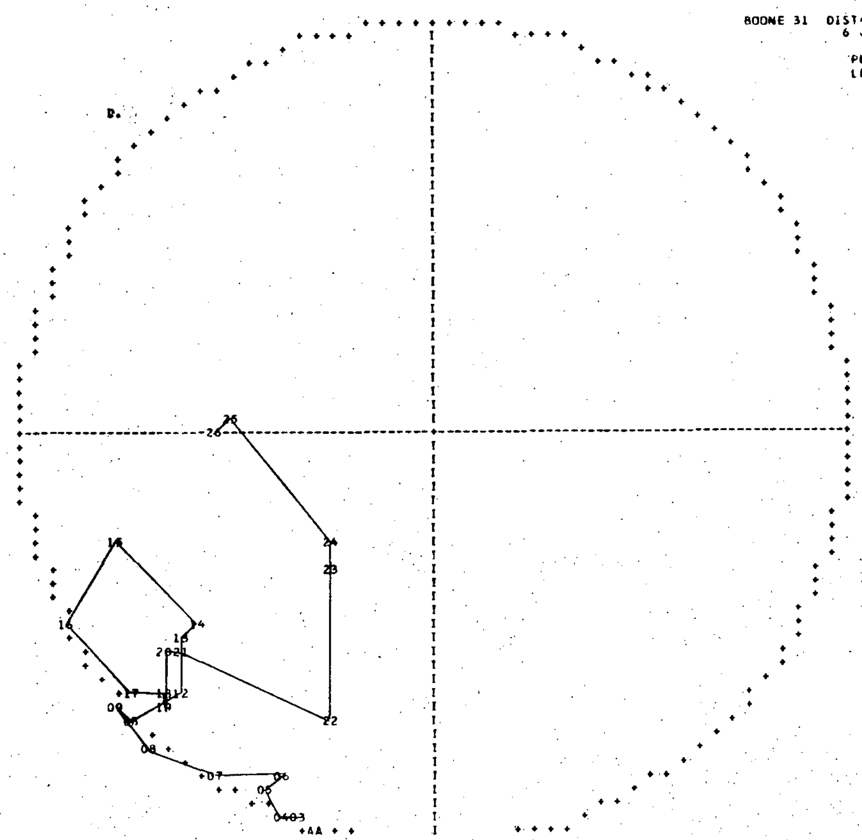
PLOTS TO FIT 17-26
LEAST TOTAL DIST

*** P31 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 02

BB 10 11



BOONE 31 DIST=D0/(1.5+COS) SUM WT=1
6 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

*** P31 ***

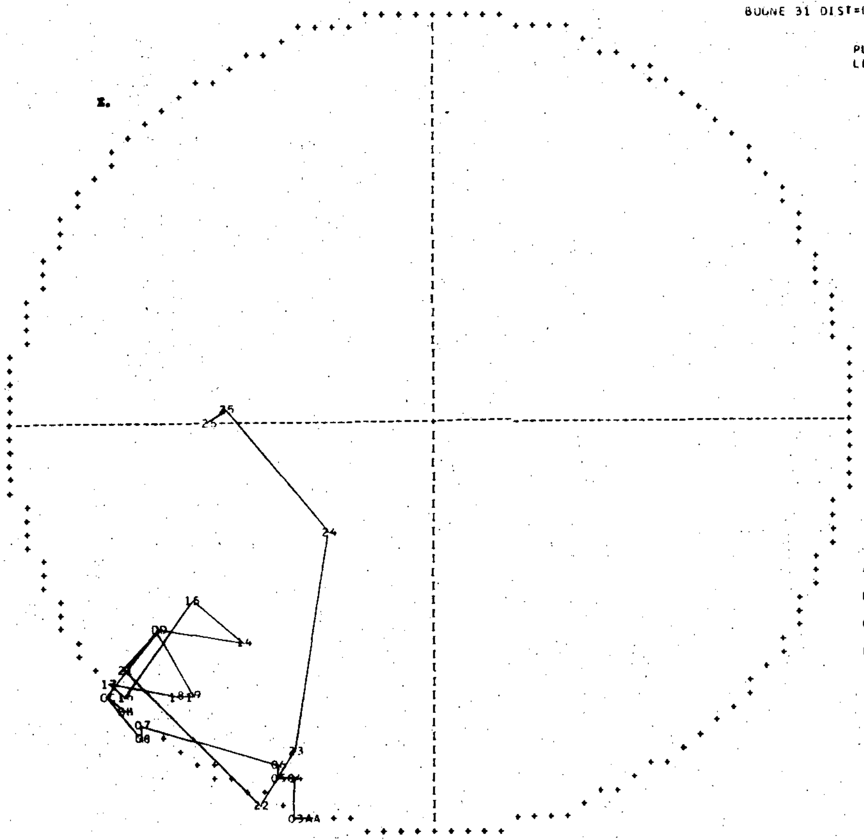
	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 02

BB 10 11

Fig. 6C,D

XBL 711-2705



BOONE 31 DIST=DO/(1.5+COS) EUC WT=1
9 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

*** P31 ***

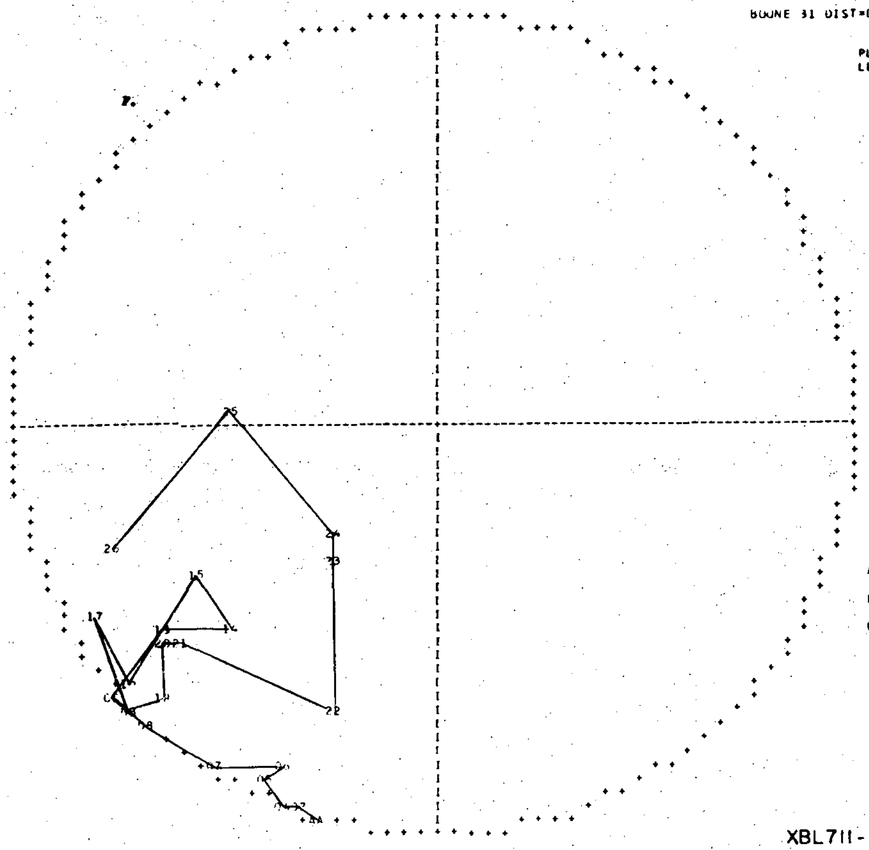
	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 02

BB 10 11

CC 09 12

DD 13 20



BOONE 31 DIST=DO/(1.5+COS) EUC WT=J+1/2
10 JAN 71

PLOTS TO FIT 41-HZ
LEAST TOTAL DIST

*** P31 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 02

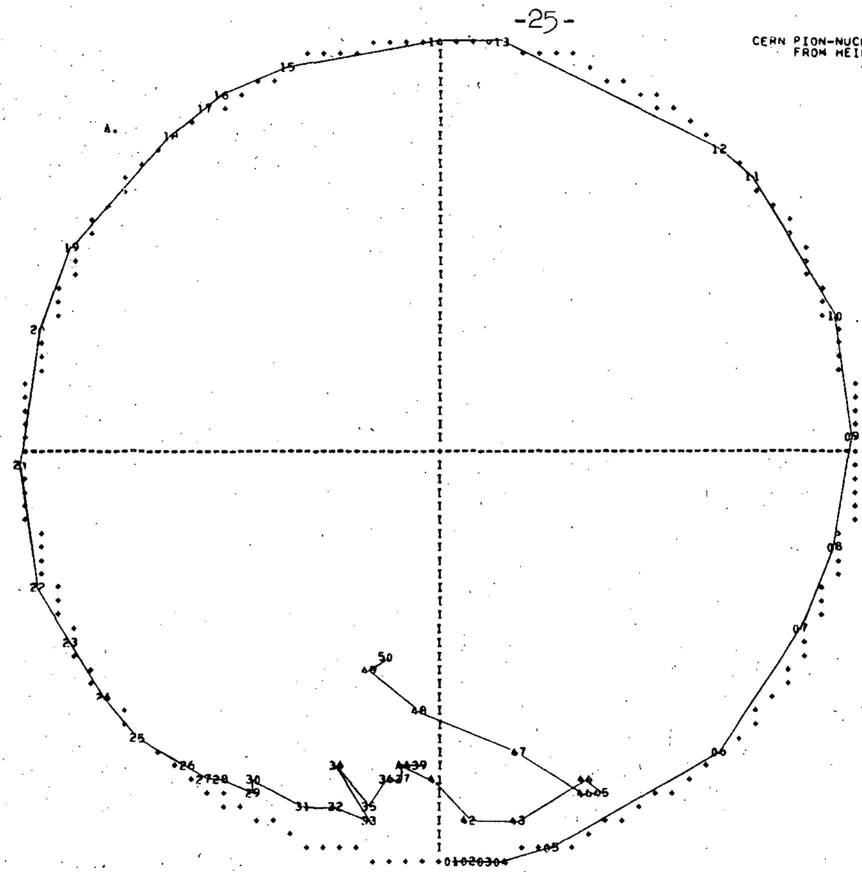
BB 10 11 18

CC 09 12

XBL711-2706

Fig. 6E,F

CERN PION-NUCLEON EXPERIMENTAL FITS.
FROM HEIDELBERG, 9/67.
ORIGIN AT BOTTOM SCALE=1.0



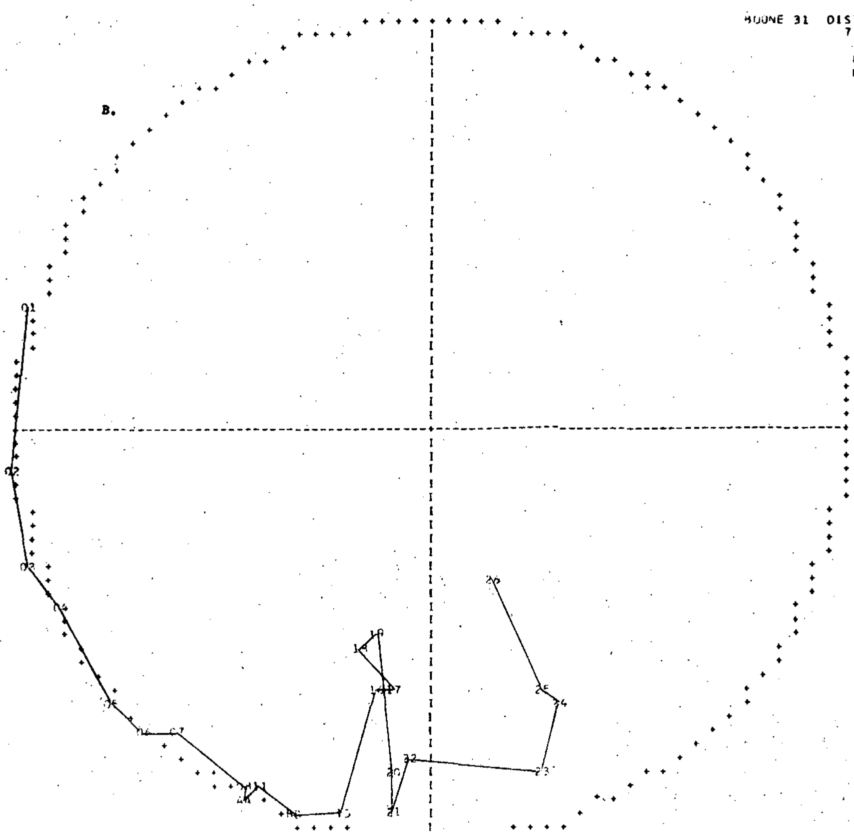
*** P33 ***

	P	T	M
01	80	21	1096
02	98	31	1104
03	108	37	1109
04	115	41	1113
05	140	58	1127
06	192	98	1160
07	219	120	1178
08	231	130	1186
09	245	142	1195
10	255	151	1202
11	271	165	1213
12	276	170	1217
13	297	189	1231
14	303	194	1235
15	321	210	1248
16	328	217	1252
17	331	220	1255
18	337	225	1259
19	361	247	1275
20	385	270	1292
21	427	310	1320
22	490	370	1362
23	532	410	1390
24	573	450	1417
25	614	490	1443
26	658	533	1470
27	675	550	1481
28	707	581	1501
29	726	600	1512
30	745	618	1524
31	777	650	1543
32	826	698	1572
33	875	746	1601
34	904	775	1617
35	925	796	1629
36	975	845	1658
37	1000	870	1672
38	1030	900	1688
39	1080	949	1716
40	1121	990	1738
41	1180	1049	1769
42	1280	1148	1821
43	1360	1228	1862
44	1444	1311	1903
45	1505	1372	1933
46	1579	1446	1968
47	1700	1566	2025
48	1880	1746	2107
49	2010	1875	2163
50	2070	1935	2189

AA 38 40

HUUNE 31 DIST=DO SUM WT=1
7 JAN 71

PLUTS TO FIT 17-ZH
LEAST TOTAL DIST



*** P33 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 09 10

BB 12 13 14

XBL711-2701

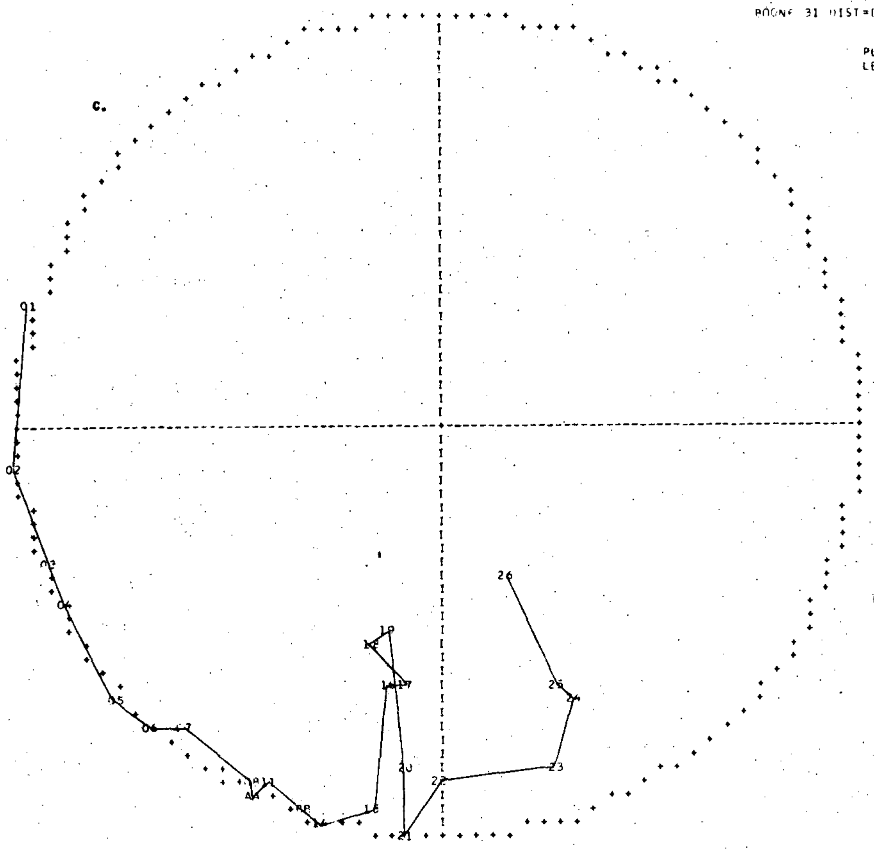
Fig. 7A,B

BOONE 31 DIST=DC EUC WT=1
8 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST

*** P33 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025



AA 09 10

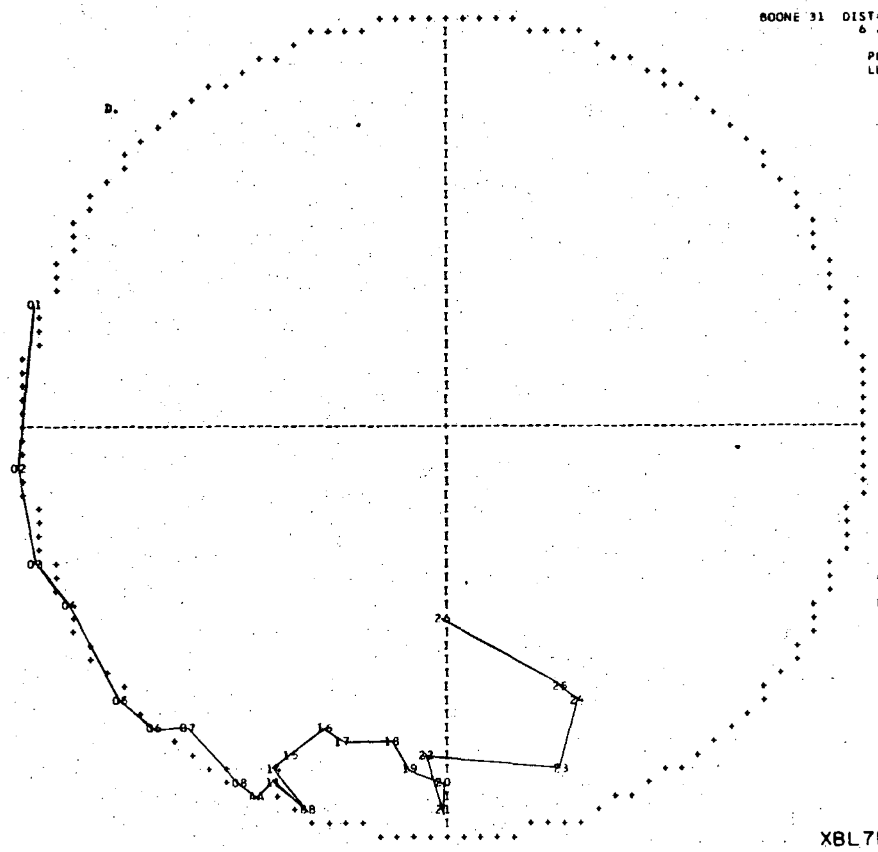
BB 12 13

BOONE 31 DIST=DO/(1.5+COS) SUM WT=1
6 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

*** P33 ***

	P	T	M
01	395	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025



AA 09 10

BB 12 13

XBL711-2702

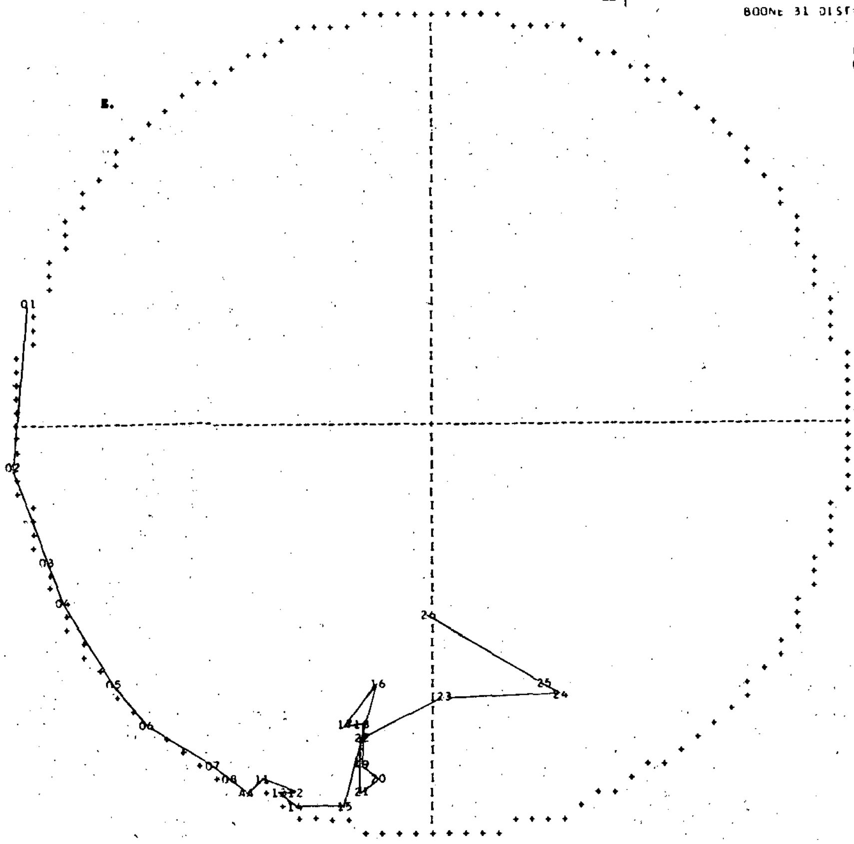
Fig. 7C,D

BOONE 31 DIST=DO/(1.5+COS) EUC WT=1
9 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

*** P33 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025



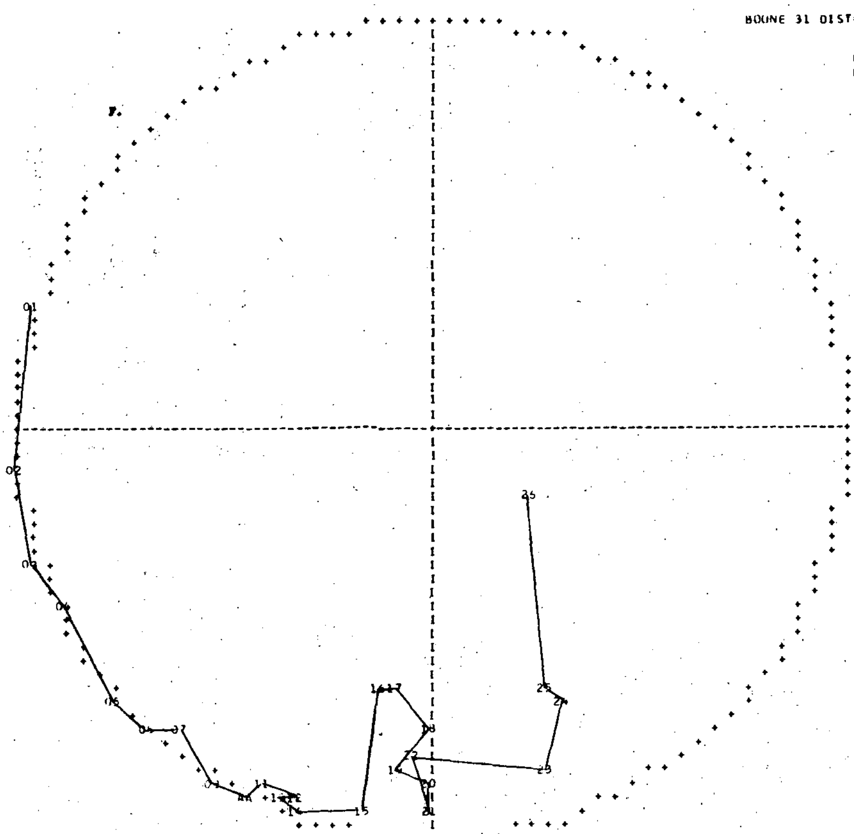
AA 09 10

BOONE 31 DIST=DO/(1.5+COS) EUC WT=J+1/2
10 JAN 71

PLOTS TO FIT 41-HZ
LEAST TOTAL DIST

*** P33 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

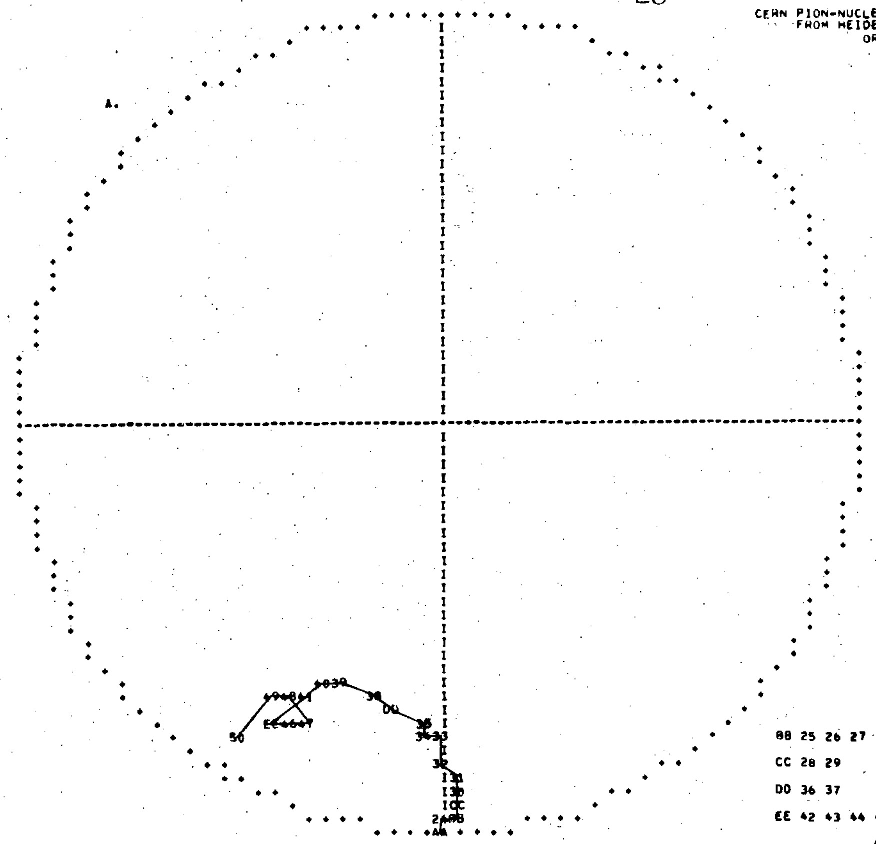


AA 09 10

XBL711-2703

Fig. 7E,F

CERN PION-NUCLEON EXPERIMENTAL FITS,
FROM HEIDELBERG, 9/67,
ORIGIN AT BOTTOM SCALE=1,0



*** D33 ***

	P	T	M
01	80	21	1096
02	98	31	1104
03	108	37	1109
04	115	41	1113
05	140	58	1127
06	192	98	1160
07	219	120	1178
08	231	130	1186
09	245	142	1195
10	255	151	1202
11	271	165	1213
12	276	170	1217
13	297	189	1231
14	303	194	1235
15	321	210	1248
16	328	217	1252
17	331	220	1255
18	337	225	1259
19	361	247	1275
20	385	270	1292
21	427	310	1320
22	490	370	1362
23	532	410	1390
24	573	450	1417
25	614	490	1443
26	658	533	1470
27	675	550	1481
28	707	581	1501
29	726	600	1512
30	745	618	1524
31	777	650	1543
32	826	698	1572
33	875	746	1601
34	904	775	1617
35	925	796	1629
36	975	845	1658
37	1000	870	1672
38	1030	900	1688
39	1080	949	1716
40	1121	990	1738
41	1180	1049	1769
42	1280	1148	1821
43	1360	1228	1862
44	1444	1311	1903
45	1505	1372	1933
46	1579	1446	1968
47	1700	1566	2025
48	1880	1746	2107
49	2010	1875	2163
50	2070	1935	2189

BB 25 26 27

CC 28 29

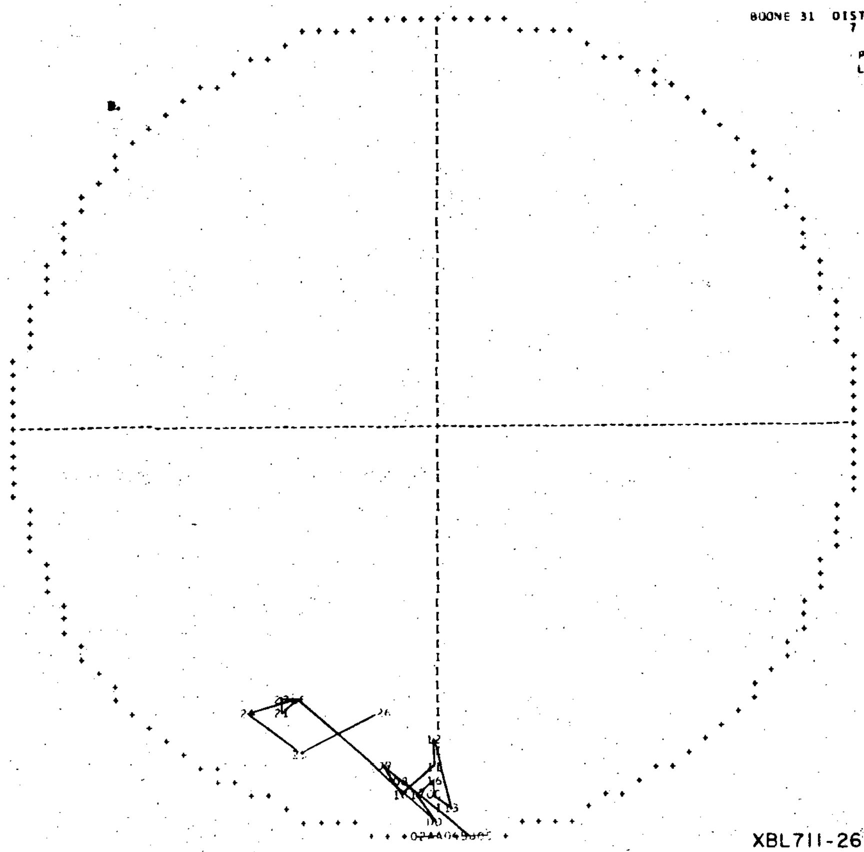
DD 36 37

EE 42 43 44 45

AA 01 02 03 04 05
06 07 08 09 *

BOONE 31 DIST=DD SUM *T=1
7 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST



*** D33 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 03

BB 06 07

CC 14 15

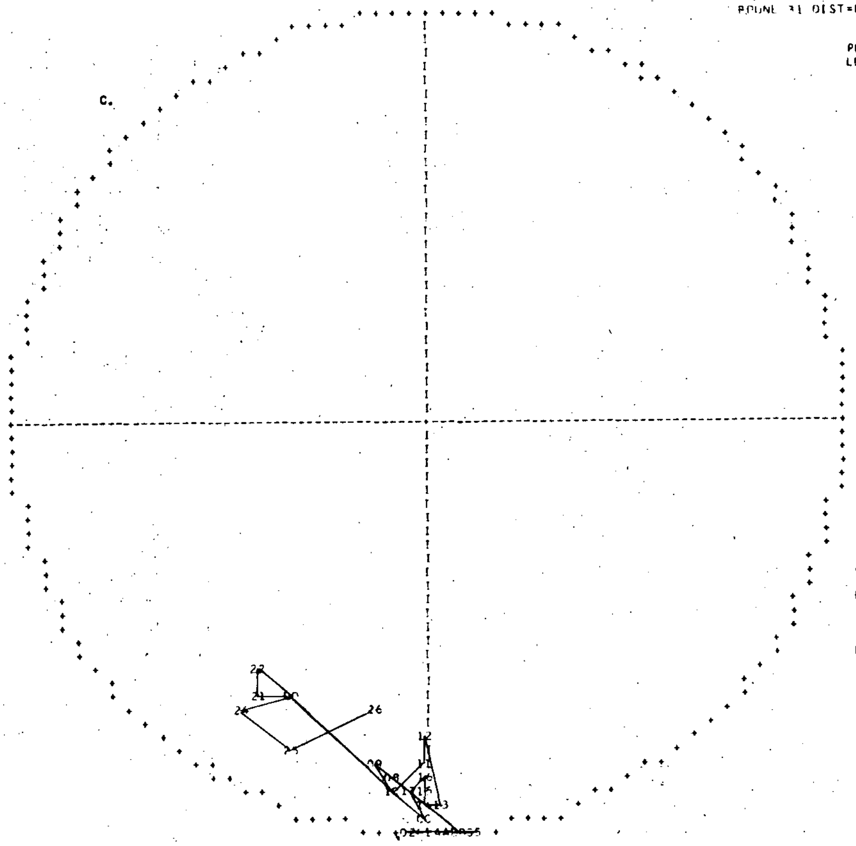
DD 18 19

EE 20 23

XBL711-2698

Fig. 8A,B

C.



BOONE 31 DIST=D0 EUC WT=1
8 JAN 71

PLOTS TO FIT 17-ZF
LEAST TOTAL DIST

*** D33 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1568
26	1700	1566	2025

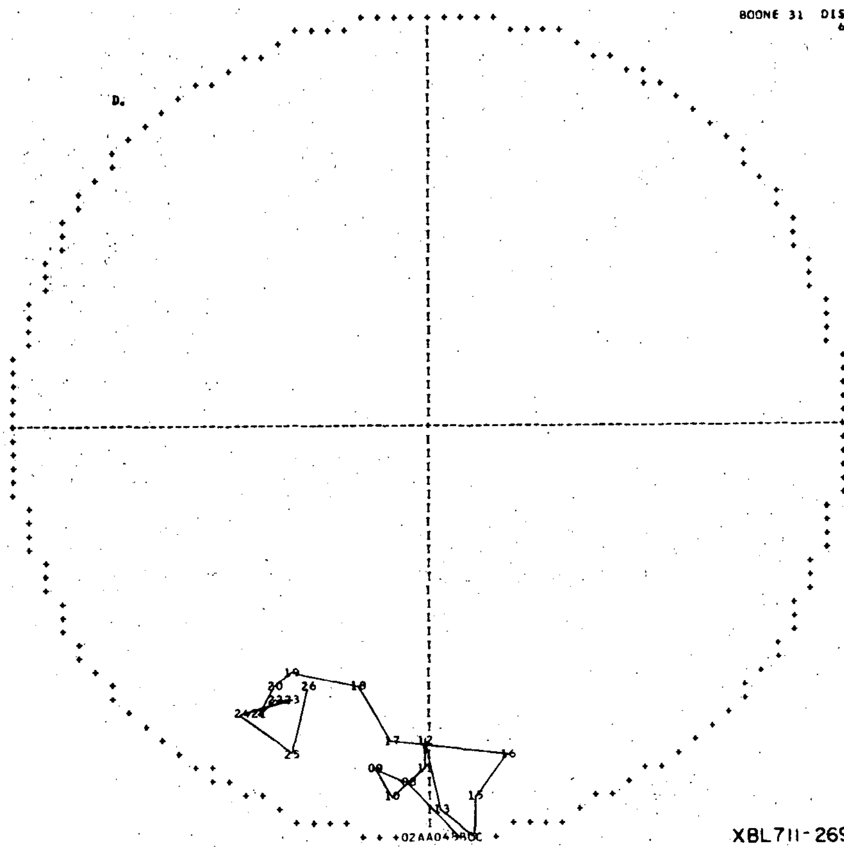
AA 03 04

BB 06 07

CC 18 19

DD 20 23

D.



BOONE 31 DIST=D0/(1.5+COS) SUM WT=1
6 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

*** D33 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

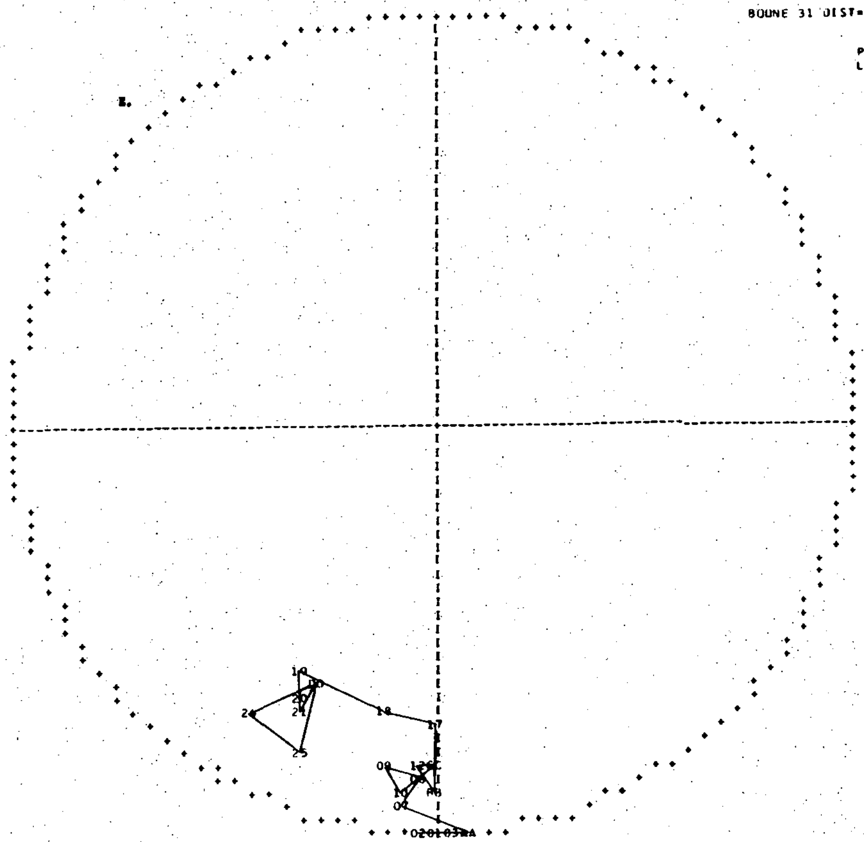
AA 01 03

BB 06 07

CC 05 14

XBL711-2699

Fig. 8C,D



BOUNE 31 DIST=DD/(1.5+COS) EUC WT=1
9 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

*** D33 ***

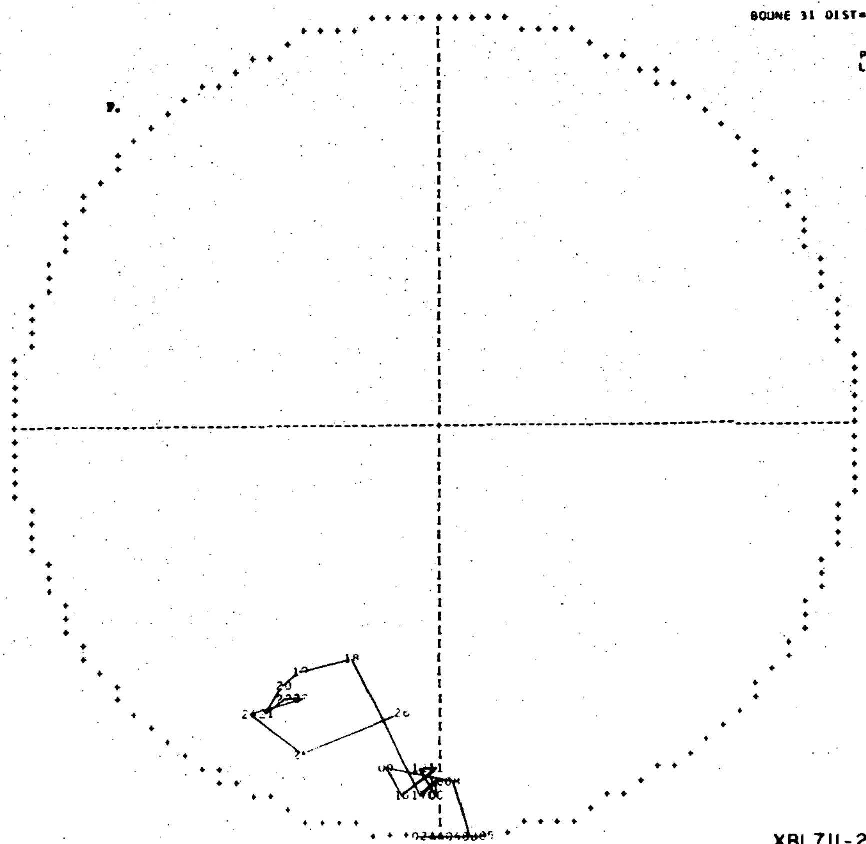
	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 04 05 06

BB 13 14 15

CC 11 16

DD 22 23 26



BOUNE 31 DIST=DD/(1.5+COS) EUC WT=J+1/2
10 JAN 71

PLOTS TO FIT 41-HZ
LEAST TOTAL DIST

*** D33 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1962
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 03

BB 06 07

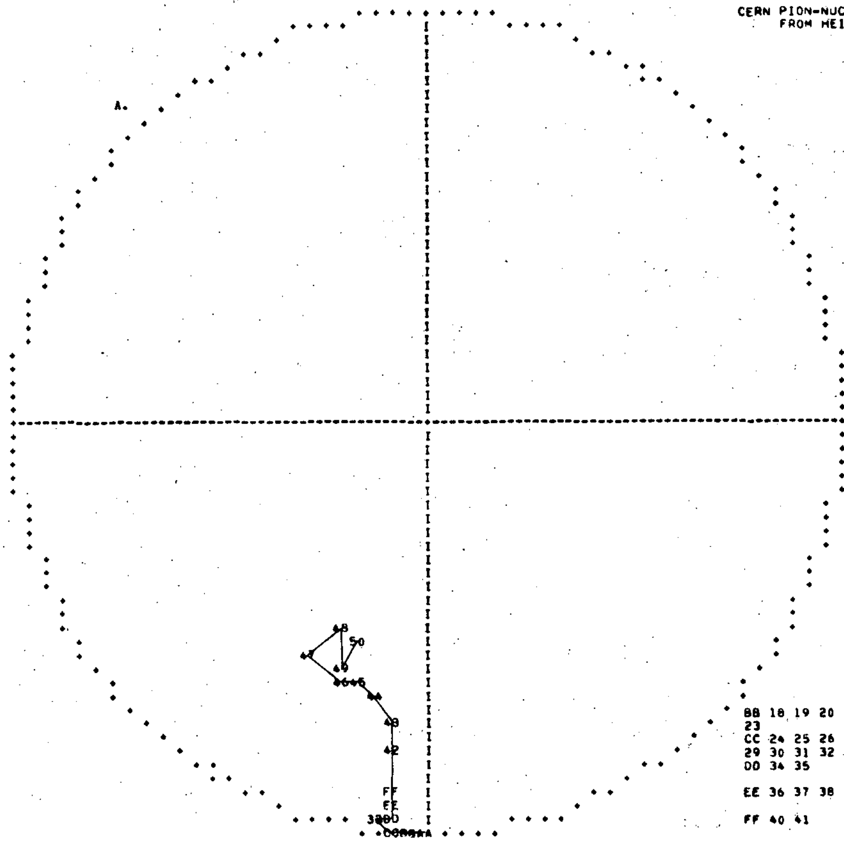
CC 13 14 15

XBL711-2700

Fig. 8E,F

CERN PION-NUCLEON EXPERIMENTAL FITS.
FROM HEIDELBERG, 9/67.
ORIGIN AT BOTTOM SCALE=1.0

A.



*** 035 ***

	P	T	M
01	80	21	1096
02	98	31	1104
03	108	37	1109
04	115	41	1113
05	140	58	1127
06	192	98	1160
07	219	120	1178
08	231	130	1186
09	245	142	1195
10	255	151	1202
11	271	165	1213
12	276	170	1217
13	297	189	1231
14	303	194	1235
15	321	210	1248
16	328	217	1252
17	331	220	1255
18	337	225	1259
19	361	247	1275
20	385	270	1292
21	427	310	1320
22	490	370	1362
23	532	410	1390
24	573	450	1417
25	614	490	1443
26	658	533	1470
27	675	550	1481
28	707	581	1501
29	726	600	1512
30	745	618	1524
31	777	650	1543
32	826	698	1572
33	875	746	1601
34	904	775	1617
35	925	796	1629
36	975	845	1658
37	1000	870	1672
38	1030	900	1688
39	1080	949	1716
40	1121	990	1738
41	1180	1049	1769
42	1280	1148	1821
43	1360	1228	1862
44	1444	1311	1903
45	1505	1372	1933
46	1579	1446	1968
47	1700	1566	2025
48	1880	1746	2107
49	2010	1875	2163
50	2070	1935	2189

BB 18 19 20 21 22
23
CC 24 25 26 27 28
29 30 31 32
DD 34 35

EE 36 37 38 39

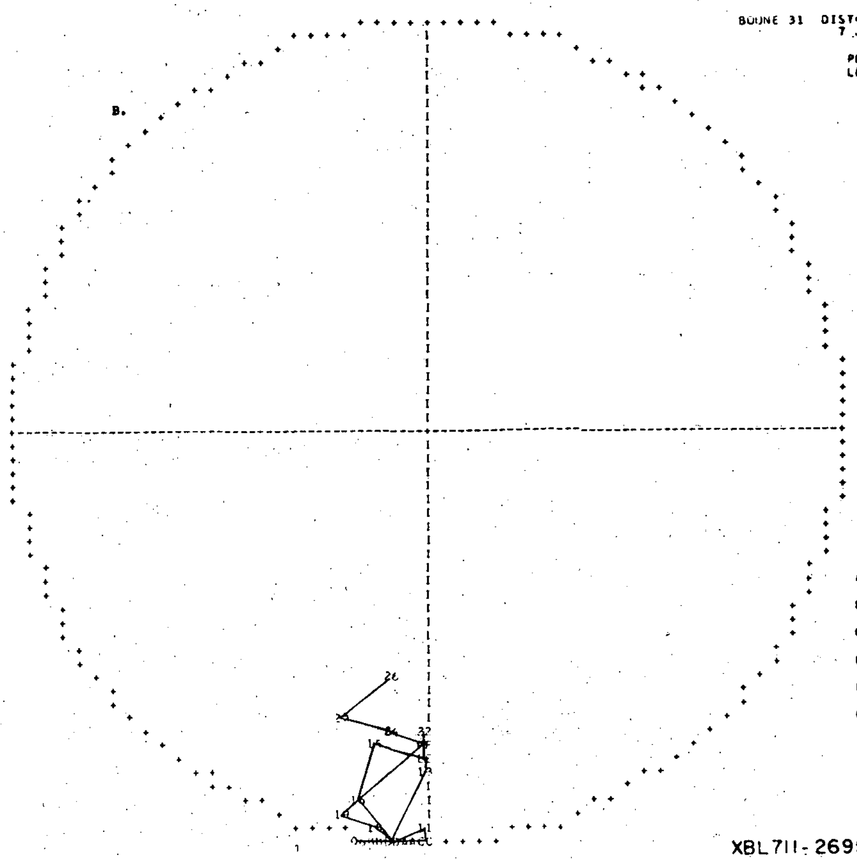
FF 40 41

AA 01 02 03 04 05
06 07 08 09 .

BOUNE 31 DIST=DO SUM WT=1
7 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST

B.



*** 035 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 03

BB 05 07

CC [illegible] 08 09 10

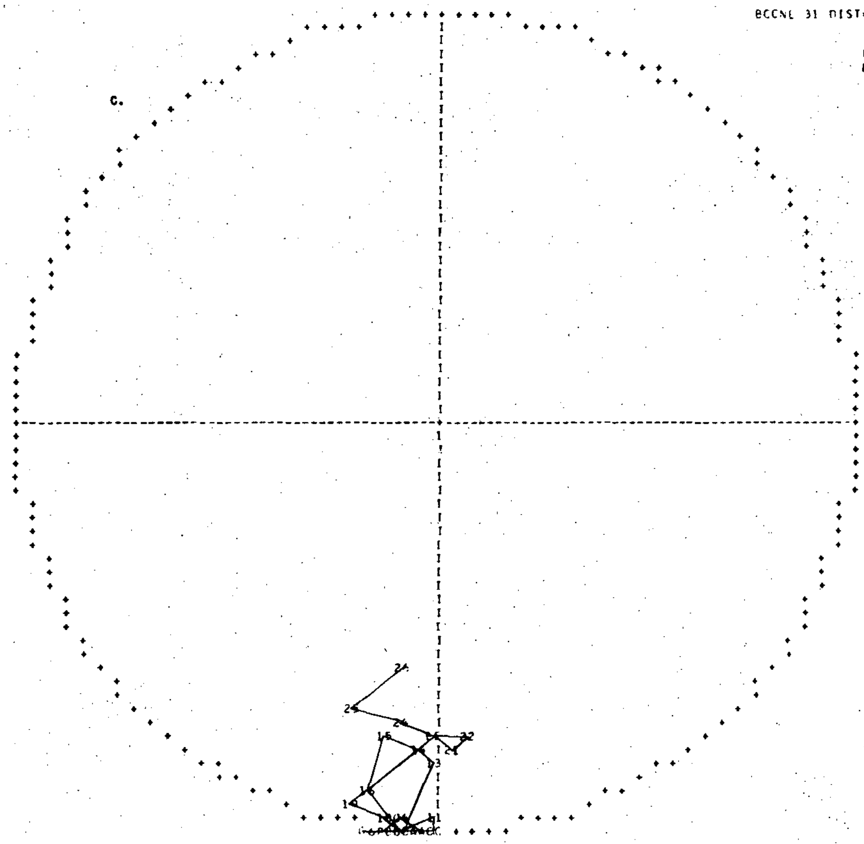
DD 04 12 17

EE 14 21

FF 20 23

XBL711-2695

Fig. 9A,B



BOONE 31 DIST=DD EUC WT=1
8 JAN 71

PLOTS TO FIT 17-26
LEAST TOTAL DIST

*** D35 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

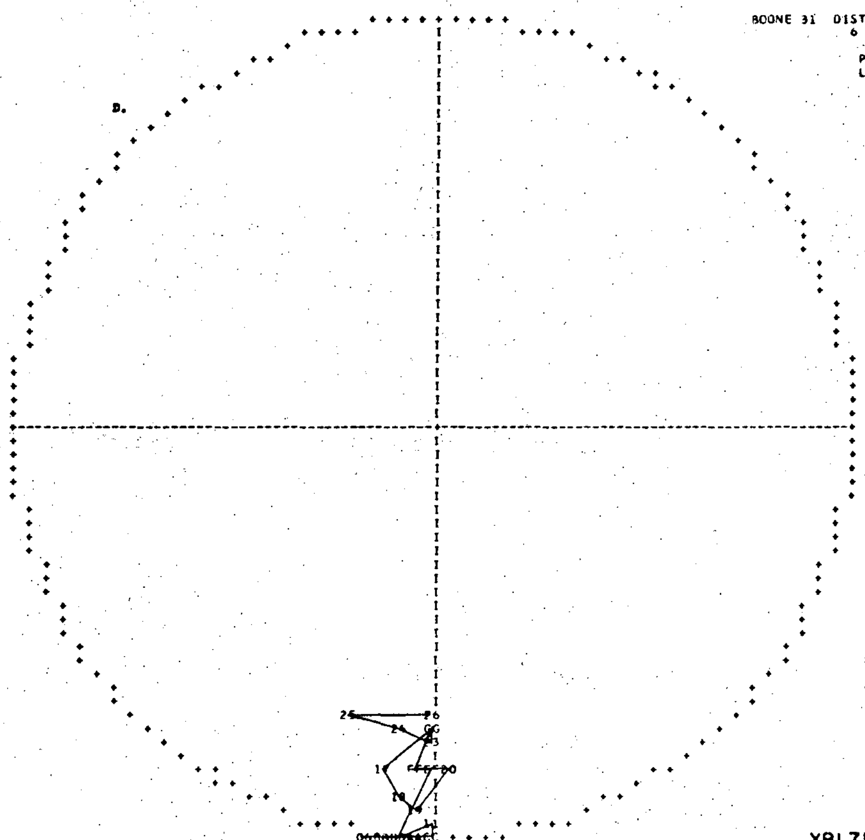
AA 01 03

BB 05 07

CC 02 08 09 10

DD 12 17

EE 20 23



BOONE 31 DIST=DD/(1.5+COS) SUM WT=1
6 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

*** D35 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 03

BB 05 07

CC 02 08 09 10

DD 04 12

EE 13 14

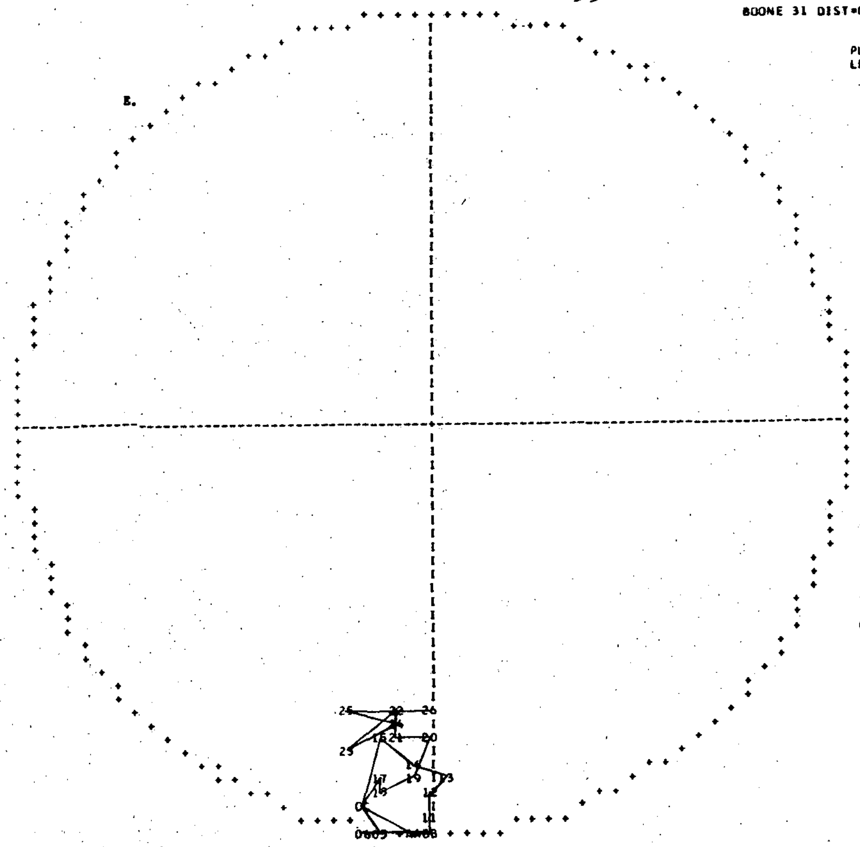
FF 15 21

GG 16 22

XBL711-2696

Fig. 9C,D

E.



BOONE 31 DIST=DO/(1.5+COS) EUC WT=1
9 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

*** D35 ***

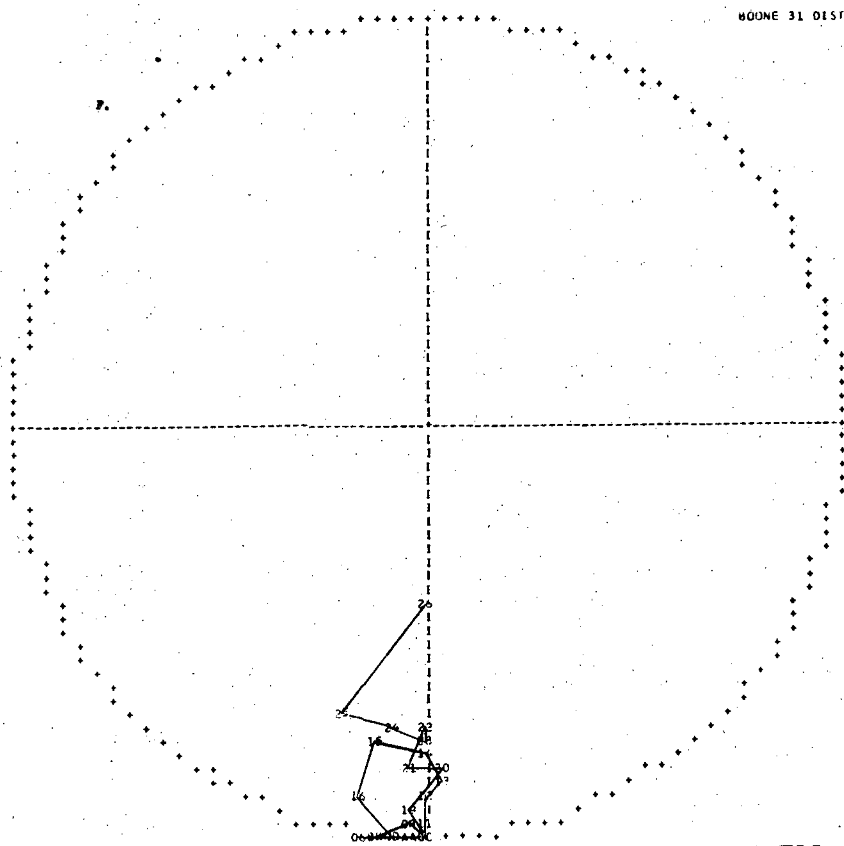
	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	619	1524
11	777	650	1543
12	826	598	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 03

BB 02 07 08 09 10

CC 04 16

F.



BOONE 31 DIST=DO/(1.5+COS) EUC WT=J+1/2
10 JAN 71

PLOTS TO FIT 41-HZ
LEAST TOTAL DIST

*** D35 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 03

BB 05 07

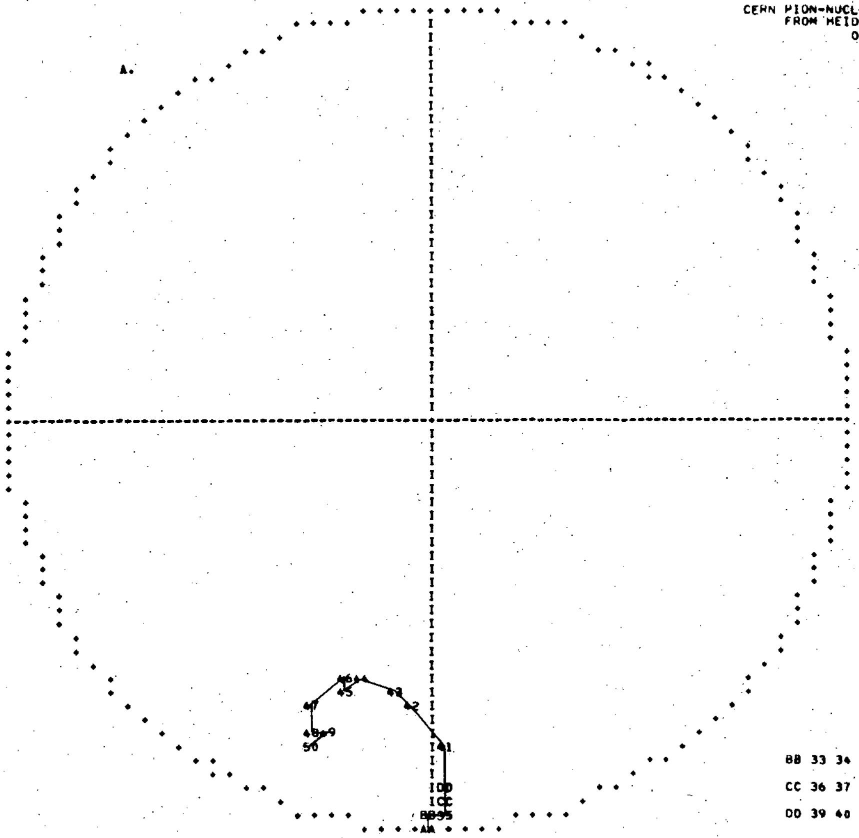
CC 02 09 10 18

DD 04 17

Fig. 9E,F

XBL 711-2697

CERN PION-NUCLEON EXPERIMENTAL FITS.
FROM HEIDELBERG. 9/67.
ORIGIN AT BOTTOM SCALE=1.0



*** F35 ***

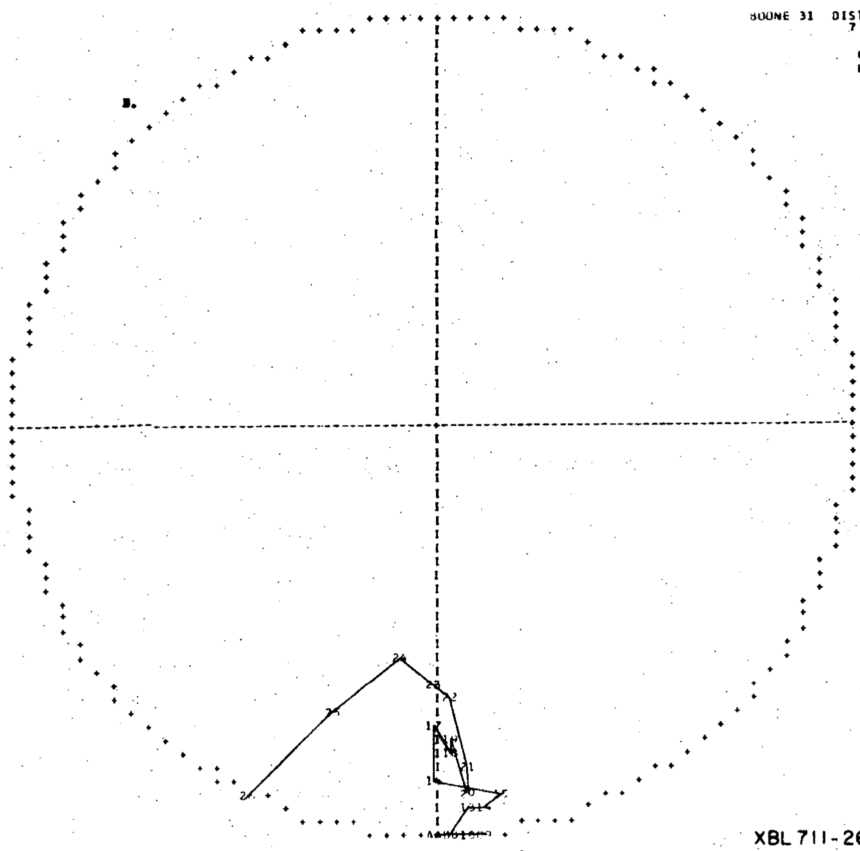
	P	T	M
01	80	21	1096
02	98	31	1104
03	108	37	1109
04	115	41	1113
05	140	58	1127
06	192	98	1160
07	219	120	1178
08	231	130	1186
09	245	142	1195
10	255	151	1202
11	271	165	1213
12	276	170	1217
13	297	189	1231
14	303	194	1235
15	321	210	1248
16	328	217	1252
17	331	220	1255
18	337	225	1259
19	361	247	1275
20	385	270	1292
21	427	310	1320
22	490	370	1362
23	532	410	1390
24	573	450	1417
25	614	490	1443
26	658	533	1470
27	675	550	1481
28	707	581	1501
29	726	600	1512
30	745	618	1524
31	777	650	1543
32	826	698	1572
33	875	746	1601
34	904	775	1617
35	925	796	1629
36	975	845	1658
37	1000	870	1672
38	1030	900	1688
39	1080	949	1716
40	1121	990	1738
41	1180	1049	1769
42	1280	1148	1821
43	1360	1228	1862
44	1444	1311	1903
45	1505	1372	1933
46	1579	1446	1968
47	1700	1566	2025
48	1880	1746	2107
49	2010	1875	2163
50	2070	1935	2189

BB 33 34
CC 36 37 38
DD 39 40

AA 01 02 03 04 05
06 07 08 09 +

BOONE 31 DIST=DO SUM WT=1
7 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST



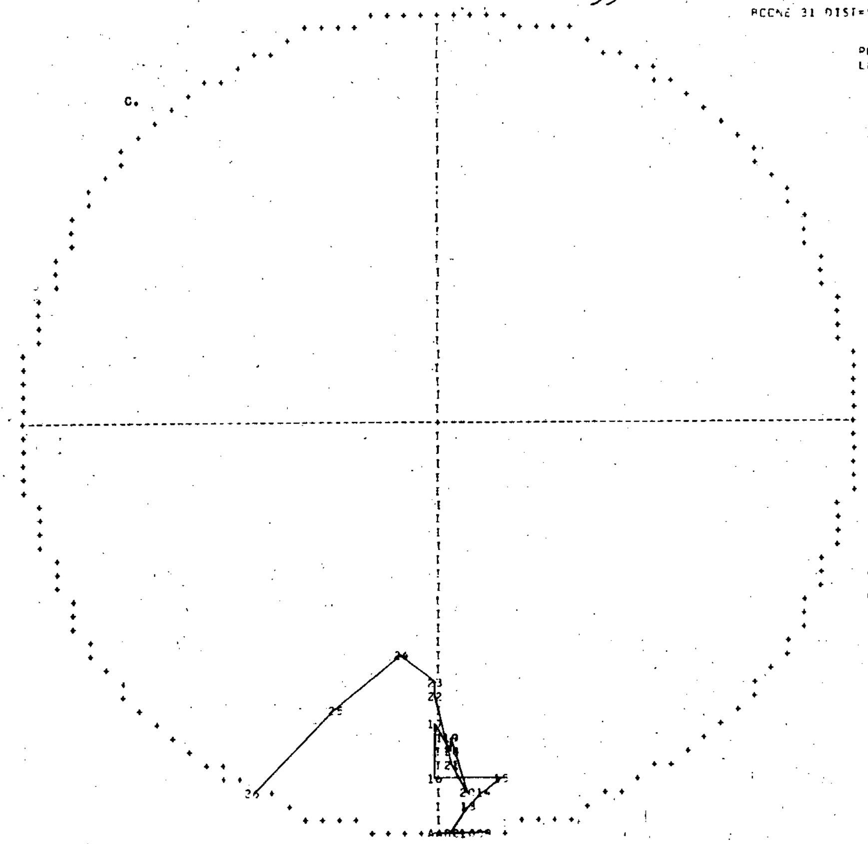
*** F35 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 02 03 04 05
06 07 08
BB 11 12

XBL 711-2692

Fig. 10A,B



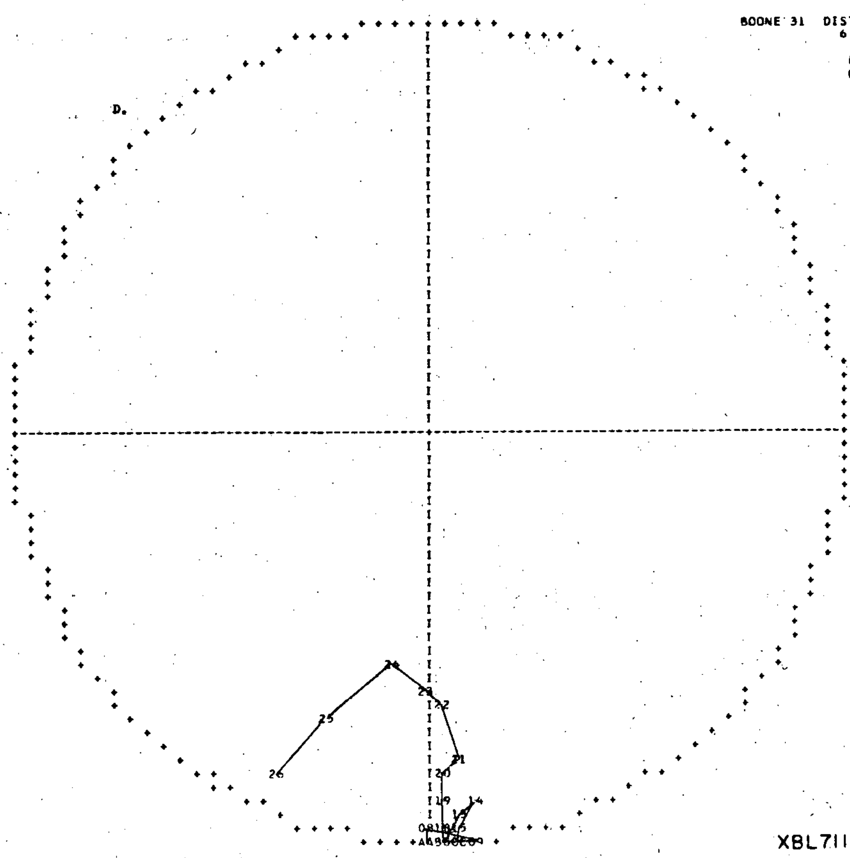
BOONE 31 DIST=DO EUC WT=1
8 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST

*** F35 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 02 03 04 05
06 07 08
BB 11 12



BOONE 31 DIST=D0/(1.5+COS) SUM WT=1
6 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

*** F35 ***

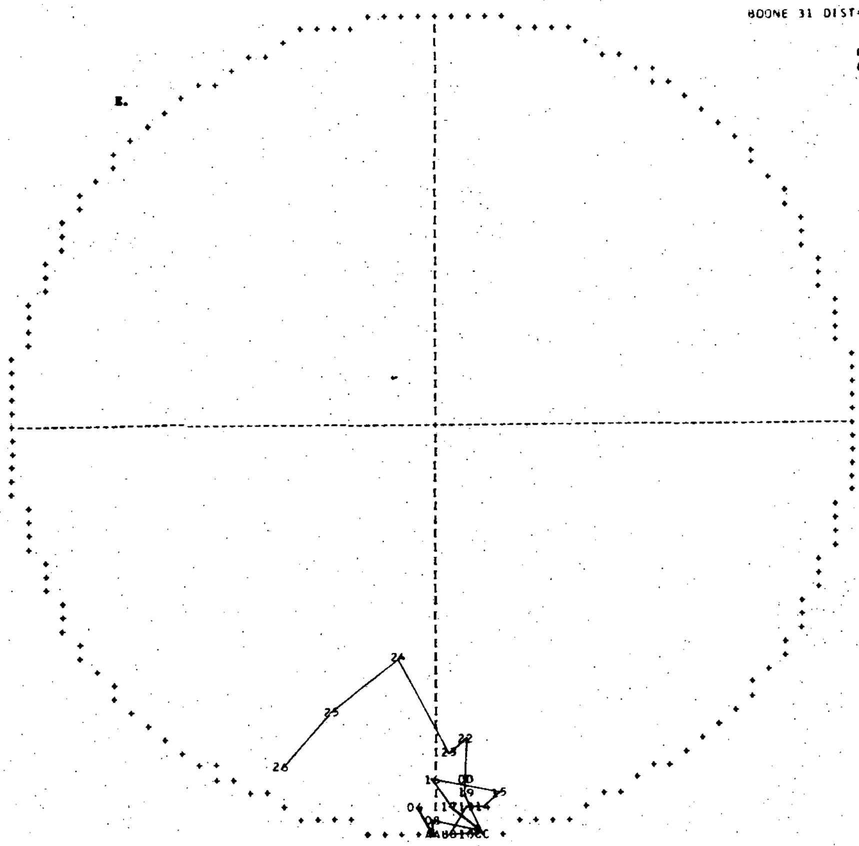
	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 02 03 04 05
06 07
BB 11 12 17

CC 10 16

XBL711-2693

Fig. 10C,D



BOONE 31 DIST=DO/(1.5+COS) EUC WT=1
9 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

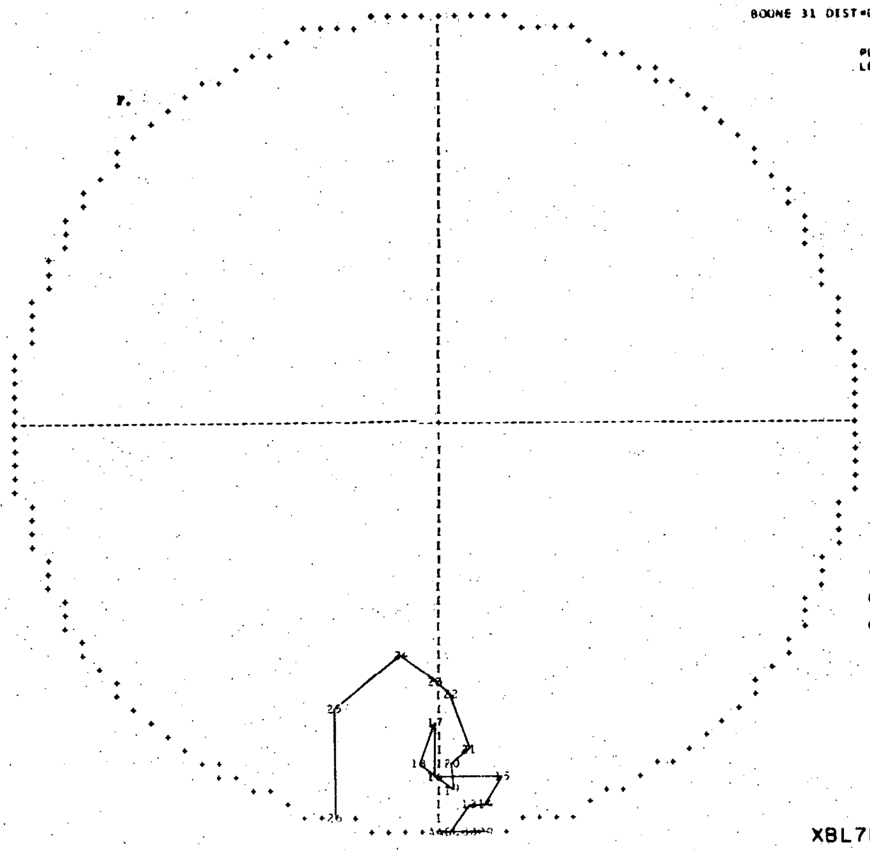
*** F35 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	926	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 02 03 05 06
07
BB 11 12

CC 09 18

DD 20 21



BOONE 31 DIST=DO/(1.5+COS) EUC WT=J+1/2
10 JAN 71

PLOTS TO FIT 41-HZ
LEAST TOTAL DIST

*** F35 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1130	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

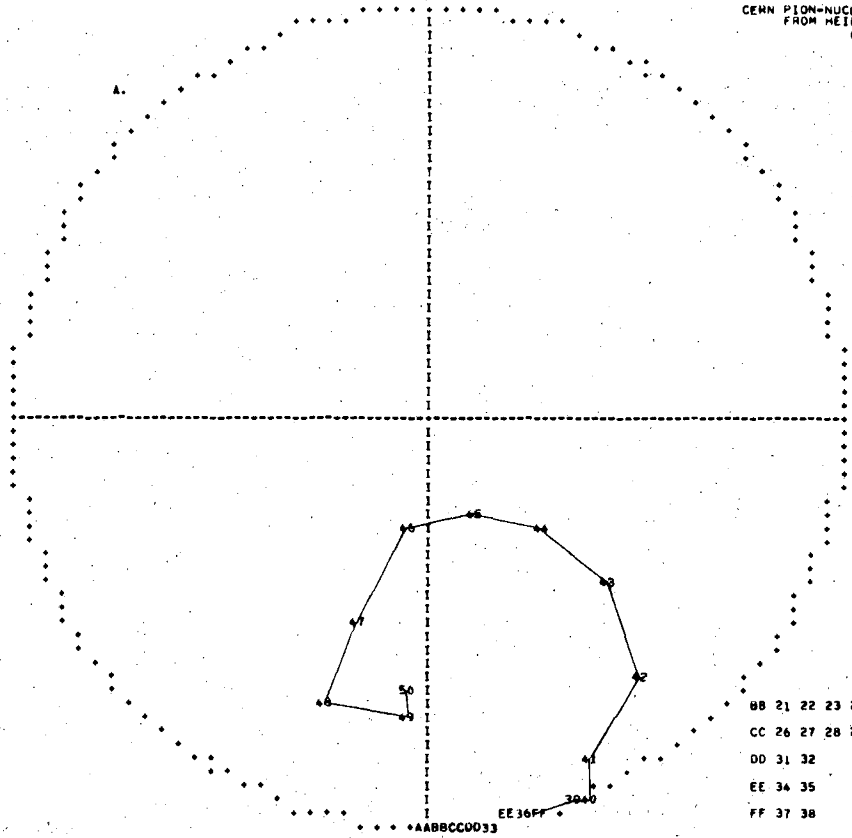
AA 01 02 03 04 05
06 07
BB 08 10

CC 11 12

XBL711-2694

Fig. 10E,F

CERN PION-NUCLEON EXPERIMENTAL FITS.
FROM HEIDELBERG, 9/67.
ORIGIN AT BOTTOM SCALE=1.0



*** F37 ***

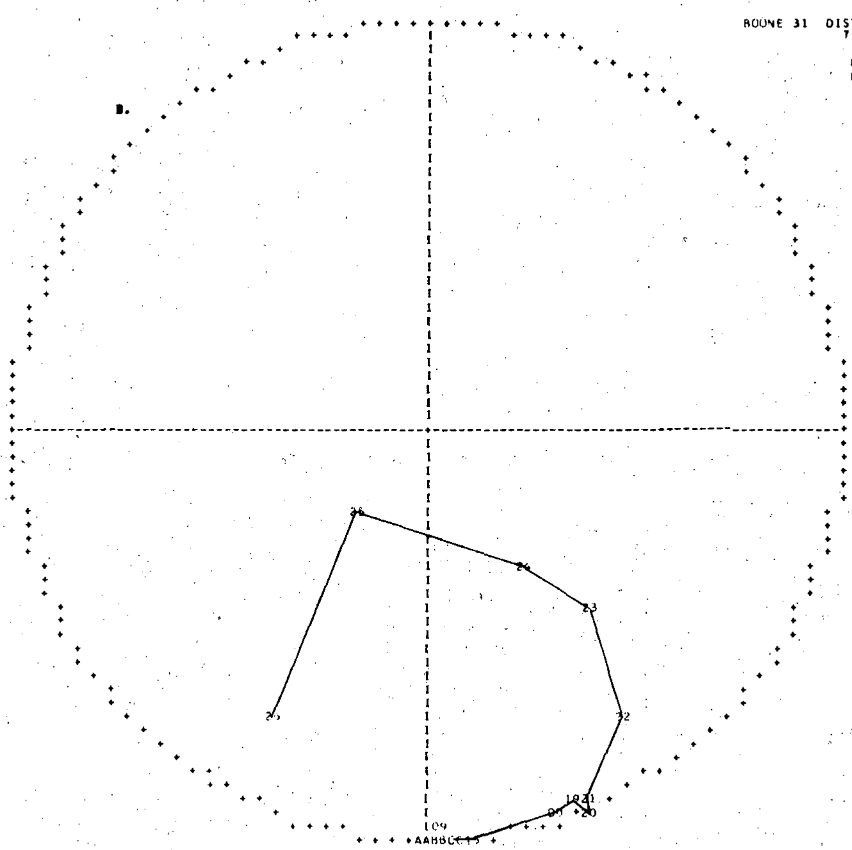
	P	T	M
01	80	21	1096
02	98	31	1104
03	108	37	1109
04	115	41	1113
05	140	58	1127
06	192	98	1160
07	219	120	1178
08	231	130	1186
09	245	142	1195
10	255	151	1202
11	271	165	1213
12	276	170	1217
13	297	189	1231
14	303	194	1235
15	321	210	1248
16	328	217	1252
17	331	220	1255
18	337	225	1259
19	361	247	1275
20	385	270	1292
21	427	310	1320
22	490	370	1362
23	532	410	1390
24	573	450	1417
25	614	490	1443
26	658	533	1470
27	675	550	1481
28	707	581	1501
29	726	600	1512
30	745	618	1524
31	777	650	1543
32	826	698	1572
33	875	746	1601
34	904	775	1617
35	925	796	1629
36	975	845	1658
37	1000	870	1672
38	1030	900	1688
39	1080	949	1716
40	1121	990	1738
41	1180	1049	1769
42	1280	1148	1821
43	1360	1228	1862
44	1444	1311	1903
45	1505	1372	1933
46	1579	1446	1968
47	1700	1566	2025
48	1880	1746	2107
49	2010	1875	2163
50	2070	1935	2189

BB 21 22 23 24 25
CC 26 27 28 29 30
DD 31 32
EE 34 35
FF 37 38

AA 01 02 03 04 05
06 07 08 09 +

BOONE 31 DIST=00 SUM WT=1
7 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST



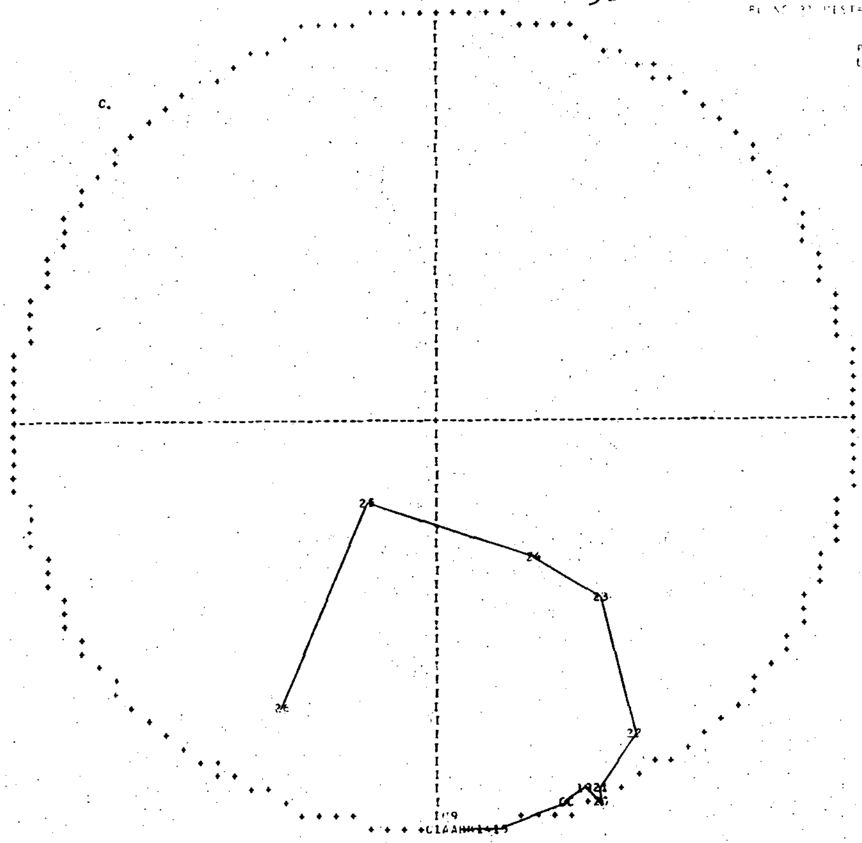
*** F37 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	945	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 03 04
BB 02 05 06
CC 07 08 10 11 12
13 14
DD 16 17 18

XBL711-2671

Fig. 11A,B



BOONE 31 DIST=00/(1.5+COS) SUM WT=1
6 JAN 71

PLOTS TO FIT 17-26
LEAST TOTAL DIST

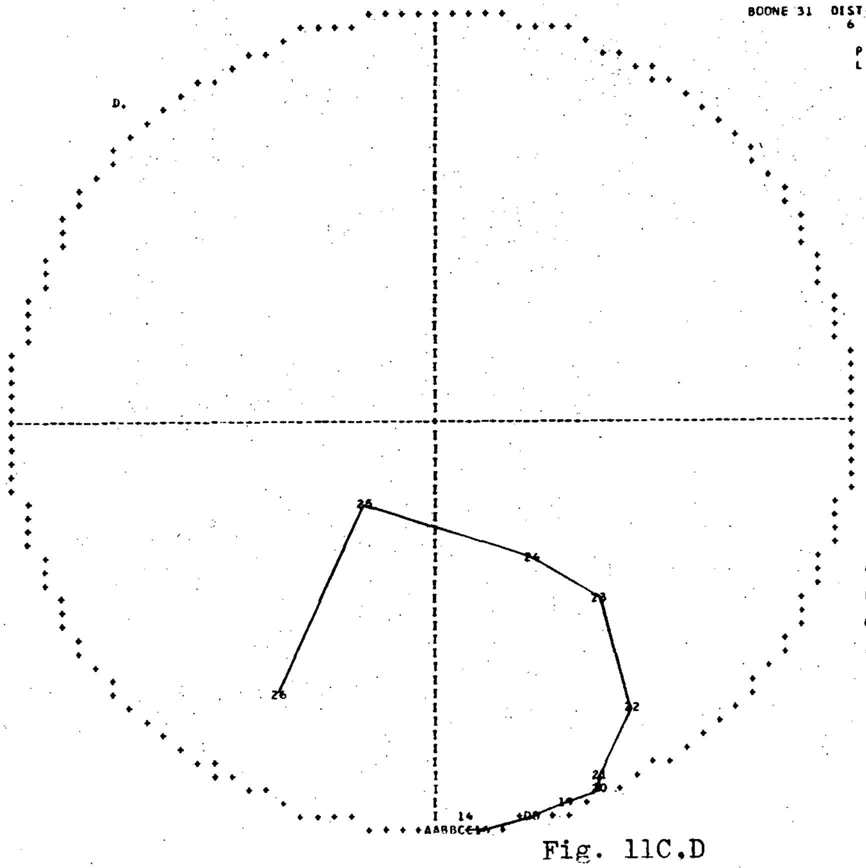
*** F37 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 02 03 04 05 06

BB 07 08 10 11 12
13

CC 16 17 18



BOONE 31 DIST=00/(1.5+COS) SUM WT=1
6 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

*** F37 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 03 04 09

BB 02 05 06

CC 07 08 10 11 12
13 15

DD 17 18

Fig. 11C,D

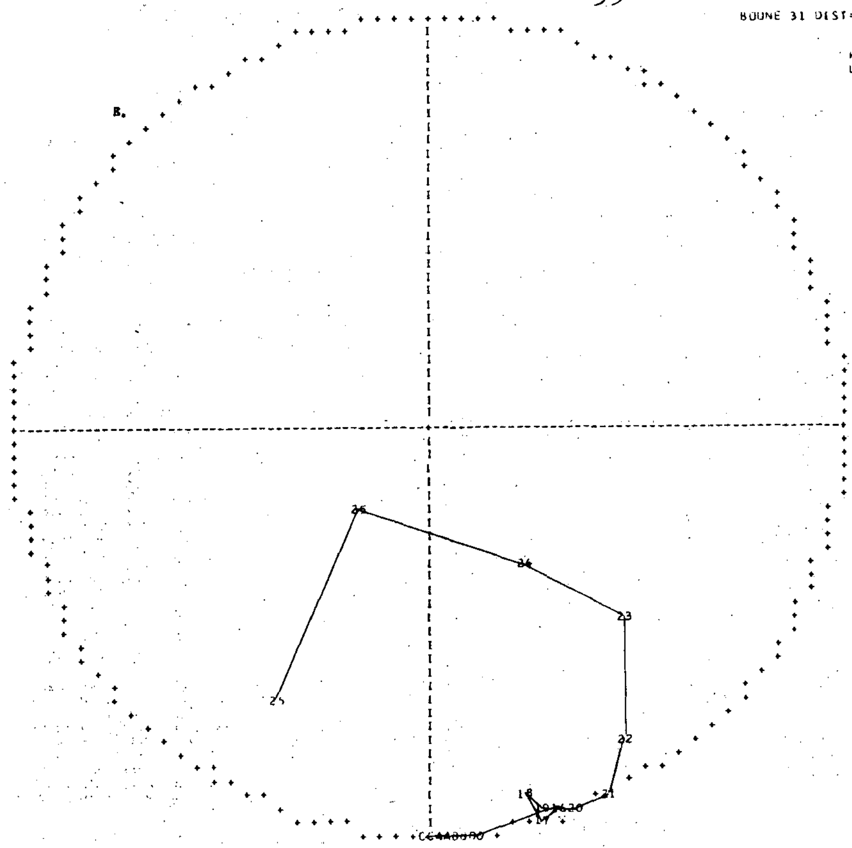
XBL711-2672

BOUNE 31 DIST=D0/(1.5+COS) EUC WT=1
9 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

*** F37 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025



AA 02 03 05 06

BB 04 07 08 10 11
13 14

CC 01 09

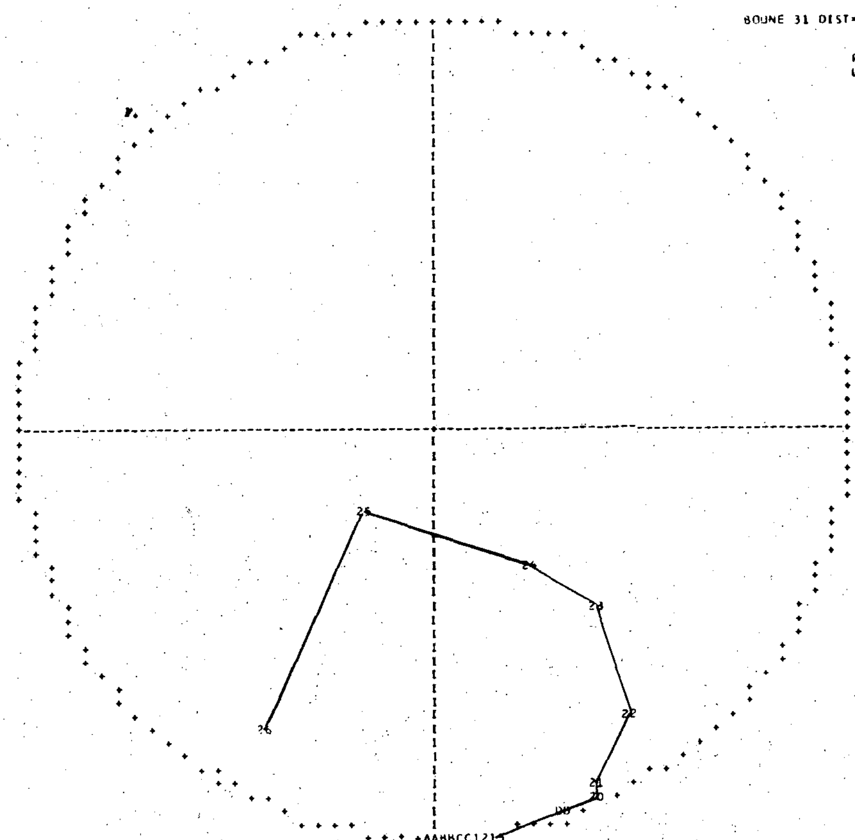
DD 12 15

BOUNE 31 DIST=D0/(1.5+COS) EUC WT=J+1/2
10 JAN 71

PLOTS TO FIT 41-HZ
LEAST TOTAL DIST

*** F37 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025



AA 01 03 04 09

BB 02 05 06 08

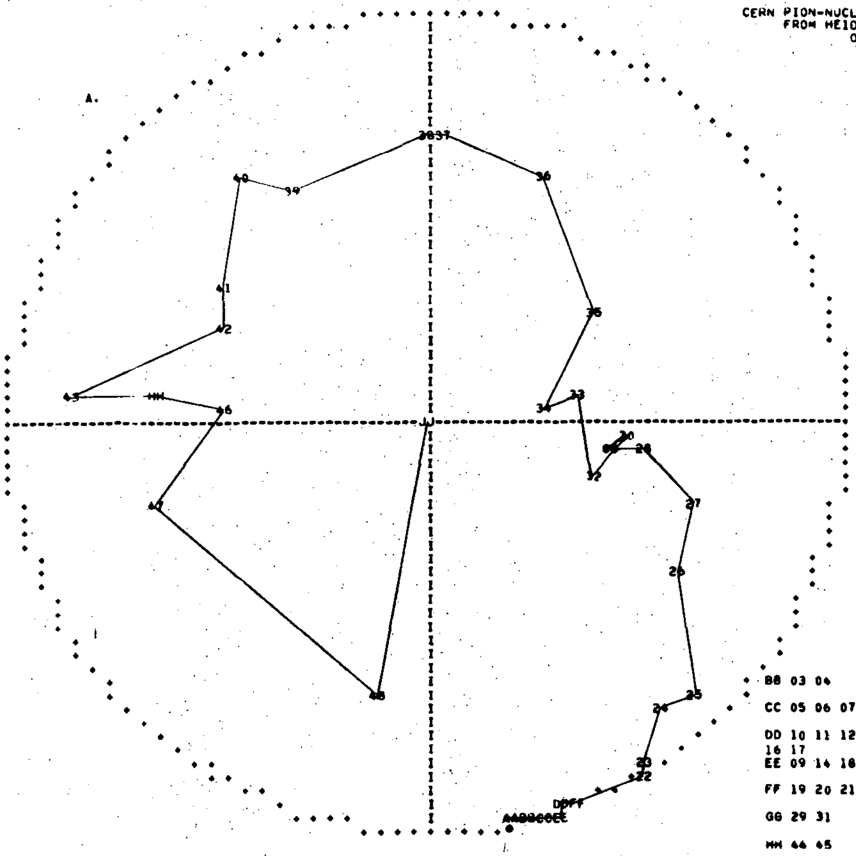
CC 07 10 11 13 14

DD 16 17 18 19

Fig. 11E,F

XBL711-2673

CERN PION-NUCLEON EXPERIMENTAL FITS.
FROM HEIDELBERG, 9/67.
ORIGIN AT BOTTOM SCALE=1.0



*** S11 ***

	P	T	M
01	80	21	1096
02	98	31	1104
03	108	37	1109
04	115	41	1113
05	140	58	1127
06	192	98	1160
07	219	120	1178
08	231	130	1186
09	245	142	1195
10	255	151	1202
11	271	165	1213
12	276	170	1217
13	297	189	1231
14	303	194	1235
15	321	210	1248
16	328	217	1252
17	331	220	1255
18	337	225	1259
19	361	247	1275
20	385	270	1292
21	427	310	1320
22	490	370	1362
23	532	410	1390
24	573	450	1417
25	614	490	1443
26	658	533	1470
27	675	550	1481
28	707	581	1501
29	726	600	1512
30	745	618	1524
31	777	650	1543
32	826	698	1572
33	875	746	1601
34	904	775	1617
35	925	796	1629
36	975	845	1658
37	1000	870	1672
38	1030	900	1688
39	1080	949	1716
40	1121	990	1738
41	1180	1049	1769
42	1280	1148	1821
43	1360	1228	1862
44	1444	1311	1903
45	1505	1372	1933
46	1579	1446	1968
47	1700	1566	2025
48	1880	1746	2107
49	2010	1875	2163
50	2070	1935	2189

BB 03 04

CC 05 06 07 08

DD 10 11 12 13 15
16 17

EE 09 14 18

FF 19 20 21

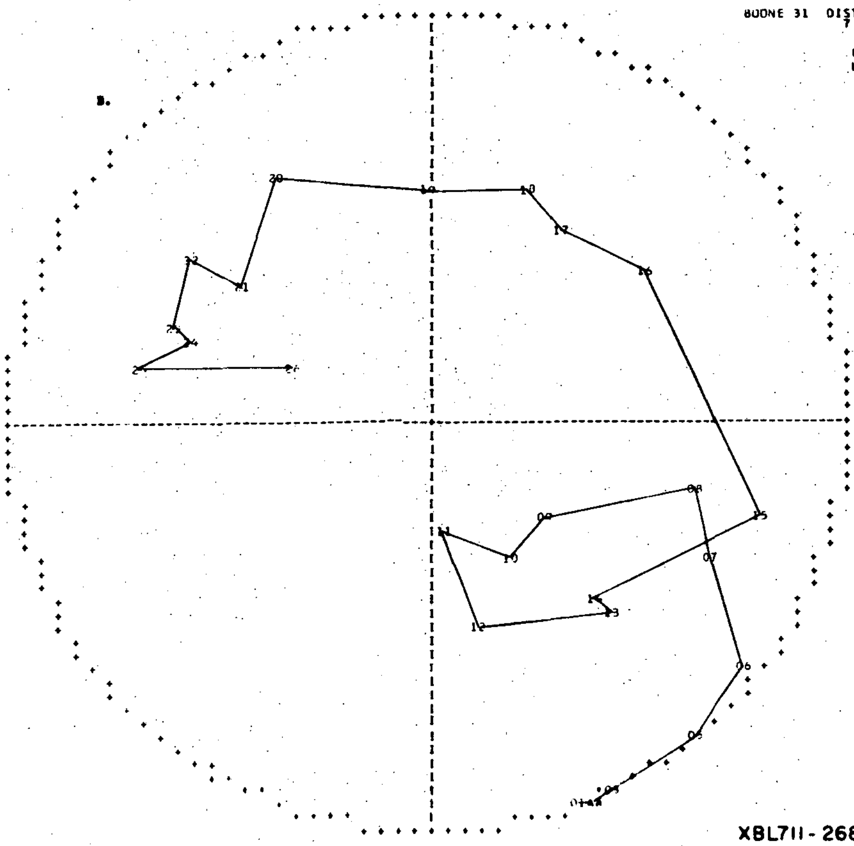
GG 29 31

HH 44 45   AA 01 02

JJ 49 50

BOONE 31 DIST=DD SUM WT=1
7 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST



*** S11 ***

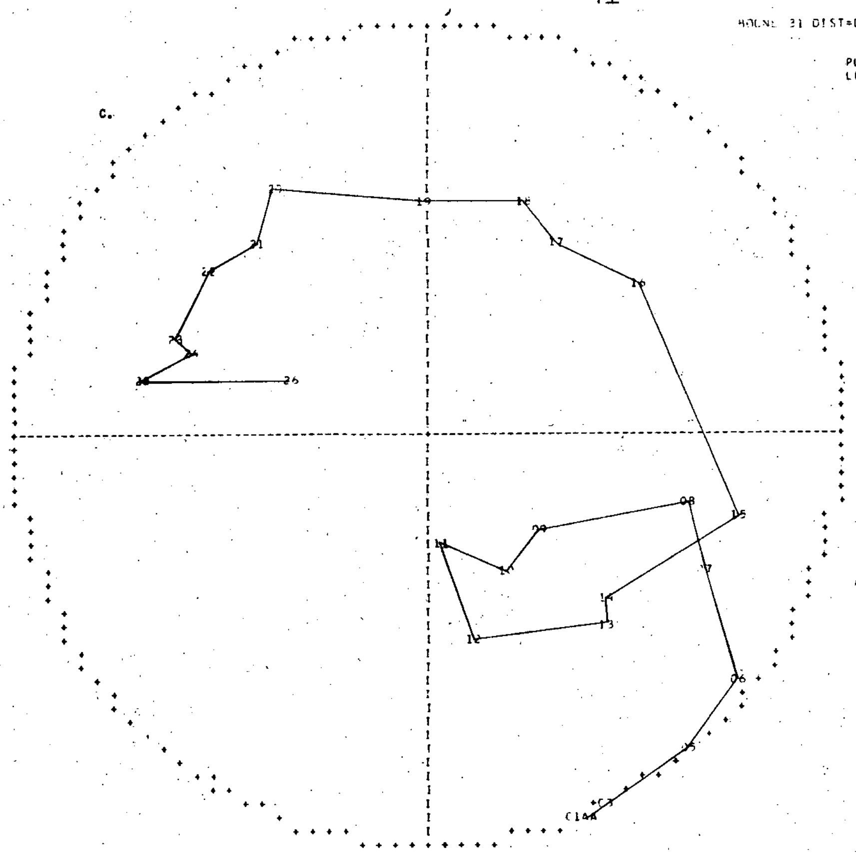
	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1290	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 02 04

XBL711-2689

Fig. 12A,B

C.



BOONE 31 DIST=DO EUC WT=1
8 JAN 71

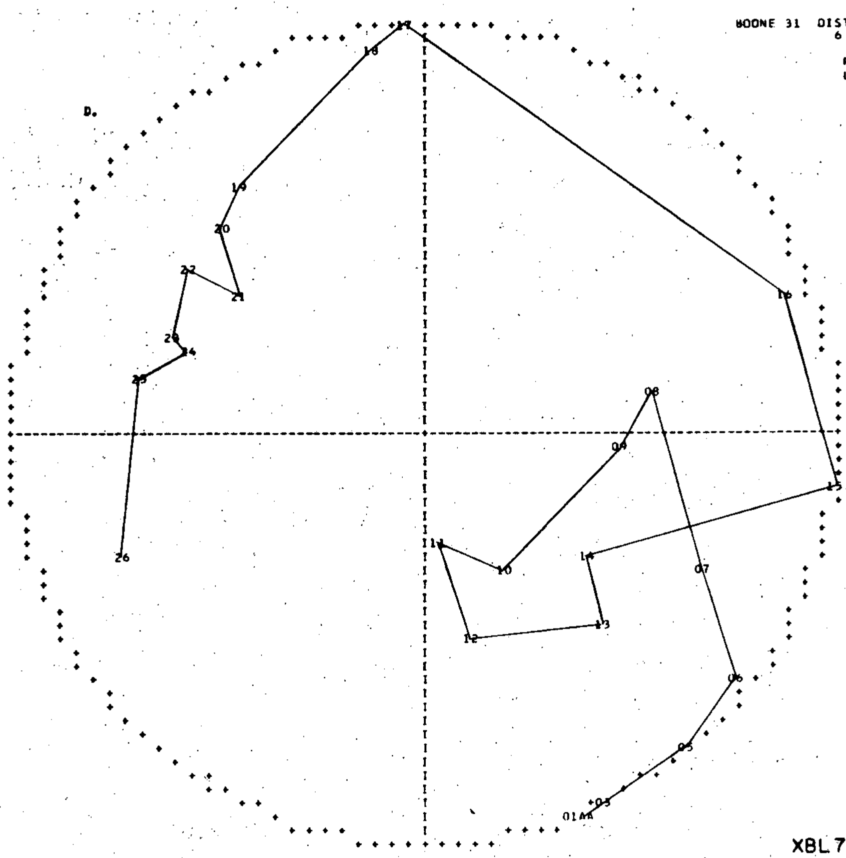
PLOTS TO FIT 17-26
LEAST TOTAL DIST

*** S11 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 02 04

D.



BOONE 31 DIST=DO/(1.5+COS) SUM WT=1
6 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

*** S11 ***

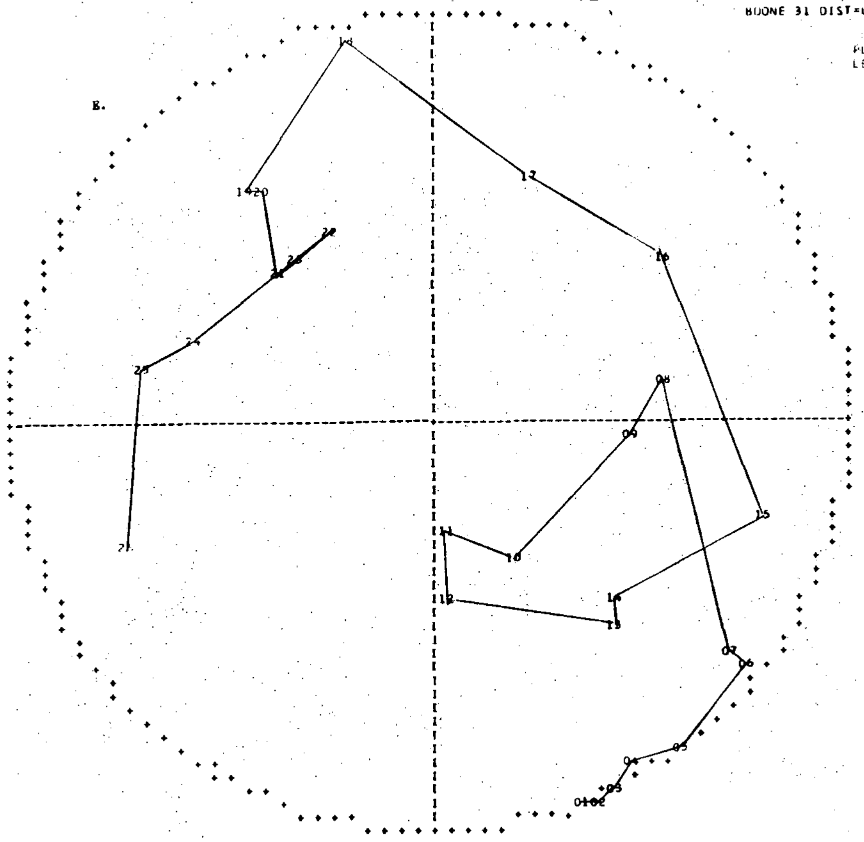
	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 02 04

XBL 711-2690

Fig. 12C,D

E.



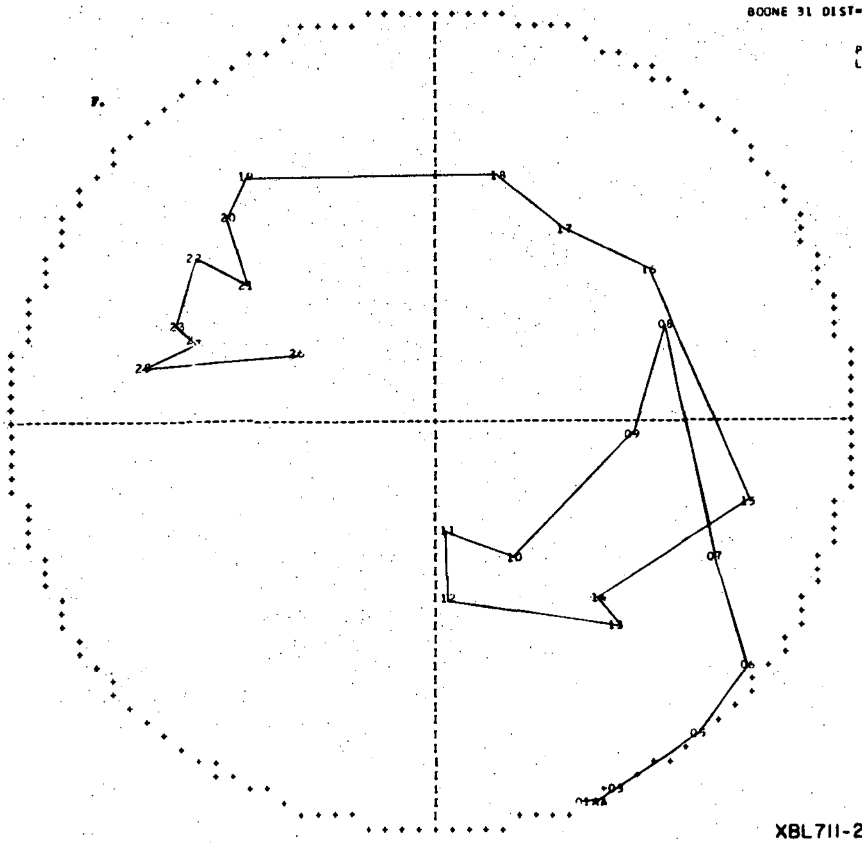
BOONE 31 DIST=DO/(1.5+COS) EUC WT=1
9 JAN 71

PLOTS T. FIT 7-NI
LEAST TOTAL DIST

*** S11 ***

	P	T	M
01	3[illegible]5	70	129[illegible]
02	427	310	13[illegible]
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	173[illegible]
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

F.



BOONE 31 DIST=DO/(1.5+COS) EUC WT=J+1/2
10 JAN 71

PLOTS TO FIT 41-HZ
LEAST TOTAL DIST

*** S11 ***

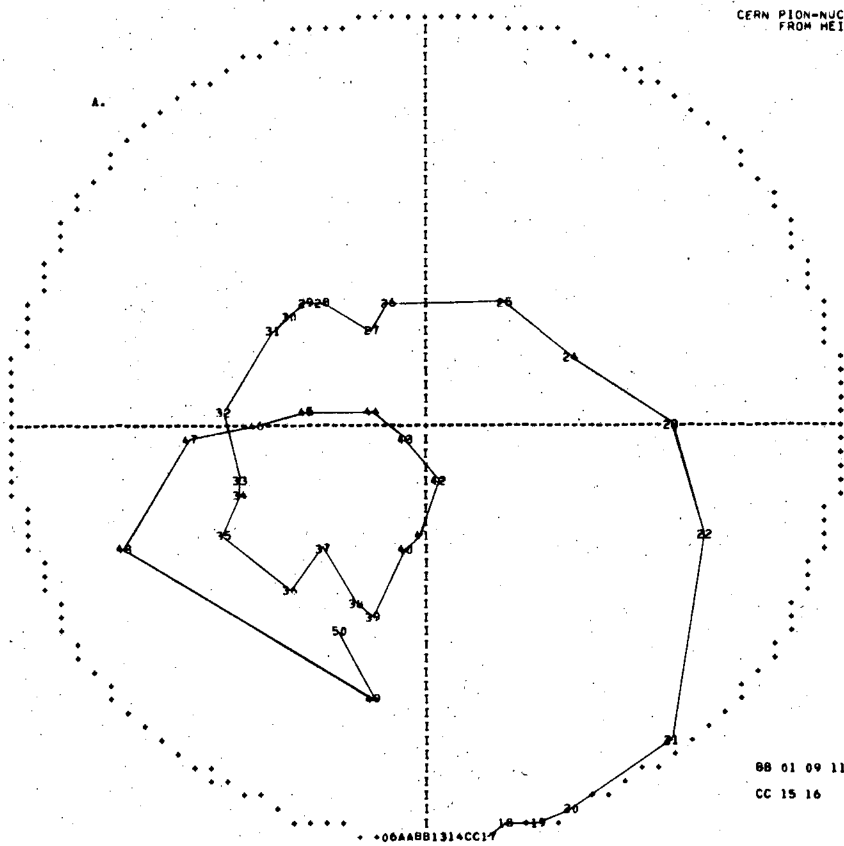
	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 02 04

XBL711-2691

Fig. 12E,F

CERN PION-NUCLEON EXPERIMENTAL FITS.
FROM HEIDELBERG, 9/67.
ORIGIN AT BOTTOM SCALE=1.0



*** P11 ***

	P	T	M
01	80	21	1096
02	98	31	1104
03	108	37	1109
04	115	41	1113
05	140	58	1127
06	192	98	1160
07	219	120	1178
08	231	130	1186
09	245	142	1195
10	255	151	1202
11	271	165	1213
12	276	170	1217
13	297	189	1231
14	303	194	1235
15	321	210	1248
16	328	217	1252
17	331	220	1255
18	337	225	1259
19	361	247	1275
20	385	270	1292
21	427	310	1320
22	490	370	1362
23	532	410	1390
24	573	450	1417
25	614	490	1443
26	658	533	1470
27	675	550	1481
28	707	581	1501
29	726	600	1512
30	745	618	1524
31	777	650	1543
32	826	698	1572
33	875	746	1601
34	904	775	1617
35	925	796	1629
36	975	845	1658
37	1000	870	1672
38	1030	900	1688
39	1080	949	1716
40	1121	990	1738
41	1180	1049	1769
42	1280	1148	1821
43	1360	1228	1862
44	1444	1311	1903
45	1505	1372	1933
46	1579	1446	1968
47	1700	1566	2025
48	1880	1746	2107
49	2010	1875	2163
50	2070	1935	2189

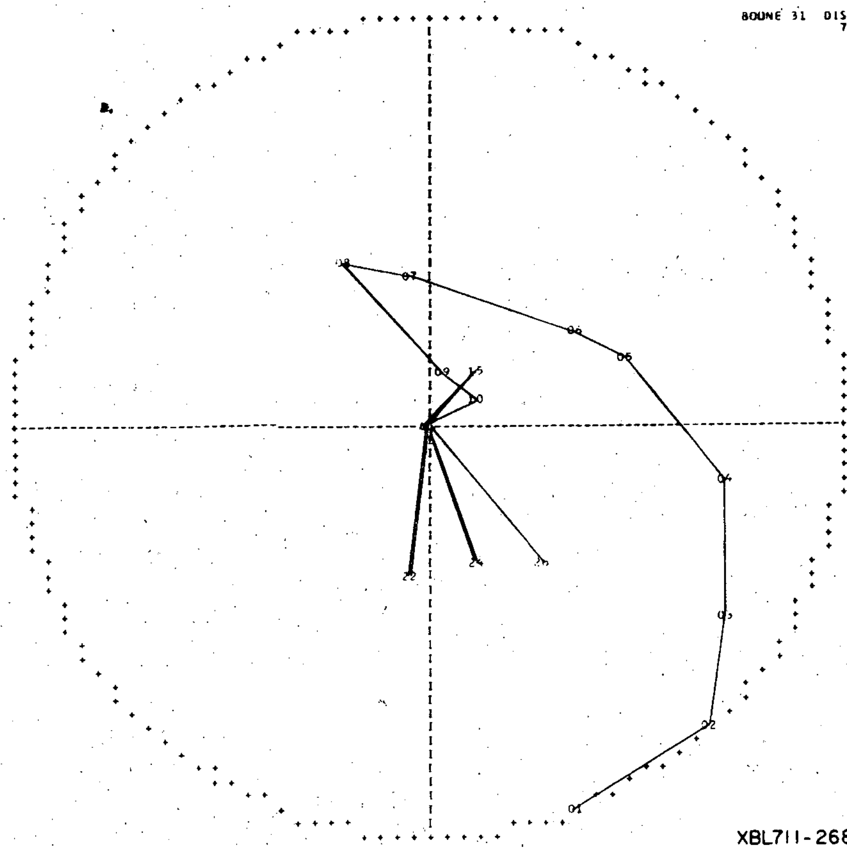
BB 01 09 11 12

CC 15 16

AA 02 03 04 05 07
08 10

BOUNE 31 DIST=00 SUM WT=1
7 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST



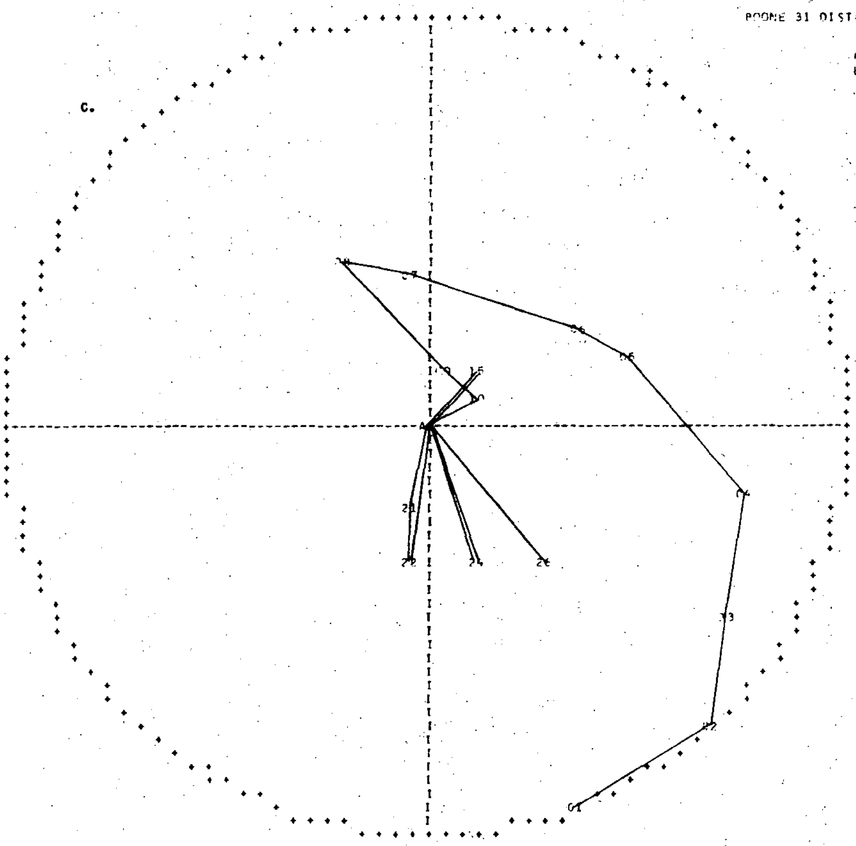
*** P11 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 11 12 13 14 16
17 18 19 20 +

XBL711-2686

Fig. 13A,B



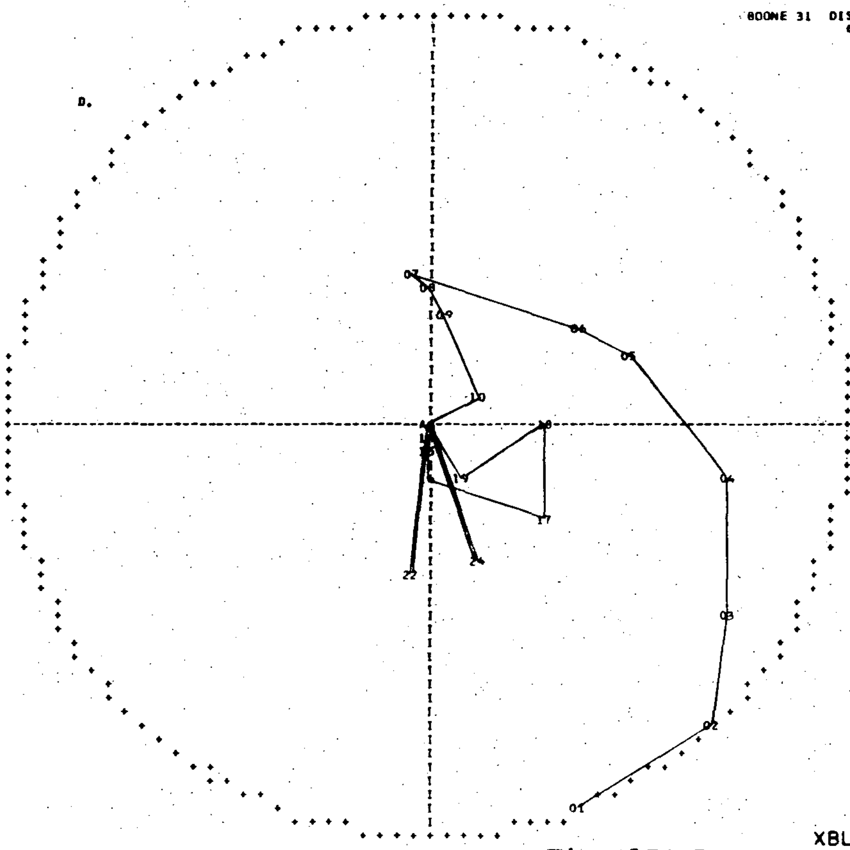
BOONE 31 DIST=DO EUC WT=1
8 JAN 71

PLOTS TO FIT 17-26
LEAST TOTAL DIST

*** P11 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 11 12 13 14 16
17 18 19 20 +



BOONE 31 DIST=DO/(1.5+COS) SUM WT=1
6 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

*** P11 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 11 12 13 20 21
23 25 26

XBL711-2687

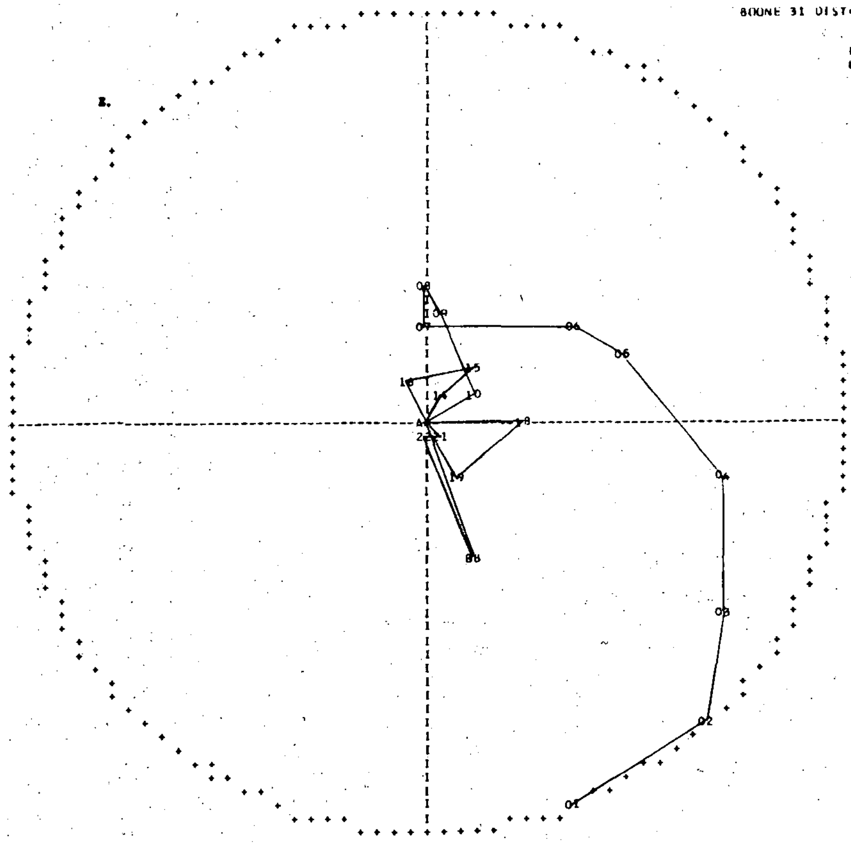
Fig. 13C,D

BOONE 31 DIST=DO/(1.5+COS) EUC WT=1
9 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

*** P11 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025



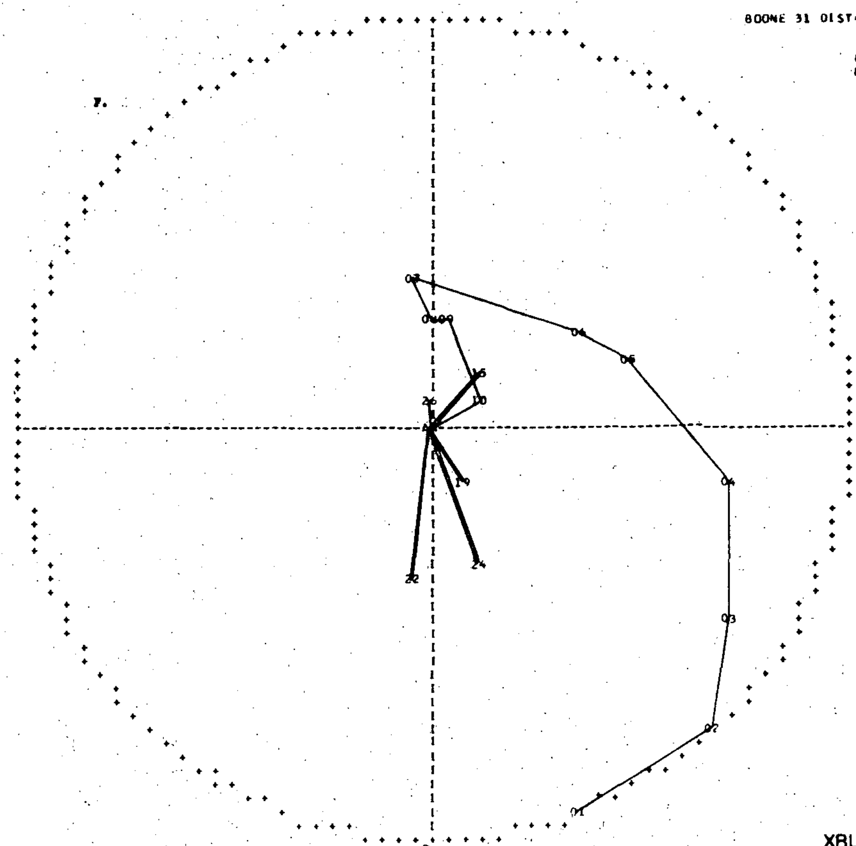
AA 11 12 13 17 20
25 26
BB 23 24

BOONE 31 DIST=DO/(1.5+COS) EUC WT=J+1/2
10 JAN 71

PLOTS TO FIT 41-HZ
LEAST TOTAL DIST

*** P11 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

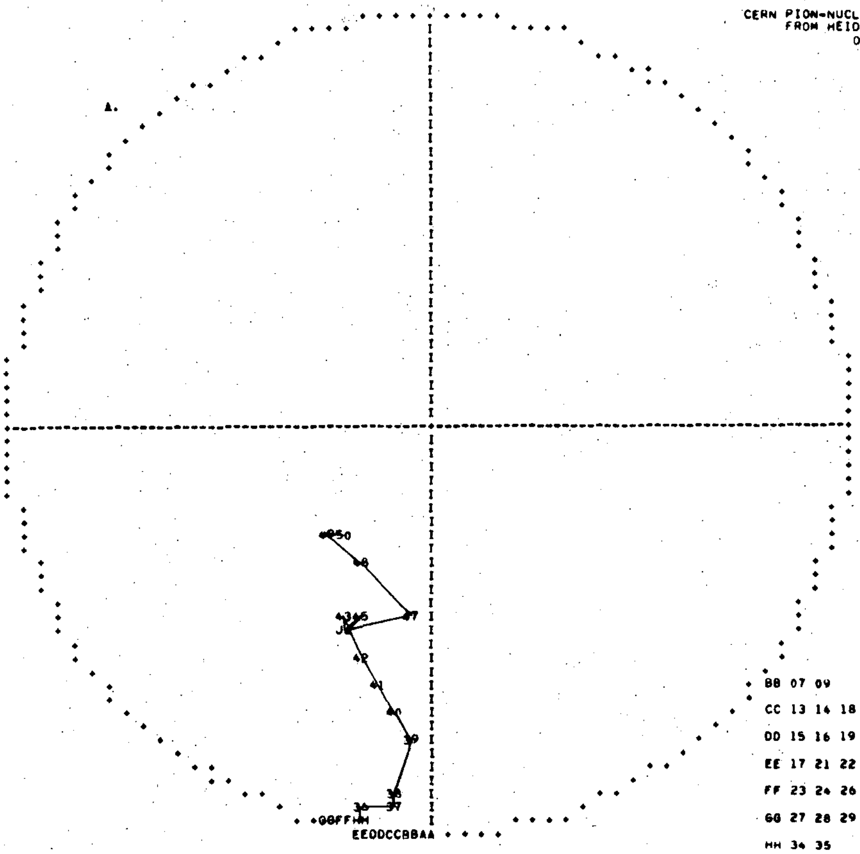


AA 11 12 13 14 16
17 18 20 21 +

XBL711-2688

Fig. 13E,F

CERN PION-NUCLEON EXPERIMENTAL FITS.
FROM HEIDELBERG, 9/67.
ORIGIN AT BOTTOM SCALE=1.0



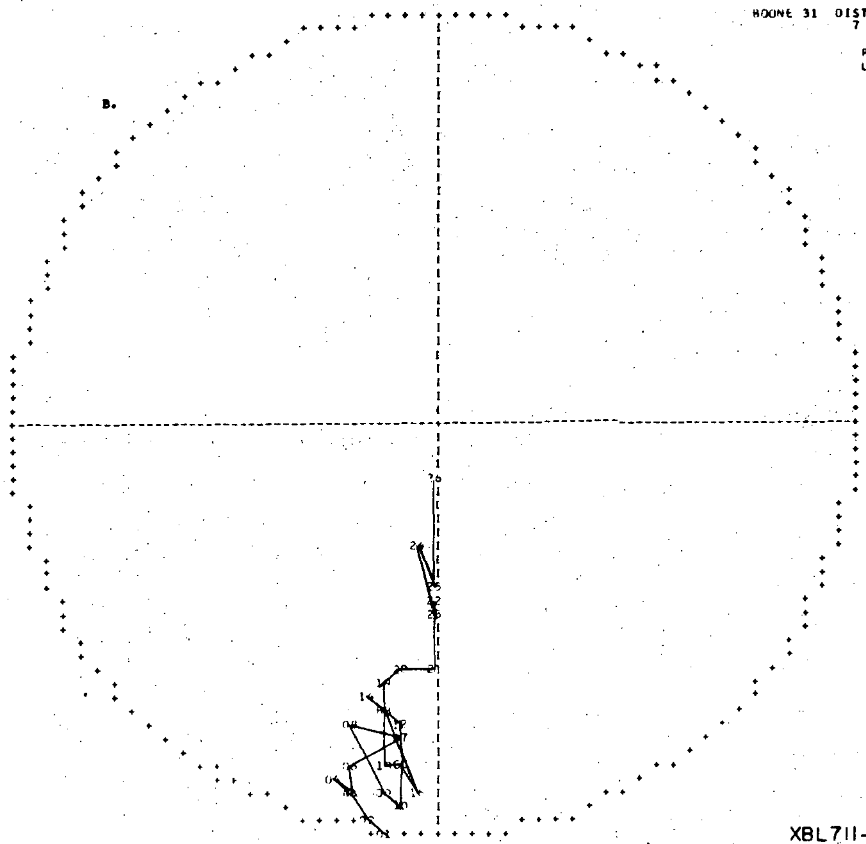
*** P13 ***

	P	T	M
01	80	21	1096
02	98	31	1104
03	108	37	1109
04	115	41	1113
05	140	58	1127
06	192	98	1160
07	219	120	1178
08	231	130	1186
09	245	142	1195
10	255	151	1202
11	271	165	1213
12	276	170	1217
13	297	189	1231
14	303	194	1235
15	321	210	1248
16	328	217	1252
17	331	220	1255
18	337	225	1259
19	361	247	1275
20	385	270	1292
21	427	310	1320
22	490	370	1362
23	532	410	1390
24	573	450	1417
25	614	490	1443
26	658	533	1470
27	675	550	1481
28	707	581	1501
29	726	600	1512
30	745	618	1524
31	777	650	1543
32	826	698	1572
33	875	746	1601
34	904	775	1617
35	925	796	1629
36	975	845	1658
37	1000	870	1672
38	1030	900	1688
39	1080	949	1716
40	1121	990	1738
41	1180	1049	1769
42	1280	1148	1821
43	1360	1228	1862
44	1444	1311	1903
45	1505	1372	1933
46	1579	1446	1968
47	1700	1566	2025
48	1880	1746	2107
49	2010	1875	2163
50	2070	1935	2189

BB 07 09
CC 13 14 18
DD 15 16 19 20
EE 17 21 22 25
FF 23 24 26 30 33
GG 27 28 29 31 32
HH 34 35
AA 01 02 03 04 05 06 08 10 11 12
JJ 44 46

BOONE 31 DIST=DO SUM WT=1
7 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST



*** P13 ***

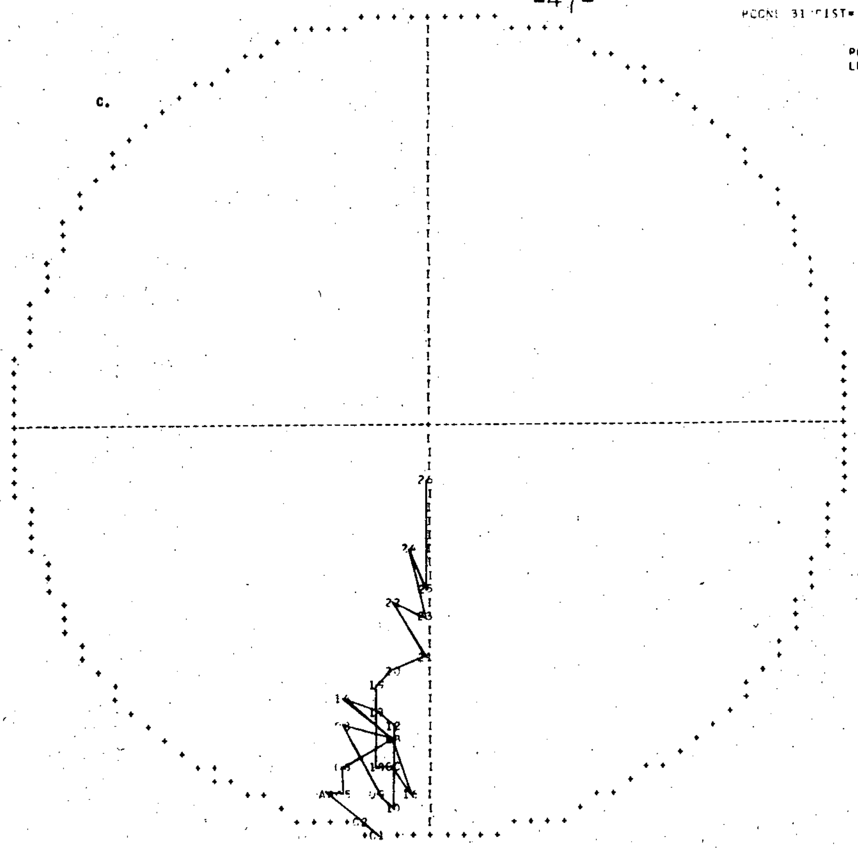
	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA J3 05
HB 13 15
CC .1 17

XBL711-2683

Fig. 14A,B

C.



BOONE 31 DIST=DD EUC WT=1
8 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST

*** P13 ***

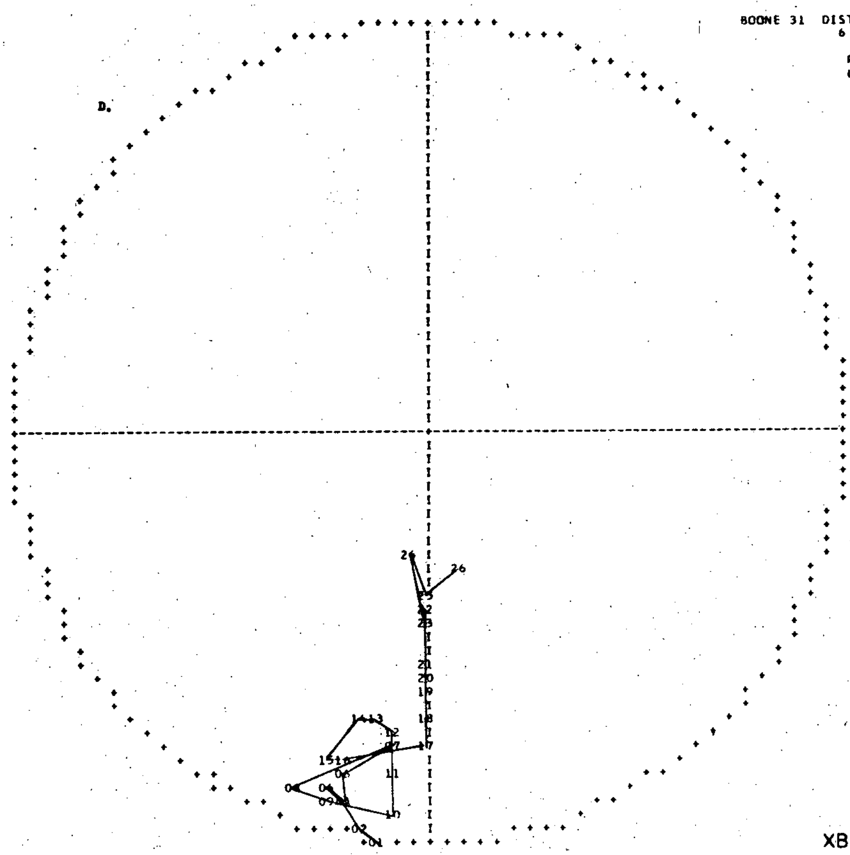
	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1698
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 03 04

BB 07 15

CC 11 17

D.



BOONE 31 DIST=DD/(1.5+COS) SUM WT=1
6 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

*** P13 ***

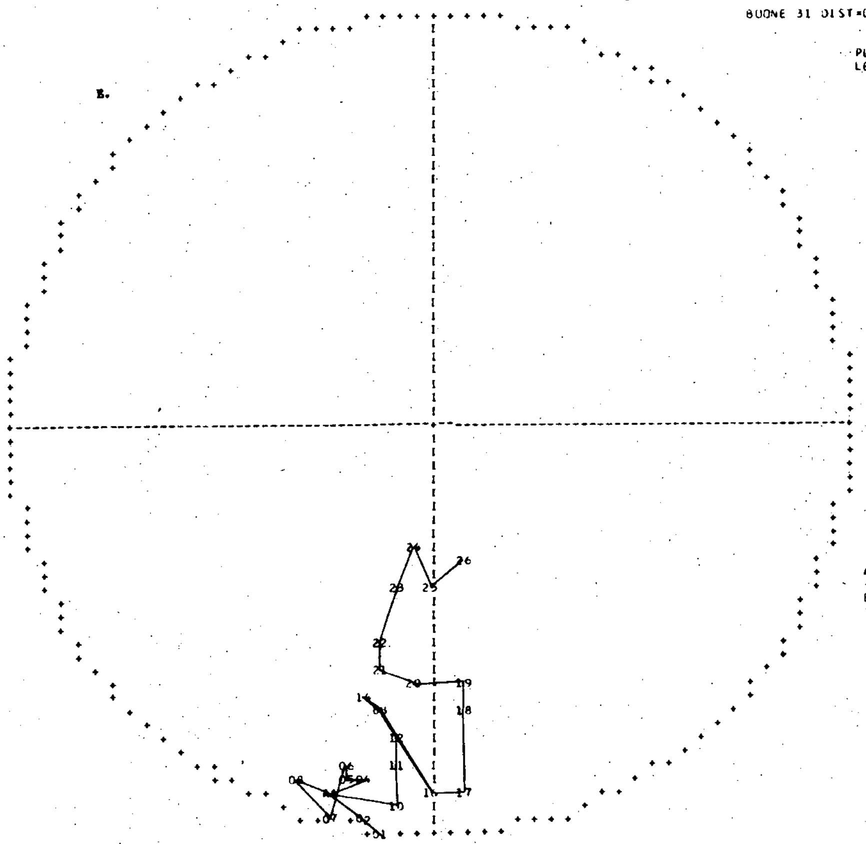
	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 03 05

XBL711-2684

Fig. 14C,D

E.



BOONE 31 DIST=D0/(1.5+COS) EUC WT=1
9 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

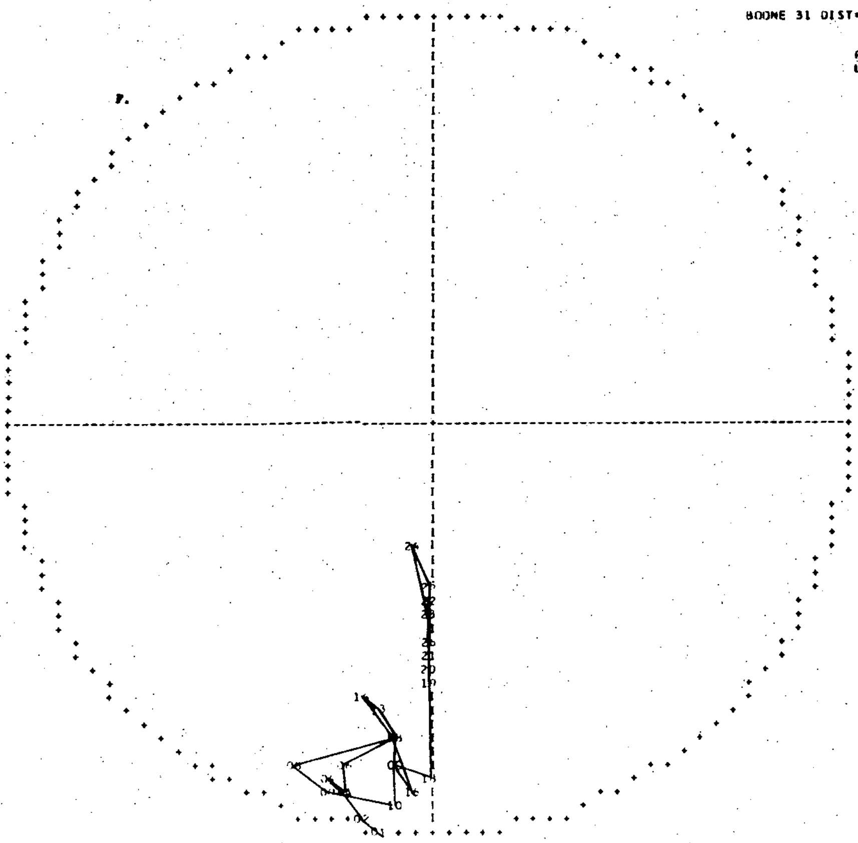
*** P13 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 03 09

BB 13 15

F.



BOONE 31 DIST=D0/(1.5+COS) EUC WT=J+1/2
10 JAN 71

PLOTS TO FIT 41-HZ
LEAST TOTAL DIST

*** P13 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	945	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 03 05

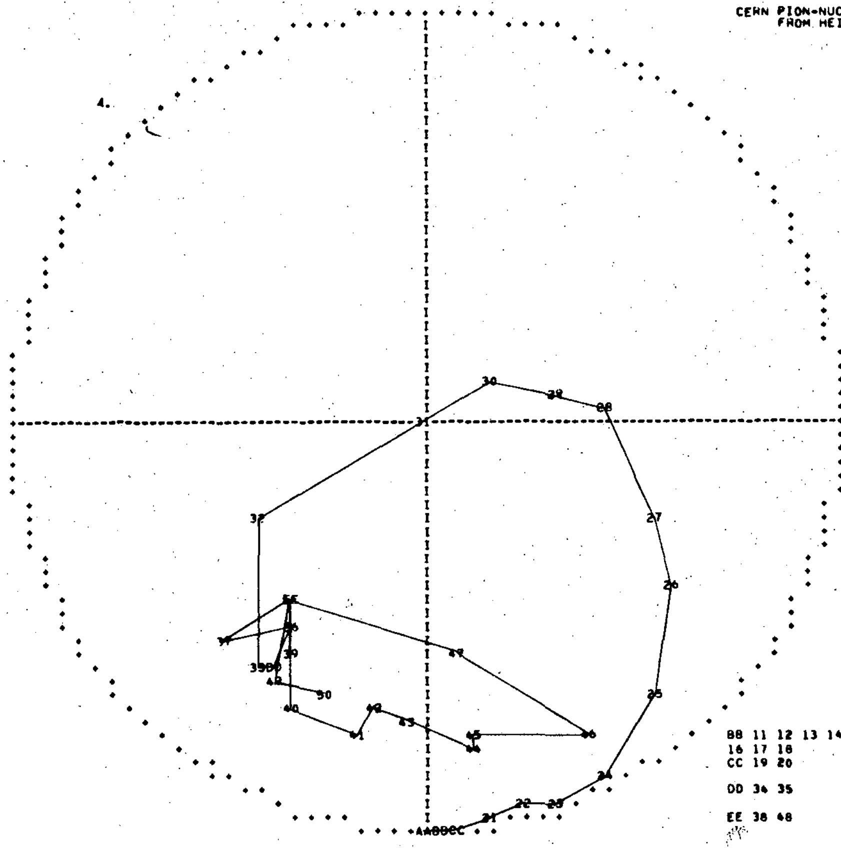
BB 07 12 15

CC 11 17

XBL711-2685

Fig. 14E,F

CERN PION-NUCLEON EXPERIMENTAL FITS.
FROM HEIDELBERG, 9/67.
ORIGIN AT BOTTOM SCALE=1.0



*** D13 ***

	P	T	M
01	80	21	1096
02	98	31	1104
03	108	37	1109
04	115	41	1113
05	140	58	1127
06	192	98	1160
07	219	120	1178
08	231	130	1186
09	245	142	1195
10	255	151	1202
11	271	165	1213
12	276	170	1217
13	297	189	1231
14	303	194	1235
15	321	210	1248
16	328	217	1252
17	331	220	1255
18	337	225	1259
19	361	247	1275
20	385	270	1292
21	427	310	1320
22	490	370	1362
23	532	410	1390
24	573	450	1417
25	614	490	1443
26	658	533	1470
27	675	550	1481
28	707	581	1501
29	726	600	1512
30	745	618	1524
31	777	650	1543
32	826	698	1572
33	875	746	1601
34	904	775	1617
35	925	796	1629
36	975	845	1658
37	1000	870	1672
38	1030	900	1688
39	1080	949	1716
40	1121	990	1738
41	1180	1049	1769
42	1280	1148	1821
43	1360	1228	1862
44	1444	1311	1903
45	1505	1372	1933
46	1579	1446	1968
47	1700	1566	2025
48	1880	1746	2107
49	2010	1875	2163
50	2070	1935	2189

BB 11 12 13 14 15
16 17 18
CC 19 20

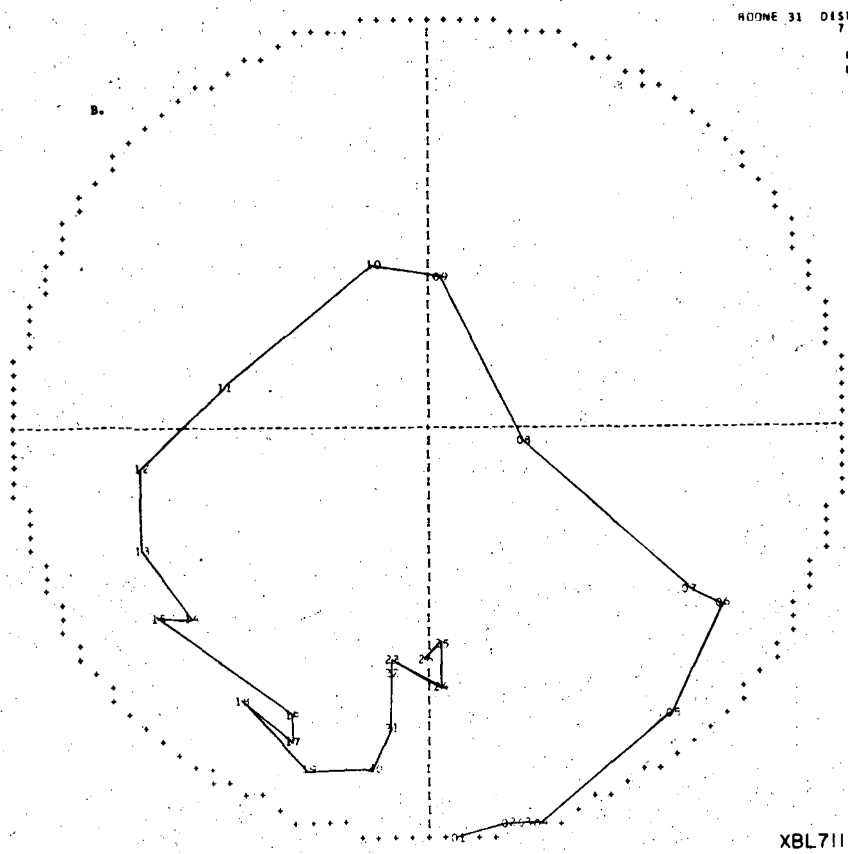
DD 34 35

EE 38 48

AA 01 02 03 04 05
06 07 08 09 10

BOONE 31 DIST=DO SUM WT=1
7 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST



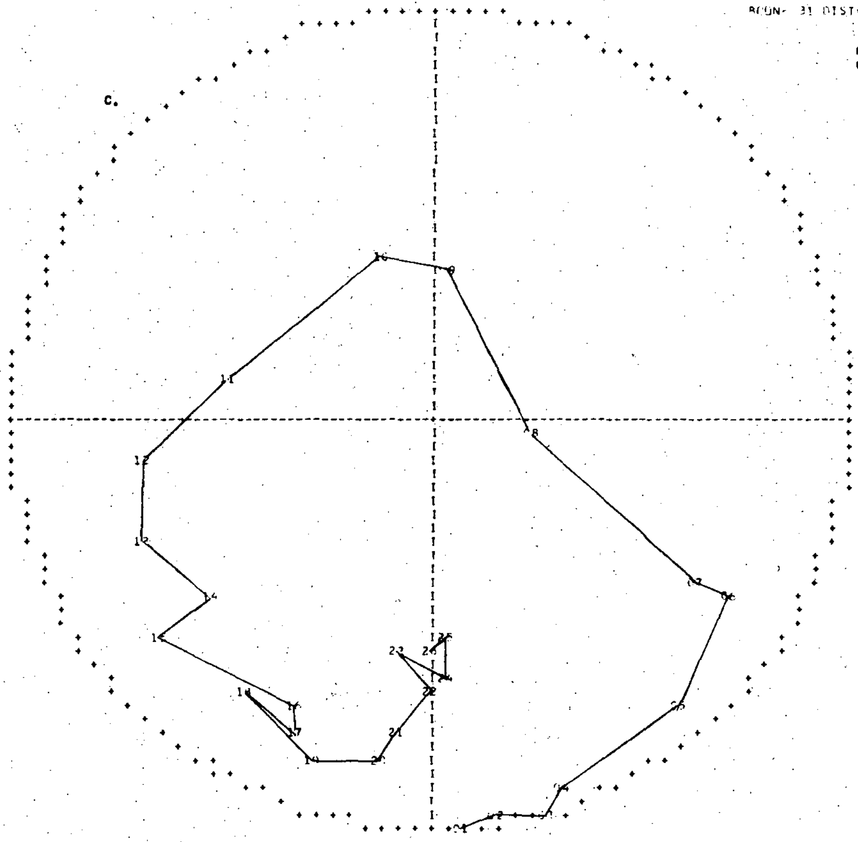
*** D13 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

XBL711-2680

Fig. 15A,B

C.



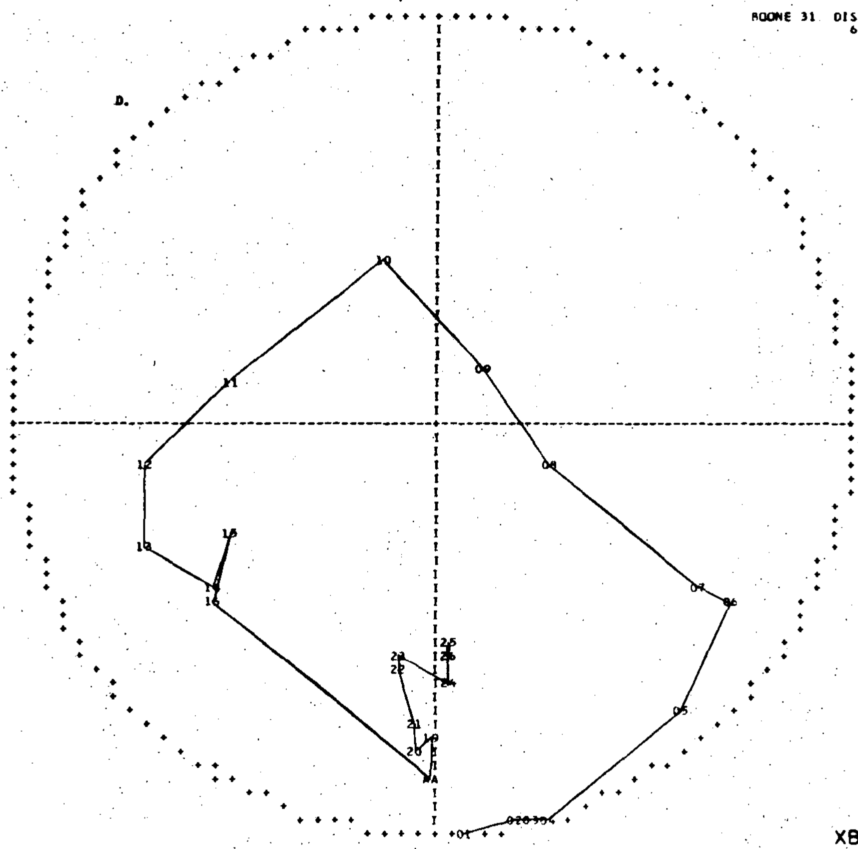
BOONE 31 DIST=D. EUC WT=1
8 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST

*** D13 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

D.



BOONE 31 DIST=DO/(1.5+COS) SUM WT=1
6 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

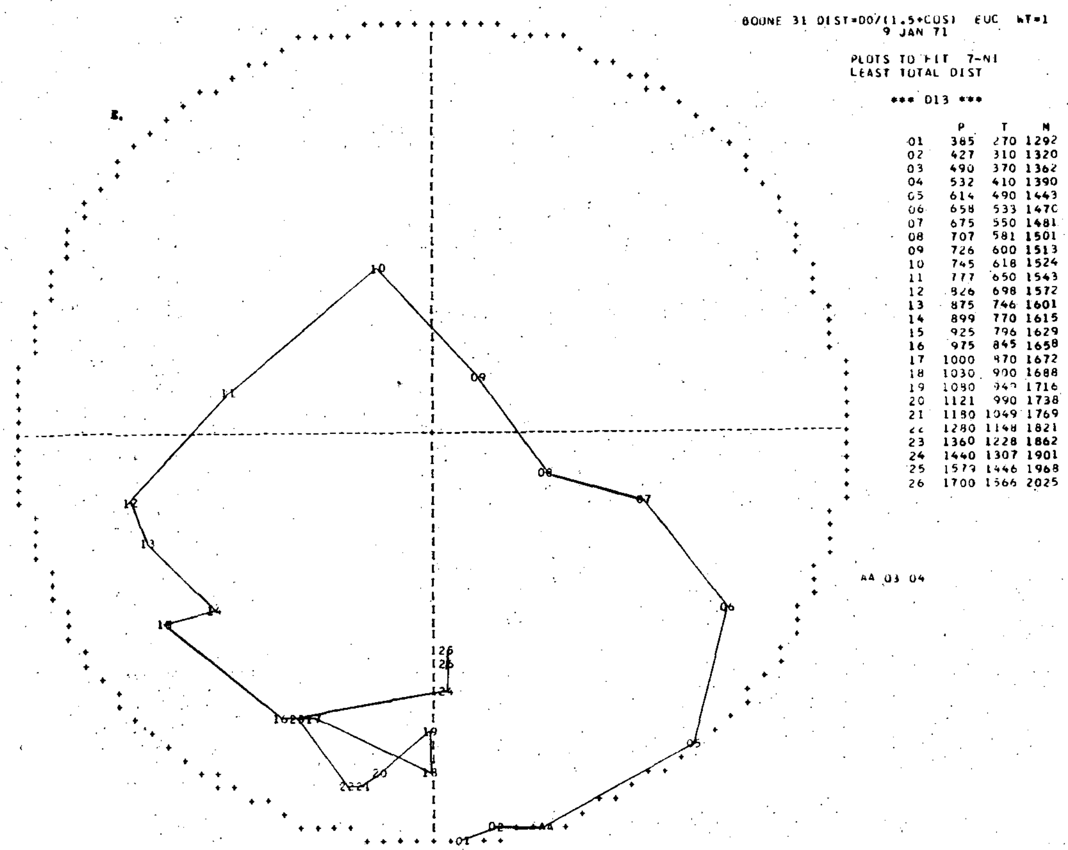
*** D13 ***

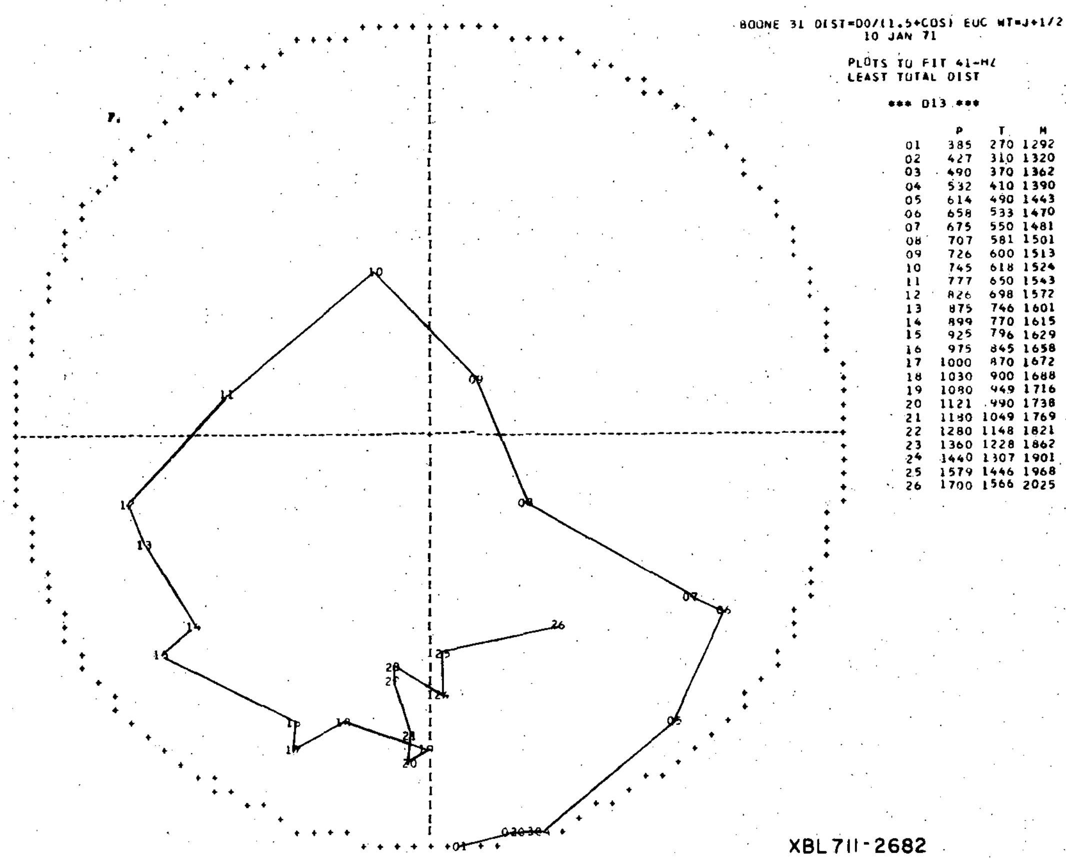
	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 17 18

XBL 711-2681

Fig. 15C,D

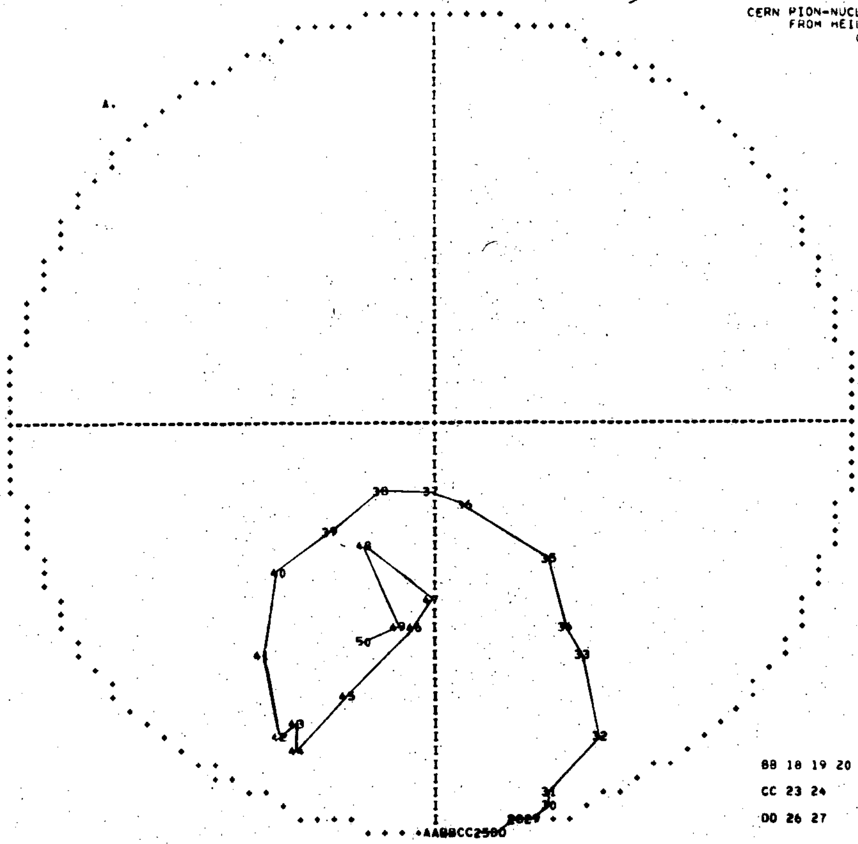




XBL 711-2682

Fig. 15E,F

CERN PION-NUCLEON EXPERIMENTAL FITS.
FROM HEIDELBERG, 9/67.
ORIGIN AT BOTTOM SCALE=1.0



*** DIS ***

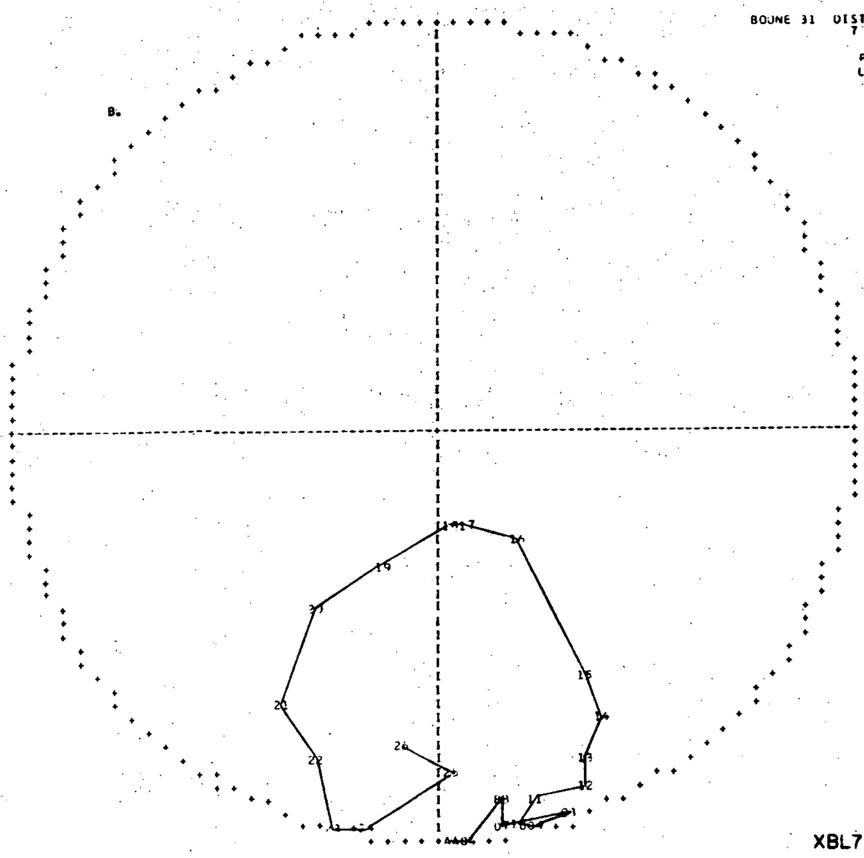
	P	T	M
01	80	21	1096
02	98	31	1104
03	108	37	1109
04	115	41	1113
05	140	58	1127
06	192	98	1160
07	219	120	1178
08	231	130	1186
09	245	142	1195
10	255	151	1202
11	271	165	1213
12	276	170	1217
13	297	189	1231
14	303	194	1235
15	321	210	1248
16	328	217	1252
17	331	220	1255
18	337	225	1259
19	361	247	1275
20	385	270	1292
21	427	310	1320
22	490	370	1362
23	532	410	1390
24	573	450	1417
25	614	490	1443
26	658	533	1470
27	675	550	1481
28	707	581	1501
29	726	600	1512
30	745	618	1524
31	777	650	1543
32	826	698	1572
33	875	746	1601
34	904	775	1617
35	925	796	1629
36	975	845	1658
37	1000	870	1672
38	1030	900	1688
39	1080	949	1716
40	1121	990	1738
41	1180	1049	1769
42	1280	1148	1821
43	1360	1228	1862
44	1444	1311	1903
45	1505	1372	1933
46	1579	1446	1968
47	1700	1566	2025
48	1880	1746	2107
49	2010	1875	2163
50	2070	1935	2189

BB 18 19 20 21 22
CC 23 24
DD 26 27

AA 01 02 03 04 05
06 07 08 09 *

BOUNE 31 DIST=DO SUM WT=1
7 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST



*** DIS ***

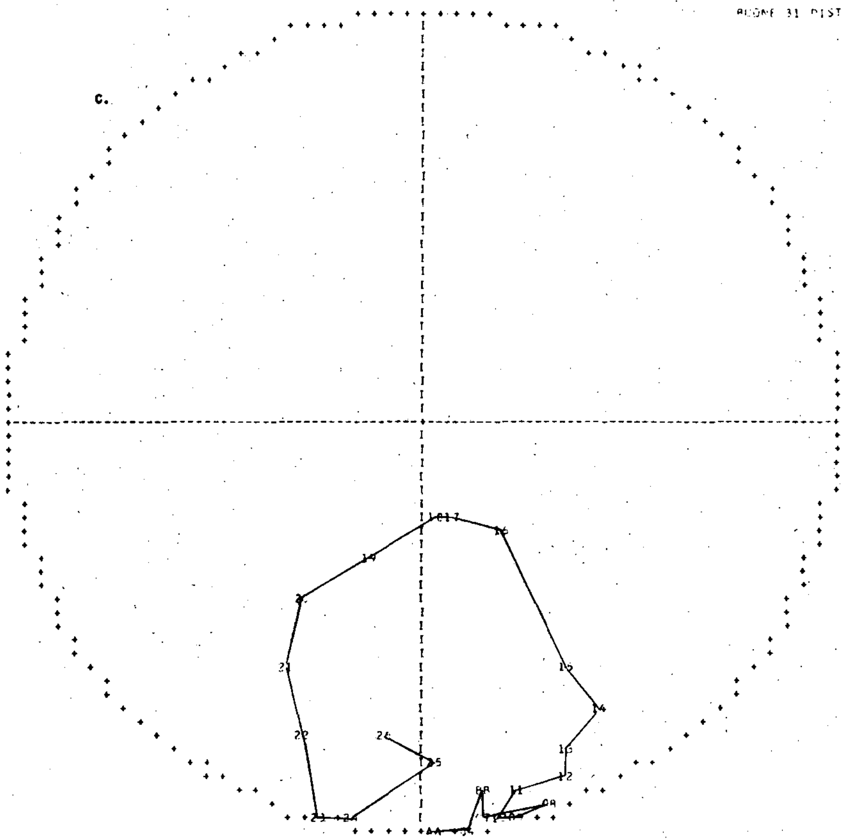
	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 02 03
BB 05 06

XBL711-2677

Fig. 16A,B

C.



BOONE 31 DIST=D EUC WT=1
8 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST

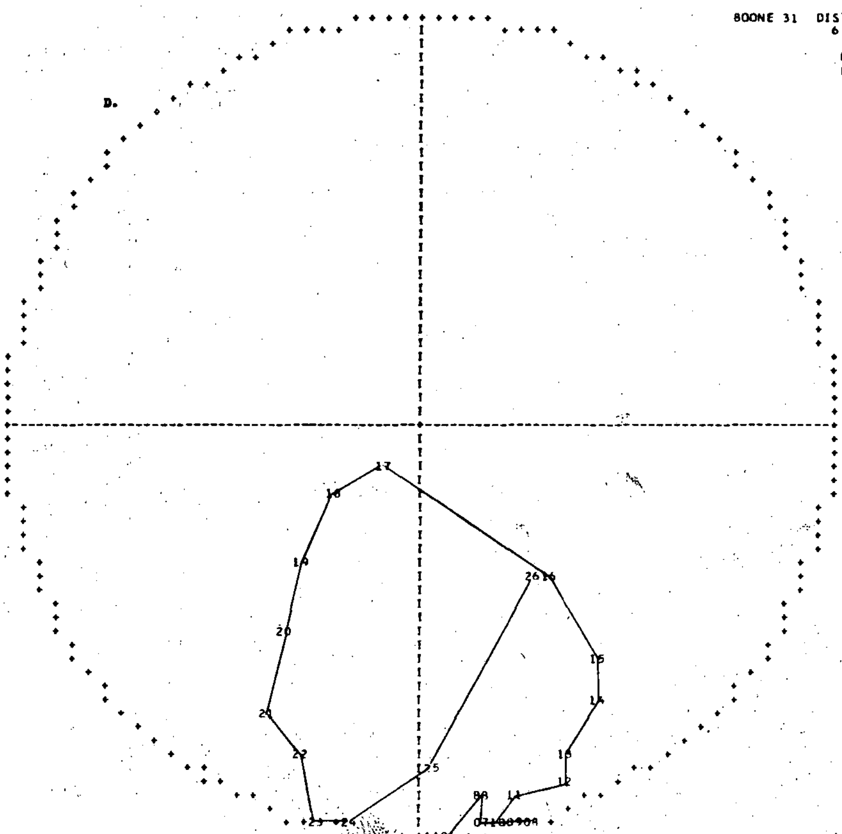
*** D15 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 02 03

BB 05 06

D.



BOONE 31 DIST=D0/(1.5+COS) SUM WT=1
6 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

*** D15 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

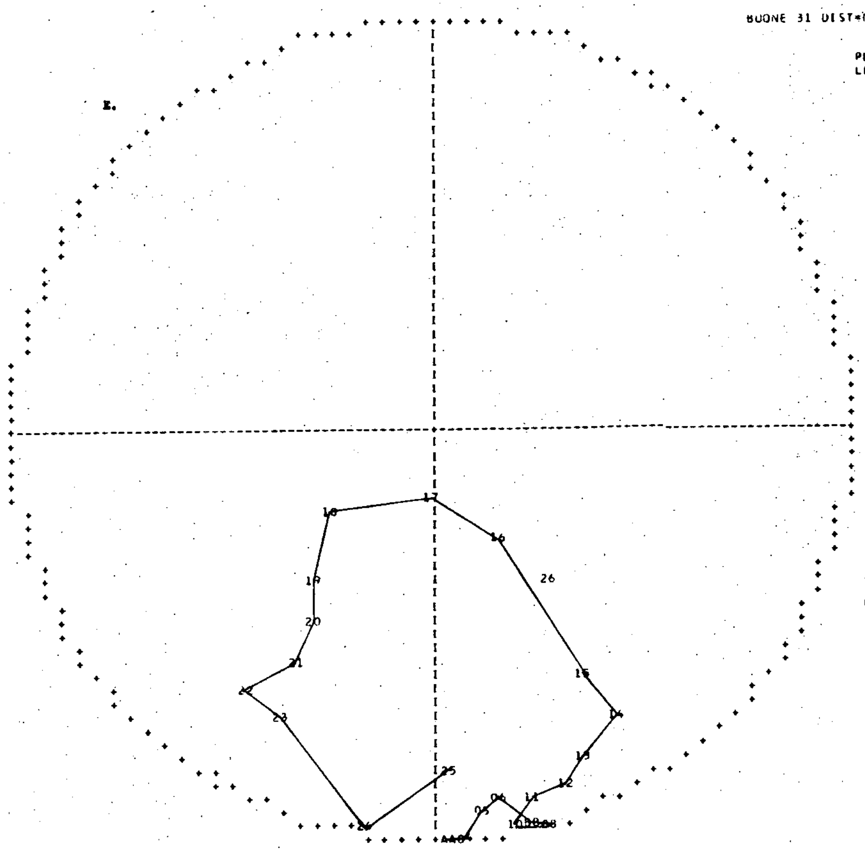
AA 01 02 03

BB 05 06

XBL 711-2678

Fig. 16C,D

E.



BOONE 31 DIST=D0/(1.5+COS) EUC WT=1
9 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

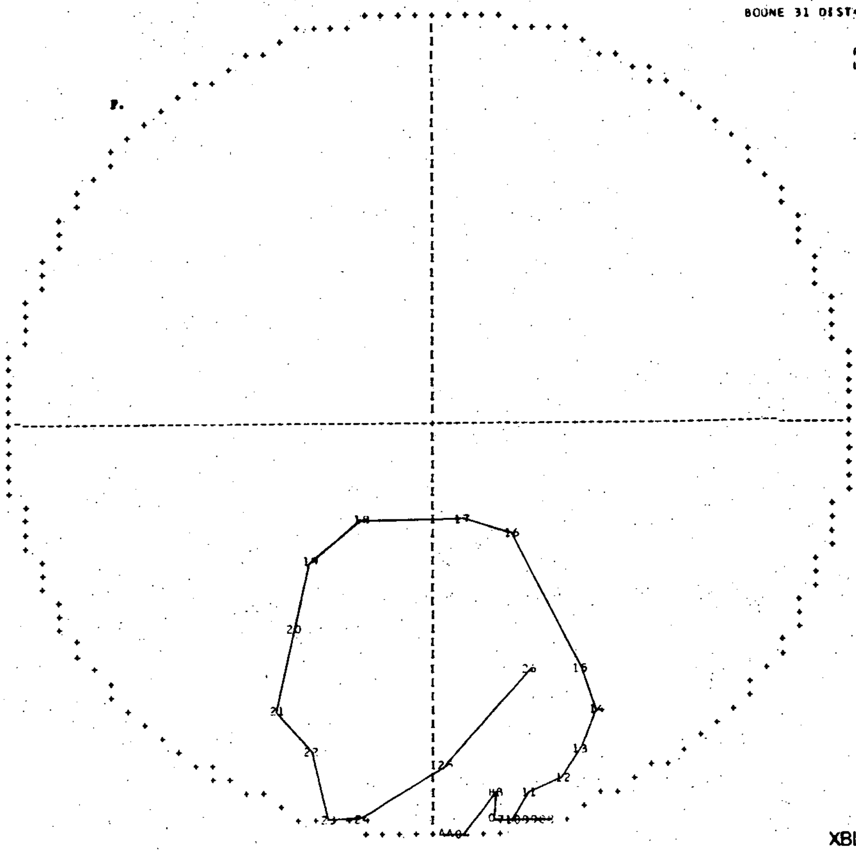
*** D15 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 02 03

BB 07 09

F.



BOONE 31 DIST=D0/(1.5+COS) EUC WT=J+1/2
10 JAN 71

PLOTS TO FIT 41-HZ
LEAST TOTAL DIST

*** D15 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 02 03

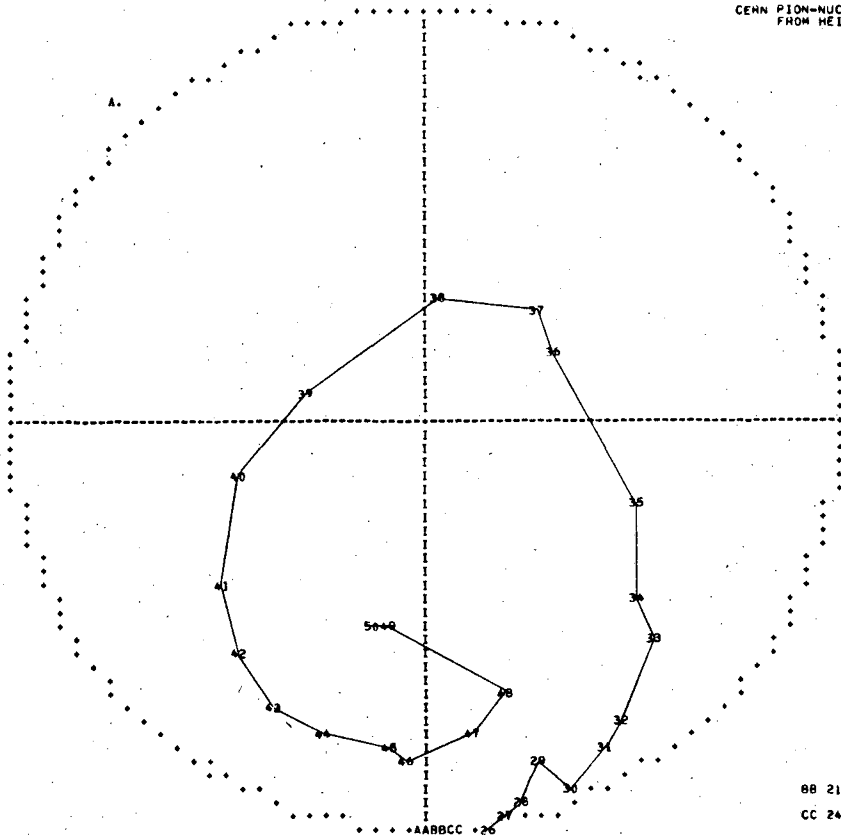
BB 05 06

XBL711-2679

Fig. 16E,F

CERN PION-NUCLEON EXPERIMENTAL FITS.
FROM HEIDELBERG. 9/67.
ORIGIN AT BOTTOM SCAL .0

A.



*** F15 ***

	P	T	M
01	80	21	1096
02	98	31	1104
03	108	37	1109
04	115	41	1113
05	140	58	1127
06	192	98	1160
07	219	120	1178
08	231	130	1186
09	245	142	1195
10	255	151	1202
11	271	165	1213
12	276	170	1217
13	297	189	1231
14	303	194	1235
15	321	210	1248
16	328	217	1252
17	331	220	1255
18	337	225	1259
19	361	247	1275
20	385	270	1292
21	427	310	1320
22	490	370	1362
23	532	410	1390
24	573	450	1417
25	614	490	1443
26	658	533	1470
27	675	550	1481
28	707	581	1501
29	726	600	1512
30	745	618	1524
31	777	650	1543
32	826	698	1572
33	875	746	1601
34	904	775	1617
35	925	796	1629
36	975	845	1658
37	1000	870	1672
38	1030	900	1688
39	1080	949	1716
40	1121	990	1738
41	1180	1049	1769
42	1280	1148	1821
43	1360	1228	1862
44	1444	1311	1903
45	1505	1372	1933
46	1579	1446	1968
47	1700	1566	2025
48	1880	1746	2107
49	2010	1875	2163
50	2070	1935	2189

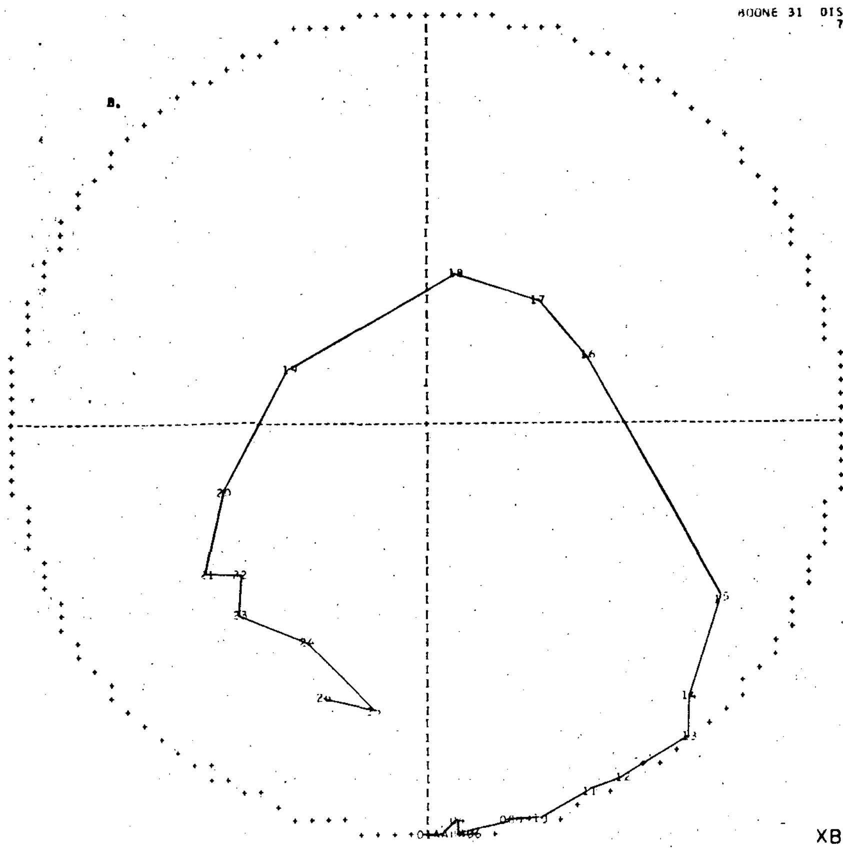
BB 21 22 23
CC 24 25

AA 01 02 03 04 05
06 07 08 09 +

BOONE 31 DIST=DO SUM WT=1
7 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST

B.



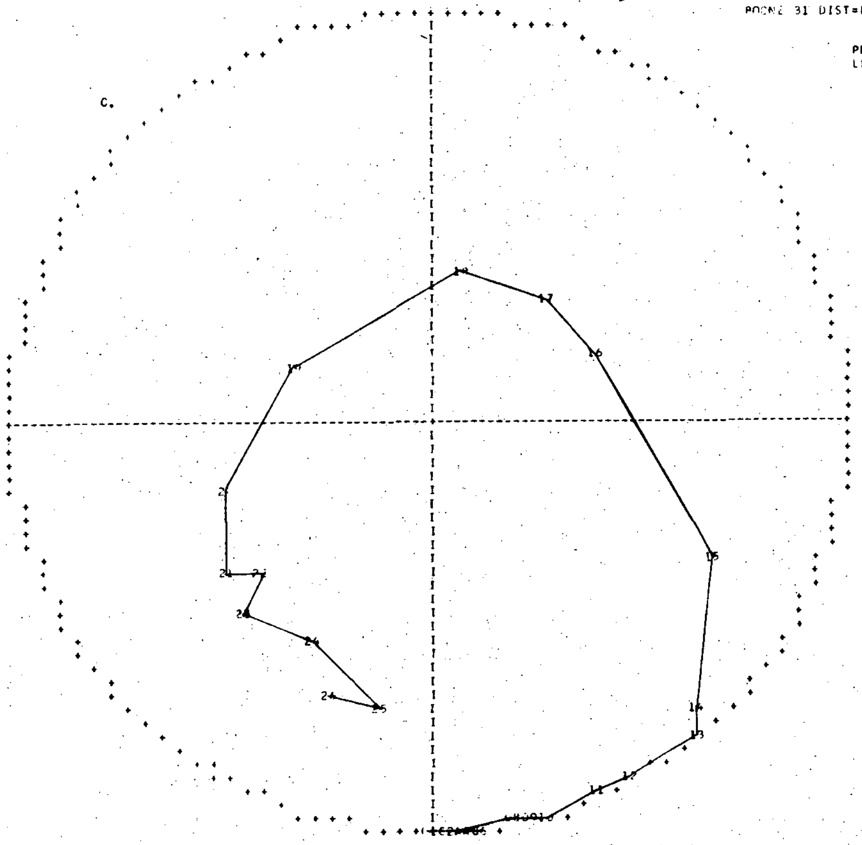
*** F15 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 02 03
BB 05 07

XBL711-2674

Fig. 17A,B



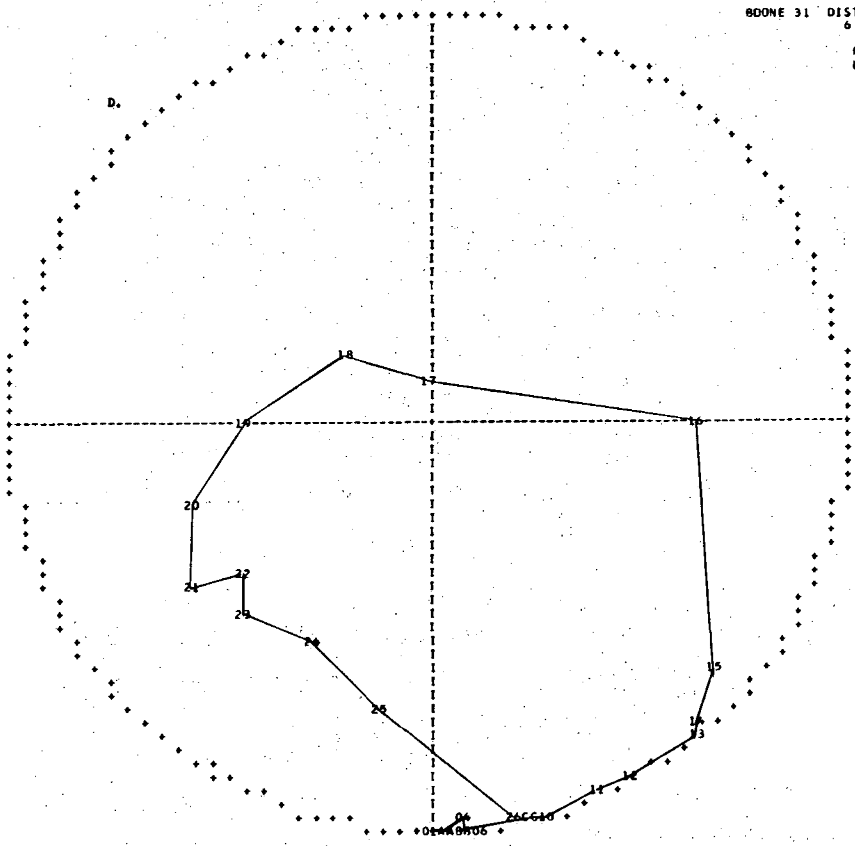
BOONE 31 DIST=DO EUC WT=1
8 JAN 71

PLOTS TO FIT 17-ZN
LEAST TOTAL DIST

*** F15 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 03 04 05 07



BOONE 31 DIST=DO/(1.5+COS) SUM WT=1
6 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

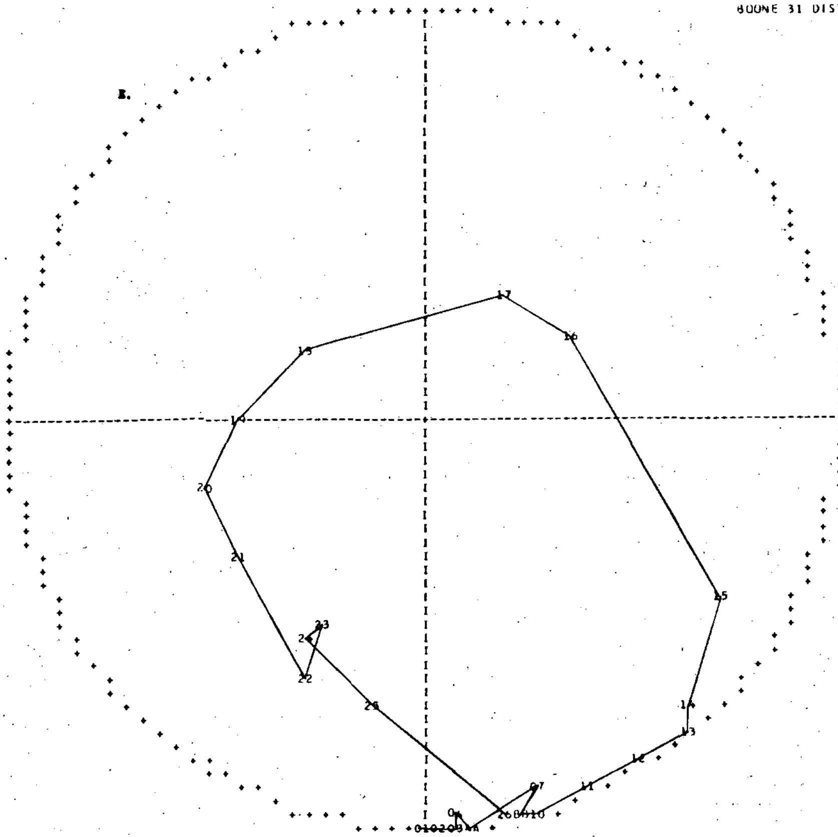
*** F15 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 02 03
BB 05 07
CC 08 09

XBL711-2675

Fig. 17C,D



BOONE 31 DIST=DO/(1.5+COS) EUC WT=1
9 JAN 71

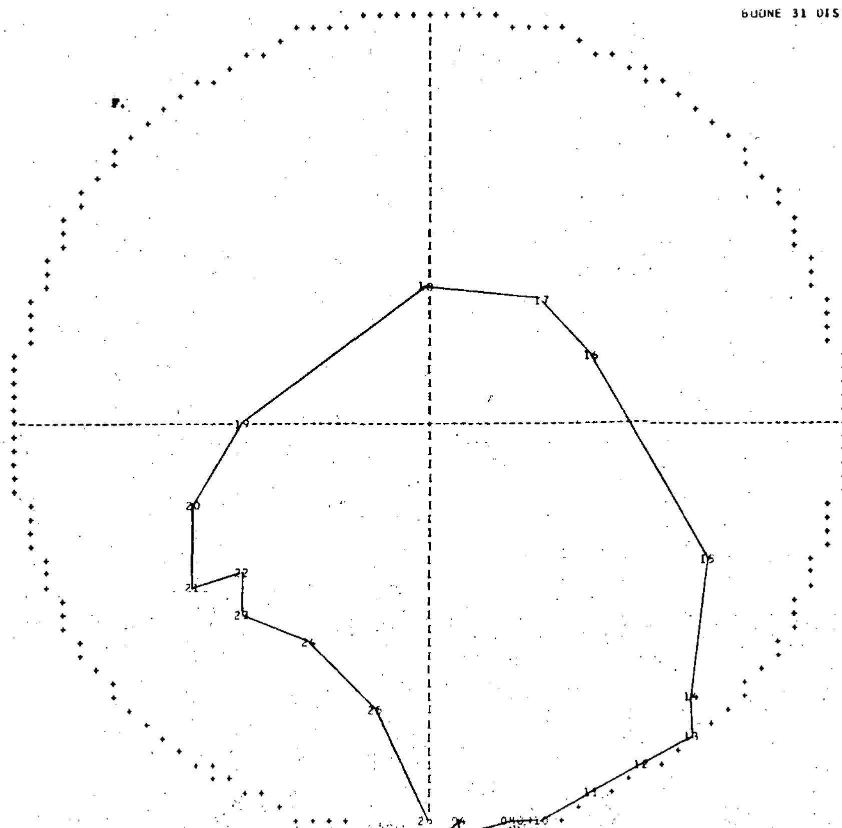
PLOTS TO FIT 7-NI
LEAST TOTAL DIST

*** F15 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 05 06

BB 08 09



BOONE 31 DIST=DO/(1.5+COS) EUC WT=J+1/2
10 JAN 71

PLOTS TO FIT 41-HZ
LEAST TOTAL DIST

*** F15 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 02 03

BB 05 07

XBL711-2676

Fig. 17E,F

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