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ENERGY CONTINUATION OF AN ENERGY-INDEPENDENT PION-NUCLEON PHASE-SHIFT ANALYSIS FROM 385 TO 1700 MeV<sup>6c</sup>

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R. D. Field, Jr.

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ENERGY CONTINUATION OF AN ENERGY-INDEPENDENT  
PION-NUCLEON PHASE-SHIFT ANALYSIS FROM 385  
TO 1700 MeV/c\*

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February 10, 1971

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.<sup>1</sup>

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<sup>2</sup> 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.<sup>1</sup> Solutions were found at some 26 momenta from  $p_{\text{lab}} = 385$  to  $p_{\text{lab}} = 1700$  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  $\chi^2$ . The data include the  $\pi^+, \pi^-$  and charge-exchange differential cross sections as well as the  $\pi^+$  and  $\pi^-$  polarizations. The parameters  $\eta$  and  $\delta$  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  $\ell$  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  $\eta$ 's and  $\delta$ '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  $\chi^2$  are removed. In the earlier work done at Berkeley<sup>1</sup> 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  $\chi^2$ , the worst  $\chi^2$ , 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  $\chi^2$  of each solution remain reasonably good. The  $\chi^2$  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  $\chi^2$  at each energy has very discontinuous and rough behavior and hence is unsatisfactory. On the other hand, a method that imposes smoothness while ignoring  $\chi^2$  may give a poor fit to the data. The best method is one that keeps only reasonable  $\chi^2$ , 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"  $D_i^{\text{sum}}$  for the path  $i$  as

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

where a path consists of one solution at each momentum  $k$ , and where  $\ell$  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,

$$d_0(\ell, j, I, k, i) = |\tilde{T}(\ell, j, I, k, i) - \tilde{T}(\ell, j, I, k-1, i)|, \quad (2)$$

where  $\tilde{T}$  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

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

In this definition of distance we are considering the  $\ell$ ,  $j$ , and  $I$  variables as making up a many-dimensional Euclidian space, whereas  $D_i^{\text{sum}}$  is just the sum over  $\ell$ ,  $j$ , 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  $\ell$ ,  $j$ , 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  $\theta$  is the angle between the vectors

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

and

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

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  $\theta = 0^\circ$  to the distance in the backward direction  $\theta = 180^\circ$ . 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;<sup>2</sup>

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

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

Path D--We use  $D^{\text{sum}}$  and

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

Path E--We use  $D^{\text{Euc}}$  and

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

Path F--We use  $D^{\text{Euc}}$  and

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

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.<sup>2</sup>

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  $\chi^2$ 's for each of our five paths, where the total number of degrees of freedom is 2069. To get the total  $\chi^2$  for a path we add the  $\chi^2$ 's for each solution along the path. We see that the two methods D and E, which use the smoothing function, give better total  $\chi^2$ . 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<sup>3</sup> (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  $p_{\text{lab}} = 707 \text{ MeV}/c$  (Fig. 13). Finally, there appears to be additional resonance-like structure in the following waves:

<u>Partial wave</u>	<u>Mass region</u>	<u>Figure</u>
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  $\chi^2$  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  $\pi^+ p$  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  $\pi N$  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.

	<u>p<sub>lab</sub> (MeV/c)</u>	<u>Number of fits</u>	<u>Degrees of freedom</u>	<u>Best χ<sup>2</sup></u>	<u>Worst χ<sup>2</sup></u>
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).

	<u>p<sub>lab</sub> (MeV/c)</u>	<u>Number of fits</u>	<u>Degrees of freedom</u>	<u>Best χ<sup>2</sup></u>	<u>Worst χ<sup>2</sup></u>
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  $\chi^2$  for our five paths, where the total number of data points is 2069.

<u>Path</u>	<u>Total <math>\chi^2</math></u>
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  $k-\ell$ .

Fig. 2. Argand diagram illustrating two possible paths.

Fig. 3. Argand diagram illustrating the vectors  $\tilde{A}$  and  $\tilde{B}$  and the angle  $\theta$  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

$$d(\ell, j, I, k, i) = [1/(1.5 + \cos \theta)] d_0 \text{ and } |\tilde{B}| = d_0.$$

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.

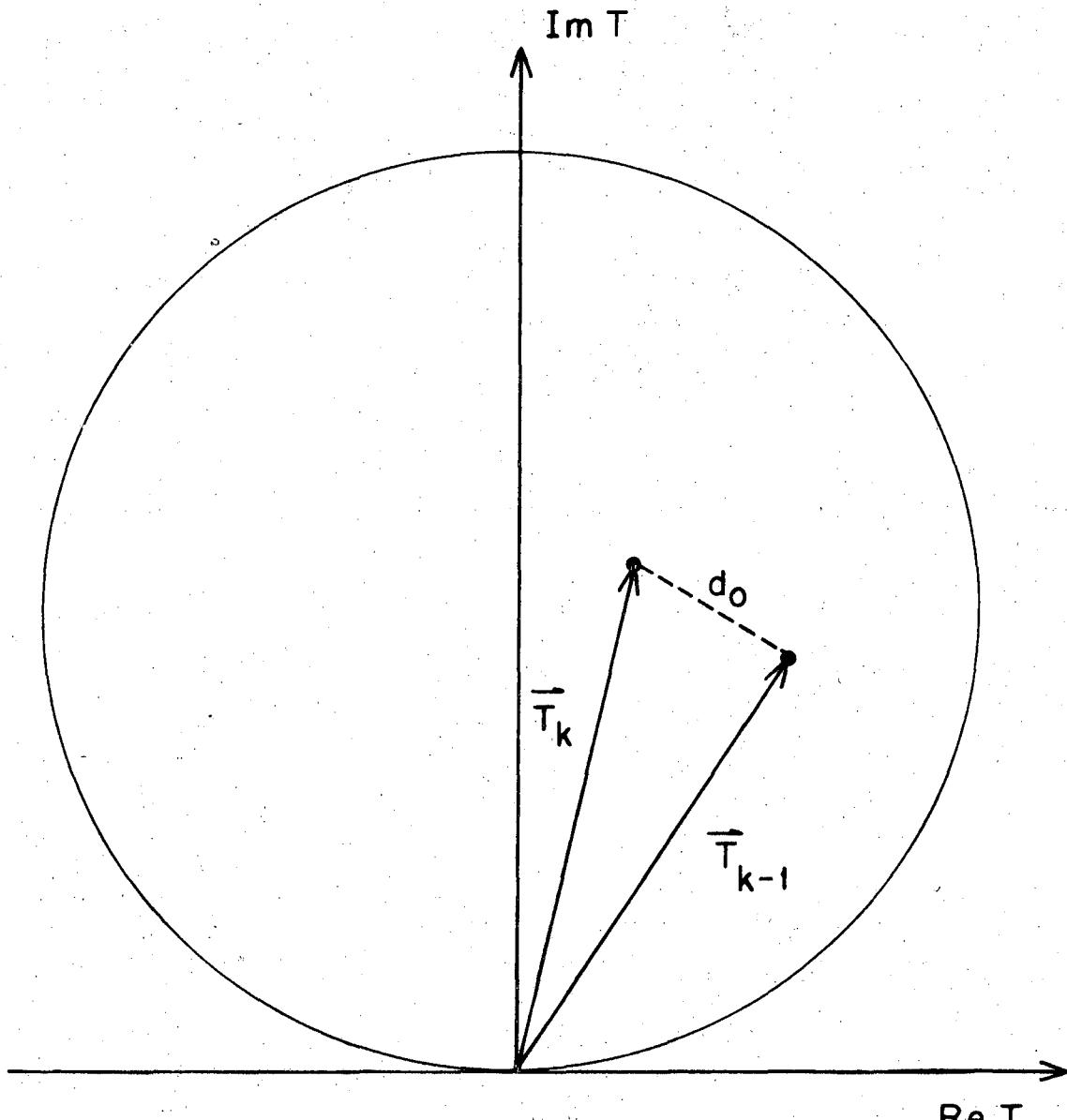


Fig. 1.

XBL7II-2651

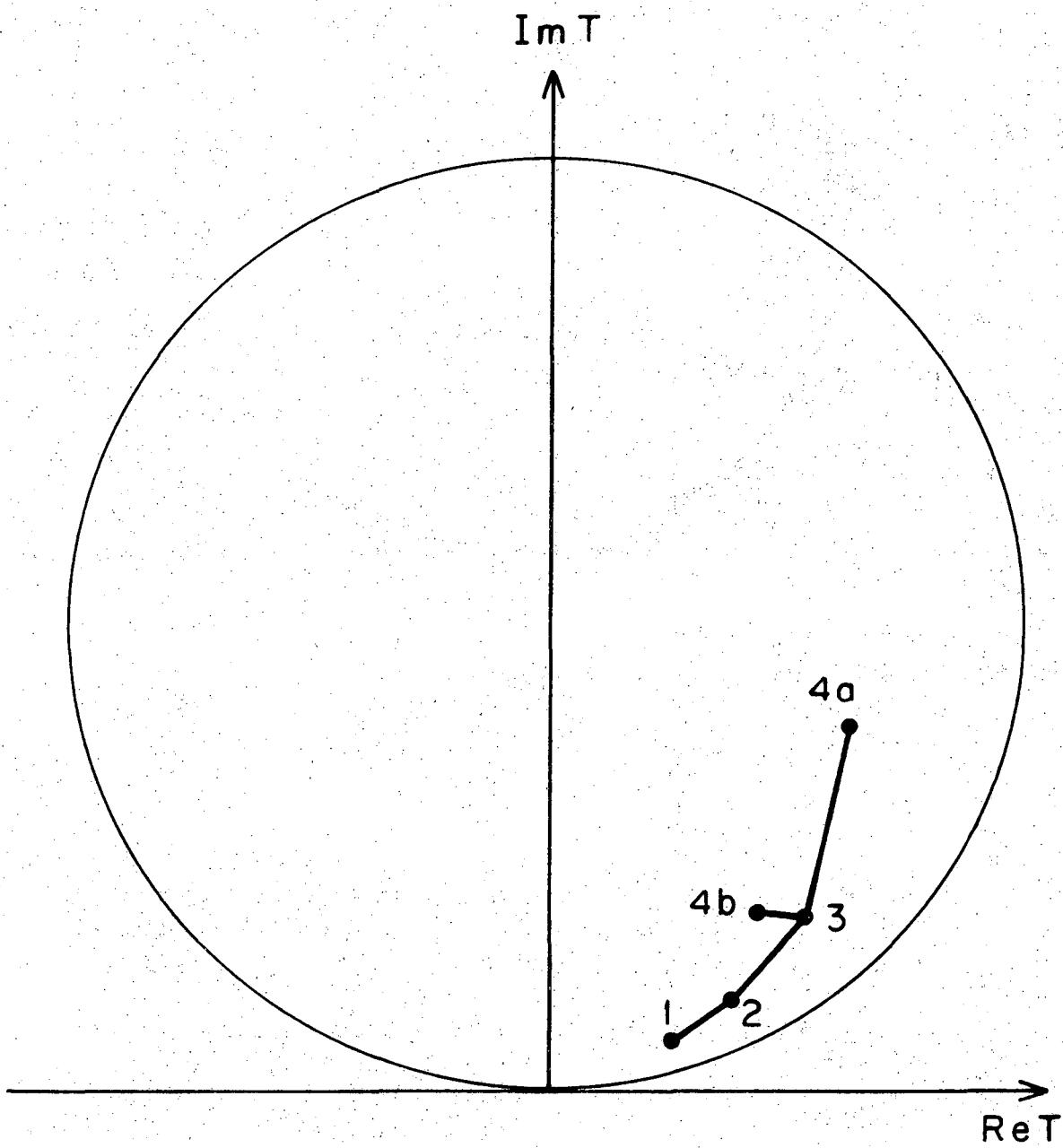


Fig. 2.

XBL7II-2652

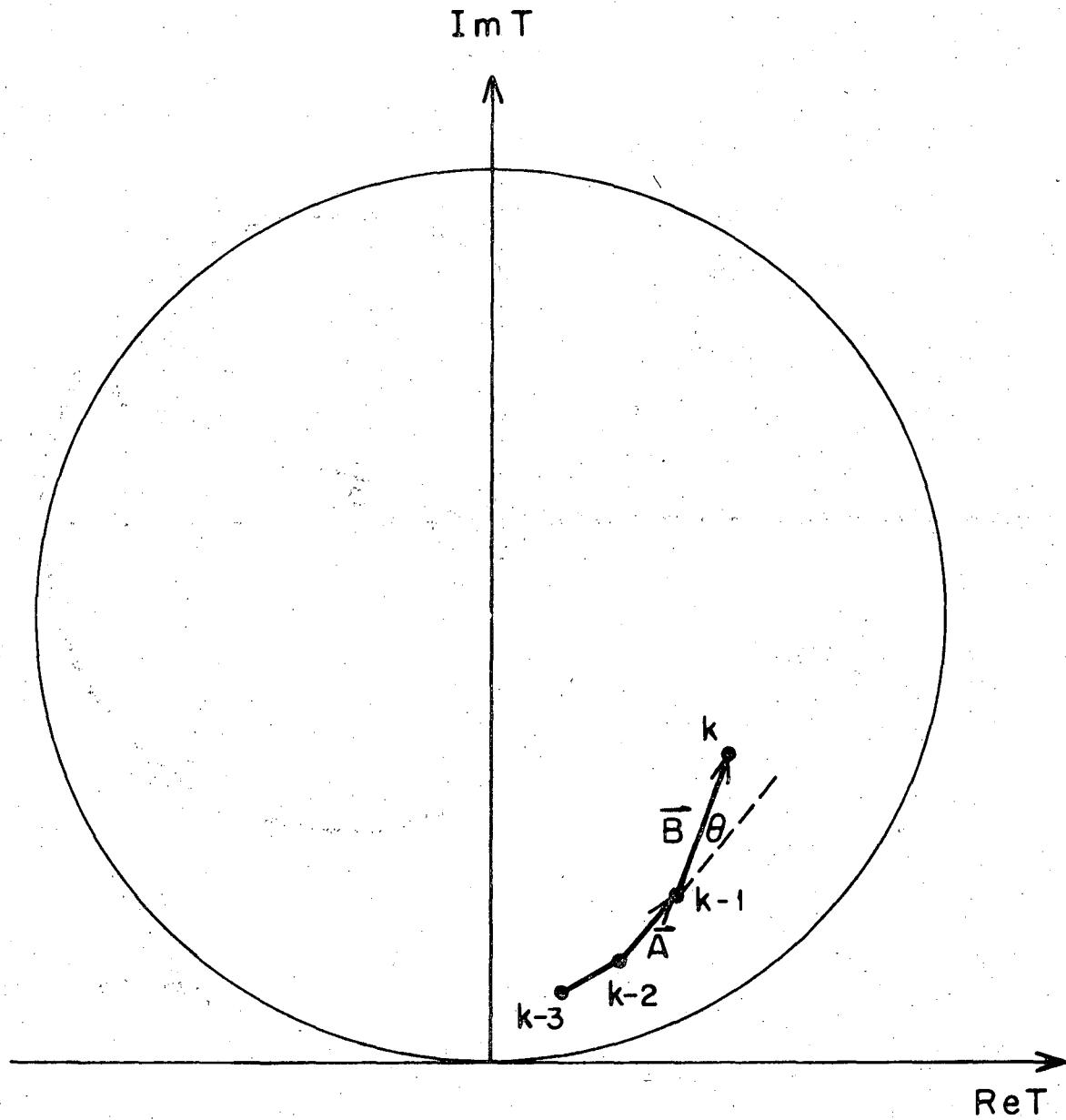


Fig. 3.

XBL7II-2653

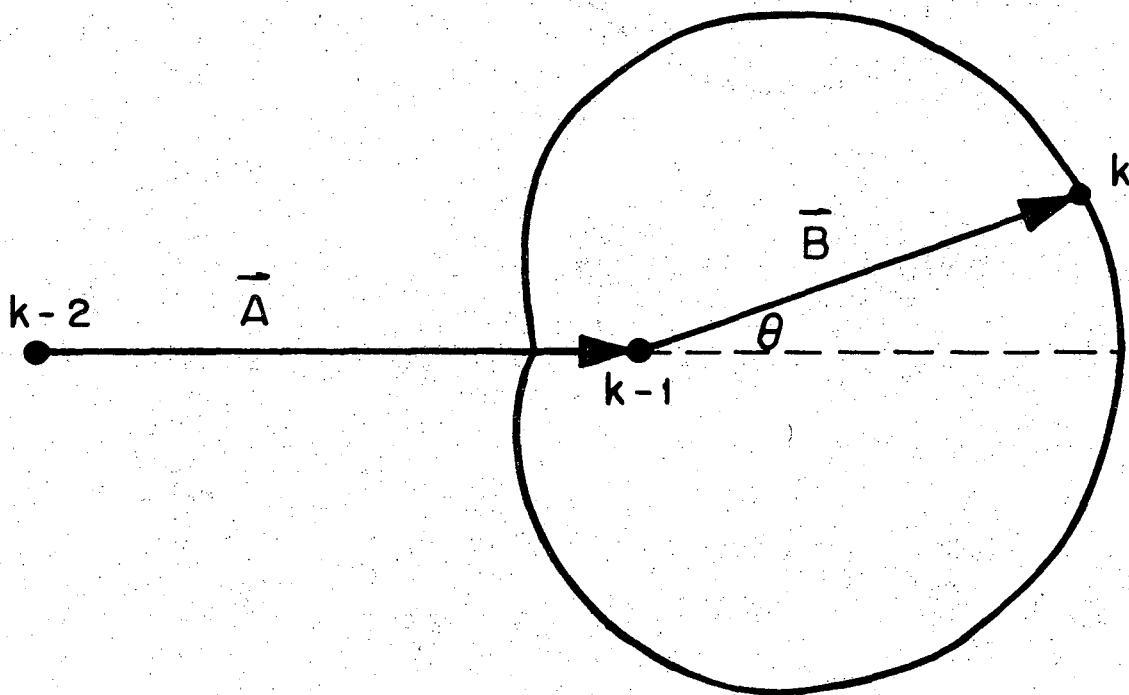
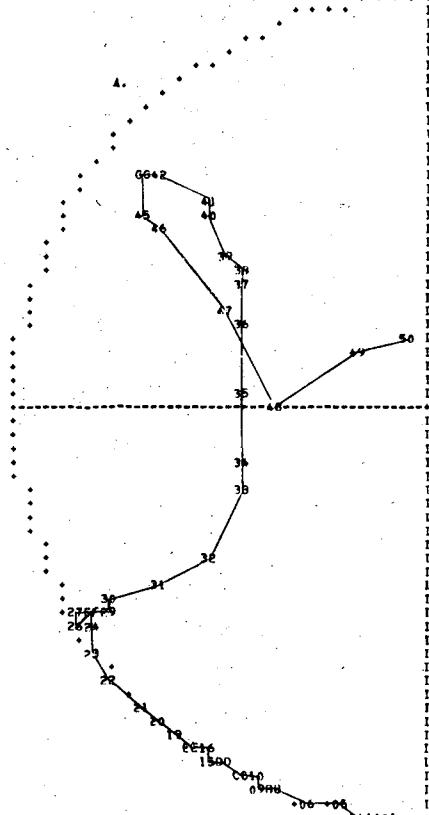


Fig. 4.

XBL711-2654

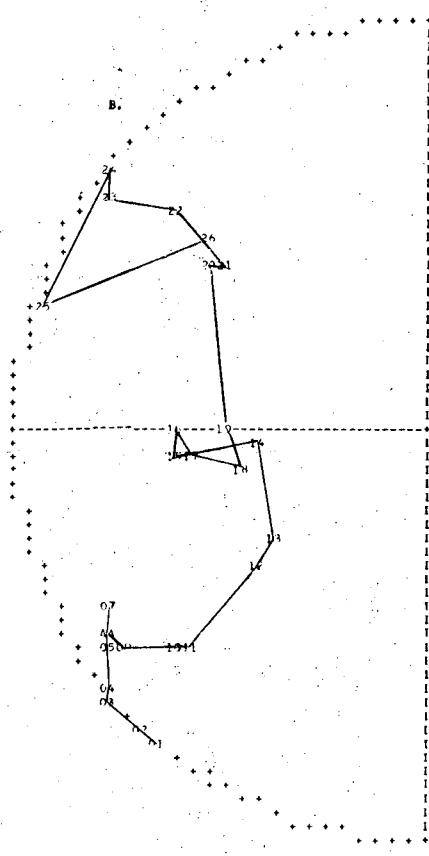
CERN PION-NUCLEON EXPERIMENTAL FITS.  
FROM HEIDELBERG, 9/67.  
ORIGIN AT BOTTOM SCALE=1.0.



\*\*\* 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	767	581	1501	
29	726	600	1512	
30	745	618	1524	
31	771	650	1543	
32	826	699	1572	
33	875	746	1601	
34	925	796	1629	
35	845	645	1558	
36	1000	870	1672	
37	1030	900	1688	
38	1080	949	1716	
39	1121	990	1738	
40	1180	1049	1769	
41	1280	1148	1821	
CC	11 12	1360	1228	1862
DD	13 14	1444	1311	1903
EE	17 18	1505	1372	1933
FF	25 28	1579	1446	1968
GG	43 44	1700	1566	2025
GG	43 44	1880	1746	2107
GG	43 44	2010	1875	2163
GG	43 44	2070	1935	2189

AA 02 03



800NE 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	945	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

BOONE 31 DIST=00 FUC T=1  
6 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	452	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	1611
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 32

RR CE CR

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

PLOTS TO FIT 7-NH  
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	450	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 7II-2708

Fig. 5C,D

BOONE 31 DIST=00/(1.5+CUS) EUC WT=1  
9 JAN 71

PLOTS TO FIT 7-NI  
LEAST TOTAL DIST.

\*\*\* S31 \*\*\*

	P	T	M
01	345	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	974	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

BOONE 31 DIST=00/(1.5+COS) EUC WT=J+1/2  
10 JAN 71

PLOTS TO FIT 41-HZ  
LEAST TOTAL DIST.

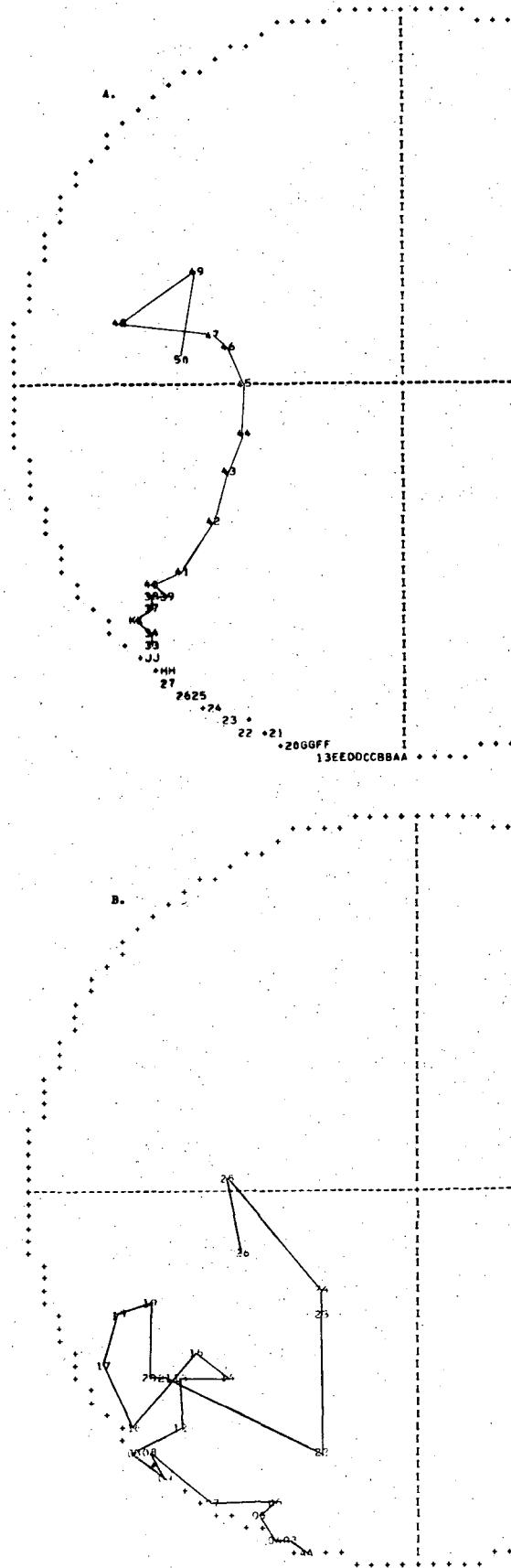
\*\*\* S31 \*\*\*

	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	974	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

XBL7II-2709

Fig. 5E,F

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



\*\*\* P31 \*\*\*

	P	T	M
01	80	21	1096
02	98	31	1194
03	108	37	1190
04	116	41	1113
05	140	50	1127
06	192	98	1166
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	975	746	1601
34	984	775	1617
35	925	784	1629
36	975	845	1658
37	1000	870	1672
38	1030	900	1688
BB 04 05	39	1060	949 1716
CC 06 07	40	1121	990 1738
DD 08 09 10	41	1180	1049 1769
EE 11 12	42	1280	1148 1821
FF 14 15 16 17	43	1360	1228 1862
GG 18 19	44	1444	1311 1903
HH 20 29 30	45	1595	1372 1933
JJ 31 32 AA 01 02 03	46	1579	1446 1968
KK 35 36	47	1760	1566 2025
MM 26 27 28	48	1860	1746 2107
NN 18 19	49	2010	1875 2163
OO 20 29 30	50	2070	1935 2189

ROUTINE 31 DIST=0.0 SUM WT=1  
7 JAN 71

PLOTS TO FIT IT-ZH  
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

XBL7II-2704

Fig. 6A,B

UCRL-20250

BOONE 31 DIST=D1 EUC WT=1  
6 JAN 71

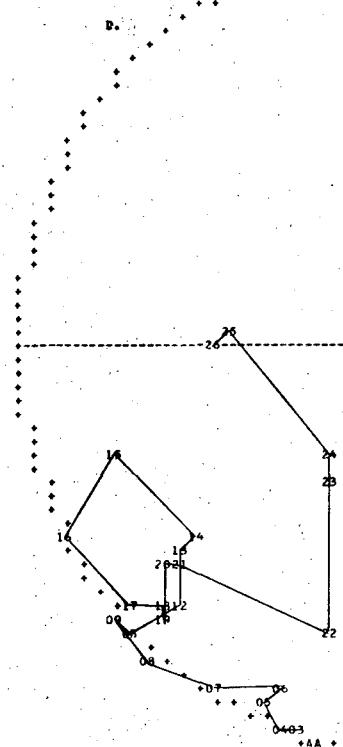
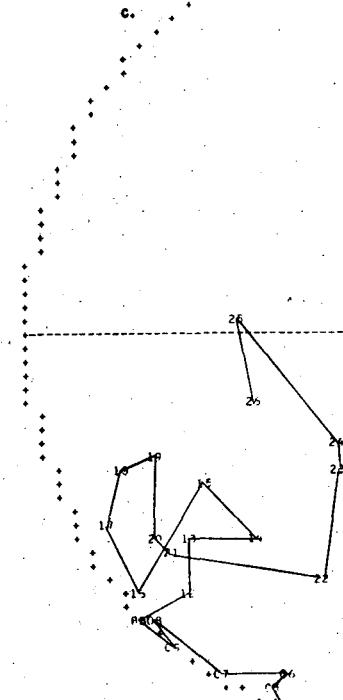
PLOTS TO FIT 17-24  
LEAST TOTAL DIST

\*\*\* 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	1060	945	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-S\*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	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 01 02

BB 10 11

Fig. 6C,D

XBL 711-2705

BUONE 31 DIST=DO/(1.5+COSI EUC WT=1  
9 JAN 71

PLOTS TO FIT 7-NI  
LEAST TOTAL DIST

\*\*\* P31 \*\*\*

	P	T	M
01	335	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	610	1524
11	777	650	1543
12	826	690	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

BUONE 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	1242
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	610	1524
11	777	650	1543
12	826	690	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

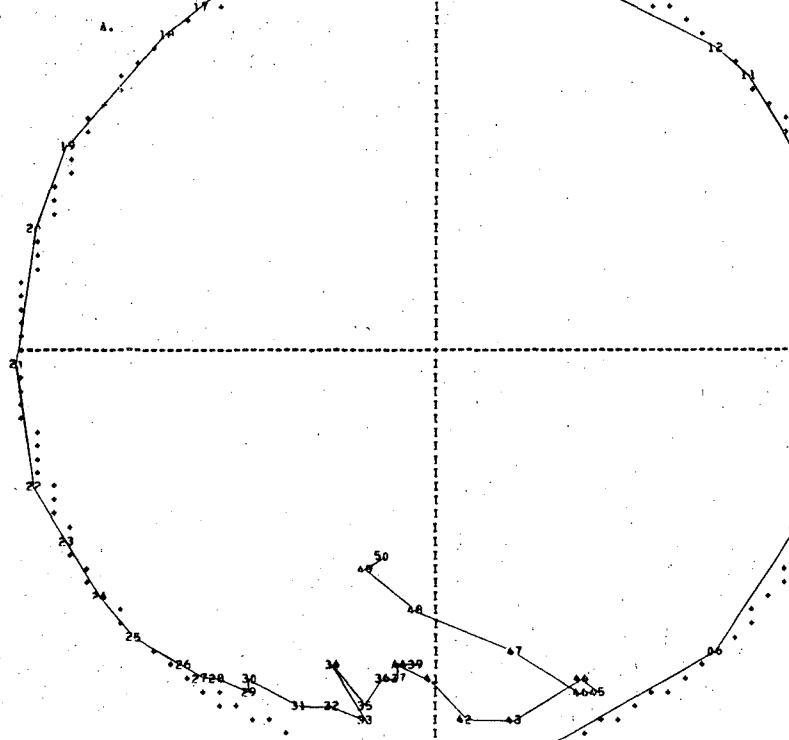
CC 09 12

XBL7II-2706

Fig. 6E,F

-25-

UCRL-20250



\*\*\* P33 \*\*\*

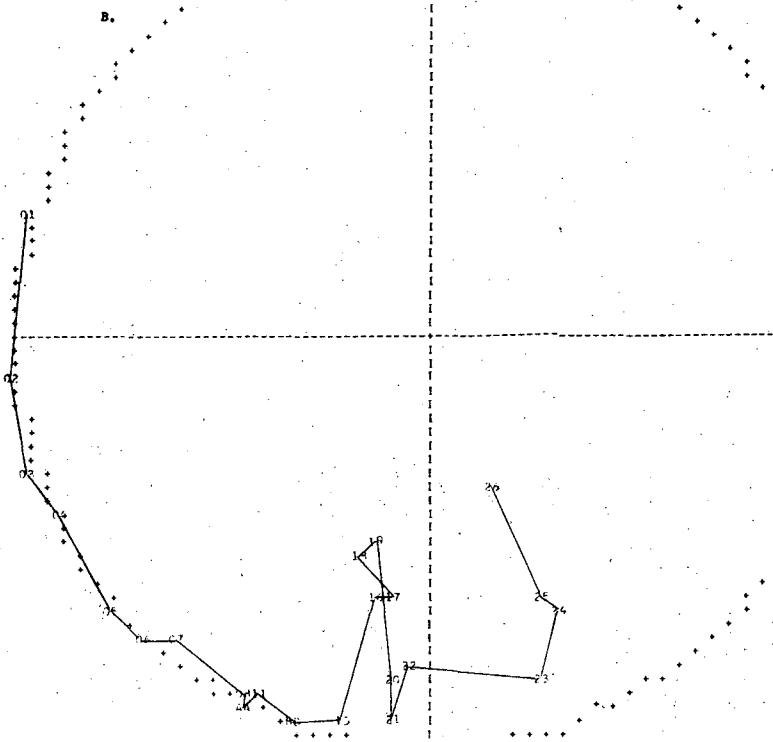
P	T	M
01	80	21 1096
02	98	31 1104
03	108	37 1109
04	115	41 1113
05	140	58 1127
06	192	98 1160
07	219	120 1178
08	231	130 1186
09	245	142 1195
10	255	151 1202
11	271	165 1213
12	276	170 1217
13	297	189 1231
14	303	199 1235
15	321	210 1248
16	328	217 1252
17	331	220 1255
18	337	225 1259
19	361	247 1275
20	385	270 1292
21	427	310 1320
22	490	370 1362
23	532	610 1392
24	573	450 1417
25	514	490 1443
26	558	533 1470
27	675	550 1481
28	707	581 1501
29	726	500 1512
30	745	618 1524
31	771	650 1543
32	824	696 1572
33	875	676 1601
34	904	775 1617
35	925	796 1629
36	975	846 1647
37	1000	870 1672
38	1230	900 1686
39	1080	949 1716
40	1121	990 1736
41	1180	1049 1769
42	1260	1146 1821
43	1360	1228 1862
44	1444	1311 1903
45	1505	1372 1933
46	1579	1446 1968
47	1700	1565 2025
48	1860	1764 2107
49	2010	1875 2163
50	2070	1935 2183

44 38 40

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

PLTS TO FIT 17-ZH  
LEAST TOTAL DIST

\*\*\* P33 \*\*\*



\*\*\* P 33 \*\*\*

	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	540	1470
07	675	550	1481
08	707	570	1500
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	1466	1968
26	1700	1566	2025

AA 09 1

BB 12 13 14

XBL711-2701

Fig. 7A,B

BOONE 31 DIST=00 EUC WT=1  
8 JAN 71

PLOTS TO FIT 17-ZH  
LEAST TOTAL DIST

\*\*\* P32 \*\*\*

	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	1461
08	707	580	1501
09	724	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

RH 12 13

BOONE 31 DIST=00/(1.5+COS) SUM WT=1  
6 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	1461
08	707	580	1501
09	724	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

XBL7II-2702

Fig. 7C,D

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

PLOTS TO FIT 7-N1  
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+COSI) 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	1150
06	176	98	1156
07	210	128	1178
08	231	130	1184
09	248	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	1006	870	1672
38	1030	900	1688
39	1080	949	1716
40	1121	990	1738
41	1186	1049	1769
42	1286	1148	1821
43	1320	1230	1862
44	1446	1311	1903
45	1585	1372	1933
46	1579	1446	1968
CC 28	29	1700	1566
DU 36	37	1880	1746
EE 42	43	2010	1875
EE 44	45	2070	1935
EE 46		2189	

AA 01 02 03 04 05

06 07 08 09 \*

BUONE 31 DIST=DO 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	656	533	1470
07	675	550	1481
08	726	600	1512
09	745	618	1524
10	777	650	1543
11	826	698	1572
12	875	746	1601
13	904	775	1617
14	925	796	1629
15	975	845	1658
16	1006	870	1672
17	1030	900	1688
18	1080	949	1716
19	1121	990	1738
20	1186	1049	1769
21	1286	1148	1821
22	1320	1230	1862
23	1446	1311	1903
24	1579	1446	1968
25	1700	1566	2025

AA 01 03

BB 06 07

CC 14 15

DU 18 19

EE 20 23

XBL7II-2698

Fig. 8A,B

UCRL-20250

POINT #1 DIST=00 EUC WT=1  
A JAN 71

PLCTS TO FIT 17-ZH  
LEAST TOTAL DIST

\*\*\* D33 \*\*\*

P	T	R
91	385	270
92	427	31C
93	491	37C
94	522	41C
95	614	49C
96	658	533
97	675	560
98	767	571
99	726	605
10	745	618
11	777	567
12	826	698
13	875	766
14	894	773
15	925	796
16	975	845
17	1030	873
18	1030	900
19	1087	955
20	1121	990
21	1187	1049
22	1280	1148
23	1367	1282
24	1440	1357
25	1575	1464
26	1700	1566
		2025

AA C2 C4

RR 06 CT

CC 19 19

DD 20 23

BOONE 31 DIST=00/11.5+COSI SUM WT=1  
6 JAN 71

PLOTS TO FIT 7-NI  
LEAST TOTAL DIST

\*\*\* D33 \*\*\*

	P	T	M
01	365	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	514	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1518
10	745	610	1524
11	771	630	1543
12	626	698	1572
13	875	746	1601
14	899	770	1610
15'	925	794	1625
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	1494	1961
26	1700	1566	2025

AA 01 03.

- BB Q6 07

CC 05 14

XBL711-2699

Fig. 8C,D



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

\*\*\* 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	211	126 1178
08	231	136 1186
09	245	142 1195
10	245	151 1202
11	271	175 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	690 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 01 02 03 04 05

06 07 08 09 \*

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

PLOTS TO FIT IT-ZH  
LEAST TOTAL DIST

\*\*\* 035 \*\*\*

P	T	M
01	385	270 1292
02	437	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	791 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 17

EE 14 21

FF 20 23

XBL7II-2695

Fig. 9A,B

BCCNL 31 DIST=03 EUC WT=1  
8 JAN 71

PLOTS TO FIT 17-24  
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	1120	970	1738
21	1180	1049	1769
22	1220	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1575	1446	1968
26	1700	1566	2025

AA 01 03

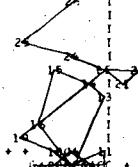
BB 05 07

CC 02 08 09 10

DD 12 17

EE 20 23

C.



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

PLOTS TO FIT 7-MI  
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	1120	970	1738
21	1180	1049	1769
22	1220	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1575	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

B.

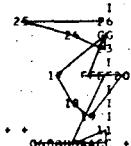


Fig. 9C,D

XBL7II-2696

BOONE 31 DIST=00/(1.5+COSI) EUC WT=1  
9 JAN 71

PLOTS TO FIT 7-NI  
LEAST TOTAL DIST

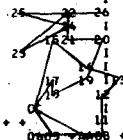
\*\*\* D35 \*\*\*

	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	610	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	940	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



BOONE 31 DIST=00/(1.5+COSI) EUC WT=J+1/2  
10 JAN 71

PLOTS TO FIT 41-HZ  
LEAST TOTAL DIST

\*\*\* D35 \*\*\*

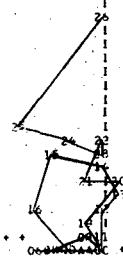
	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	610	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	940	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



XBL 711-2697  
Fig. 9E,F

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

\*\*\* F35 \*\*\*

	P	T	M	
01	80	21	1096	
02	99	31	1106	
03	149	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	169	1231	
14	303	194	1235	
15	321	210	1244	
16	320	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	1476	
27	675	550	1481	
28	767	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	795	1629	
36	975	845	1658	
37	1000	870	1672	
38	1030	900	1688	
39	1080	949	1716	
40	1121	990	1738	
41	1160	1049	1769	
42	1280	1148	1821	
43	1360	1228	1862	
44	1446	1311	1903	
45	1505	1372	1933	
46	1579	1446	1968	
88 33 34	47	1700	1566	2025
48	1880	1746	2107	
CC 36 37 38	49	2010	1875	2163
50	2070	1935	2189	
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 LT-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	795	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 09 \*

BB 11 12

XBL 711-2692

Fig. 10A,B

BOONE 31 DIST=00 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	658	1572
13	875	746	1601
14	899	770	1615
15	925	790	1629
16	975	845	1658
17	1030	870	1672
18	1030	900	1688
19	1121	990	1738
20	1180	1049	1769
21	1180	1148	1821
22	1280	1148	1862
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

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

PLOTS TO FIT T-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	790	1629
16	975	845	1658
17	1030	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

XBL7II-2693

Fig. 10C,D

BOONE 31 DIST=DD/(1.5+COSI) EUC WT=1  
9 JAN 71

PLOTS TO FIT 7-N1  
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	790	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	940	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 05 06  
07  
BB 11 12  
CC 09 18  
DD 20 21

BOONE 31 DIST=DD/(1.5+COSI) 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	790	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	940	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

XBL7II-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	1246
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	820	680	1572
33	875	746	1601
34	904	775	1617
35	925	796	1639
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
CC 26	1505	1372	1933
27	1579	1446	1968
28	1700	1566	2025
29	1880	1766	2107
30	2010	1875	2163
EE 34	2070	1935	2189
35	2070	1935	2189

AA 01 02 03 04 05  
06 07 08 09 0\*

ROUTINE 31 DIST=DO 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

XBL7II-2671

Fig. 11A,B

PLTS TO FIT 17-2H  
LEAST TOTAL DIST

\*\*\* F37 \*\*\*

	P	T	M
01	385	270	1293
02	427	310	1320
03	490	370	1362
04	532	410	1353
05	614	490	1443
06	658	433	1479
07	674	550	1481
08	707	581	1501
09	726	609	1513
10	745	618	1545
11	747	656	1543
12	826	698	1572
13	875	746	1611
14	909	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	1963
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+COSI) SUM WT=1  
6 JAN 71

PLTS 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	609	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

16 17 18

XBL7II- 2672

Fig. 11C,D

UCRL-20250

BOUNE 31 DIST=00/(1.5+CUS) EUC WT=1/2

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	610	1524
11	777	650	1543
12	822	690	1572
13	875	740	1601
14	895	770	1635
15	935	800	1659
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	1240	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=00/(1.5+CUS) 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	610	1524
11	777	650	1543
12	822	690	1572
13	875	740	1601
14	895	770	1635
15	935	800	1659
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	1240	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

13 14

CC 07 10 11 13 14

DD 16 17 18 19

Fig. 11E,F

XBL7II-2673

UCRL-20250

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

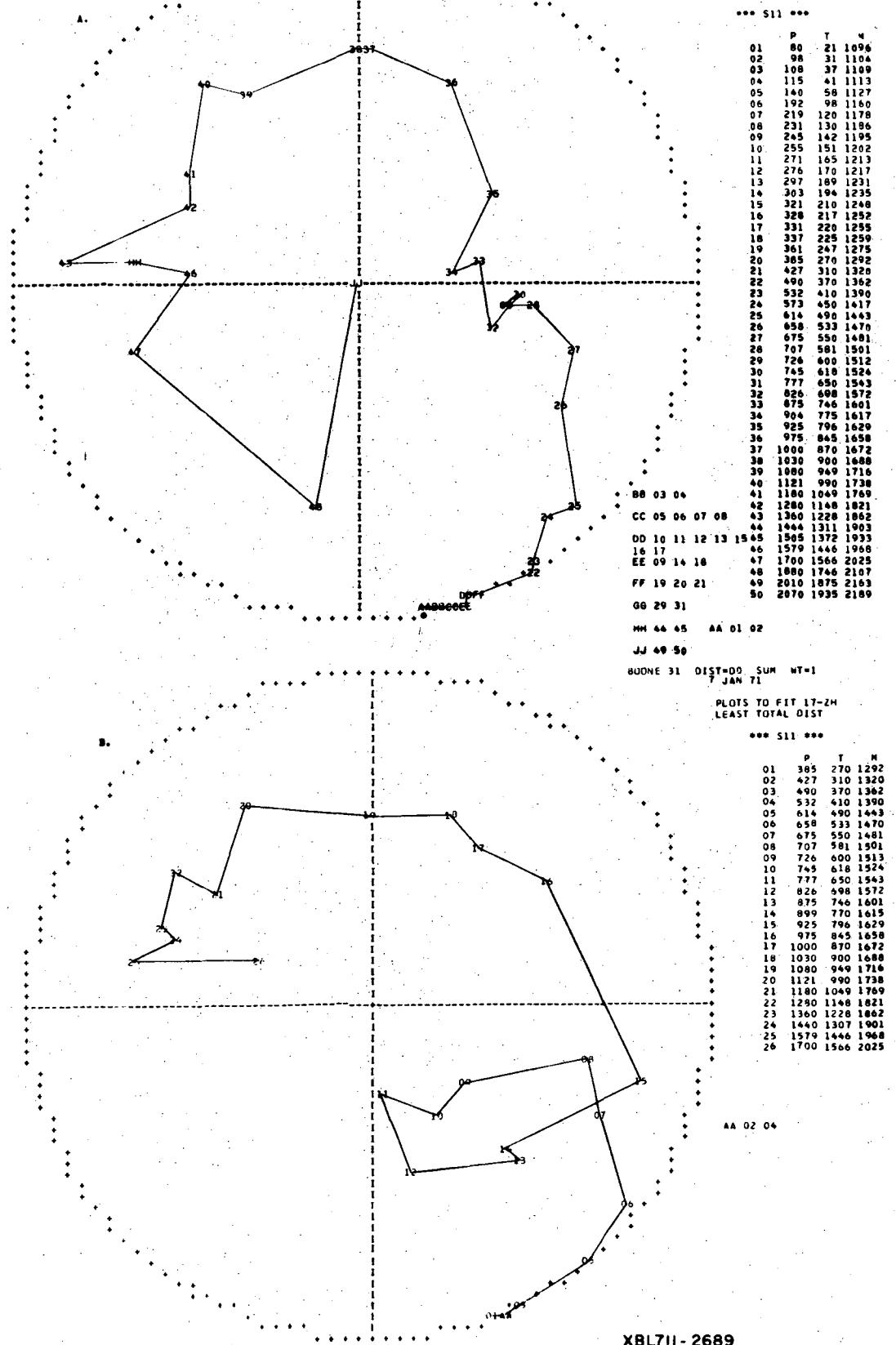
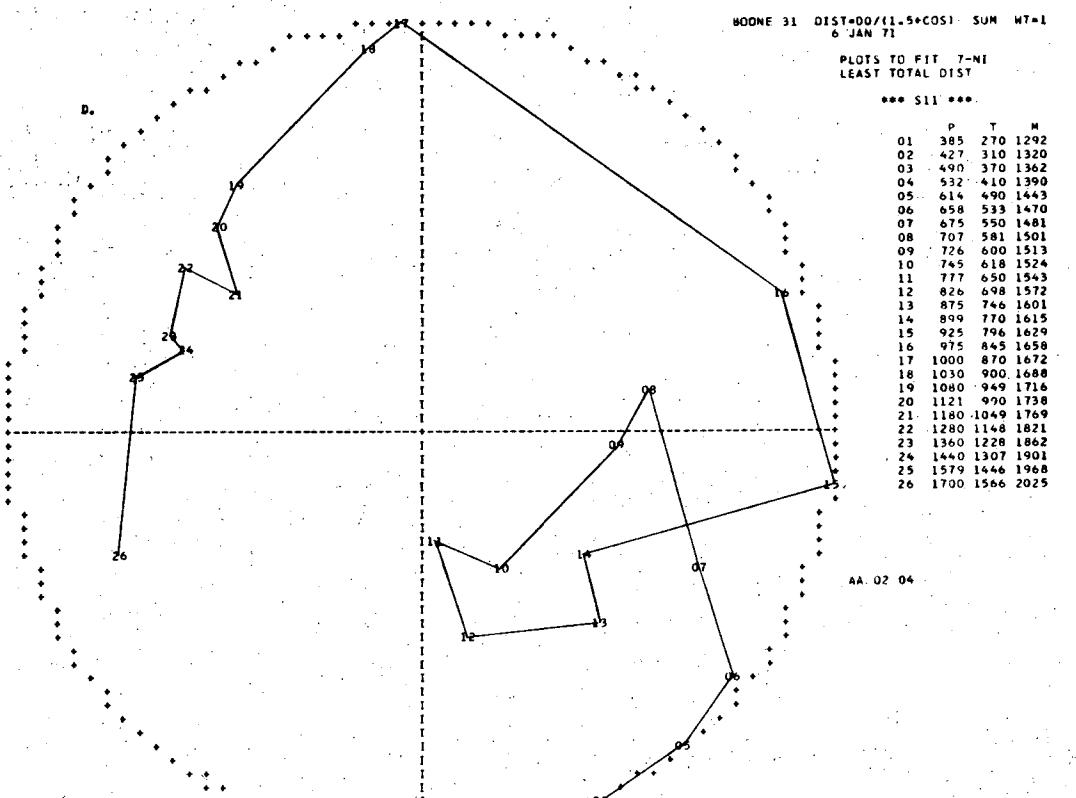
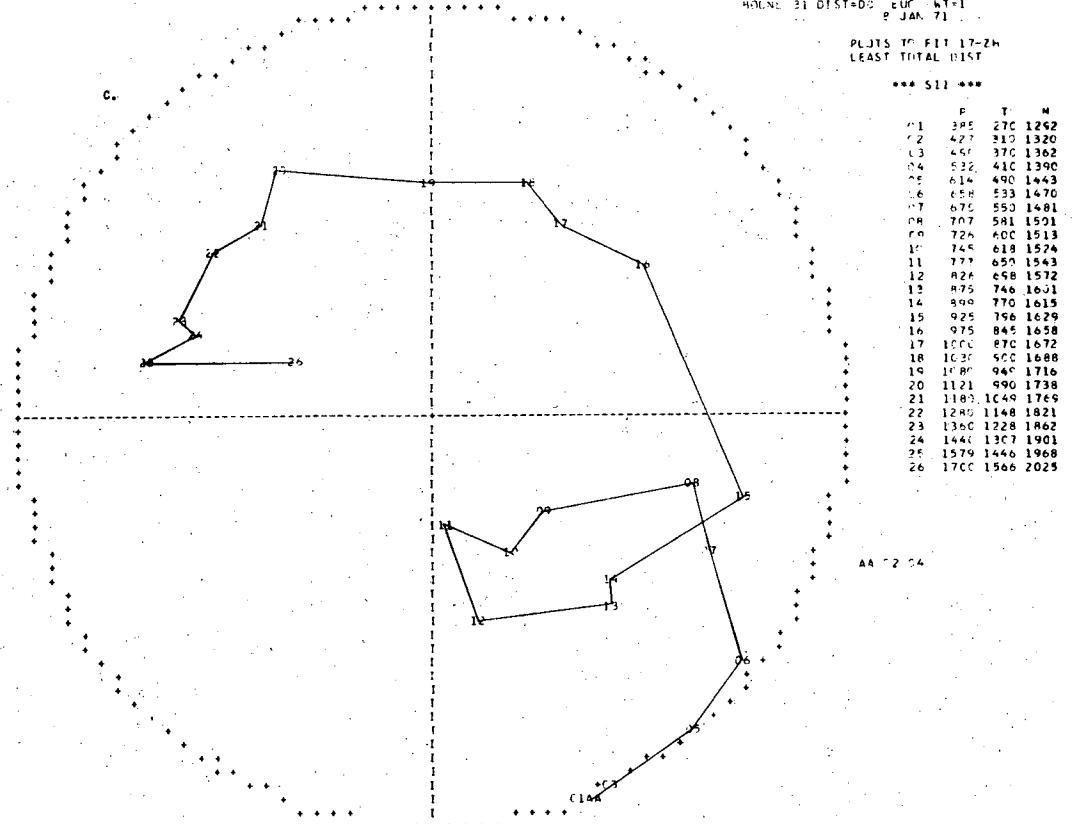


Fig. 12A,B



XBL711-2690

Fig. 12C,D

BUONE 31 DIST=00/(1.5+COSI) EUC WT=1  
10 JAN 71

PLOTS TO FIT 7-11  
LEAST TOTAL DIST

\*\*\* SII \*\*\*

	P	T	M
01	335	70	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

BUONE 31 DIST=00/(1.5+COSI) EUC WT=J+1/2  
10 JAN 71

PLOTS TO FIT 41-MHz  
LEAST TOTAL DIST

\*\*\* SII \*\*\*

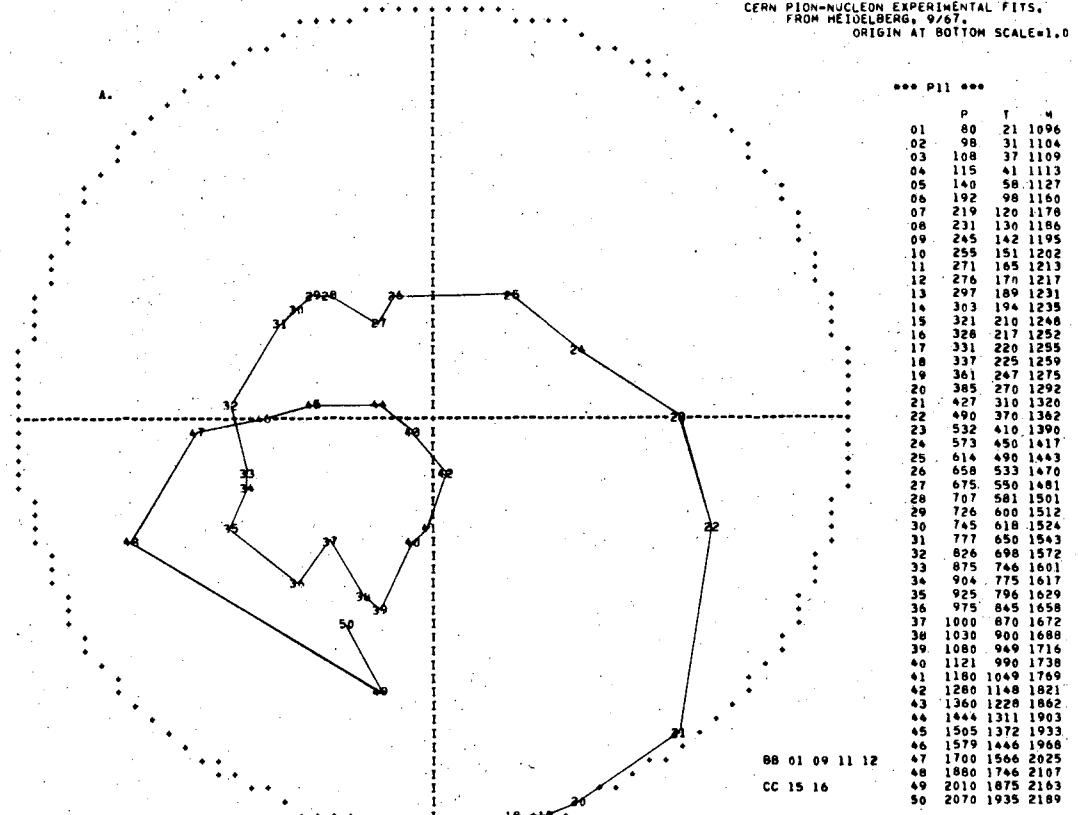
	P	T	M
01	335	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	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

XBL7II-2691

Fig. 12E,F

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



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	N
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	1444	1311 1903
25	1505	1372 1933
26	1700	1566 2025

AA 11 12 13 14 16  
17 18 19 20 \*

XBL7II-2686

Fig. 13A,B

POONE 31 DIST=DO EUC WT=1  
6 JAN 71

PLOTS TO FIT 17-ZH  
LEAST TOTAL DIST

\*\*\* PII \*\*\*

	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 15  
17 18 19 20 \*

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

PLOTS TO FIT 7-NI  
LEAST TOTAL DIST

\*\*\* PII \*\*\*

	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

-45-

UCRL-20250

B00NE 31 DIST=00/(1.5\*COSI) 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

B00NE 31 DIST=00/(1.5\*COSI) EUC WT=J+1/2  
10 JAN 71

PLOTS TO FIT 41-HZ  
LEAST TOTAL DIST

\*\*\* P11 \*\*\*

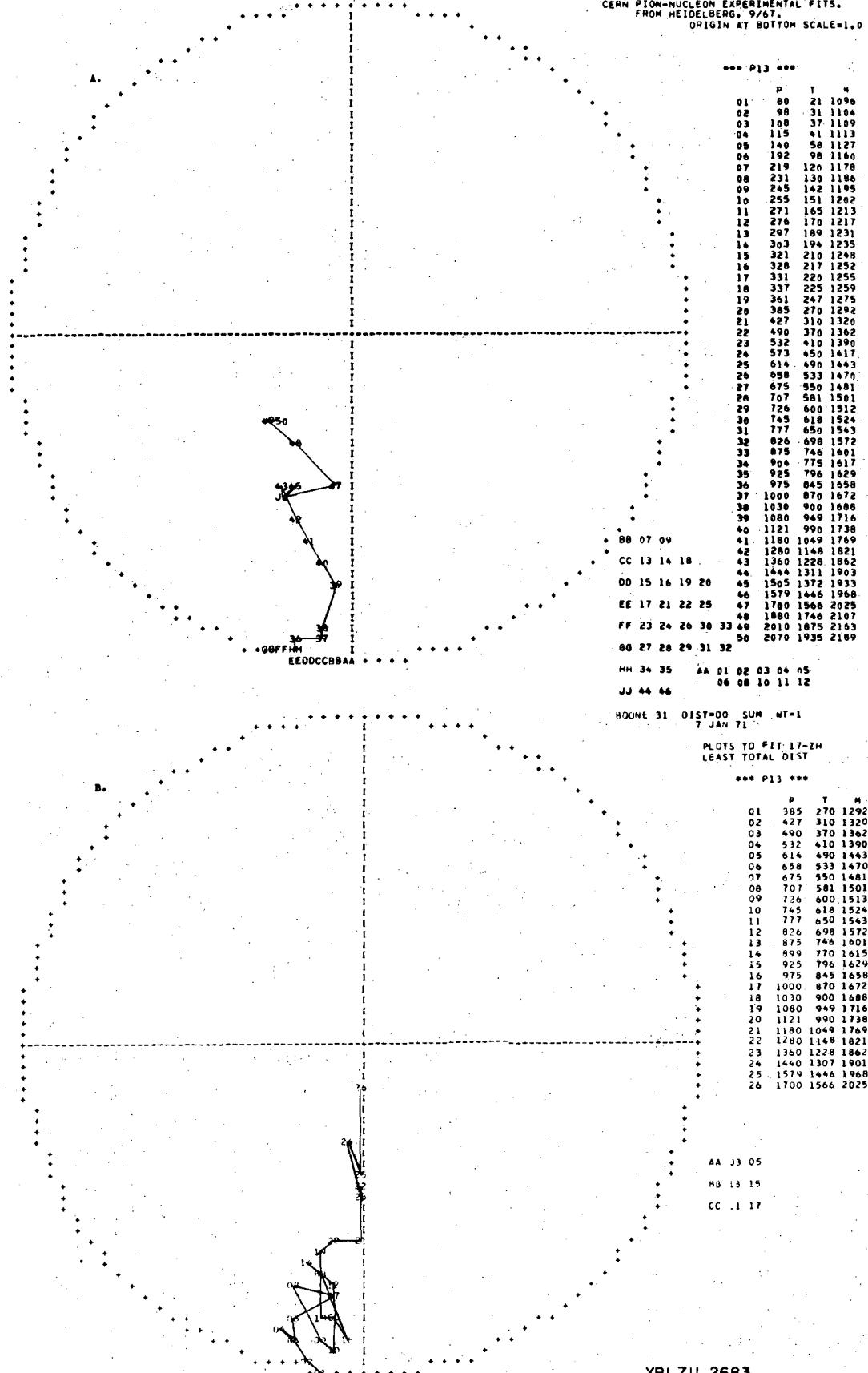
	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1443
06	658	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1080	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

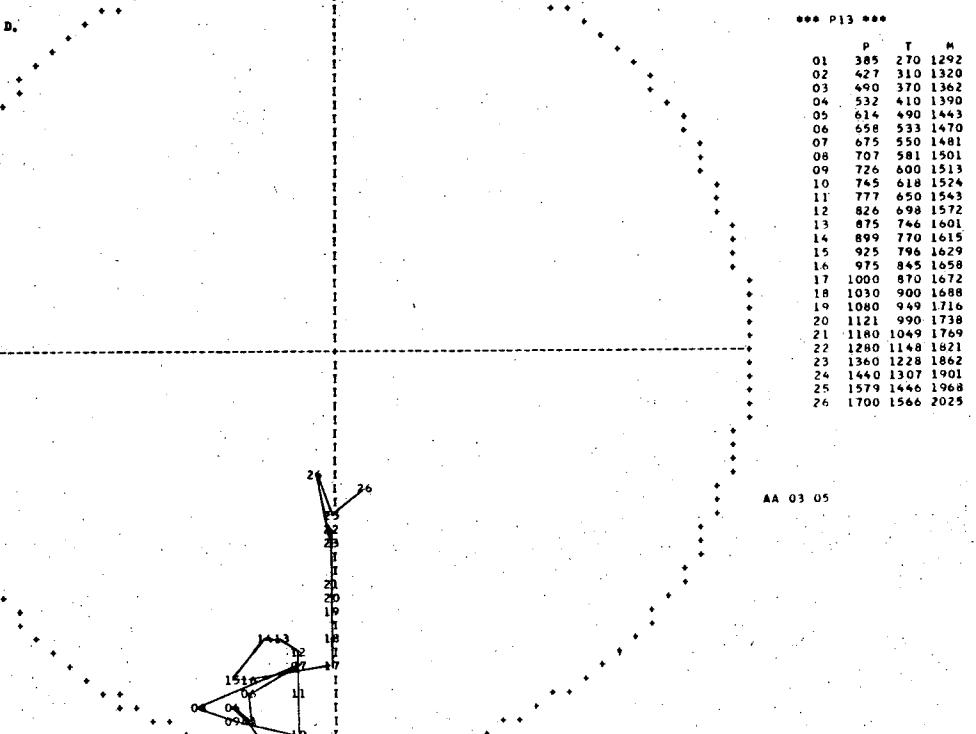
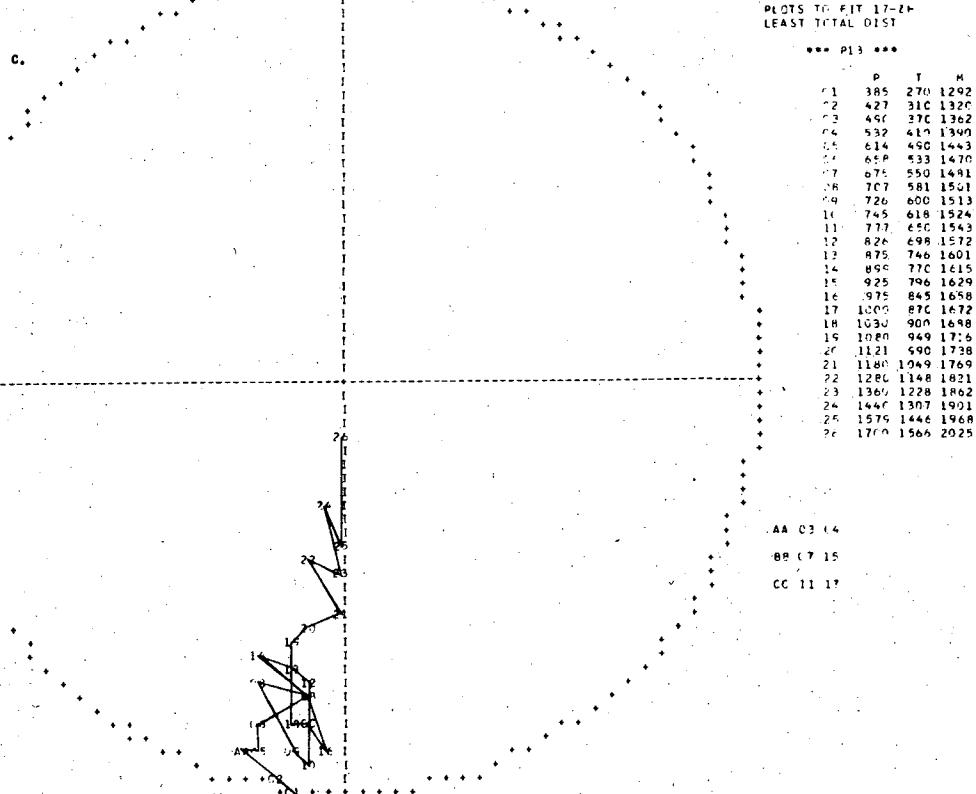
Fig. 13E,F

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



XBL7II-2683

Fig. 14A,B



XBL7II-2684

Fig. 14C,D

BUONE 31 DIST=00/(1.5+COSI) EUC WT=1  
9 JAN 71

PLOTS TO FIT 7-N1  
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	1463
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	794	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	1564	2025

AA 03 09

BB 13 15

BUONE 31 DIST=00/(1.5+COSI) EUC WT=J+1/2  
10 JAN 71

PLOTS TO FIT 41-H2  
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	1463
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	794	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	1564	2025

AA 03 05

BB 07 12 15

CC 11 17

XBL7II-2685

Fig. 14E,F

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

\*\*\* 013 \*\*\*

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	176 1217
13	297	189 1231
14	303	194 1235
15	321	217 1248
16	328	217 1252
17	331	220 1253
18	335	225 1259
19	361	257 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	1200	1148 1821
43	1300	1220 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 01 02 03 04 05  
06 07 08 09 10

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

PLOTS TO FIT 17-ZH  
LEAST TOTAL DIST

\*\*\* 013 \*\*\*

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	999	770 1615
15	925	796 1629
16	975	845 1658
17	1000	870 1672
18	1030	900 1688
19	1040	949 1716
20	1121	990 1738
21	1180	1049 1769
22	1240	1148 1821
23	1300	1220 1862
24	1440	1307 1901
25	1579	1446 1968
26	1700	1566 2025

XBL711-2680

Fig. 15A,B

RECDN- 31 DIST+D. LUC WT=1  
8 JAN 71

PLOTS TO FIT 17-ZH  
LEAST TOTAL DIST

\*\*\* 013 \*\*\*

	P	T	M
1	385	210	1292
2	427	310	1320
3	490	370	1362
4	532	410	1390
5	614	490	1443
6	658	533	1470
7	675	550	1481
8	707	581	1511
9	726	600	1513
10	745	618	1524
11	777	650	1543
12	826	658	1572
13	875	746	1611
14	899	770	1615
15	925	796	1629
16	975	845	1658
17	1000	876	1672
18	1034	900	1688
19	1080	949	1716
20	1121	991	1734
21	1180	1149	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1921
25	1579	1446	1968
26	1707	1564	2025

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

PLOTS TO FIT T-NI  
LEAST TOTAL DIST

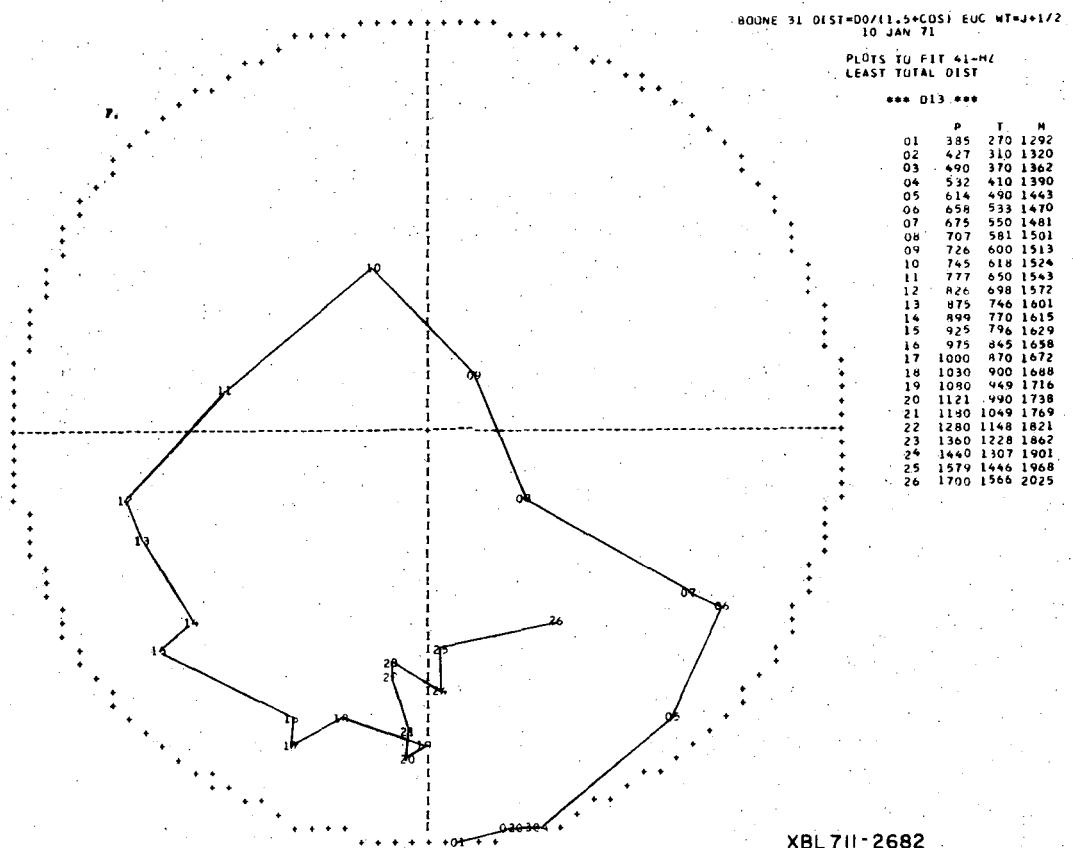
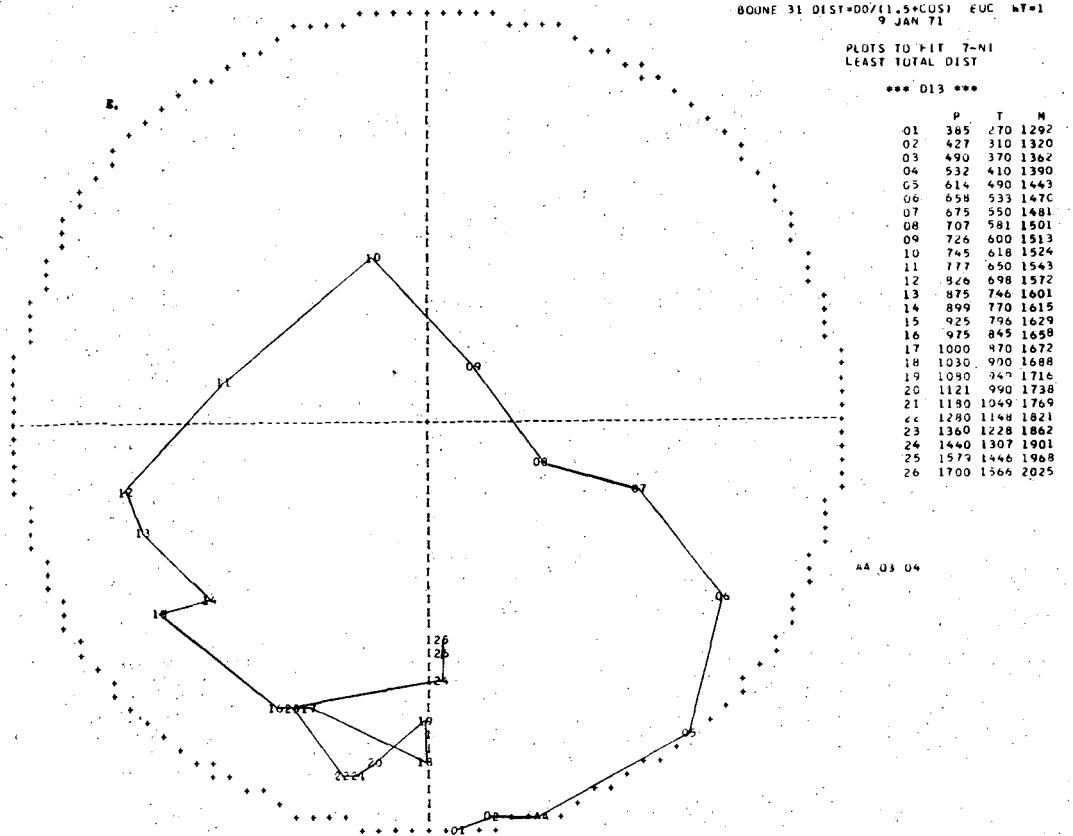
\*\*\* D13 \*\*\*

	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	1684
19	1080	949	1716
20	1121	990	1738
21	1181	1049	1769
22	1268	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1560	2025

AA 17 16

XBL 711-2681

Fig. 15C,D



XBL7II-2682

Fig. 15E,F

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

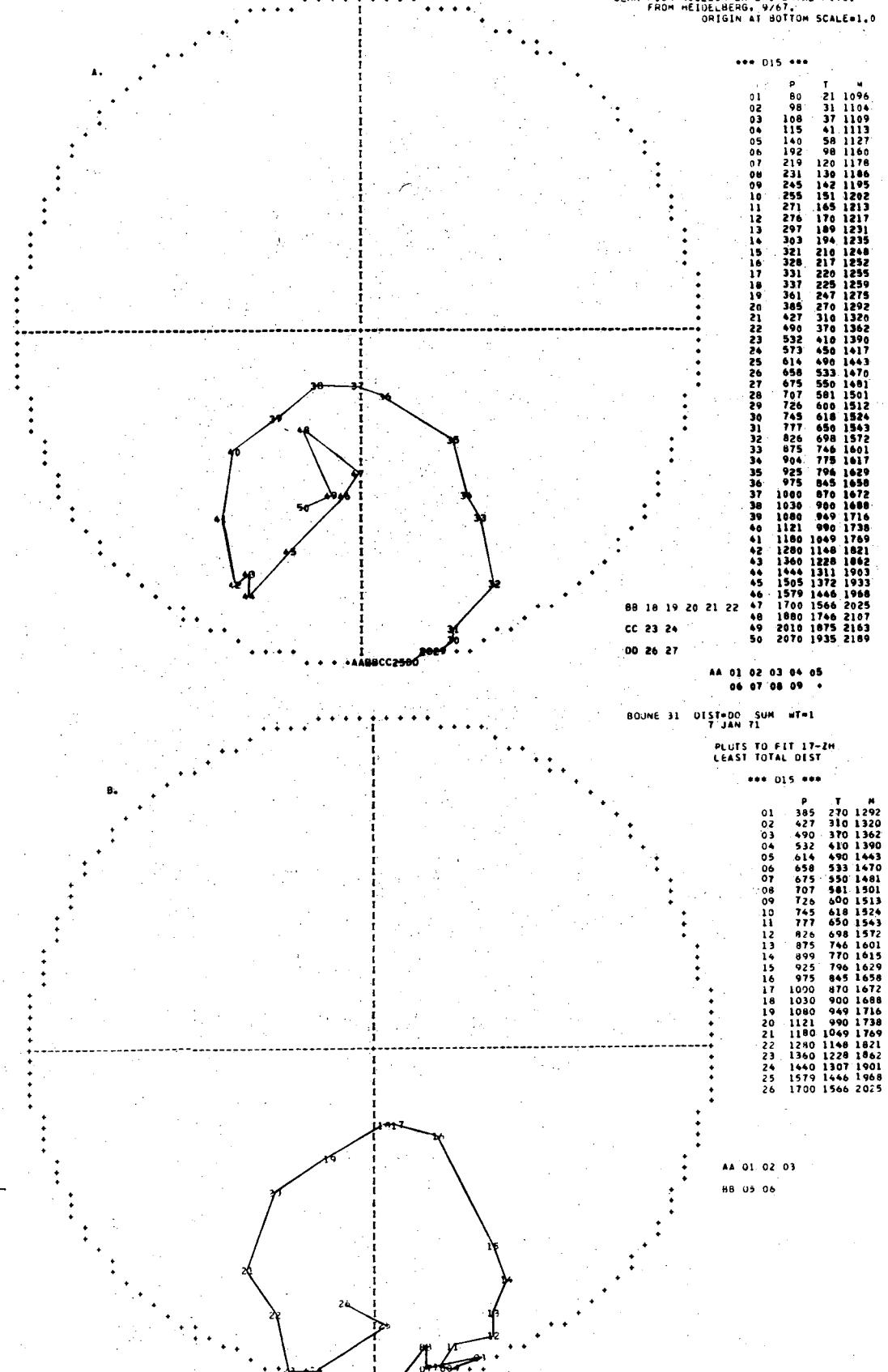


Fig. 16A,B

BOONE 31 DIST=0/(1.5\*COS) SUM WT=1  
6 JAN 71

PLOTS TO FIT 17-21  
LEAST TOTAL DIST

\*\*\* D15 \*\*\*

	P	T	M
01	385	270	1292
02	427	310	1320
03	491	370	1362
04	532	410	1390
05	614	490	1443
06	656	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	765	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

BOONE 31 DIST=0/(1.5\*COS) SUM WT=1  
6 JAN 71

PLOTS TO FIT 7-11  
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	656	533	1470
07	675	550	1481
08	707	581	1501
09	726	600	1513
10	765	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

XBL7II-2678

Fig. 16C,D

BUONE 31 DIST=00/(1.5+COSI) 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	2029

AA 01 02 03

BB 07 09 .

BUONE 31 DIST=00/(1.5+COSI) EUC WT=J+1/2  
10 JAN 71

PLOTS TO FIT 41-MHz  
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	2029

AA 01 02 03

BB 05 06 .

XBL7II-2679

Fig. 16E,F

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

\*\*\* 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	198	98	1160
07	219	120	1176
08	231	130	1186
09	245	142	1195
10	255	151	1202
11	271	165	1213
12	276	170	1218
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
88	21	22	23
89	2010	1875	2163
90	2070	1935	2189
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

\*\*\* 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	1280	1148	1821
22	1360	1228	1862
23	1440	1307	1901
24	1579	1446	1968
25	1700	1566	2025

AA 02 03  
BB 05 07

XBL7II-2674

Fig. 17A,B

BORNE 31 DIST=00 EUC WT=1  
6 JAN 71

PLOTS TO FIT 17-ZF  
LEAST TOTAL DIST

\*\*\* F14 \*\*\*

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	490	1463
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 14 05 07

BORNE 31 DIST=00/(1.5\*COSI) 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	1463
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

XBL7II-2675

Fig. 17C,D

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

PLOTS TO FIT 7-NI  
LEAST TOTAL DIST

\*\*\* FIG \*\*\*

	P	T	M
01	345	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	828	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	1689
19	1080	949	1716
20	1121	986	1738
21	1180	1049	1769
22	1240	1146	1801
23	1360	1228	1862
24	1440	1307	1901
25	1570	1446	1968
26	1700	1566	2025

AA 05 06

BB 08 09

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

PLOTS TO FIT 41-HZ  
LEAST TOTAL DIST

\*\*\* FIG \*\*\*

	P	T	M
01	345	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	828	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	986	1738
21	1180	1049	1769
22	1240	1146	1801
23	1360	1228	1862
24	1440	1307	1901
25	1570	1446	1968
26	1700	1566	2025

AA 02 03

BB 05 07

XBL7II-2676

Fig. 17E,F

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