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

R. D. Field, Jr.

February 10, 1971

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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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Berkeley, California 94720

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.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 Lovelace² 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 $p_{\text{lab}} = 385$ 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 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 Berkeley¹ 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

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

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

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

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 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

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

and

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

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 $\theta = 180^\circ$. 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;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

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

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.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 wave³ (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 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

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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.

	<u>p_{lab} (MeV/c)</u>	<u>Number of fits</u>	<u>Degrees of freedom</u>	<u>Best χ^2</u>	<u>Worst χ^2</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_{lab} (MeV/c)</u>	<u>Number of fits</u>	<u>Degrees of freedom</u>	<u>Best χ^2</u>	<u>Worst χ^2</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 χ^2 for our five paths, where the total number of data points is 2069.

<u>Path</u>	<u>Total χ^2</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 $k-1$.
- Fig. 2. Argand diagram illustrating two possible paths.
- Fig. 3. Argand diagram illustrating the vectors $\underline{A}$ and $\underline{B}$ 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
- $$d(\ell, j, I, k, i) = [1/(1.5 + \cos \theta)] d_0 \quad \text{and} \quad |\underline{B}| = d_0.$$
- 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.

XBL 711-2652

Fig. 3.

XBL711-2653

Fig. 4.

XBL711-2654

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

*** 531 ***

	P	T	N
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	1513
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	1307	1901
45	1505	1372	1933
46	1579	1446	1968
47	1700	1566	2025
48	1800	1746	2107
49	2010	1875	2183
50	2070	1935	2189

AA 02 03

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

PLOTS TO FIT 17-24
LEAST TOTAL DIST

*** 531 ***

	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	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 06 08

Fig. 5A,B

XBL711-2707

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

PLOTS TO FIT 17-26
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	1069	1769
22	1280	1146	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA C1 22

RR C6 C8

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

PLOTS TO FIT 7-MI
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	1069	1769
22	1280	1146	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=00/(1.5+CUS) EUC WT=1
9 JAN 71

PLOTS TO FIT T-NI
LEAST TOTAL DIST

*** 531 ***

	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	1686
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+CDS) EUC WT=1/2
10 JAN 71

PLOTS TO FIT 41-M2
LEAST TOTAL DIST

*** 531 ***

	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	1686
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

XBL711-2709

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	1076
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	1198
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	1382
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	1513
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	1440	1311	1901
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

ROUTE 31 DIST=00 SUM MT=1
7 JAN 71

PLOTS TO FIT 17-2H
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	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	1311	1901
25	1579	1446	1968
26	1700	1566	2025

AA 01 02

BB 10 11

Fig. 6A,B

XBL711-2704

ROONE 31 DIST=01 EUC WT=1
8 JAN 71

PLCTS TO FIT 17-21
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	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

RR 10 11

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

PLCTS TO FIT 7-11
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

BUMME 31 DIST=00/(1.5+COS) EUC WT=1
9 JAN 71

PLOTS TO FIT 7-NI
LEAST TOTAL DIST

*** P31 ***

	P	F	M
01	335	270	1292
02	427	310	1320
03	490	370	1362
04	532	410	1390
05	614	470	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	1300	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

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

PLOTS TO FIT 41-NI
LEAST TOTAL DIST

*** P31 ***

	P	F	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	1040	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1280	1148	1821
23	1300	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

-25-

UCRL-20250
CEHN 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	1150
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	326	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

HUONE 31 DIST=00 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	1512
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=00/11.5+0051 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	1686
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
BH 12 13

BOONE 31 DIST=00/11.5+0051 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	1686
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
BH 12 13

Fig. 7C,D

XBL711-2702

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=00/(1.5+COS) EUC WT=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

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

*** 033 ***

	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	1190
07	219	120	1178
08	231	130	1184
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	577	460	1417
25	614	490	1443
26	658	533	1470
27	675	550	1481
28	707	581	1501
29	740	600	1513
30	745	618	1524
31	777	650	1543
32	826	698	1572
33	875	746	1601
34	904	775	1615
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	1988
47	1700	1566	2025
48	1800	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

BUONE 31 DIST=00 SUM =T=1
7 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST

*** 033 ***

	P	T	M
01	395	270	1292
02	427	310	1320
03	440	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	1307	1901
25	1574	1446	1960
26	1700	1566	2025

AA 01 03

BB 06 07

CC 14 15

DD 18 19

EE 20 21

XBL711-2698

Fig. 8A,B

POINT 11 DIST=00 EUC WT=1
R JAN 71

PLCTS TO FIT 17-21
LEAST TOTAL DIST

*** D33 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1367
04	532	410	1390
05	614	460	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	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 C3 04

RR 06 07

CC 18 19

DD 22 23

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

PLCTS TO FIT 7-11
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	1060	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=00/11.5+COS1 EUC WT=1
9 JAN 71

PLOTS TO FIT 7-N1
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	1573	1446	1968
26	1700	1566	2025

AA 04 05 06

BB 13 14 15

CC 11 16

DD 22 23 26

BOUNE 31 DIST=00/11.5+COS1 EUC WT=1/2
10 JAN 71

PLOTS TO FIT 41-M2
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	1573	1446	1968
26	1700	1566	2025

AA 01 03

BB 06 07

CC 13 14 15

Fig. 8E,F

XBL7H-2700

CERN PION-NUCLEON EXPERIMENTAL FITS.
FROM HEIDELBERG, 9/67.
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	219	126	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	1513
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	1440	1307	1901
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 24 25 26 27 28

DD 30 31 32

EE 36 37 38 39

FF 40 41

AA 01 02 03 04 05

06 07 08 09

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

PLOTS TO FIT 17-2H
LEAST TOTAL DIST

*** 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 02 08 09 10

DD 04 12 17

EE 14 21

FF 20 23

XBL711-2695

Fig. 9A,B

BOONE 31 DIST=03 EUC MT=1
8 JAN 71

PLOTS TO FIT 17-17
LEAST TOTAL DIST

*** D35 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	450	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	1050	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 17

DD 12 17

EE 20 23

BOONE 31 DIST=00/(1.5*CO5) SUM MT=1
8 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	1050	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

Fig. 9C,D

XBL7H-2696

BOONE 31 DIST=00/11.5*COSI EUC MT=1
9 JAN 71

PLOTS TO FIT 7-MI
LEAST TOTAL DIST

*** 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 02 07 08 09 10

CC 04 16

BOONE 31 DIST=00/11.5*COSI EUC MT=J+1/2
10 JAN 71

PLOTS TO FIT 41-MI
LEAST TOTAL DIST

*** 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 02 09 10 18

DD 04 17

Fig. 9E,F

XBL 711-2697

CEHN PION-NUCLEON EXPERIMENTAL FITS,
FROM WEIDELBERG, 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	287	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	1513
30	745	618	1524
31	777	650	1543
32	826	698	1572
33	875	746	1601
34	899	770	1615
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

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

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST

*** F35 ***

	P	T	M
01	305	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	1307	1901
25	1579	1446	1968
26	1700	1566	2025

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

Fig. 10A,B

XBL 711-2692

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

PLOTS TO FIT 17-26
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	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
98 11 12

ROONE 31 DIST=00/(11.5+COS) SUM WT=1
6 JAN 71

PLOTS TO FIT 7-NE
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	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=00/11.5*COS1 EUC WT=1
9 JAN 71

PLOTS TO FIT 7-M1
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	1229	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1588	2025

AA 01 02 03 05 06

BB 07

CC 09 18

DD 20 21

BOONE 31 DIST=00/11.5*COS1 EUC WT=J+1/2
10 JAN 71

PLOTS TO FIT 41-M2
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	1140	1049	1769
22	1280	1148	1821
23	1360	1229	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1588	2025

AA 01 02 03 04 05

BB 08 10

CC 11 12

XBL711-2694

Fig. 10E,F

CEBN 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	96	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	221	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	1513
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	2167
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
BB 07 08 09

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

PLOTS TO FIT 17-2H
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	900	770	1614
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

BB 02 05 06

CC 07 08 10 11 12

DD 13 14

EE 16 17 18

XBL711-2671

Fig. 11A,B

PLANE TO FIT 17-26
LEAST TOTAL DIST

*** F37 ***

P	T	M
01	385	270 1262
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 12 13 14 15 16
BR 07 08 09 10 11 12
13
CC 16 17 18

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

POINTS TO FIT 7-M
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 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 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=00/11.5+CS1 EUC WT=1
9 JAN 71

PLOTS TO FIT 7-N1
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	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

CC 01 09

DD 12 15

BOUNE 31 DIST=00/11.5+CS1 EUC WT=1+1/2
10 JAN 71

PLOTS TO FIT 41-H2
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

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	440	370	1362
23	512	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	1513
30	745	618	1524
31	777	650	1543
32	826	698	1572
33	875	746	1601
34	899	770	1615
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	1290	1148	1821
43	1360	1228	1862
44	1440	1307	1901
45	1579	1444	1968
46	1700	1566	2025
47	1875	1746	2107
48	2010	1875	2163
49	2070	1935	2189

BB 03 04

CC 05 06 07 08

DD 10 11 12 13 1545

EE 09 14 18

FF 19 20 21

GG 29 31

HH 44 45 AA 01 02

JJ 48 50

BUONE 31 DIST=00 SUM NT=1
7 JAN 71

PLOTS TO FIT 17-2H
LEAST TOTAL DIST

*** S11 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	490	370	1362
04	512	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	1444	1968
26	1700	1566	2025

AA 02 04

XBL711-2689

Fig. 12A,B

HOMER 31 DIST=00 SUM WT=1
6 JAN 71

PLOTS TO FIT 17-24
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	970	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 12 14

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

PLOTS TO FIT 7-11
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	970	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

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

PLOTS TO FIT 7-41
LEAST TOTAL DIST

*** S11 ***

	P	T	M
01	335	270	1294
02	427	310	1367
03	490	370	1367
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

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

PLOTS TO FIT 41-M2
LEAST TOTAL DIST

*** S11 ***

	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

XBL711-2691

Fig. 12E,F

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

*** P11 ***

	P	T	H
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	363	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	1513
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

88 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	H
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	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

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

PLOTS TO FIT 17-20
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

ROONE 31 DIST=00/11.5*CO51 SUM WT=1
8 JAN 71

PLOTS TO FIT 7-N1
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

Fig. 13C,D

XBL711-2687

BIRNIE 31 DIST=00/(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	1260	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 11 12 13 17 29
25 26
BB 23 24

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

PLOTS TO FIT 41-MZ
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	1260	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

Fig. 13E,F

XBL711-2688

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

*** P13 ***

	P	T	M
01	80	21	1096
02	96	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	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	1470
27	675	550	1481
28	707	581	1501
29	726	600	1513
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	1240	1148	1821
43	1360	1228	1862
44	1440	1307	1901
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 49

GG 27 28 29 31 32

HH 34 35

JJ 44 46

NOONE 31

DIST=00 SUM WT=1

7 JAN 71

PLOTS TO FIT 17-2H

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	1240	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA J3 05

H0 13 15

CC 11 17

Fig. 14A,B

XBL711-2683

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

PLOTS TO FIT 17-24
LEAST TOTAL DIST

*** P13 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	450	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 14
BB 17 15
CC 11 17

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

PLOTS TO FIT 7-21
LEAST TOTAL DIST

*** P13 ***

	P	T	M
01	385	270	1292
02	427	310	1320
03	450	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

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

PLOTS TO FIT 7-M
LEAST TOTAL DIST

*** P13 ***

	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	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1060	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

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

PLOTS TO FIT 41-M2
LEAST TOTAL DIST

*** P13 ***

	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	975	845	1658
17	1000	870	1672
18	1030	900	1688
19	1060	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

CEMN 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	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	1240	1148	1821
43	1360	1228	1862
44	1440	1307	1901
45	1505	1372	1933
46	1579	1446	1968
47	1700	1506	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

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

PLOTS TO FIT 17-2H
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	1512
10	745	618	1524
11	777	650	1543
12	826	698	1572
13	875	746	1601
14	904	775	1617
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	1240	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1506	2025

XBL711-2680

Fig. 15A,B

RUN- 31 DIST=D, LUC WT=1
6 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST

*** D12 ***

	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	1734
21	1180	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

ADONE 31 DIST=D0/(11.9+COS) SUM WT=1
6 JAN 71

PLOTS TO FIT T-M1
LEAST TOTAL DIST

*** U13 ***

	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	1734
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

BOUNE 31 DIST=DO/(1.5+COS) EUC WT=1
9 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	1090	949	1716
20	1121	990	1738
21	1190	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

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

PLOTS TO FIT 41-MZ
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	1090	949	1716
20	1121	990	1738
21	1190	1049	1769
22	1280	1148	1821
23	1360	1228	1862
24	1440	1307	1901
25	1579	1446	1968
26	1700	1566	2025

XBL 711-2682

Fig. 15E,F

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

*** D15 ***

	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	1513
30	745	618	1524
31	777	650	1543
32	826	698	1572
33	875	746	1601
34	899	770	1615
35	925	796	1629
36	975	845	1658
37	1000	870	1672
38	1030	900	1686
39	1080	949	1716
40	1121	990	1738
41	1180	1049	1769
42	1200	1140	1821
43	1360	1228	1862
44	1440	1307	1901
45	1505	1372	1933
46	1579	1446	1968
47	1700	1566	2025
48	1880	1746	2107
49	2016	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=00 SUM WT=1
7 JAN 71

PLOTS TO FIT 17-ZH
LEAST TOTAL DIST

*** U15 ***

	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	1686
19	1080	949	1716
20	1121	990	1738
21	1180	1049	1769
22	1200	1140	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

BOONE 31 DIST=D₀ HIC WT=1
8 JAN 71
PLOTS TO FIT 17-26
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

BOONE 31 DIST=D₀/(1.5*CO₂) SUM WT=1
8 JAN 71

PLOTS TO FIT 7-21
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

BOUND 31 DIST=00/(1.5+COS) EUC WT=1
9 JAN 71

PLOTS TO FIT T=H1
LEAST TOTAL DIST

*** D15 ***

	P	T	H
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

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

PLOTS TO FIT 41-H2
LEAST TOTAL DIST

*** D15 ***

	P	T	H
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

CEHN 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	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	365	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	899	770	1615
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	1860	1746	2107
49	2810	1875	2163
50	2070	1935	2189

BB 21 22 23
CC 24 25

AA 01 02 03 04 05
06 07 08 09 .

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

PLOTS TO FIT 17-2H
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	1512
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	1307	1901
25	1579	1446	1968
26	1700	1566	2025

AA 02 03

BB 05 07,

XBL711-2674

Fig. 17A,B

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

PLGTS TO FIT 17-20
LEAST TOTAL DIST

*** FIS ***

P	T	H
01	446	270 12.2
02	427	310 13.0
03	450	370 13.2
04	532	410 13.3
05	614	490 14.3
06	658	533 14.70
07	675	550 14.81
08	707	581 15.1
09	726	600 15.3
10	745	618 15.4
11	777	650 15.3
12	826	698 15.7
13	875	746 16.1
14	899	770 16.15
15	925	796 16.9
16	975	845 16.8
17	1000	870 16.2
18	1030	900 16.8
19	1080	949 17.6
20	1121	990 17.8
21	1180	1049 17.69
22	1280	1148 18.21
23	1360	1228 18.62
24	1440	1307 19.1
25	1579	1446 19.8
26	1700	1566 20.25

AA 03 14 25 07

ROONE 31 DIST=00/(1.5*COSE) SUM WT=1
6 JAN 71

PLGTS TO FIT 7-11
LEAST TOTAL DIST

*** FIS ***

P	T	H
01	385	270 12.92
02	427	310 13.20
03	490	370 13.62
04	532	410 13.90
05	614	490 14.43
06	658	533 14.70
07	675	550 14.81
08	707	581 15.01
09	726	600 15.13
10	745	618 15.24
11	777	650 15.43
12	826	698 15.72
13	875	746 16.01
14	899	770 16.15
15	925	796 16.29
16	975	845 16.58
17	1000	870 16.72
18	1030	900 16.88
19	1080	949 17.16
20	1121	990 17.38
21	1180	1049 17.69
22	1280	1148 18.21
23	1360	1228 18.62
24	1440	1307 19.01
25	1579	1446 19.48
26	1700	1566 20.25

AA 02 03

BB 05 07

CC 08 09

Fig. 17C,D

XBL711-2675

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

PLOTS TO FIT 7-N1
LEAST TOTAL DIST

*** F15 ***

	P	F	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

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

PLOTS TO FIT 41-M2
LEAST TOTAL DIST

*** F15 ***

	P	F	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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