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INFORMAL REPORT

Cross Sections for
 $P + \text{Nucleus} \rightarrow \pi^{\pm} + \dots$
for 740-MeV Protons

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Cross Sections for $P + \text{Nucleus} \rightarrow \pi^{\pm} + \dots$ for 740-MeV Protons

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CROSS SECTIONS FOR $P + \text{NUCLEUS} \rightarrow \pi^{\pm} + \dots$ FOR 740-MeV PROTONS

by

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ABSTRACT

Cross sections for $\pi^{\pm}$ production by 740-MeV protons on various nuclei are presented.

I. INTRODUCTION

Pion-production cross sections for protons for protons on hydrogen and other nuclei constitute some of the basic data for medium-energy physics, equally important in the theoretical understanding of pion physics and as input for the design of pion beams for the new generation of meson factories now under construction. Many experiments have measured some of these cross sections; however no experiment had been undertaken which covered a wide range of target materials, production angles, and pion energies. In the present work there was enough redundancy in the identification of particles so that counting efficiencies and backgrounds could be accurately measured and taken into account in the computation of cross sections, and so that the proton and electron component in each momentum channel could also be measured. Here we report measurement of the differential cross section for pion production ($d^2\sigma/d\Omega dE$) by 730-MeV protons on H, D, Be, C, Al, Ti, Cu, Ag, Ta, Pb, and Th at eleven lab angles in the interval 15° - 150° and at twelve energies in the interval 25-550 MeV. The vast amount of data represented by this matrix of parameters required automatic data handling and reduction, which was accomplished using an on-line digital computer with data reduction simultaneously done during the experiment. The experiment used the external proton beam of the 184-in. cyclotron at the Lawrence Radiation Laboratory, a liquid-hydrogen target and various

solid targets, and a pion spectrometer consisting of a bending magnet and an array of 12 counter telescopes.

II. EXPLANATION OF TABLES

The tables consist of the differential cross sections for various energies and angles in the laboratory frame. The errors listed are to be understood as follows: The systematic error in the beam-current measurement, which affects all cross sections the same, introduced by the uncertainty in our calibration of ion-chamber gain is believed to be about 10%. This is not included in the stated errors. The channel-inscattering correction introduces an average uncertainty of 10%, and is included in the stated errors. The other corrections and estimates introduce relatively small uncertainty, which is included in the stated errors, namely the estimates of solid angle, momentum interval, target number, counter efficiency, corrections for $\pi\mu$ decay, target absorption, computer deadtime, zero events, etc. The statistical uncertainty is typically of the order of 3%.

The protons are believed to come from scattering and from nuclear reactions in the target, and the appropriate corrections have been applied to them. The tabulated proton cross sections should provide a reliable guide for calculating beam contamination in experimental setups. The positrons and electrons arise from π and μ decay in flight

and from π^0 γ -decay and subsequent pair production in the general region of the target. There may be some contribution from reactions in the channel wall. The electron numbers should be regarded only as an order-of-magnitude indication of the backgrounds to be encountered in an experimental setup,

and are presented as the ratio of e^+/π^+ ; the number of e^+ is approximately equal to the number of e^- .

A detailed discussion of the experiment and results will appear in Physical Review D, December 1972.

CROSS SECTION FOR π^+ FROM LH

TOTAL CROSS SECTION (MILLIBARNS) 13.50 $\pm$.73

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	5.22 $\pm$.20	30	43.3 $\pm$ 7.0
20	4.26 $\pm$.16	52	59.7 $\pm$ 5.4
30	3.15 $\pm$.11	79	54.5 $\pm$ 4.4
45	1.47 $\pm$.06	105	51.7 $\pm$ 4.4
60	1.03 $\pm$.04	155	37.7 $\pm$ 3.2
75	.87 $\pm$.04	205	32.3 $\pm$ 2.6
90	.66 $\pm$.05	255	28.4 $\pm$ 2.4
105	.68 $\pm$.05	305	21.3 $\pm$ 2.0
120	.49 $\pm$.05	358	16.4 $\pm$ 1.7
135	.40 $\pm$.05	408	5.0 $\pm$.6
150	.29 $\pm$.04		

CROSS SECTION FOR π^- FROM LH

TOTAL CROSS SECTION (MILLIBARNS) .03 $\pm$.01

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	.04 $\pm$.01	30	.4 $\pm$.1
20	.03 $\pm$.01	52	.2 $\pm$.1

CROSS SECTION FOR PI- FROM D

TOTAL CROSS SECTION (MILLIBARNS) 11.42 +- .55

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	4.55 +- .18	30	29.1 +- 5.3
20	3.61 +- .14	52	40.4 +- 4.1
30	2.68 +- .11	79	45.9 +- 4.1
45	1.34 +- .05	105	48.2 +- 4.4
60	.97 +- .04	155	37.1 +- 3.3
75	1.17 +- .06	205	28.6 +- 2.5
90	1.29 +- .09	255	24.5 +- 2.2
		553	.1 +- .1
		553	.1 +- .1
		553	.1 +- .1
		553	.1 +- .1

CROSS SECTION FOR PI- FROM D

TOTAL CROSS SECTION (MILLIBARNS) 1.12 +- .06

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	.56 +- .02	30	3.2 +- .7
20	.46 +- .02	52	3.4 +- .4
30	.29 +- .01	79	4.0 +- .4
45	.18 +- .01	105	4.6 +- .5
60	.13 +- .01	155	4.1 +- .4
75	.07 +- .01	205	3.3 +- .3
90	.05 +- .01	255	2.7 +- .3
		553	0.0 +- .1
		553	0.0 +- .1

CROSS SECTION FOR π^+ FROM BETOTAL CROSS SECTION (MILLIBARNS) 27.28 $\pm$ 1.40

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	9.22 $\pm$.30	30	100.0 $\pm$ 16.0
20	7.50 $\pm$.25	52	137.1 $\pm$ 12.1
30	5.63 $\pm$.19	79	128.5 $\pm$ 10.3
45	3.08 $\pm$.11	105	116.8 $\pm$ 9.8
60	2.12 $\pm$.09	155	77.1 $\pm$ 6.4
75	1.82 $\pm$.10	205	58.8 $\pm$ 4.6
90	1.55 $\pm$.10	255	48.1 $\pm$ 4.0
105	1.46 $\pm$.11	305	35.1 $\pm$ 3.4
120	1.11 $\pm$.10	358	20.9 $\pm$ 2.1
135	.89 $\pm$.08	408	8.2 $\pm$ 1.0
150	.78 $\pm$.08	486	1.5 $\pm$.2
		553	.2 $\pm$.1

CROSS SECTION FOR π^- FROM BETOTAL CROSS SECTION (MILLIBARNS) 6.49 $\pm$.37

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	1.67 $\pm$.06	30	31.4 $\pm$ 5.0
20	1.47 $\pm$.05	52	37.8 $\pm$ 3.4
30	1.21 $\pm$.04	79	34.1 $\pm$ 2.7
45	.74 $\pm$.03	105	30.0 $\pm$ 2.5
60	.55 $\pm$.03	155	18.0 $\pm$ 1.5
75	.46 $\pm$.03	205	12.1 $\pm$ 1.0
90	.42 $\pm$.03	255	8.4 $\pm$.7
105	.39 $\pm$.03	305	5.1 $\pm$.5
120	.30 $\pm$.03	358	2.5 $\pm$.3
135	.25 $\pm$.02	408	.6 $\pm$.1
150	.20 $\pm$.02	486	.1 $\pm$.1

CROSS SECTION FOR π^+ FROM CTOTAL CROSS SECTION (MILLIBARNS) 35.04 $\pm$ 1.82

ANGLE	MILLIBARNS PER STERADIAN	ENERGY	MICROBARNS PER MEV
15	11.12 $\pm$.36	30	136.0 $\pm$ 21.8
20	9.04 $\pm$.29	52	191.2 $\pm$ 17.0
30	6.91 $\pm$.23	79	175.7 $\pm$ 14.1
45	3.93 $\pm$.14	105	150.9 $\pm$ 12.7
60	2.80 $\pm$.12	155	96.2 $\pm$ 8.0
75	2.45 $\pm$.14	205	71.0 $\pm$ 5.6
90	2.02 $\pm$.13	255	57.0 $\pm$ 4.8
105	1.95 $\pm$.15	305	41.8 $\pm$ 4.0
120	1.45 $\pm$.12	358	25.1 $\pm$ 2.6
135	1.41 $\pm$.13	408	10.7 $\pm$ 1.3
150	1.04 $\pm$.09	486	2.2 $\pm$.3
		553	.3 $\pm$.1

CROSS SECTION FOR π^- FROM CTOTAL CROSS SECTION (MILLIBARNS) 6.64 $\pm$.41

ANGLE	MILLIBARNS PER STERADIAN	ENERGY	MICROBARNS PER MEV
15	1.61 $\pm$.06	30	35.7 $\pm$ 5.7
20	1.36 $\pm$.05	52	42.1 $\pm$ 3.7
30	1.14 $\pm$.04	79	35.7 $\pm$ 2.9
45	.77 $\pm$.03	105	30.0 $\pm$ 2.5
60	.57 $\pm$.03	155	17.7 $\pm$ 1.5
75	.49 $\pm$.03	205	11.3 $\pm$.9
90	.44 $\pm$.03	255	7.3 $\pm$.6
105	.42 $\pm$.04	305	4.3 $\pm$.4
120	.31 $\pm$.03	358	2.2 $\pm$.2
135	.30 $\pm$.03	408	.6 $\pm$.1
150	.22 $\pm$.02		

CROSS SECTION FOR π^+ FROM ALTOTAL CROSS SECTION (MILLIBARNS) 53.07 $\pm$ 2.87

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	15.11 $\pm$.49	30	228.8 $\pm$ 36.6
20	12.53 $\pm$.40	52	316.6 $\pm$ 28.0
30	9.91 $\pm$.32	79	272.1 $\pm$ 21.7
45	5.80 $\pm$.21	105	231.8 $\pm$ 19.5
60	4.25 $\pm$.20	155	140.0 $\pm$ 11.6
75	3.69 $\pm$.21	205	98.0 $\pm$ 7.8
90	3.20 $\pm$.21	255	78.7 $\pm$ 6.6
105	3.19 $\pm$.26	305	56.4 $\pm$ 5.4
120	2.50 $\pm$.21	358	34.6 $\pm$ 3.5
135	2.10 $\pm$.18	408	14.9 $\pm$ 1.7
150	1.89 $\pm$.17	486	3.0 $\pm$.4
		553	.4 $\pm$.1

CROSS SECTION FOR π^- FROM ALTOTAL CROSS SECTION (MILLIBARNS) 13.17 $\pm$.92

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	2.70 $\pm$.10	30	86.2 $\pm$ 13.7
20	2.36 $\pm$.09	52	92.8 $\pm$ 8.2
30	2.05 $\pm$.08	79	68.8 $\pm$ 5.5
45	1.43 $\pm$.07	105	54.5 $\pm$ 4.6
60	1.13 $\pm$.07	155	29.4 $\pm$ 2.5
75	1.00 $\pm$.07	205	18.4 $\pm$ 1.5
90	.92 $\pm$.08	255	12.0 $\pm$ 1.1
105	.87 $\pm$.08	305	6.8 $\pm$.7
120	.72 $\pm$.07	358	3.5 $\pm$.4
135	.68 $\pm$.07	408	1.0 $\pm$.1
150	.51 $\pm$.05	486	.2 $\pm$.1

CROSS SECTION FOR π^+ FROM Ti TOTAL CROSS SECTION (MILLIBARNS) 66.97 $\pm$ 3.65

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	18.18 $\pm$.59	30	295.7 $\pm$ 47.5
20	14.93 $\pm$.48	52	430.7 $\pm$ 38.2
30	12.03 $\pm$.39	79	352.1 $\pm$ 28.3
45	7.22 $\pm$.28	105	295.9 $\pm$ 25.0
60	5.38 $\pm$.26	155	173.7 $\pm$ 14.5
75	4.55 $\pm$.25	205	122.1 $\pm$ 9.8
90	4.23 $\pm$.28	255	93.3 $\pm$ 8.0
105	4.01 $\pm$.31	305	67.7 $\pm$ 6.6
120	3.43 $\pm$.29	358	41.1 $\pm$ 4.2
135	2.91 $\pm$.25	408	17.4 $\pm$ 2.1
150	2.54 $\pm$.23	486	3.7 $\pm$.6
		553	.6 $\pm$.2

CROSS SECTION FOR π^- FROM Ti TOTAL CROSS SECTION (MILLIBARNS) 21.22 $\pm$ 1.63

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	3.93 $\pm$.16	30	157.5 $\pm$ 25.1
20	3.52 $\pm$.15	52	151.7 $\pm$ 13.4
30	3.20 $\pm$.14	79	105.2 $\pm$ 8.5
45	2.23 $\pm$.12	105	80.3 $\pm$ 6.8
60	1.81 $\pm$.12	155	41.9 $\pm$ 3.5
75	1.56 $\pm$.13	205	26.1 $\pm$ 2.1
90	1.49 $\pm$.14	255	16.4 $\pm$ 1.5
105	1.46 $\pm$.15	305	9.4 $\pm$ 1.0
120	1.27 $\pm$.13	358	4.9 $\pm$.5
135	1.18 $\pm$.13	408	1.4 $\pm$.2
150	.91 $\pm$.10	486	.4 $\pm$.1

CROSS SECTION FOR π^+ FROM CU

TOTAL CROSS SECTION (MILLIBARNS) 77.32 $\pm$ 4.32

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	19.98 $\pm$.65	30	355.0 $\pm$ 56.9
20	16.49 $\pm$.53	52	490.5 $\pm$ 43.5
30	13.43 $\pm$.44	79	410.7 $\pm$ 32.9
45	8.03 $\pm$.30	105	338.9 $\pm$ 28.6
60	6.25 $\pm$.30	155	196.0 $\pm$ 16.4
75	5.65 $\pm$.34	205	136.5 $\pm$ 10.9
90	4.76 $\pm$.33	255	104.3 $\pm$ 8.9
105	4.74 $\pm$.37	305	76.0 $\pm$ 7.4
120	4.03 $\pm$.34	358	45.9 $\pm$ 4.7
135	3.55 $\pm$.30	408	20.0 $\pm$ 2.4
150	3.14 $\pm$.28	486	4.3 $\pm$.6
		553	.7 $\pm$.2

CROSS SECTION FOR π^+ FROM AG

TOTAL CROSS SECTION (MILLIBARNS) 91.64 $\pm$ 5.14

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	22.02 $\pm$.72	30	426.4 $\pm$ 68.6
20	18.63 $\pm$.62	52	605.9 $\pm$ 53.9
30	15.19 $\pm$.50	79	496.3 $\pm$ 39.9
45	9.30 $\pm$.36	105	413.8 $\pm$ 35.0
60	7.50 $\pm$.37	155	231.7 $\pm$ 19.5
75	6.87 $\pm$.42	205	155.5 $\pm$ 12.6
90	6.03 $\pm$.41	255	118.3 $\pm$ 10.2
105	5.68 $\pm$.43	305	85.4 $\pm$ 8.4
120	5.05 $\pm$.43	358	53.0 $\pm$ 5.5
135	4.27 $\pm$.34	408	21.1 $\pm$ 2.6
150	3.78 $\pm$.32	486	4.4 $\pm$.7
		553	.7 $\pm$.2

CROSS SECTION FOR P1- FROM CU

TOTAL CROSS SECTION (MILLIBARNS) 25.18 +- 2.03

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	4.60 +- .20	30	199.3 +- 31.7
20	4.07 +- .18	52	177.4 +- 15.7
30	3.65 +- .17	79	119.5 +- 9.6
45	2.63 +- .15	105	89.0 +- 7.5
60	2.20 +- .16	155	47.5 +- 4.0
75	2.01 +- .17	205	28.3 +- 2.3
90	1.73 +- .17	255	18.8 +- 1.7
105	1.66 +- .17	305	10.5 +- 1.1
120	1.48 +- .16	358	5.3 +- .6
135	1.45 +- .17	408	1.5 +- .2
150	1.11 +- .13	486	.3 +- .1

CROSS SECTION FOR P1- FROM AG

TOTAL CROSS SECTION (MILLIBARNS) 35.00 +- 2.97

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	6.02 +- .27	30	294.3 +- 46.8
20	5.38 +- .25	52	248.4 +- 22.0
30	4.93 +- .25	79	159.3 +- 12.8
45	3.67 +- .23	105	117.5 +- 10.0
60	3.14 +- .25	155	60.4 +- 5.1
75	2.74 +- .25	205	36.7 +- 3.0
90	2.19 +- .21	255	23.5 +- 2.1
105	2.44 +- .27	305	13.4 +- 1.4
120	2.11 +- .24	358	6.6 +- .7
135	2.09 +- .24	408	1.9 +- .2
150	1.68 +- .20	486	.4 +- .1

CROSS SECTION FOR π^+ FROM TATOTAL CROSS SECTION (MILLIBARNS) 100.99 $\pm$ 5.60

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	23.68 $\pm$.79	30	457.1 $\pm$ 73.8
20	18.98 $\pm$.63	52	690.3 $\pm$ 61.4
30	15.69 $\pm$.51	79	572.5 $\pm$ 46.1
45	9.94 $\pm$.37	105	467.1 $\pm$ 39.5
60	7.75 $\pm$.36	155	257.1 $\pm$ 21.7
75	7.15 $\pm$.41	205	167.0 $\pm$ 13.6
90	6.44 $\pm$.44	255	128.4 $\pm$ 11.1
105	6.83 $\pm$.50	305	91.9 $\pm$ 9.0
120	5.95 $\pm$.47	358	56.3 $\pm$ 5.9
135	5.28 $\pm$.41	408	24.2 $\pm$ 2.9
150	5.03 $\pm$.42	486	4.6 $\pm$.7
		553	.7 $\pm$.2

CROSS SECTION FOR π^- FROM TATOTAL CROSS SECTION (MILLIBARNS) 51.35 $\pm$ 4.66

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	8.23 $\pm$.42	30	466.0 $\pm$ 74.0
20	7.67 $\pm$.41	52	351.8 $\pm$ 31.1
30	6.72 $\pm$.36	79	220.0 $\pm$ 17.7
45	4.93 $\pm$.33	105	157.4 $\pm$ 13.3
60	4.26 $\pm$.35	155	79.9 $\pm$ 6.8
75	3.95 $\pm$.37	205	48.3 $\pm$ 4.0
90	3.78 $\pm$.40	255	30.8 $\pm$ 2.7
105	3.80 $\pm$.43	305	17.1 $\pm$ 1.8
120	3.12 $\pm$.36	358	8.8 $\pm$ 1.0
135	3.33 $\pm$.40	408	2.3 $\pm$.3
150	2.64 $\pm$.32	486	.6 $\pm$.1

CROSS SECTION FOR π^+ FROM PBTOTAL CROSS SECTION (MILLIBARNS) 104.17 $\pm$ 5.79

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	22.98 $\pm$.76	30	473.9 $\pm$ 76.3
20	19.01 $\pm$.62	52	730.2 $\pm$ 64.8
30	15.59 $\pm$.50	79	599.5 $\pm$ 48.2
45	10.01 $\pm$.38	105	487.2 $\pm$ 41.2
60	7.80 $\pm$.36	155	264.7 $\pm$ 22.2
75	7.34 $\pm$.42	205	169.9 $\pm$ 13.7
90	7.67 $\pm$.52	255	128.3 $\pm$ 11.1
105	7.32 $\pm$.55	305	92.7 $\pm$ 9.1
120	6.22 $\pm$.49	358	57.1 $\pm$ 5.9
135	5.38 $\pm$.40	408	23.2 $\pm$ 2.8
150	4.95 $\pm$.39	486	4.2 $\pm$.7
		553	.7 $\pm$.2

CROSS SECTION FOR π^- FROM PBTOTAL CROSS SECTION (MILLIBARNS) 53.72 $\pm$ 4.89

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	8.53 $\pm$.42	30	489.9 $\pm$ 77.7
20	7.69 $\pm$.38	52	371.4 $\pm$ 32.8
30	7.07 $\pm$.40	79	231.3 $\pm$ 18.6
45	5.15 $\pm$.34	105	164.2 $\pm$ 13.9
60	4.39 $\pm$.36	155	81.7 $\pm$ 6.9
75	4.11 $\pm$.39	205	50.5 $\pm$ 4.1
90	4.10 $\pm$.43	255	31.4 $\pm$ 2.8
105	4.17 $\pm$.48	305	17.9 $\pm$ 1.8
120	3.34 $\pm$.39	358	8.8 $\pm$ 1.0
135	3.20 $\pm$.37	408	2.3 $\pm$.3
150	2.63 $\pm$.31	486	.4 $\pm$.1

CROSS SECTION FOR π^+ FROM THTOTAL CROSS SECTION (MILLIBARNS) 107.89 $\pm$ 5.94

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	23.83 $\pm$.82	30	475.1 $\pm$ 77.4
20	19.49 $\pm$.67	52	757.7 $\pm$ 67.7
30	16.24 $\pm$.53	79	624.1 $\pm$ 50.5
45	10.53 $\pm$.40	105	509.6 $\pm$ 43.4
60	8.29 $\pm$.38	155	276.2 $\pm$ 23.5
75	7.41 $\pm$.40	205	180.3 $\pm$ 14.8
90	7.34 $\pm$.52	255	137.2 $\pm$ 12.0
105	7.64 $\pm$.54	305	96.6 $\pm$ 9.6
120	6.77 $\pm$.52	358	60.7 $\pm$ 6.4
135	5.67 $\pm$.41	408	24.7 $\pm$ 3.1
150	5.21 $\pm$.41	486	4.4 $\pm$.8
		553	.6 $\pm$.2

CROSS SECTION FOR π^- FROM THTOTAL CROSS SECTION (MILLIBARNS) 60.44 $\pm$ 5.54

ANGLE -----	MILLIBARNS PER STERADIAN -----	ENERGY -----	MICROBARNS PER MEV -----
15	9.33 $\pm$.46	30	554.2 $\pm$ 88.1
20	8.46 $\pm$.43	52	418.0 $\pm$ 37.0
30	7.78 $\pm$.42	79	255.0 $\pm$ 20.6
45	5.77 $\pm$.39	105	183.8 $\pm$ 15.6
60	4.94 $\pm$.42	155	92.5 $\pm$ 7.9
75	4.60 $\pm$.44	205	54.3 $\pm$ 4.5
90	4.52 $\pm$.48	255	36.8 $\pm$ 3.3
105	4.50 $\pm$.50	305	20.2 $\pm$ 2.1
120	4.07 $\pm$.48	358	10.1 $\pm$ 1.1
135	4.05 $\pm$.49	408	2.7 $\pm$.4
150	2.95 $\pm$.35	486	.5 $\pm$.1

CROSS SECTION FOR P FROM LM
(MICROBARN PER STERADIAN-MEV)

ANGLE	ENERGY							
	60	71	86	103	125	148	188	225
15	14.2 +- 1.9	27.4 +- 3.1	31.7 +- 3.2	38.8 +- 4.4	46.1 +- 5.4	52.7 +- 7.0	68.7 +- 9.1	64.8 +- 11.5
20	14.6 +- 1.9	25.6 +- 2.9	28.4 +- 2.9	32.3 +- 3.6	38.8 +- 4.8	44.6 +- 5.9	49.7 +- 7.4	49.6 +- 8.8
30	12.3 +- 1.5	22.2 +- 2.4	23.4 +- 2.3	26.4 +- 2.9	29.2 +- 3.4	38.1 +- 4.8	28.0 +- 4.2	23.4 +- 4.2
45	6.4 +- .8	9.9 +- 1.1	9.3 +- .9	8.6 +- 1.8	7.8 +- .8	4.8 +- .6	1.4 +- .3	1.5 +- .3
60	1.9 +- .3	3.3 +- .4	4.9 +- .5	6.7 +- .7	11.8 +- 1.3	184.5 +- 24.1	1.6 +- .2	
75	1.3 +- .2	.4 +- .1	.3 +- .1	.1 +- .1				
90	.1 +- .1	.1 +- .1						

CROSS SECTION FOR P FROM D
(MICROBARN PER STERADIAN-MEV)

ANGLE	ENERGY							
	60	71	86	103	125	148	188	225
15	19.1 +- 3.0	28.1 +- 3.8	33.2 +- 3.7	48.7 +- 4.9	53.7 +- 6.5	58.5 +- 7.9	64.2 +- 9.7	68.4 +- 12.3
20	18.3 +- 2.7	28.5 +- 3.6	30.3 +- 3.3	37.9 +- 4.5	39.9 +- 4.9	47.8 +- 6.4	49.4 +- 7.5	52.7 +- 9.5
30	15.2 +- 2.3	24.3 +- 3.0	24.1 +- 2.7	28.2 +- 3.3	31.6 +- 3.9	31.4 +- 4.3	38.2 +- 4.6	27.3 +- 4.9
45	8.5 +- 1.3	12.1 +- 1.6	11.5 +- 1.3	12.8 +- 1.5	12.6 +- 1.6	12.8 +- 1.7	11.1 +- 1.8	13.4 +- 2.4
60	14.6 +- 1.7	23.9 +- 2.5	27.9 +- 2.6	34.8 +- 3.8	43.3 +- 5.8	43.2 +- 5.7	21.2 +- 3.2	9.8 +- 1.6
75	28.8 +- 3.1	33.1 +- 3.5	26.3 +- 2.6	28.8 +- 2.3	16.4 +- 1.9	12.3 +- 1.6	7.7 +- 1.2	4.8 +- .7
90	28.8 +- 2.3	21.7 +- 2.3	18.6 +- 1.8	19.6 +- 1.7	12.7 +- 1.5	9.8 +- 1.2	4.7 +- .7	2.8 +- .4

CROSS SECTION FOR P FROM BE
(MICROBARN PER STERADIAN-MEV)

ANGLE	ENERGY							
	60	71	86	103	125	148	188	225
15	49.4 +- 5.7	103.3 +- 10.8	106.8 +- 10.3	126.4 +- 13.9	144.8 +- 16.7	161.2 +- 21.1	174.5 +- 25.9	178.4 +- 31.6
20	52.3 +- 6.0	96.6 +- 10.2	93.8 +- 9.1	107.7 +- 11.9	121.9 +- 14.1	133.6 +- 17.5	139.5 +- 20.0	139.8 +- 24.8
30	49.3 +- 5.7	92.5 +- 9.7	92.5 +- 9.0	102.0 +- 11.3	109.2 +- 12.6	114.1 +- 15.0	110.7 +- 16.5	102.8 +- 18.2
45	44.3 +- 5.5	30.0 +- 8.4	74.7 +- 7.2	80.3 +- 8.9	86.3 +- 10.0	87.1 +- 11.4	85.4 +- 12.7	83.4 +- 14.8
60	50.3 +- 5.7	79.4 +- 8.3	72.5 +- 7.0	77.5 +- 8.5	78.6 +- 9.1	76.2 +- 10.0	62.5 +- 9.3	42.8 +- 7.6
75	40.6 +- 4.6	61.0 +- 6.4	51.9 +- 5.0	47.5 +- 5.2	40.3 +- 4.7	30.6 +- 4.0	17.6 +- 2.6	10.1 +- 1.8
90	25.5 +- 2.9	30.6 +- 3.2	23.7 +- 2.3	18.9 +- 2.1	14.6 +- 1.7	10.4 +- 1.4	5.3 +- .8	2.3 +- .4
105	20.1 +- 2.3	21.2 +- 2.2	15.9 +- 1.5	12.1 +- 1.3	8.5 +- 1.0	5.5 +- .7	2.1 +- .3	.7 +- .1
120	7.4 +- .8	11.0 +- 1.2	7.9 +- .6	6.3 +- .7	4.1 +- .5	2.4 +- .3	.7 +- .1	.2 +- .1
135	4.8 +- .5	7.4 +- .8	5.7 +- .6	4.2 +- .5	2.7 +- .3	1.4 +- .2	.3 +- .1	
150	4.9 +- .6	7.3 +- .8	4.7 +- .5	3.5 +- .4	2.1 +- .2	1.0 +- .1	.3 +- .1	

CROSS SECTION FOR P FROM C
(MICROBARN PER STERADIAN-MEV)

ANGLE	ENERGY							
	60	71	86	103	125	148	188	225
15	71.8 +- 8.4	144.5 +- 15.3	150.0 +- 14.6	168.9 +- 18.7	195.7 +- 22.7	208.8 +- 27.4	222.7 +- 33.2	220.6 +- 39.1
20	78.0 +- 9.0	133.2 +- 14.0	132.8 +- 12.9	147.4 +- 16.3	164.1 +- 19.0	172.7 +- 22.6	178.5 +- 26.8	177.5 +- 31.5
30	80.3 +- 9.2	134.5 +- 14.2	131.4 +- 12.7	144.1 +- 15.9	150.5 +- 17.4	157.6 +- 20.6	149.2 +- 22.2	139.3 +- 24.7
45	73.4 +- 8.4	115.6 +- 12.1	110.1 +- 10.6	116.2 +- 12.8	122.3 +- 14.1	122.3 +- 16.0	118.3 +- 17.6	108.5 +- 19.2
60	74.8 +- 8.5	111.0 +- 11.6	102.6 +- 9.9	107.0 +- 11.6	106.5 +- 12.3	100.7 +- 13.2	82.8 +- 12.3	59.9 +- 10.6
75	62.0 +- 7.1	83.8 +- 8.9	76.3 +- 7.4	68.3 +- 7.5	60.5 +- 7.0	47.5 +- 6.2	28.1 +- 4.2	15.8 +- 2.8
90	47.0 +- 4.8	48.1 +- 5.0	38.4 +- 3.7	31.2 +- 3.4	24.1 +- 2.8	17.1 +- 2.2	8.8 +- 1.3	4.0 +- .7
105	30.2 +- 3.4	35.7 +- 3.7	25.9 +- 2.5	19.9 +- 2.2	14.5 +- 1.7	9.4 +- 1.2	3.7 +- .6	1.4 +- .2
120	11.5 +- 1.3	17.3 +- 1.8	12.6 +- 1.2	10.4 +- 1.2	7.2 +- .8	4.2 +- .6	1.4 +- .2	.4 +- .1
135	10.8 +- 1.2	15.2 +- 1.6	10.6 +- 1.0	8.2 +- .9	5.3 +- .6	3.0 +- .4	.8 +- .1	.2 +- .1
150	8.7 +- 1.0	12.4 +- 1.3	8.4 +- .8	6.5 +- .7	4.1 +- .5	2.2 +- .3	.5 +- .1	.1 +- .1

CROSS SECTION FOR P FROM AL
(MICROBARN PER STERADIAN-MEV)

ANGLE	ENERGY							
	60	71	86	103	125	148	180	225
15	156.9 -- 18.0	308.1 -- 32.4	296.6 -- 28.5	331.2 -- 36.5	362.7 -- 41.9	387.0 -- 50.7	387.7 -- 57.7	377.0 -- 66.0
20	168.1 -- 19.1	300.0 -- 31.4	274.0 -- 26.4	297.4 -- 32.8	315.7 -- 36.5	332.3 -- 43.5	322.9 -- 48.8	318.6 -- 55.0
30	167.3 -- 19.1	300.9 -- 31.5	280.0 -- 27.1	291.2 -- 32.1	304.3 -- 35.2	306.9 -- 40.2	281.3 -- 41.8	256.3 -- 45.4
45	158.9 -- 18.0	259.6 -- 27.1	235.1 -- 22.7	242.2 -- 26.7	244.6 -- 28.2	240.1 -- 31.4	216.2 -- 32.4	196.1 -- 34.7
60	159.3 -- 18.1	237.8 -- 24.0	213.7 -- 20.6	212.1 -- 23.4	285.7 -- 23.8	192.2 -- 25.2	152.8 -- 22.7	118.9 -- 19.7
75	133.5 -- 15.2	187.6 -- 19.6	157.9 -- 15.2	145.3 -- 16.0	127.0 -- 14.7	99.7 -- 13.1	61.3 -- 9.1	36.7 -- 6.5
90	97.2 -- 11.0	117.2 -- 12.2	91.9 -- 8.9	75.0 -- 8.3	58.7 -- 6.8	42.5 -- 5.6	22.0 -- 3.3	10.4 -- 1.8
105	85.4 -- 9.7	90.0 -- 9.4	65.6 -- 6.3	49.9 -- 5.5	35.6 -- 4.1	23.4 -- 3.1	9.8 -- 1.5	3.7 -- .7
120	33.6 -- 3.0	49.8 -- 5.2	34.1 -- 3.3	27.6 -- 3.1	19.3 -- 2.2	11.9 -- 1.6	4.3 -- .6	1.3 -- .2
135	24.3 -- 2.8	35.2 -- 3.7	27.8 -- 2.7	21.5 -- 2.4	14.4 -- 1.7	8.1 -- 1.1	2.8 -- .4	.7 -- .1
150	24.3 -- 2.8	34.3 -- 3.6	22.7 -- 2.2	17.6 -- 2.0	11.7 -- 1.4	6.6 -- .9	1.8 -- .3	.4 -- .1

CROSS SECTION FOR P FROM TI
(MICROBARN PER STERADIAN-MEV)

ANGLE	ENERGY							
	60	71	86	103	125	148	180	225
15	245.7 -- 26.2	500.9 -- 52.7	464.7 -- 45.0	517.5 -- 57.1	545.2 -- 63.1	569.4 -- 74.6	545.3 -- 81.2	530.8 -- 94.1
20	267.7 -- 36.6	493.2 -- 51.7	436.3 -- 42.2	463.5 -- 51.1	479.1 -- 55.4	488.8 -- 63.9	476.9 -- 70.9	441.6 -- 78.3
30	275.8 -- 31.4	493.8 -- 51.8	442.1 -- 42.7	466.6 -- 51.4	471.5 -- 54.5	462.7 -- 60.6	429.1 -- 62.5	378.1 -- 65.6
45	262.2 -- 29.8	431.9 -- 45.2	371.1 -- 35.8	381.3 -- 42.8	377.9 -- 43.7	364.1 -- 47.7	324.3 -- 48.2	288.4 -- 49.7
60	251.1 -- 28.5	399.7 -- 41.8	342.0 -- 33.8	331.3 -- 36.5	319.6 -- 34.9	291.3 -- 38.1	238.4 -- 34.3	166.9 -- 29.6
75	214.5 -- 24.4	323.5 -- 33.8	256.2 -- 24.7	238.4 -- 25.4	198.5 -- 22.9	168.3 -- 21.8	98.1 -- 14.6	59.1 -- 10.5
90	171.9 -- 19.5	223.5 -- 23.4	164.4 -- 15.9	134.5 -- 14.8	104.6 -- 12.1	75.6 -- 9.9	39.9 -- 5.9	19.1 -- 3.4
105	146.6 -- 16.7	153.4 -- 16.1	114.5 -- 11.1	86.7 -- 9.6	62.8 -- 7.3	39.9 -- 5.2	17.3 -- 2.6	6.7 -- 1.2
120	68.2 -- 7.8	94.2 -- 10.1	64.3 -- 6.2	50.9 -- 5.6	35.8 -- 4.2	21.5 -- 2.8	7.8 -- 1.2	2.4 -- .4
135	51.8 -- 5.9	71.8 -- 7.5	50.8 -- 4.9	39.8 -- 4.3	26.3 -- 3.1	14.8 -- 2.8	4.8 -- .7	1.1 -- .2
150	48.5 -- 5.3	64.4 -- 7.8	42.4 -- 4.1	32.8 -- 3.5	21.6 -- 2.5	11.9 -- 1.6	3.4 -- .5	.9 -- .2

CROSS SECTION FOR P FROM CU
(MICROBARN PER STERADIAN-MEV)

ANGLE	ENERGY							
	60	71	86	103	125	148	188	225
15	106.2 -- 35.2	630.5 -- 66.3	592.3 -- 57.3	629.2 -- 69.4	680.6 -- 78.7	677.0 -- 88.7	659.9 -- 98.2	625.9 -- 111.0
20	154.6 -- 40.5	622.4 -- 65.3	559.6 -- 54.1	583.0 -- 64.3	600.3 -- 69.4	595.7 -- 78.0	568.3 -- 84.6	522.3 -- 92.6
30	769.9 -- 42.1	636.5 -- 66.6	566.5 -- 54.7	580.0 -- 63.9	588.9 -- 68.0	568.2 -- 74.4	505.2 -- 75.2	444.4 -- 78.8
45	144.0 -- 39.1	550.7 -- 57.6	478.0 -- 46.1	478.2 -- 52.7	475.3 -- 54.9	449.0 -- 58.7	391.3 -- 58.2	338.1 -- 59.0
60	334.2 -- 37.9	513.2 -- 53.7	431.2 -- 41.8	415.0 -- 45.7	388.8 -- 46.1	364.1 -- 47.6	282.7 -- 42.8	283.7 -- 36.1
75	286.5 -- 32.5	408.0 -- 42.7	335.0 -- 32.3	297.3 -- 32.7	256.1 -- 29.6	204.6 -- 28.8	125.8 -- 18.7	75.1 -- 13.3
90	214.5 -- 24.3	264.9 -- 27.7	200.6 -- 19.3	164.1 -- 18.1	129.9 -- 15.0	92.2 -- 12.1	49.1 -- 7.3	23.6 -- 4.2
105	196.6 -- 22.3	204.1 -- 21.4	150.3 -- 14.5	112.3 -- 12.4	80.7 -- 9.3	53.3 -- 7.0	23.0 -- 3.4	8.4 -- 1.6
120	86.5 -- 9.9	122.8 -- 12.9	84.9 -- 8.2	68.8 -- 7.3	45.4 -- 5.3	28.0 -- 3.7	18.0 -- 1.5	3.4 -- .8
135	64.2 -- 7.5	90.1 -- 9.4	65.6 -- 8.4	49.9 -- 5.5	34.2 -- 4.8	19.3 -- 2.5	6.1 -- .9	1.6 -- .3
150	48.7 -- 8.9	82.3 -- 8.7	53.9 -- 5.2	42.4 -- 4.7	28.3 -- 3.3	15.5 -- 2.1	4.6 -- .7	1.2 -- .2

CROSS SECTION FOR P FROM AS
(MICROBARN PER STERADIAN-MEV)

ANGLE	ENERGY							
	60	71	86	103	125	148	188	225
15	483.6 -- 55.2	944.2 -- 99.2	851.1 -- 82.2	913.1 -- 108.6	937.5 -- 108.3	934.4 -- 122.3	873.1 -- 129.9	846.5 -- 133.3
20	539.4 -- 61.6	941.9 -- 98.8	813.6 -- 78.7	832.3 -- 91.8	848.8 -- 97.1	821.9 -- 107.6	757.8 -- 112.8	691.7 -- 122.6
30	941.2 -- 63.8	961.4 -- 100.6	836.4 -- 88.7	833.8 -- 91.8	837.3 -- 96.7	796.7 -- 104.3	694.6 -- 103.3	585.9 -- 103.8
45	535.6 -- 68.8	828.0 -- 86.6	713.5 -- 68.8	694.1 -- 76.6	674.7 -- 77.9	628.5 -- 82.2	538.1 -- 80.8	453.4 -- 80.4
60	527.2 -- 59.8	775.6 -- 81.1	647.2 -- 62.4	689.4 -- 67.1	573.2 -- 66.2	513.3 -- 67.2	393.7 -- 58.8	283.7 -- 56.3
75	447.1 -- 59.8	633.2 -- 66.2	506.1 -- 48.8	458.1 -- 49.6	387.1 -- 44.7	384.1 -- 39.8	198.1 -- 28.3	113.5 -- 26.1
90	341.6 -- 38.8	424.1 -- 44.3	322.3 -- 31.1	259.8 -- 28.6	203.1 -- 23.5	146.6 -- 19.2	77.5 -- 11.5	38.8 -- 4.7
105	184.8 -- 34.7	321.6 -- 33.7	239.3 -- 22.2	174.6 -- 19.3	124.1 -- 14.4	88.6 -- 10.6	35.5 -- 5.3	14.1 -- 2.8
120	139.9 -- 15.9	194.7 -- 28.4	128.6 -- 12.4	101.8 -- 11.2	71.0 -- 8.2	42.8 -- 5.8	15.9 -- 2.4	5.1 -- .9
135	107.5 -- 12.2	144.5 -- 15.2	106.7 -- 10.3	82.4 -- 9.1	54.4 -- 6.3	31.7 -- 4.2	18.7 -- 1.8	2.8 -- .5
150	101.4 -- 11.6	137.8 -- 14.4	88.0 -- 8.5	66.8 -- 7.3	45.4 -- 5.3	25.1 -- 3.3	7.6 -- 1.2	2.8 -- .4

CROSS SECTION FOR P FROM TA
(MICROBARN PER STERADIAN-MEV)

ANGLE	ENERGY							
	60	71	86	103	125	148	188	225
15	667.1 -- 76.2	1236.0 -- 129.6	1131.6 -- 109.4	1172.4 -- 129.2	1189.4 -- 137.5	1169.7 -- 153.1	1067.7 -- 158.9	966.1 -- 171.3
20	736.0 -- 83.8	1223.7 -- 128.2	1076.2 -- 103.9	1071.0 -- 118.0	1067.5 -- 125.4	1038.9 -- 136.0	936.8 -- 139.4	834.3 -- 147.9
30	728.3 -- 82.8	1264.7 -- 132.3	1102.4 -- 186.3	1091.3 -- 120.1	1064.4 -- 122.9	995.6 -- 130.3	850.4 -- 126.5	715.2 -- 126.7
45	702.2 -- 79.7	1093.8 -- 114.3	939.1 -- 90.5	884.1 -- 99.5	863.1 -- 99.6	792.1 -- 103.6	661.3 -- 98.3	553.0 -- 98.8
60	681.5 -- 77.3	1008.8 -- 105.5	826.8 -- 79.7	777.5 -- 85.6	724.5 -- 83.7	640.0 -- 83.7	489.0 -- 72.7	354.9 -- 82.9
75	577.3 -- 55.5	812.2 -- 84.9	654.7 -- 63.1	577.3 -- 63.6	493.7 -- 57.0	393.0 -- 51.4	244.1 -- 36.3	146.5 -- 26.8
90	400.7 -- 45.5	522.6 -- 54.7	416.5 -- 40.2	343.1 -- 37.8	274.8 -- 31.7	198.1 -- 25.9	107.8 -- 16.1	54.1 -- 9.6
105	444.8 -- 50.5	476.2 -- 49.2	342.4 -- 33.0	255.3 -- 28.1	183.3 -- 21.2	128.7 -- 15.8	52.8 -- 7.9	21.9 -- 3.9
120	213.6 -- 24.3	292.8 -- 30.7	197.6 -- 19.1	151.3 -- 16.7	107.9 -- 12.5	65.9 -- 8.7	24.8 -- 3.7	8.1 -- 1.5
135	165.0 -- 18.7	231.2 -- 23.2	158.6 -- 15.3	119.4 -- 13.2	81.6 -- 9.5	47.6 -- 6.3	15.6 -- 2.3	4.4 -- .8
150	148.5 -- 16.9	202.2 -- 21.2	132.4 -- 12.8	100.0 -- 11.1	67.5 -- 7.8	39.1 -- 5.2	11.9 -- 1.8	3.2 -- .8

CROSS SECTION FOR P FROM PB
(MICROBARN PER STERADIAN-MEV)

ANGLE	ENERGY							
	60	71	86	103	125	148	188	225
15	675.7 -- 77.0	1231.3 -- 127.1	1146.8 -- 110.7	1197.5 -- 131.9	1197.6 -- 138.4	1144.3 -- 152.4	1081.9 -- 150.9	969.5 -- 171.8
20	768.9 -- 86.6	1252.8 -- 131.1	1098.3 -- 106.0	1106.1 -- 121.8	1090.7 -- 126.0	1057.2 -- 138.4	952.4 -- 141.7	840.1 -- 150.5
30	777.1 -- 88.3	1266.2 -- 132.4	1132.5 -- 109.2	1109.8 -- 122.2	1088.2 -- 125.6	1006.1 -- 131.6	860.2 -- 127.9	720.2 -- 127.6
45	732.6 -- 83.2	1108.2 -- 115.9	959.4 -- 92.5	928.0 -- 102.2	870.4 -- 101.5	804.2 -- 105.2	670.6 -- 99.7	555.6 -- 98.5
60	706.0 -- 88.1	1004.8 -- 105.0	851.7 -- 82.1	797.7 -- 87.8	739.3 -- 85.4	658.2 -- 86.1	499.4 -- 74.3	363.2 -- 64.4
75	608.9 -- 69.1	811.8 -- 84.9	663.2 -- 64.0	585.6 -- 64.5	502.8 -- 58.1	393.8 -- 51.5	248.4 -- 37.8	151.7 -- 26.9
90	546.1 -- 61.9	642.0 -- 67.1	499.0 -- 48.1	406.7 -- 44.8	317.6 -- 36.7	225.8 -- 29.5	121.2 -- 18.0	59.8 -- 18.6
105	454.5 -- 51.6	510.9 -- 53.5	363.9 -- 35.1	276.0 -- 30.4	199.5 -- 23.1	129.2 -- 16.9	50.1 -- 8.4	23.4 -- 4.2
120	217.4 -- 24.7	296.2 -- 31.8	206.0 -- 19.9	160.5 -- 17.7	114.5 -- 13.3	70.1 -- 9.2	26.3 -- 3.9	9.2 -- 1.7
135	153.8 -- 17.5	211.7 -- 22.2	168.5 -- 16.3	125.6 -- 13.9	85.4 -- 9.9	50.4 -- 6.8	17.0 -- 2.6	5.0 -- .9
150	156.7 -- 17.8	206.3 -- 21.6	138.5 -- 13.4	105.2 -- 11.6	70.0 -- 8.1	39.5 -- 5.2	13.0 -- 2.0	3.2 -- .8

CROSS SECTION FOR P FROM LH
(MICROBARN PER STERADIAN-MEV)

ANGLE	ENERGY							
	60	71	86	103	125	148	168	225
15	728.1 +- 83.3	1400.2 +-147.0	1257.0 +-121.6	1294.7 +-142.8	1288.8 +-149.1	1278.6 +-167.5	1164.9 +-173.4	1045.1 +-185.3
20	809.4 +- 92.3	1401.8 +-147.0	1184.1 +-114.4	1199.8 +-132.3	1182.8 +-136.8	1130.0 +-148.0	1012.8 +-150.8	911.2 +-161.6
30	835.4 +- 94.9	1414.4 +-147.9	1212.6 +-116.9	1205.3 +-132.7	1174.2 +-135.6	1086.8 +-142.2	922.5 +-137.2	777.3 +-137.7
45	777.7 +- 88.3	1231.1 +-128.8	1031.1 +- 99.4	997.9 +-109.9	955.5 +-110.3	869.5 +-113.6	726.7 +-108.1	598.5 +-106.1
60	751.5 +- 85.2	1120.6 +-117.1	921.7 +- 88.8	862.5 +- 95.9	799.6 +- 92.3	702.5 +- 91.9	534.5 +- 79.5	393.6 +- 69.7
75	658.2 +- 74.7	928.4 +- 97.1	731.9 +- 70.6	650.7 +- 71.6	554.0 +- 64.0	439.6 +- 57.5	276.3 +- 41.1	166.9 +- 29.6
90	461.7 +- 52.4	609.5 +- 63.8	470.9 +- 45.4	393.7 +- 43.4	305.5 +- 35.3	228.1 +- 29.9	124.1 +- 18.5	63.0 +- 11.2
105	410.9 +- 50.0	571.6 +- 59.8	415.6 +- 40.1	311.2 +- 34.3	229.6 +- 26.5	148.0 +- 19.4	65.9 +- 9.8	26.0 +- 4.6
120	283.7 +- 32.2	380.6 +- 39.9	253.5 +- 24.5	193.3 +- 21.3	134.8 +- 15.6	85.1 +- 11.2	32.2 +- 4.8	10.7 +- 1.9
135	218.7 +- 26.9	287.1 +- 30.1	191.0 +- 18.5	143.7 +- 15.9	97.6 +- 11.3	56.8 +- 7.5	19.7 +- 3.0	5.0 +- .9
150	194.5 +- 22.1	251.7 +- 26.4	159.8 +- 15.5	119.0 +- 13.2	79.7 +- 9.3	44.8 +- 5.9	14.3 +- 2.2	3.7 +- .7

RATIO OF E+ TO PI+ FROM LH

ANGLE	ENERGY										
	98	132	168	201	259	315	369	423	478	530	610
15	.241 +- .071	.130 +- .050	.052 +- .022	.037 +- .012	.005 +- .003	.005 +- .002	.003 +- .001				
20	.543 +- .119	.138 +- .032	.064 +- .018	.015 +- .008	.008 +- .003	.002 +- .001	.001 +- .001	.002 +- .001	.002 +- .001	.003 +- .003	
30	.314 +- .073	.107 +- .024	.052 +- .010	.015 +- .005	.005 +- .002	.002 +- .001	.003 +- .001				
45	.201 +- .038	.062 +- .010	.018 +- .004	.006 +- .002	.002 +- .001	.001 +- .001	.002 +- .001				
60	.078 +- .012	.015 +- .003	.006 +- .001	.003 +- .001	.001 +- .001						
75	.051 +- .004	.011 +- .001	.004 +- .001	.002 +- .001							
90	.028 +- .003	.004 +- .001	.001 +- .001								
105	.015 +- .001	.003 +- .001									
120	.008 +- .001	.002 +- .001									
135	.013 +- .001	.001 +- .001									
150	.007 +- .002										

RATIO OF E- TO PI- FROM LH

	ENERGY											
ANGLE	98	132	166	201	259	315	369	423	478	530	618	678
15	2.151 +- .107	1.915 +- .086	2.900 +- .166	1.060 +- .075	1.702 +- .173	1.153 +- .164	.143 +- .060					
20	1.548 +- .064	1.639 +- .060	4.302 +- .201	2.887 +- .163	1.260 +- .094							
30	6.386 +- .427	5.792 +- .414										
120	1.932 +- .386											
150	1.597 +- .180											

RATIO OF E- TO PI- FROM D

ANGLE	ENERGY											
	98	132	168	201	259	315	369	423	478	530	610	678
15	.587	.234	.154	.063	.022	.008	.003	.001	.002	.001	.032	
	+- .152	+- .082	+- .043	+- .018	+- .007	+- .004	+- .002	+- .001	+- .001	+- .002	+- .023	
20	.592	.348	.062	.026	.020	.009	.007	.004	.001	.002		
	+- .169	+- .090	+- .030	+- .018	+- .007	+- .003	+- .002	+- .002	+- .001	+- .002		
30	.311	.294	.090	.037	.013	.005						
	+- .093	+- .051	+- .031	+- .015	+- .004	+- .002						
45	.392	.144	.040	.023	.006	.008	.003	.002	.007			
	+- .074	+- .023	+- .012	+- .006	+- .002	+- .002	+- .002	+- .003	+- .009			
60	.144	.036	.011	.007	.003							
	+- .038	+- .012	+- .005	+- .003	+- .002							
75	.113	.022	.007	.006	.002							
	+- .018	+- .005	+- .002	+- .002	+- .001							
90	.021	.005	.003									
	+- .007	+- .002	+- .001									

RATIO OF E- TO PI- FROM D

ANGLE	ENERGY											
	98	132	168	201	259	315	369	423	478	530	610	678
15	1.377 -- .118	1.059 -- .087	.706 -- .062	.441 -- .044	.101 -- .016	.059 -- .008	.023 -- .004	.016 -- .004	.016 -- .004	.028 -- .021		
20	.961 -- .091	1.022 -- .083	.498 -- .047	.313 -- .033	.095 -- .015	.046 -- .008	.026 -- .005	.014 -- .004	.009 -- .005			
30	4.071 -- .454	1.283 -- .137	.626 -- .077	.271 -- .041	.047 -- .014	.025 -- .008	.006 -- .005	.011 -- .006	.038 -- .015	.178 -- .001		
45	2.699 -- .125	.983 -- .048	.403 -- .025	.172 -- .012	.039 -- .005	.019 -- .003	.008 -- .005					
60	.913 -- .068	.255 -- .026	.126 -- .012	.045 -- .006	.021 -- .004	.006 -- .006	.012 -- .016					
75	.689 -- .091	.298 -- .030	.098 -- .013	.034 -- .008	.016 -- .009	.026 -- .023	.050 -- .037	.366 -- .256				
90	.516 -- .075	.173 -- .022	.077 -- .014	.042 -- .012								

RATIO OF E+ TO P1+ FROM BE

ANGLE	ENERGY											
	98	132	168	201	259	315	369	423	478	530	610	678
15	.709 -- .075	.310 -- .014	.126 -- .007	.055 -- .003	.020 -- .002	.008 -- .001	.005 -- .001	.002 -- .001	.002 -- .001	.003 -- .001		
20	.545 -- .043	.200 -- .015	.073 -- .007	.037 -- .004	.009 -- .001	.005 -- .001	.003 -- .001	.002 -- .001				
30	.458 -- .035	.183 -- .013	.068 -- .006	.031 -- .003	.010 -- .001	.004 -- .001	.003 -- .001	.002 -- .001	.001 -- .001	.004 -- .002		
45	.247 -- .023	.081 -- .007	.026 -- .003	.012 -- .002	.004 -- .001	.002 -- .001	.002 -- .001	.003 -- .001				
60	.137 -- .012	.034 -- .003	.017 -- .002	.006 -- .001	.003 -- .001	.002 -- .001	.003 -- .001	.002 -- .002				
75	.101 -- .009	.023 -- .002	.012 -- .001	.004 -- .001	.002 -- .001	.002 -- .001						
90	.086 -- .003	.019 -- .001	.007 -- .001	.003 -- .001	.003 -- .001							
105	.064 -- .004	.013 -- .001	.004 -- .001	.002 -- .001	.003 -- .001							
120	.050 -- .004	.010 -- .001	.004 -- .001	.001 -- .001								
135	.037 -- .002	.011 -- .001	.004 -- .001									
150	.040 -- .003	.010 -- .001	.004 -- .001	.001 -- .001								

RATIO OF E- TO P1- FROM BE

ANGLE	ENERGY											
	98	132	168	201	259	315	369	423	478	530	610	678
15	1.388 -- .056	.747 -- .026	.346 -- .015	.168 -- .009	.066 -- .005	.032 -- .003	.016 -- .002	.009 -- .002	.005 -- .002	.006 -- .003		
20	.987 -- .041	.513 -- .019	.250 -- .012	.121 -- .007	.052 -- .004	.021 -- .002	.013 -- .002	.008 -- .002	.008 -- .002	.001 -- .001		
30	1.257 -- .053	.569 -- .022	.225 -- .011	.091 -- .006	.036 -- .003	.014 -- .002	.012 -- .002	.009 -- .002	.004 -- .002	.007 -- .005		
45	.945 -- .029	.285 -- .009	.120 -- .005	.056 -- .003	.020 -- .002	.010 -- .001	.005 -- .001	.003 -- .001	.005 -- .003	.019 -- .013		
60	.472 -- .019	.149 -- .006	.061 -- .003	.027 -- .002	.011 -- .002	.008 -- .002	.008 -- .003	.008 -- .004				
75	.370 -- .015	.108 -- .005	.043 -- .003	.018 -- .002	.011 -- .002	.003 -- .001						
90	.312 -- .010	.090 -- .003	.031 -- .002	.014 -- .001	.007 -- .002	.004 -- .003						
105	.252 -- .009	.065 -- .003	.025 -- .002	.010 -- .001	.001 -- .001	.005 -- .003						
120	.197 -- .007	.059 -- .003	.024 -- .002	.011 -- .002	.005 -- .002							
135	.194 -- .009	.050 -- .003	.018 -- .002	.008 -- .002	.004 -- .003	.011 -- .011						
150	.158 -- .008	.042 -- .003	.016 -- .002	.007 -- .002	.007 -- .004							

RATIO OF E+ TO P1- FROM C

ANGLE	ENERGY											
	98	132	168	201	259	315	369	423	478	530	610	678
15	.693 -- .063	.296 -- .024	.079 -- .009	.045 -- .005	.015 -- .002	.008 -- .002	.004 -- .001	.002 -- .001	.003 -- .001	.001 -- .001	.002 -- .002	
20	.627 -- .036	.144 -- .012	.062 -- .006	.022 -- .003	.012 -- .002	.006 -- .001	.003 -- .001	.001 -- .001	.002 -- .001	.001 -- .002	.004 -- .003	
30	.453 -- .039	.125 -- .011	.055 -- .004	.023 -- .003	.010 -- .002	.005 -- .001	.002 -- .001	.002 -- .001				
45	.222 -- .017	.057 -- .005	.025 -- .003	.010 -- .001	.004 -- .001	.003 -- .001	.002 -- .001					
60	.119 -- .011	.032 -- .003	.014 -- .002	.007 -- .001	.004 -- .001	.003 -- .001						
75	.074 -- .007	.020 -- .002	.007 -- .001	.004 -- .001	.002 -- .001							
90	.083 -- .003	.019 -- .001	.006 -- .001	.003 -- .001	.002 -- .001							
105	.061 -- .004	.013 -- .001	.005 -- .001	.002 -- .001	.003 -- .001	.001 -- .001						
120	.040 -- .004	.010 -- .001	.005 -- .001	.002 -- .001								
135	.046 -- .004	.011 -- .001	.004 -- .001	.002 -- .001	.002 -- .002							
150	.032 -- .004	.010 -- .001	.003 -- .001	.001 -- .001								

RATIO OF E- TO P1- FROM C

ANGLE	ENERGY											
	98	132	168	201	259	315	369	423	478	530	610	678
15	1.381 -- .048	.604 -- .019	.314 -- .013	.155 -- .004	.071 -- .005	.038 -- .003	.017 -- .002	.009 -- .002	.011 -- .002			
20	1.383 -- .055	.469 -- .018	.238 -- .011	.136 -- .007	.054 -- .004	.024 -- .003	.016 -- .002	.013 -- .002	.005 -- .002	.008 -- .004		
30	1.384 -- .053	.420 -- .015	.203 -- .009	.104 -- .006	.049 -- .004	.021 -- .002	.010 -- .002	.008 -- .002	.003 -- .002	.006 -- .005		
45	.823 -- .025	.275 -- .009	.124 -- .005	.059 -- .003	.023 -- .002	.012 -- .002	.009 -- .002	.004 -- .002	.005 -- .002			
60	.498 -- .016	.138 -- .005	.066 -- .003	.033 -- .002	.015 -- .002	.006 -- .001	.009 -- .002	.002 -- .002	.014 -- .010			
75	.407 -- .016	.111 -- .005	.048 -- .003	.025 -- .002	.007 -- .002	.008 -- .003	.005 -- .004	.010 -- .010				
90	.368 -- .011	.104 -- .004	.042 -- .002	.020 -- .002	.012 -- .002	.008 -- .003	.013 -- .007	.022 -- .022				
105	.289 -- .009	.071 -- .003	.027 -- .002	.011 -- .001	.005 -- .002	.005 -- .003						
120	.221 -- .008	.069 -- .003	.029 -- .002	.010 -- .002	.003 -- .002							
135	.213 -- .008	.061 -- .003	.026 -- .002	.013 -- .002	.007 -- .003							
150	.184 -- .008	.044 -- .003	.020 -- .002	.007 -- .002	.005 -- .003							

RATIO OF E- TO PI- FROM AL

ANGLE	ENERGY											
	90	132	168	201	259	315	369	423	478	530	610	678
15	.661 -- .053	.191 -- .014	.087 -- .008	.046 -- .004	.021 -- .003	.009 -- .001	.005 -- .001	.003 -- .001	.002 -- .001			
20	.328 -- .021	.119 -- .007	.067 -- .005	.030 -- .003	.012 -- .001	.006 -- .001	.004 -- .001	.002 -- .001	.002 -- .001	.002 -- .001	.002 -- .001	
30	.377 -- .027	.127 -- .009	.054 -- .005	.028 -- .003	.010 -- .002	.005 -- .001	.002 -- .001					
45	.262 -- .013	.061 -- .004	.026 -- .002	.012 -- .001	.004 -- .001	.003 -- .001	.002 -- .001					
60	.152 -- .012	.031 -- .003	.012 -- .002	.007 -- .001	.005 -- .001	.003 -- .001						
75	.116 -- .008	.023 -- .002	.012 -- .001	.007 -- .001	.003 -- .001	.001 -- .001	.002 -- .002					
90	.091 -- .003	.023 -- .001	.009 -- .001	.004 -- .001	.002 -- .001	.001 -- .001						
105	.065 -- .005	.015 -- .001	.005 -- .001	.002 -- .001	.002 -- .001	.004 -- .003						
120	.052 -- .004	.013 -- .001	.004 -- .001									
135	.048 -- .003	.011 -- .001	.004 -- .001	.002 -- .001								
150	.045 -- .004	.010 -- .001	.005 -- .001	.002 -- .001								

RATIO OF E- TO PI- FROM AL

ANGLE	ENERGY											
	90	132	168	201	259	315	369	423	478	530	610	678
15	.000 -- .002	.451 -- .016	.257 -- .011	.146 -- .008	.071 -- .005	.041 -- .004	.017 -- .002	.011 -- .002	.009 -- .002	.013 -- .005	.006 -- .006	
20	.052 -- .034	.327 -- .013	.214 -- .010	.110 -- .006	.053 -- .004	.036 -- .003	.016 -- .002	.012 -- .002	.009 -- .002			
30	.093 -- .033	.305 -- .011	.161 -- .007	.091 -- .005	.046 -- .004	.022 -- .003	.015 -- .002	.011 -- .002	.006 -- .003			
45	.577 -- .019	.105 -- .007	.104 -- .005	.053 -- .003	.026 -- .002	.016 -- .002	.010 -- .002	.006 -- .002	.002 -- .002			
60	.367 -- .011	.110 -- .004	.064 -- .003	.035 -- .002	.020 -- .002	.013 -- .002	.006 -- .002	.004 -- .003				
75	.305 -- .012	.101 -- .005	.047 -- .003	.023 -- .002	.015 -- .002	.003 -- .002	.003 -- .003					
90	.209 -- .009	.097 -- .003	.048 -- .002	.025 -- .002	.013 -- .002	.006 -- .002						
105	.753 -- .008	.071 -- .003	.030 -- .002	.019 -- .002	.006 -- .002							
120	.178 -- .007	.054 -- .002	.029 -- .002	.015 -- .002	.009 -- .003	.006 -- .006						
135	.195 -- .008	.054 -- .003	.022 -- .003	.009 -- .002	.004 -- .003							
150	.143 -- .007	.046 -- .003	.022 -- .003	.015 -- .003	.009 -- .004							

RATIO OF E+ TO P1+ FROM T1

ANGLE	ENERGY											
	98	132	168	201	259	315	369	423	478	530	610	678
15	.551 .052	.242 .019	.104 .010	.059 .006	.024 .003	.009 .002	.006 .001	.002 .001	.004 .001	.003 .001		
20	.493 .040	.139 .011	.064 .006	.034 .004	.019 .002	.009 .001	.004 .001	.003 .001	.003 .001	.001 .001		
30	.366 .030	.100 .008	.058 .005	.031 .003	.011 .002	.003 .001	.001 .001	.002 .001	.002 .001	.001 .001		
45	.225 .018	.067 .006	.031 .004	.015 .002	.008 .002	.004 .001	.003 .001					
60	.141 .011	.037 .003	.020 .002	.008 .001	.003 .001	.001 .001	.002 .001					
75	.109 .009	.025 .002	.012 .001	.007 .001	.003 .001	.002 .001	.004 .003					
90	.123 .006	.027 .002	.012 .001	.005 .001	.002 .001	.002 .001	.005 .003					
105	.087 .006	.020 .002	.005 .001	.003 .001	.001 .001							
120	.064 .005	.013 .001	.005 .001	.003 .001								
135	.050 .004	.013 .001	.004 .001	.003 .001	.001 .001	.005 .003						
150	.042 .005	.013 .001	.007 .001	.004 .001								

RATIO OF E- TO P1- FROM T1

ANGLE	ENERGY											
	98	132	168	201	259	315	369	423	478	530	610	678
15	.793 .039	.408 .018	.243 .014	.127 .009	.088 .007	.032 .004	.016 .003	.012 .003	.012 .003			
20	.624 .028	.297 .013	.178 .009	.106 .007	.050 .004	.028 .004	.013 .002	.006 .002	.006 .002	.002 .003	.017 .012	
30	.550 .072	.261 .010	.153 .007	.089 .005	.047 .004	.025 .003	.007 .002	.009 .002	.004 .002	.001 .004		
45	.430 .017	.159 .007	.100 .005	.052 .004	.027 .003	.014 .002	.010 .002	.008 .003	.008 .005	.009 .009		
60	.268 .010	.108 .004	.050 .003	.036 .003	.018 .002	.007 .002	.015 .004	.014 .006	.007 .007			
75	.261 .011	.089 .004	.048 .003	.024 .003	.015 .003	.008 .003	.007 .005					
90	.217 .008	.082 .003	.043 .003	.022 .002	.013 .003	.006 .003	.005 .005					
105	.191 .008	.069 .003	.028 .002	.015 .002	.005 .003	.009 .005						
120	.158 .006	.050 .003	.030 .003	.013 .002	.007 .003	.005 .005						
135	.170 .008	.057 .003	.027 .003	.010 .002	.002 .002	.009 .009						
150	.117 .007	.042 .003	.018 .002	.011 .002								

RATIO OF E+ TO P1- FROM CU

ANGLE	ENERGY											
	98	132	168	201	259	315	369	423	478	530	610	676
15	.007 -- .071	.234 -- .018	.121 -- .312	.066 -- .007	.026 -- .004	.014 -- .002	.005 -- .001	.004 -- .001	.003 -- .001	.001 -- .001	.005 -- .003	
20	.528 -- .044	.138 -- .011	.082 -- .007	.039 -- .005	.020 -- .003	.010 -- .002	.003 -- .001					
30	.489 -- .032	.128 -- .009	.063 -- .005	.040 -- .004	.018 -- .002	.009 -- .001	.003 -- .001	.002 -- .001	.002 -- .001	.003 -- .002		
45	.280 -- .018	.082 -- .006	.040 -- .003	.024 -- .002	.007 -- .001	.003 -- .001	.003 -- .001					
60	.147 -- .011	.040 -- .003	.021 -- .002	.012 -- .002	.004 -- .001	.003 -- .001	.002 -- .001	.002 -- .002				
75	.115 -- .007	.035 -- .002	.016 -- .002	.007 -- .001	.004 -- .001	.004 -- .001	.001 -- .001	.011 -- .008	.010 -- .010	.044 -- .044		
90	.149 -- .006	.034 -- .002	.012 -- .001	.007 -- .001	.003 -- .001							
105	.112 -- .006	.022 -- .002	.008 -- .001	.005 -- .001	.002 -- .001	.003 -- .002						
120	.079 -- .005	.018 -- .002	.007 -- .001	.003 -- .001								
135	.052 -- .004	.017 -- .001	.006 -- .001	.003 -- .001								
150	.075 -- .005	.016 -- .002	.004 -- .001	.005 -- .001	.003 -- .002							

RATIO OF E- TO P1- FROM CU

ANGLE	ENERGY											
	98	132	168	201	259	315	369	423	478	530	610	676
15	.768 -- .634	.414 -- .016	.245 -- .012	.155 -- .009	.082 -- .006	.051 -- .005	.021 -- .003	.014 -- .003	.009 -- .003	.006 -- .006		
20	.068 -- .023	.318 -- .011	.205 -- .009	.130 -- .006	.074 -- .004	.042 -- .003	.027 -- .003	.015 -- .002	.009 -- .002	.009 -- .006	.013 -- .009	
30	.584 -- .019	.278 -- .009	.166 -- .007	.109 -- .005	.051 -- .004	.029 -- .003	.015 -- .002	.007 -- .002	.004 -- .002			
45	.425 -- .014	.198 -- .008	.119 -- .006	.068 -- .004	.038 -- .003	.023 -- .003	.014 -- .003	.011 -- .004	.011 -- .005			
60	.305 -- .010	.119 -- .005	.069 -- .004	.038 -- .003	.018 -- .002	.010 -- .002	.012 -- .004	.016 -- .007				
75	.280 -- .010	.106 -- .005	.054 -- .004	.032 -- .003	.019 -- .003	.015 -- .004	.016 -- .008					
90	.303 -- .009	.108 -- .004	.059 -- .003	.033 -- .003	.018 -- .003	.009 -- .004						
105	.247 -- .009	.078 -- .004	.039 -- .003	.016 -- .003	.002 -- .003	.006 -- .006						
120	.169 -- .006	.064 -- .003	.034 -- .003	.019 -- .003	.005 -- .003							
135	.167 -- .007	.053 -- .003	.030 -- .003	.018 -- .002	.015 -- .006	.024 -- .017						
150	.138 -- .006	.051 -- .003	.029 -- .003	.014 -- .003	.003 -- .003							

RATIO OF E- TO PI- FROM AS

	ENERGY											
ANGLE	98	132	168	201	259	315	369	423	478	530	610	678
15	-- .061 -- .060	-- .318 -- .021	-- .141 -- .011	-- .085 -- .007	-- .035 -- .004	-- .019 -- .003	-- .006 -- .001	-- .005 -- .001	-- .002 -- .001			
20	-- .067 -- .054	-- .225 -- .017	-- .127 -- .011	-- .047 -- .006	-- .022 -- .003	-- .012 -- .002	-- .007 -- .002	-- .005 -- .001	-- .002 -- .001	-- .002 -- .002		
30	-- .088 -- .037	-- .191 -- .012	-- .092 -- .007	-- .051 -- .004	-- .025 -- .003	-- .008 -- .001	-- .004 -- .001	-- .003 -- .001	-- .002 -- .001	-- .005 -- .003		
45	-- .496 -- .029	-- .108 -- .007	-- .058 -- .004	-- .024 -- .003	-- .011 -- .002	-- .008 -- .002	-- .002 -- .001					
60	-- .217 -- .014	-- .078 -- .005	-- .031 -- .003	-- .017 -- .002	-- .006 -- .001	-- .005 -- .002	-- .003 -- .002	-- .002 -- .002				
75	-- .142 -- .011	-- .048 -- .003	-- .025 -- .002	-- .009 -- .001	-- .005 -- .001	-- .003 -- .002	-- .002 -- .002	-- .005 -- .005				
90	-- .223 -- .009	-- .048 -- .002	-- .029 -- .002	-- .009 -- .001	-- .004 -- .001	-- .005 -- .002	-- .005 -- .003					
105	-- .148 -- .009	-- .028 -- .002	-- .013 -- .002	-- .004 -- .001	-- .003 -- .001							
120	-- .108 -- .006	-- .024 -- .002	-- .007 -- .001	-- .005 -- .001	-- .003 -- .001							
135	-- .104 -- .007	-- .019 -- .002	-- .008 -- .001	-- .004 -- .001	-- .004 -- .002							
150	-- .095 -- .007	-- .020 -- .002	-- .008 -- .001	-- .003 -- .001	-- .001 -- .001							

RATIO OF E- TO PI- FROM AS

ANGLE	ENERGY											
	98	132	168	201	259	315	369	423	478	538	610	678
15	-- .054 -- .034	-- .438 -- .017	-- .268 -- .014	-- .182 -- .010	-- .119 -- .008	-- .058 -- .005	-- .031 -- .004	-- .014 -- .003	-- .013 -- .003	-- .028 -- .009	-- .034 -- .017	
20	-- .056 -- .022	-- .334 -- .011	-- .245 -- .009	-- .158 -- .007	-- .094 -- .005	-- .050 -- .004	-- .029 -- .003	-- .015 -- .002	-- .019 -- .003	-- .006 -- .004	-- .012 -- .008	-- .072 -- .072
30	-- .084 -- .018	-- .386 -- .009	-- .201 -- .007	-- .127 -- .005	-- .070 -- .004	-- .038 -- .003	-- .018 -- .002	-- .014 -- .003	-- .011 -- .003	-- .008 -- .005	-- .029 -- .017	
45	-- .442 -- .014	-- .196 -- .007	-- .128 -- .006	-- .088 -- .004	-- .048 -- .003	-- .026 -- .003	-- .015 -- .003	-- .007 -- .003	-- .003 -- .003	-- .010 -- .010		
60	-- .317 -- .016	-- .141 -- .005	-- .086 -- .004	-- .052 -- .003	-- .028 -- .003	-- .022 -- .004	-- .010 -- .003	-- .016 -- .003	-- .008 -- .007			
75	-- .311 -- .011	-- .119 -- .005	-- .064 -- .004	-- .045 -- .004	-- .026 -- .004	-- .014 -- .004	-- .010 -- .008	-- .009 -- .008				
90	-- .338 -- .013	-- .115 -- .005	-- .068 -- .005	-- .042 -- .004	-- .028 -- .006	-- .023 -- .008	-- .020 -- .014					
105	-- .249 -- .008	-- .096 -- .004	-- .052 -- .003	-- .027 -- .003	-- .018 -- .004	-- .019 -- .009	-- .016 -- .025					
120	-- .101 -- .006	-- .075 -- .003	-- .046 -- .003	-- .022 -- .003	-- .013 -- .004	-- .010 -- .007						
135	-- .205 -- .008	-- .070 -- .004	-- .034 -- .004	-- .020 -- .003	-- .013 -- .006	-- .009 -- .009						
150	-- .158 -- .006	-- .058 -- .003	-- .034 -- .003	-- .017 -- .003	-- .011 -- .005							

RATIO OF E+ TO P1+ FROM TA

ANGLE	ENERGY											
	98	132	168	201	259	315	369	423	478	530	618	678
15	1.324 -- .086	.413 -- .026	.229 -- .016	.123 -- .010	.047 -- .005	.026 -- .003	.010 -- .002	.007 -- .002	.004 -- .001	.004 -- .002	.004 -- .004	.004 -- .004
20	1.368 -- .085	.304 -- .019	.163 -- .012	.103 -- .008	.046 -- .005	.021 -- .003	.008 -- .002	.005 -- .001	.003 -- .001	.003 -- .002	.003 -- .004	.003 -- .004
30	.961 -- .092	.263 -- .014	.155 -- .009	.070 -- .005	.035 -- .003	.015 -- .002	.006 -- .001	.004 -- .001	.003 -- .001	.003 -- .003	.003 -- .003	.003 -- .003
45	.728 -- .032	.143 -- .007	.076 -- .005	.044 -- .003	.017 -- .002	.010 -- .002	.006 -- .001	.003 -- .002				
60	.391 -- .020	.088 -- .005	.054 -- .004	.021 -- .002	.010 -- .002	.008 -- .002	.002 -- .001					
75	.343 -- .017	.061 -- .004	.033 -- .003	.016 -- .002	.010 -- .002	.005 -- .002	.006 -- .003	.005 -- .005				
90	.298 -- .012	.065 -- .003	.027 -- .002	.016 -- .002	.007 -- .002	.007 -- .003	.003 -- .003					
105	.228 -- .010	.043 -- .002	.021 -- .002	.008 -- .001	.004 -- .001	.003 -- .002	.013 -- .009					
120	.149 -- .008	.033 -- .002	.016 -- .002	.006 -- .001	.005 -- .002	.003 -- .003						
135	.156 -- .007	.028 -- .002	.012 -- .001	.006 -- .001	.003 -- .001							
150	.142 -- .008	.029 -- .002	.010 -- .001	.003 -- .001	.002 -- .002							

RATIO OF E- TO P1- FROM TA

ANGLE	ENERGY											
	98	132	168	201	259	315	369	423	478	530	618	678
15	.761 -- .029	.500 -- .018	.301 -- .015	.238 -- .012	.129 -- .008	.078 -- .006	.041 -- .005	.029 -- .004	.018 -- .004	.022 -- .018	.007 -- .007	.007 -- .007
20	.604 -- .019	.379 -- .012	.272 -- .010	.189 -- .008	.122 -- .006	.068 -- .005	.034 -- .003	.023 -- .003	.017 -- .003	.019 -- .005	.007 -- .007	.059 -- .059
30	.654 -- .020	.310 -- .010	.237 -- .009	.153 -- .007	.078 -- .005	.050 -- .004	.024 -- .003	.014 -- .003	.013 -- .004	.014 -- .008		
45	.490 -- .013	.245 -- .008	.147 -- .006	.093 -- .004	.059 -- .004	.030 -- .003	.016 -- .003	.012 -- .004	.013 -- .005	.010 -- .010	.079 -- .079	
60	.347 -- .010	.163 -- .005	.107 -- .005	.059 -- .004	.041 -- .004	.025 -- .004	.019 -- .005	.010 -- .006				
75	.353 -- .011	.137 -- .005	.088 -- .005	.055 -- .004	.031 -- .004	.024 -- .005	.010 -- .006	.030 -- .017				
90	.356 -- .008	.146 -- .004	.084 -- .004	.049 -- .003	.035 -- .005	.023 -- .006						
105	.286 -- .008	.109 -- .004	.064 -- .004	.036 -- .003	.011 -- .004	.019 -- .007						
120	.216 -- .007	.088 -- .003	.049 -- .003	.032 -- .004	.022 -- .005	.014 -- .008						
135	.192 -- .007	.083 -- .004	.048 -- .004	.029 -- .004	.007 -- .004							
150	.169 -- .007	.078 -- .004	.045 -- .004	.020 -- .003	.014 -- .006							

RATIO OF E- TO P1- FROM P8

ANGLE	ENERGY											
	90	132	168	201	259	315	369	423	478	530	610	678
15	.118 -- .099	.567 -- .027	.315 -- .017	.144 -- .010	.063 -- .005	.020 -- .003	.017 -- .002	.006 -- .001	.007 -- .001	.002 -- .001	.003 -- .001	.003 -- .003
20	1.944 -- .094	.440 -- .022	.246 -- .014	.145 -- .009	.065 -- .005	.020 -- .003	.012 -- .002	.007 -- .001	.002 -- .001	.003 -- .001	.003 -- .001	.003 -- .003
30	1.440 -- .066	.370 -- .015	.186 -- .010	.107 -- .006	.046 -- .004	.017 -- .002	.007 -- .001	.006 -- .001	.002 -- .001	.001 -- .001	.007 -- .001	.007 -- .007
45	.040 -- .030	.220 -- .010	.107 -- .006	.052 -- .004	.021 -- .002	.013 -- .002	.004 -- .001	.005 -- .002	.003 -- .002	.003 -- .002	.003 -- .002	.003 -- .002
60	.040 -- .026	.145 -- .007	.059 -- .004	.029 -- .003	.016 -- .002	.000 -- .002	.005 -- .002	.004 -- .003	.004 -- .004	.004 -- .004	.004 -- .004	.004 -- .004
75	.040 -- .020	.091 -- .005	.044 -- .003	.025 -- .002	.015 -- .002	.012 -- .003	.002 -- .002	.002 -- .002	.002 -- .002	.002 -- .002	.002 -- .002	.002 -- .002
90	.001 -- .012	.000 -- .003	.034 -- .002	.015 -- .001	.018 -- .002	.005 -- .002	.004 -- .003	.004 -- .003	.004 -- .003	.004 -- .003	.004 -- .003	.004 -- .003
105	.311 -- .013	.057 -- .003	.022 -- .002	.010 -- .001	.006 -- .002	.004 -- .003	.004 -- .003	.004 -- .003	.004 -- .003	.004 -- .003	.004 -- .003	.004 -- .003
120	.205 -- .008	.044 -- .002	.019 -- .002	.009 -- .001	.003 -- .001	.003 -- .001	.003 -- .001	.003 -- .001	.003 -- .001	.003 -- .001	.003 -- .001	.003 -- .001
135	.176 -- .009	.036 -- .002	.016 -- .002	.009 -- .002	.003 -- .002	.003 -- .002	.003 -- .002	.003 -- .002	.003 -- .002	.003 -- .002	.003 -- .002	.003 -- .002
150	.202 -- .009	.039 -- .002	.012 -- .001	.009 -- .002	.004 -- .002	.004 -- .002	.004 -- .002	.004 -- .002	.004 -- .002	.004 -- .002	.004 -- .002	.004 -- .002

RATIO OF E- TO P1- FROM P8

ANGLE	ENERGY											
	90	132	168	201	259	315	369	423	478	530	610	678
15	1.021 -- .032	.019 -- .010	.427 -- .014	.274 -- .011	.170 -- .000	.095 -- .004	.044 -- .005	.033 -- .004	.020 -- .005	.014 -- .006	.012 -- .006	.012 -- .012
20	.961 -- .027	.534 -- .015	.349 -- .012	.243 -- .009	.136 -- .007	.071 -- .005	.052 -- .004	.032 -- .004	.015 -- .003	.016 -- .006	.016 -- .006	.016 -- .006
30	.790 -- .020	.427 -- .011	.316 -- .010	.205 -- .007	.114 -- .006	.057 -- .004	.032 -- .003	.025 -- .004	.004 -- .003	.011 -- .006	.001 -- .006	.001 -- .006
45	.642 -- .016	.290 -- .008	.210 -- .007	.130 -- .005	.075 -- .004	.043 -- .004	.020 -- .004	.024 -- .005	.014 -- .006	.010 -- .010	.010 -- .010	.010 -- .010
60	.673 -- .010	.212 -- .005	.130 -- .005	.062 -- .004	.053 -- .004	.032 -- .004	.020 -- .004	.013 -- .005	.011 -- .006	.030 -- .030	.030 -- .030	.030 -- .030
75	.641 -- .012	.191 -- .006	.112 -- .005	.066 -- .004	.041 -- .005	.020 -- .006	.013 -- .007	.009 -- .009	.009 -- .009	.009 -- .009	.009 -- .009	.009 -- .009
90	.672 -- .010	.184 -- .005	.104 -- .004	.060 -- .004	.037 -- .005	.017 -- .005	.021 -- .010	.021 -- .010	.021 -- .010	.021 -- .010	.021 -- .010	.021 -- .010
105	.363 -- .009	.140 -- .004	.073 -- .004	.050 -- .004	.018 -- .004	.021 -- .006	.021 -- .006	.021 -- .006	.021 -- .006	.021 -- .006	.021 -- .006	.021 -- .006
120	.270 -- .007	.110 -- .004	.049 -- .004	.043 -- .004	.027 -- .006	.047 -- .016	.047 -- .016	.047 -- .016	.047 -- .016	.047 -- .016	.047 -- .016	.047 -- .016
135	.205 -- .009	.099 -- .004	.055 -- .004	.029 -- .004	.025 -- .006	.025 -- .006	.025 -- .006	.025 -- .006	.025 -- .006	.025 -- .006	.025 -- .006	.025 -- .006
150	.214 -- .008	.102 -- .004	.057 -- .004	.029 -- .004	.024 -- .006	.033 -- .011	.033 -- .011	.033 -- .011	.033 -- .011	.033 -- .011	.033 -- .011	.033 -- .011

RATIO OF E- TO P1- FROM TH

ANGLE	ENERGY											
	94	132	164	201	259	315	369	423	478	530	610	678
15	.2230 -- .182	.457 -- .023	.231 -- .020	.131 -- .012	.048 -- .006	.020 -- .004	.012 -- .002	.008 -- .002	.003 -- .002	.004 -- .002	.004 -- .004	
20	1.639 -- .114	.367 -- .027	.181 -- .016	.104 -- .009	.040 -- .005	.018 -- .004	.010 -- .002	.004 -- .001	.003 -- .002			
30	1.087 -- .054	.266 -- .013	.142 -- .009	.079 -- .005	.034 -- .003	.014 -- .002	.007 -- .001	.003 -- .001	.005 -- .002	.002 -- .002		
45	.639 -- .035	.183 -- .011	.082 -- .006	.038 -- .004	.018 -- .003	.010 -- .002	.006 -- .002	.004 -- .002				
60	.388 -- .019	.089 -- .005	.039 -- .003	.027 -- .002	.010 -- .002	.007 -- .002	.003 -- .001					
75	.358 -- .019	.084 -- .005	.031 -- .003	.018 -- .002	.009 -- .001	.006 -- .002	.008 -- .004	.005 -- .005	.012 -- .012			
90	.289 -- .017	.061 -- .003	.027 -- .002	.012 -- .002	.010 -- .002	.001 -- .001	.003 -- .001	.022 -- .016				
105	.269 -- .016	.049 -- .002	.017 -- .002	.007 -- .001	.002 -- .001	.009 -- .004						
120	.173 -- .009	.031 -- .002	.011 -- .001	.007 -- .001	.007 -- .002	.003 -- .003	.015 -- .014					
135	.166 -- .010	.023 -- .002	.013 -- .002	.007 -- .001	.003 -- .002	.005 -- .005	.023 -- .023					
150	.154 -- .009	.031 -- .002	.010 -- .001	.007 -- .002	.000 -- .003							

RATIO OF E- TO P1- FROM TH

ANGLE	ENERGY											
	94	132	164	201	259	315	369	423	478	530	610	678
15	.721 -- .041	.418 -- .020	.303 -- .018	.186 -- .013	.119 -- .009	.062 -- .008	.038 -- .005	.021 -- .004	.013 -- .004	.019 -- .004		
20	.590 -- .022	.371 -- .013	.258 -- .011	.176 -- .008	.112 -- .006	.056 -- .005	.035 -- .003	.013 -- .003	.014 -- .003	.015 -- .004		
30	.571 -- .019	.290 -- .010	.209 -- .009	.142 -- .007	.073 -- .005	.043 -- .004	.020 -- .003	.012 -- .003	.012 -- .004	.004 -- .004	.053 -- .037	
45	.671 -- .014	.229 -- .008	.153 -- .007	.088 -- .005	.045 -- .004	.023 -- .003	.021 -- .004	.017 -- .005	.015 -- .007	.011 -- .011		
60	.314 -- .010	.152 -- .006	.108 -- .005	.072 -- .004	.033 -- .004	.014 -- .003	.016 -- .005	.007 -- .005	.020 -- .016			
75	.308 -- .009	.142 -- .005	.086 -- .004	.052 -- .004	.031 -- .004	.020 -- .005	.018 -- .007	.004 -- .006				
90	.308 -- .008	.128 -- .004	.077 -- .004	.044 -- .003	.027 -- .003	.018 -- .005						
105	.257 -- .008	.094 -- .004	.051 -- .004	.031 -- .003	.016 -- .005	.008 -- .005						
120	.187 -- .008	.080 -- .004	.053 -- .004	.019 -- .003	.012 -- .005	.015 -- .011	.023 -- .023					
135	.194 -- .007	.083 -- .004	.049 -- .004	.028 -- .004	.005 -- .003	.009 -- .004						
150	.171 -- .007	.073 -- .004	.041 -- .004	.025 -- .004	.012 -- .005	.011 -- .011						