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61-, 39-, AND 29-MeV PROTONS ON
CARBON AND OXYGEN

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CROSS SECTIONS FOR HYDROGEN AND HELIUM PARTICLES PRODUCED BY
61-, 39-, AND 29-MeV PROTONS ON CARBON AND OXYGEN

F. E. Bertrand and R. W. Peelle

Abstract

Tabulated differential cross sections are presented for proton, deuteron, triton, helium-3, and alpha particles produced in reactions of 61-, 39-, and 29-MeV protons with carbon and oxygen. Observations with energy resolution as fine as 200 keV were made at 2, 5, and 19 angles, respectively, for carbon and at 1, 4, and 18 angles for oxygen. Spectra are given in bins 1 to 5 MeV wide for energies above a cutoff of 2 to 6 MeV which is dependent on particle type. For 61-MeV incident protons on carbon, angular distributions are given for energy-integrated cross sections for emission of each of the five observed particles and for excitation of prominently excited states. Similar data are given for the oxygen target, except that few angular distributions are given for excitation of specific states. Angle-integrated energy spectra in both center-of-mass and laboratory systems are presented for each of the five outgoing particles. Since plastic scattering foils were used, cross sections for p-p scattering were obtained which proved to be consistent with interpolated values from the literature. Data analysis procedures are described and experimental uncertainties are tabulated.

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I. INTRODUCTION

This report gives tabulated and plotted laboratory differential cross sections for proton, deuteron, triton, helium-3, and alpha particles produced in carbon and in oxygen by incident proton beams of 61, 39, and 29 MeV. The energies of outgoing particles were measured with a semiconductor telescope spectrometer over an energy range from as low as 2 MeV up to the maximum energy which is kinematically possible. The lower energy limit of each spectrum depends on the type of particle and upon experimental conditions. This report is the last of a series covering measurements of charged particle production cross sections which were performed in support of space shielding studies. The results here may be of particular interest because of the importance of fast neutron reactions in tissue and the expected similarity between cross sections for reactions induced by protons and by neutrons in self-conjugate nuclides such as ^{12}C and ^{16}O .

All the experimental studies were performed using the same data acquisition and analysis systems.¹⁻³ Earlier documents in the series list results for other targets,⁴ while ref. 1 contains a preliminary analysis of much of the carbon data covered in this report. A forthcoming paper describes the features of the overall results and compares the differential cross sections for secondary protons to the predictions of the intranuclear cascade model.⁵ Results for carbon and oxygen are qualitatively different from those for heavier nuclides, primarily because of the wide spacing between the levels of the residual nuclides which are excited and the large negative Q value for formation of the reaction products.

II. DATA ACQUISITION AND ANALYSIS

Protons were accelerated by the Oak Ridge Isochronous Cyclotron, analyzed to $\sim 0.1\%$ in momentum in the facility's 153-deg magnet, and focussed on the target in a spot ~ 8 mm in diameter. The charged reaction products were detected within a 1.2-m-diam evacuated scattering chamber in a three-counter telescope composed of two silicon surface-barrier ΔE detectors, about 100 and 500 μm in thickness, and a lithium-drifted germanium stopping detector. The spectrometer contributed an energy resolution of ~ 0.2 MeV (FWHM) for 61-MeV protons. Data were obtained from four analog-to-digital converters for each event, processed and written onto magnetic tape by an on-line PDP-8 computer, and later analyzed on the Laboratory's IBM-360 computers and on the PDP-8. Secondary particles were identified, usually unambiguously, over the energy range from a few to 62 MeV by a twofold $\Delta E \times E$ method.

Flight-time spectroscopy was used for particles with energies too low to penetrate 100 μ of silicon. Velocity measurements were made possible by the narrow microstructure of the proton beam. Alternate microbursts were prevented from reaching the target by electrically sweeping them away from the entrance aperture of the beam analyzer magnet.

The hydrocarbon targets used were commercial polystyrene (CH) and polyethylene (CH_2) foils chosen for apparent uniformity. Mylar ($\text{C}_5\text{H}_4\text{O}_2$) and cellulose triacetate ($\text{C}_3\text{H}_4\text{O}_2$, "Kodacel") foils were employed to study reactions with oxygen, and the observed intensity produced by the reactions in the carbon component of these foils was removed from the results in each case by subtracting carbon data obtained in a time-adjacent data run. Surface densities were obtained by weighing the central portion of

each target after the series of experiments, and surface uniformities were established by mechanical thickness scans and in some cases by observing the position dependence of the energy lost by normally incident monoenergetic alpha particles. Nominal chemical compositions were assumed in the analysis. No chemical analyses were performed on the target foils, nor was any special effort expended to assure that the plastic materials had been manufactured without use of binders or lubricants. Therefore, the number of hydrogen atoms per cm^2 derived from the surface densities contain extra composition uncertainties of a few percent. Target properties are listed in Table 1 along with the other experimental parameters for the various series of data runs (labeled 0000, 0100, 2000, 6000, and 7000) which contributed data to this report.

Figure 1 illustrates the flow of data through the analysis, though for the oxygen data the subtraction of the carbon background required an extra step just prior to the production of final tables and integrals over angle. Using the methods described in ref. 2, the results have been corrected in first order to remove the effects of penetration of the edges of the detector collimator when a passive collimator was utilized, of multiple scattering by the ΔE detectors so that some protons missed the germanium detector, of the energy loss in the nickel-window "dead" layer covering the germanium detector, and of nuclear reactions of hydrogen particles in the germanium stopping detector.

For the 62-MeV proton runs at 25 deg, the standard correction for nuclear reactions in the germanium stopping detector proved inadequate on the basis of diagnostic information studied for each run. Presumably the difficulty occurred because detector misalignment led to multiple

Table 1. Experimental Parameters

Target Material	Run Designation	C mg/cm ²	O mg/cm ²	H mg/cm ²	Total Thickness mg/cm ²	Nonuniformity ^a ± %
CH	2000 $\theta \geq 135^\circ$, 0000, 0100	1.09		0.091	$1.18 \pm .02$	1.2
CH	6000	2.48		0.21	$2.69 \pm .05$	1.5
CH	7000	2.40		0.20	$2.60 \pm .03$	-
CH ₂	2000 $\theta < 135^\circ$	0.93		0.16	$1.09 \pm .02$	2
Mylar	0000, 0100, 2000	0.581	0.310	0.039	$0.93 \pm .01$	1.5
Kodacel ^b	6000	1.61	1.43	0.18	$3.21 \pm .04$	1.5
Kodacel	7000	1.75	1.55	0.20	$3.50 \pm .07$	1

Beam Energies

Run Designation	Beam Energy (MeV)
0100	61.50 ± 0.1
2000	61.89 ± 0.1
7000	60.86 ± 0.1
6000	38.75 ± 0.1
0000	28.81 ± 0.1

Collimators Used

Run Designation	Material	Thickness (cm)	Area ($\pm 1.5\%$) (cm ²)	Distance ($\pm 1\%$) (cm)
0000	Ta	0.13	0.522	45.8
0100	Ta	0.432	0.522	45.8
2000 - 2006	Ni	0.653	0.257	46.1
2011 - 2060	Ni	0.653	0.173	46.7
6000	Ne-102	0.1	0.342	47.0
7000	Ni	0.653	0.257	46.7

^aApproximate values for central portion based on surface gauge or alpha-particle energy-loss scans.

^bThe Kodacel foils contained a phosphorus (or possibly sulphur) contaminant possibly as strong as 2% by weight. Except for removal of the spurious elastic scattering peaks when they could be separated, no correction was made for this contamination.

Fig. 1. Flowchart of the Data Handling and Analysis Process for Typical Data. Counts from p-p scattering were removed manually between the NON-3 and BINSPEC programs. Counts from the carbon component of the "oxygen" target were subtracted in the PEAKSTRIP program for excitation of discrete levels and by a special program interposed between BINSPEC and ANGINT. For this report the binning structure in the BINSPEC and ANGINT Programs varied in the range from 1 to 5 MeV.

scattering of long-range particles out of the detector's sensitive volume. The broad level spacing of ^{12}C in the range of excitation energies up to 10 MeV allowed an approximate empirical correction.

Although 60-MeV protons lost only about 10 to 40 keV in the targets used, low-energy particles, particularly helium ions, lost a significant amount of energy (6-MeV alpha particles lost 0.8 MeV in the thinnest target but might have been stopped in the thickest one). A first-order correction was made to all the data to compensate the output spectra for the effect of this energy loss. The correction was performed by spreading the counts observed in each channel (K) over the range of channels which represented the maximum amount of energy lost by a particle of that type emerging from the target with energy $E(K)$. That is, if the maximum target energy loss for a particle emerging with energy $E(K)$ was $\Delta E(K)$, then the counts in channel K were spread over the channel range corresponding to the energy region from $E(K)$ to $E(K) + \Delta E(K)$. The counts originally in channel K were assumed to be spread uniformly over that channel's width to avoid distortion of the spectrum at interfaces between corrections. The low-energy limit of each output spectrum was taken as the lowest channel into which a full correction for the target thickness could be made; i.e., if the raw data were good above channel 20, the output data would begin with the first full channel above the energy $E(20) + \Delta E(20)$. The most marked effects of the correction were to shift the location of the evaporation peak to a slightly higher energy, and to narrow it a bit and increase its peak cross section.

A number of other correction procedures were required for a fraction of the data. A target-out background which at low energy amounted to 7%

was subtracted from the 12- and 15-deg proton spectra observed with incident 60-MeV protons. A hundred-kilovolt region near 5 MeV was obscured in each alpha-particle spectrum by counts from a calibration source, and in the "7000" runs an on-line computer programming error obliterated counts from a 1.2-MeV energy region at about 13 MeV in the ^3He and alpha spectra. In these cases the smoothness of the observed spectra allowed the raw data to be interpolated through the distorted regions.

Since the targets contained hydrogen, the pulse-height groups induced by p-p scattering had to be removed from the secondary proton spectra at angles through 80 deg. In cases where the p-p scattering peak was superposed on a smooth part of the spectrum, it was removed by interpolation without important ambiguity even though the p-p peaks were markedly broadened by the detector angular acceptance. In the region of the spectra influenced by the structure of the residual nucleus, the shape of the underlying spectrum could usually not be well estimated and in some cases pulse-height groups from inelastic scattering were irretrievably mixed with the p-p group. Such cases were corrected as well as possible on the basis of inelastic cross sections observed at nearby angles.

Table 2 lists the factors by which counts in the various runs were multiplied to give laboratory-system cross sections in millibarns/steradian. These factors were based on target thickness and composition, target geometry, detector solid angle, the electric charge collected in a carefully constructed Faraday cup, and a measured correction for the dead time of the event analysis and storage system.

Table 2a. List of Angles, Run Numbers, and Factors for Carbon

Lab Angle (deg)	Run Number	Factor	ρ_c ^(a)
<u>61 MeV</u>			
12	0121	3.55 (-3) ^b	
15	0114	4.13 (-3)	
20.8	2006	6.95 (-3) ^c	
25	2052	3.06 (-3)	1.030
30	2000	1.09 (-3)	
35	2001	5.15 (-4)	
40	2033	1.74 (-3)	1.035
45	7102	1.97 (-4)	
50	2042	9.73 (-4)	1.045
55	0103	7.05 (-4)	
60	7115	1.43 (-4)	
65	0105	7.02 (-4)	
70	2032	1.29 (-3)	1.040
75	2017	2.82 (-4)	1.040
80	0112	6.60 (-4)	
90	2023	3.68 (-4)	1.035
110	7113	1.36 (-4)	
135	2055	2.73 (-4)	1.032
160	2060	3.61 (-4)	1.030
<u>39 MeV</u>			
20°	6011	7.85 (-4)	
30°	6000	2.84 (-4)	
45°	6014	2.49 (-4)	
60°	6015	1.72 (-4)	
90°	6020	4.75 (-5)	
<u>29 MeV</u>			
11°	0031	7.40 (-3)	
30°	0024	1.35 (-3)	

^aCorrection for effective collimator narrowing which is included in the factor.

^bRead as 3.55×10^{-3} .

^cThis value is for protons. For d, t, ³He and factor = 3.47×10^{-3} .

Table 2b. List of Angles, Run Numbers, and Factors for Oxygen

Lab Angle (deg)	Run Number	$f^{(a)}$	Factor
<u>61 MeV</u>			
12 ^c	0122	.985	1.95 (-2) ^b
15	0115	1.007 ± .020	1.91 (-2)
25	2051	.975 ± .014	1.16 (-2)
30	7105	.970 ± .007	5.58 (-4)
35	2002	.975 ± .014	4.03 (-3)
40	2034	.975 ± .014	6.91 (-3)
45	7103	.970 ± .007	4.49 (-4)
50	2041	.975 ± .014	3.95 (-3)
55	0102	1.007 ± .020	3.30 (-3)
60	7116	.970 ± .007	4.01 (-4)
65	0106	1.007 ± .026	3.29 (-3)
70	2031	.975 ± .014	5.16 (-3)
75	2020	.975 ± .014	1.05 (-3)
80	0111	1.007 ± .020	3.36 (-3)
90	2024	.975 ± .014	1.49 (-3)
110	7114	.970 ± .007	2.89 (-4)
135	2056	1.007 ± .020	1.13 (-3)
160	2061	1.007 ± .020	4.26 (-3)
<u>39 MeV</u>			
20	6021	1.05 ± .01	2.13 (-3)
45	6013	1.05 ± .01	5.49 (-4)
60	6016	1.017 ± .01	2.08 (-4)
90	6017	.94 ± .02	1.932 (-4)
<u>29 MeV</u>			
30	0025	.94 ± .01	5.79 (-3)

^a"FUDGE" value used to renormalize the carbon cross section prior to subtracting out the carbon background in the oxygen-containing foils.

^bRead as 1.95×10^{-2} .

^cRun 0122 was normalized on the basis of the inelastic proton scattering in run 0121.

Table 2 also shows values of the correction ρ_c applied to compensate for the effective narrowing of the detector collimator from misalignment of its axis and from the effect of a collimator dimension narrower than a diameter of the beam spot. To estimate the magnitude of the beam-spot diameter and displacement, parameters were taken from Table 3. Where a correction is not given, it was estimated to be less than 2%. The listed values of ρ_c are uncertain by one half of the correction made.

For oxygen foils Table 2 lists the "FUDGE" parameters employed in subtracting the background from reactions with the carbon component of the oxygen-containing foils. In order that most experimental difficulties would not influence the estimation of this large "background," each run for oxygen was paired with an adjacent carbon run which was performed in just the same way except for the target foil. The results were analyzed by carrying through a complete analysis on the mylar or cellulose triacetate data just as if the carbon component were not present. At each forward angle the intensity of the strongest carbon-related group was extracted and on this peak area a local estimate was made of the "FUDGE" factor by which the observed cross section from the carbon foil would have to be multiplied to obtain the same cross section from each foil (assuming the foil compositions given above). Since for a given pair of foils these observed "FUDGE" values were nearly consistent for various detector angles in the 61-MeV data, the nonunit value was assumed to arise largely from foil weight uncertainties. Therefore the average value was generally used throughout. Note that the closeness of the f values to unity implies essential agreement between the values of carbon cross sections for excitation of discrete levels observed using the two sets of

Table 3. Systematic Uncertainties Applicable to all Particle Types.

Detector angle	± 0.5 deg
Zero angle	± 0.5 deg
Angular resolution	< 0.5 deg
Target angle	± 0.5 deg
Beam spot diameter	0.8 cm
Beam spot drift	$\pm .4$ cm
Misalignment of collimator axis projected to chamber center	$\pm .5$ cm
Cumulative uncertainty in various corrections to data	$\pm 3\%$ typ
Uncertainty in number of protons striking target	$\pm 1\%$
Uncertainty in dead time measure- ment	$\pm 2\%$
Uncertainty in scattering foil surface density ^a	2% typ
Particle discrimination uncer- tainty (> 0.1 mb/sr) for 61- MeV data	2%
Combined systematic uncertainty for 61-MeV data	5%
Combined systematic uncertainty for regions with very small cross sections	10%
Combined systematic uncertainty for for 29- and 39-MeV data	8%
Discrimination uncertainty for ⁴ He below 33 MeV for 39-MeV data	10%

^aUncertainty in hydrogen surface densities is assumed $\sim 4\%$.

foils and corroborates the assumed relative carbon and oxygen compositions of the foils. For the 40-MeV data the observations at 60 and 90 deg were inconsistent with the average value, so the "FUDGE" measured for each run was used there. This erratic behavior is believed to be related to progressive decomposition of the cellulose triacetate foils in the beam. The decomposition of the cellulose triacetate foil during the 90-deg observations for 40-MeV incident protons is confirmed by previously reported results using the same foil for incident alpha particles (the alpha-particle data was obtained after the proton data). To renormalize the results, we have relied on the $^{16}\text{O}(p,p)$ results at 39.7 MeV by Cameron *et al.*⁷ which have been generally confirmed by Snelgrove and Kasny.⁸ Our results at 20 and 45 deg are within 5% of those given by Cameron, our 60-deg results are low by 14% (possibly within estimated uncertainty), and the raw 90-deg results are 25% low. On this basis the 90-deg data were raised 25%. Our 39-MeV $^{16}\text{O}(p,d)$ results at 20 and 45 deg exactly confirm the previously reported values of Kavaloski.⁹

In the spectra region containing sharp peaks, the subtraction of the carbon background was complex because the drift of a peak position by even a few kilovolts left strong first-derivative residues in the output spectra. To minimize this effect each carbon spectrum was shifted by the optimum amount prior to subtraction, the typical shift amounting to less than one 50-keV channel.

II. UNCERTAINTIES

Data tables and graphs below show estimated standard errors propagated for the most part from the Poisson uncertainties in the experimental

counts. For low energies and small angles where a small target-out background was subtracted, the listed uncertainties take into account the background contribution. Uncertainties on particular values of spectral intensity have been expanded to take into account uncertainties in the corrections for minor experimental defects. In integrals over angle or energy these expanded uncertainties are incorrectly treated (if they relate to several successive energy bins) as if they were normally distributed; estimated systematic uncertainties in any case dominate the overall uncertainty estimates for integral quantities.

The tabulated and plotted binned cross sections for oxygen have uncertainties assigned which include the propagated effect of uncertainties in the carbon data but do not take into account the systematic uncertainty in the "FUDGE" values. If σ_0 is the output cross section for oxygen, σ_C is the separately observed value for carbon, σ_{raw} is the gross cross section for the oxygen-containing foil based on all the observed counts and the oxygen surface density, f = "FUDGE," and C/O is the nominal ratio of carbon and oxygen atomic densities (2.5 for mylar and 1.5 for Kodacel), then

$$\sigma_0 \approx \sigma_{\text{raw}} - f(C/O)\sigma_C ,$$

and the relative error in the output cross section induced by an error Δf in "FUDGE" is

$$\Delta\sigma_0/\sigma_0 = -(\sigma_C/\sigma_0)(C/O)\Delta f .$$

For the values of Δf listed in Table 2, this component of cross section uncertainty generally does not dominate in the continuum regions.

Table 3 contains estimates of systematic uncertainties which affect broad ranges of the data. These must be combined with the uncertainties listed with individual values and with the more particular uncertainties described below if one should require an overall uncertainty estimate for a single quoted cross section. As indicated in Table 3 the systematic uncertainty is estimated to be larger in regions of low cross section, such as most of the ^3He data, because the lines in $\Delta E \times E$ space which distinguish events among the particle types were derived empirically on the basis of the observed events, and scattered counts were not always apparent in the diagnostic computer outputs which were used to exhibit the fit between the data and the imposed "discrimination lines."

An unusual uncertainty in particle discrimination occurred for the two-detector $\Delta E \times E$ helium-particle data for incident 39-MeV protons. The ^3He intensity was very weak, and below 33 MeV the ΔE distributions for ^4He extended into part of the region where ^3He events were also recorded. We report no ^3He spectra for these runs, and assign an additional uncertainty of 10% to the ^4He data below 33 MeV because the quoted results may contain some ^3He events.

In the "6000" runs a plastic-scintillator anticoincidence collimator defined the detector solid angle and a small fraction ($< 1\%$) of the elastic protons passing through the plastic were not rejected. The resulting spurious groups were manually removed. For other particles and lower energies the anticoincidence efficiency was better, so no correction was made to the continuum spectra for this collimator leakage.

As described in the previous section the cellulose triacetate target with 39-MeV incident protons changed its composition as the bombardment progressed, so the 90 deg data for oxygen were renormalized and then assigned an extra 15% uncertainty.

The magnitudes of the "tail" correction for nuclear reactions in the Ge(Li) detector and for collimator edge penetration are both dependent upon the number and spectral distribution of the recorded counts. These corrections are significant only for protons at scattering angles less than about 30 deg, where the spectra are dominated by strong elastic scattering, and the corrections generally fall rapidly with angle within that range. The uncertainty in the correction for collimator penetration is taken as 20% of the correction, which is approximately proportional to pulse height. This uncertainty is important only for the 61-MeV data at 12 and 15 deg, as shown in Table 4. The reaction-tail correction rises from zero at ~ 35 MeV to its full value at 45 MeV for the 61-MeV data (between 26 and 30 MeV for the 39-MeV data) and then remains roughly constant up to the elastic scattering peak. The cross section uncertainty in the standard correction is given in Table 4 for the runs in which it is at all significant.

Table 4 also contains the large uncertainty associated with the excessive "reaction tail" for 62-MeV protons at 25 deg. A corresponding uncertainty induced by the same source is attached to proton scattering measurements exciting the few lowest levels of carbon and oxygen.

The secondary particle spectra given below sometimes show a local effect at the energy corresponding to stopping of particles in the $\sim 3 \text{ mg/cm}^2$ nickel foil which covered the Ge detector. Whether the effect

Table 4. Uncertainties in Secondary Proton Cross Sections from Tail Corrections for Reaction and Collimator Effects.

Angle (deg)	$\delta\sigma_R^{(a)}$		$\delta\sigma_c^{(b)}$	
	mb (sr·MeV) ⁻¹		mb (sr·MeV) ⁻¹	
	Carbon	Oxygen	Carbon	Oxygen
<u>Uncertainties at 45 MeV for Incident 61-MeV Protons</u>				
12	.15	.21	.08	.11
15	.12	.17	.07	.09
20.8	.07	-	.09	-
25	.7 ^c	.7 ^c	.04	.04
30	.03	.02	.02	.01
35	.01	.01	.01	.01
<u>Uncertainties at 30 MeV for Incident 39-MeV Protons</u>				
20	.09	.11	(anticoincidence collimator)	
30	.03	-		
<u>Uncertainties at 22 MeV for Incident 29-MeV Protons</u>				
11	.07	-	.07	-
30	.04	.03	.02	.02

^aExcept for the 25-deg data at 62 MeV, the values are 1/4 of the correction applied at the stated pulse height for the effect of nuclear reactions in the germanium detector.

^bTwenty percent of the correction applied at the given pulse heights for the effect of collimator penetration by protons of higher energy. No such correction is appropriate for the runs at 40 MeV using an anticoincidence collimator.

^cThis is the full magnitude at 45 MeV of the ad hoc correction applied for excessive tail. The magnitude of the uncertainty tapers from this maximum value linearly to zero at ~ 30 and ~ 60 MeV.

is exaggerated or hidden depends on the precision of the gain calibration in the second (500 μ) silicon detector and also on the pulse-height threshold on the signal from the stopping detector. The discontinuities appear at about 9, 12, and 15 MeV for protons, deuterons, and tritons, respectively, and at about 33 and 35 MeV for ^3He and ^4He . The total number of recorded counts is not affected by the difficulty in the "dead layer" correction, so the listed uncertainties are appropriate if the results are averaged over an energy interval of about 20%.

III. RESULTS FOR PROTON-PROTON SCATTERING

Subject to the additional uncertainties of the relative hydrogen content of the foils and the extraction of the scattering peak from the fluctuating background of scattering from oxygen and/or carbon, proton-proton scattering cross sections were derived from the data as a check on overall accuracy. Figure 2 shows the results compared to calculated values (line) obtained by interpolation for 61.9 MeV among measurements at 52.3,¹⁰ 66.0,¹¹ and 68.3 MeV¹² as adjusted by the systematic analyses of MacGregor.¹³ The data points were adjusted to 61.9-MeV incident energy using the same interpolation method. The plotted uncertainties are predominately systematic in origin. The results from this experiment appear to be $\sim 2\%$ low on the average relative to the interpolated line. Since most of the systematic uncertainties affect many or all of the values plotted, this level of bias is within the estimated standard errors of Table 3. Results for p-p scattering from the experiments at 39 MeV could be extracted cleanly only at 45 deg (lab), where the observations with

Fig. 2. Comparison of p-p Scattering Cross Sections Observed in the Experiment with Values Interpolated from the Literature with the Aid of the Compilation of MacGregor (see ref. 13). The uncertainty flags shown on the points include systematic uncertainties strongly correlated among the data points.

both cellulose triacetate and polystyrene foils yielded p-p cross sections $\sim 5\%$ below the similarly interpolated expected values.

IV. RESULTS FOR REACTIONS WITH CARBON AND OXYGEN

Figure 3 shows some differential cross sections vs excitation energy (in the low-excitation region) for 62-MeV protons on carbon at 35 deg. Peaks representing levels of residual nuclei from reactions with ^{12}C and ^{16}O were observed at enough angles to allow compilation of the angular distributions shown on Figs. 4-6 for ^{12}C and Fig. 7 for ^{16}O . Tables 5-10 and Tables 11-14 give the corresponding numerical values for discrete levels excited by reactions with carbon and oxygen, respectively. In these tables the uncertainties are based on the numbers of observed counts and the estimated underlying background, and upon the difficulty experienced in extracting cross sections for the stated levels from the observed pulse-height spectra. Systematic uncertainties from Table 3 should be combined with these to obtain the full estimated uncertainty for a given value. The systematic uncertainties have been included in the errors shown on Figs. 4-7.

The general character of the data observed with 61-MeV incident protons may be seen by examining Figs. 8-12 which show the spectra at some of the angles studied. Results for carbon and for oxygen are paired for ready comparison. Figures 13-15 similarly show nearly all the results for incident 39-MeV protons. In all these plots the data are averaged in bins 1- to 5-MeV wide in the lower energy regions where fluctuations in the spectra seen with narrower channels are described by Poisson counting statistics. The spectra for oxygen show considerable fluctuation because

Fig. 3. Experimental Spectra Obtained from Carbon at 35 deg for Excitation of Low-lying Levels of Residual Nuclei by 62-MeV Protons. Because of interference from the p-p scattering peak, part of the excitation energy is shown for inelastic scattering at 30 deg.

Fig. 4. Cross Sections in the c.m. System for Some Inelastic Scattering Reaction of 61-MeV Protons on Carbon.

Fig. 5. Cross Sections in the c.m. System for Some (p,d) Reactions of ~ 61 -MeV Protons on ^{12}C .

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Fig. 6. Cross Sections in the c.m. System for Some (p,t) Reactions of 61-MeV Protons on ^{12}C .

Fig. 7. Cross Sections in the c.m. System for Some (p,p) , (p,p') , and (p,d) Reactions of 61-MeV Protons on ^{16}O .

Fig. 8. Laboratory Differential Cross Sections for Emission of Secondary Protons from 61-MeV Protons on Carbon and Oxygen. In the histogram region of the curves data have been averaged into bins because essentially no nuclear fluctuations are observable.

Fig. 9. Laboratory Differential Cross Sections for Emission of Deuterons in the Reactions of 61-MeV Protons on Carbon and Oxygen.

Fig. 10. Laboratory Differential Cross Sections for Emission of Tritons in Reactions of 61-MeV Protons on Carbon and Oxygen.

Fig. 11. Laboratory Differential Cross Sections for Emission of Helium-3 Particles in Reactions of 61-MeV Protons on Carbon and Oxygen.

Fig. 12. Laboratory Differential Cross Sections for Emission of Alpha Particles in Reactions of 61-MeV Protons on Carbon and Oxygen.

Fig. 13. Laboratory Differential Cross Sections for Emission of Proton Particles in Reactions of 39-MeV Protons on Carbon and Oxygen.

Fig. 14. Laboratory Differential Cross Sections for Emission of Deuteron Particles in Reactions of 39-MeV Protons on Carbon and Oxygen.

Fig. 15. Laboratory Differential Cross Sections for Emission of Alpha Particles in Reactions of 39-MeV Protons on Carbon and Oxygen.

of the statistical degradation induced by the process of subtracting the counts from the carbon component of the scattering foils.

Figures 16 and 17 show the angular distributions (differential cross sections integrated over energy) above stated cutoff energies for the data from both carbon and oxygen bombarded by 61- and 39-MeV protons. Elastic proton scattering is not included. Tables 15 and 16 list the corresponding numerical values.

Figures 18 and 19 show the differential laboratory-system energy spectra (integrated over angle) for each observed particle type for the two incident energies. Elastic proton scattering is not included. The integrals over angle were obtained by using a trapezoidal quadrature formula which assumed that the cross section at zero degrees may be obtained by linear extrapolation against $\cos\theta$ based on the cross sections at the two smallest data angles. The integration scheme also assumed that the cross section at 180 deg is equal to the cross section at the largest angle at which data were obtained. Both assumptions are questionable but practical. Furthermore, for the data with incident proton energy of 39 MeV, observations were made at an insufficient number of angles to avoid quadrature errors less than perhaps 20%. The apparent structure in Fig. 19 can be traced to the problem of too broad an angle mesh. Tables 17 and 18 give the numerical values of the differential energy spectra for carbon and Tables 19 and 20 for oxygen. The bin energies tabulated are the lower edge of each bin.

Angle-integrated spectra were also derived in the center-of-mass system on the assumption that all observed particles were (singly) emitted from a nucleus moving with the initial center-of-mass velocity of

Fig. 16. Energy-integrated Laboratory Emission of Hydrogen and Helium Particle Carbon and Oxygen. Cross sections are shown, and elastic proton scattering is

Laboratory Differential Cross Sections for
 reactions in Reactions of 61-MeV Protons with
 targets integrated above the energy thresholds
 are excluded.

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Fig. 17. Energy-integrated Laboratory Emission of Hydrogen and Helium Particles on Carbon and Oxygen. Cross sections are in mb/ster shown, and elastic proton scattering is also shown.

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laboratory Differential Cross Sections for
 reactions in Reactions of 39-MeV Protons with
 targets integrated above the energy thresholds
 of the targets is excluded.

2

Fig. 18. Angle-integrated Laboratory System Differential Spectra for Emission of Hydrogen and Helium Particles from Reactions of 61-MeV Protons on Carbon and Oxygen.

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Fig. 19. Angle-integrated Laboratory System Differential Spectra for Emission of Hydrogen and Helium Particles from Reactions of 39-MeV Protons on Carbon and Oxygen.

projectile and target. This assumption is valid for the first particle emitted and therefore presumably for the upper energy ranges; it is certainly not fully valid at a few MeV. The c.m. energy is defined as the full kinetic energy in the c.m. system (light particle plus heavy particle), and the computation was performed by determining the laboratory system energy ranges (and corresponding mb/sr) at each lab angle which corresponded to a given c.m. system energy bin. The c.m. energies at the low side of each bin are tabulated. Values obtained in this way for carbon are in Tables 21 and 22 for the two incident energies and those for oxygen are in Tables 23 and 24. The cross sections in these tables show more structure because in the region of small residual excitation energy the quadrature combines cross sections at the same excitation energy for each angle.

Tables 25 and 26 give for carbon and oxygen the integral particle production cross sections, average spectral energies, etc. above stated energy cutoffs in the laboratory system, while Tables 27 and 28 give similar information for stated cutoff energies in the center-of-mass system. The results differ because of differing effective coverage of the low-energy reaction products.

The remaining tables give the differential cross sections excluding proton elastic scattering in energy bins from 1 to 5 MeV in width depending on the statistical accuracy of the underlying experiments. The bin energies are given at the center of each bin. The reaction values are so negative for d, T, and ^3He production that no spectra worth reporting remain for incident 29-MeV protons. The table number for a desired spectrum may be located with the help of the following chart.

Incident Energy (MeV)	Particle Type	Table Number	
		Carbon	Oxygen
61	p	29	40
	d	30	41
	t	31	42
	³ He	32	43
	α	33	44
39	p	34	45
	d	35	46
	t	36	47
	α	37	48
29	p	38	49
	α	39	50

The results for carbon in this report entirely supercede those given in ref. 1. The relation between the two sets of results depends markedly on the experimental run, energy region, etc., but many cross sections have been changed by 10% in the more refined analysis. Integrals over angle and energy agree within 10% for protons, deuterons, and alphas but differ more greatly for particle types with smaller yields.

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REFERENCES

1. F. E. Bertrand *et al.*, "Differential Cross Sections for the Charged Particles Produced by 60-MeV Protons on Carbon, Iron, and Bismuth," ORNL-4274 (1968).
2. F. E. Bertrand *et al.*, Nucl. Instr. Methods 101, 475 (1972).
3. N. W. Hill and W. P. Albritton, Nucl. Instr. Methods 75, 18 (1969).
4. Tabulated results are given in the following Oak Ridge National Laboratory documents by F. E. Bertrand and R. W. Peelle: ORNL-4450, 62-MeV protons on ^{89}Y ; ORNL-4455, 62- and 18-MeV protons on ^{27}Al ; ORNL-4456, 61-MeV protons of ^{56}Fe ; ORNL-4460, 62- and 29-MeV protons on ^{197}Au ; ORNL-4469, 62-, 39-, and 29-MeV protons on ^{54}Fe ; ORNL-4471, 62- and 29-MeV protons on ^{120}Sn ; ORNL-4638, 62- and 39-MeV protons on ^{209}Bi ; ORNL-4698, 62-MeV protons on ^{60}Ni ; and ORNL-4694, 59-MeV alphas on ^{12}C , ^{16}O , and ^{54}Fe .
5. F. E. Bertrand and R. W. Peelle, submitted to Physical Review, March 1973.
6. F. E. Bertrand and R. W. Peelle, "Hydrogen and Helium Particles Produced by 59-MeV Alpha Particle Bombardment of ^{12}C , ^{16}O , and ^{54}Fe ," ORNL-4694, July 1971.
7. J. M. Cameron *et al.*, Phys. Rev. 167, 908 (1968).
8. J. L. Snelgrove and E. Kashy, Phys. Rev. 187, 1246 (1968).
9. C. D. Kavaloski *et al.*, Phys. Rev. 132, 813 (1963).
10. S. Sanada *et al.*, Nucl. Phys. B4, 379 (1963).
11. J. N. Palmieri *et al.*, Ann. Phys. (N.Y.) 5, 299 (1958).

12. D. E. Young and L. H. Johnson, Phys. Rev. 119, 313 (1960).
13. M. H. MacGregor *et al.*, Phys. Rev. 182, 1714 (1969).

Table 5. Differential Cross Sections For Elastic Scattering of
61, 39-, and 29-MeV Protons on Carbon

c.m. Angle (deg)	Cross Section c.m. (mb/sr)	Statistical Uncertainty (%)
<u>61-MeV Protons Incident</u>		
13.0	669	0.2
16.3	599	0.1
22.6	347	0.4
27.1	133	3.0 ^a
32.4	67.4	0.3
37.9	23.5	0.4
43.3	7.01	1.4
48.5	5.91	1.0
53.8	3.62	1.5
59.1	2.90	1.4
64.3	2.20	0.7
69.5	0.95	2.6
74.7	0.49	5.0
79.8	0.371	2.7
84.9	0.305	5.0
95.1	0.177	4.5
114.8	0.047	5.5
138.6	0.020	12.1
161.7	0.0056	27
<u>39-MeV Protons Incident</u>		
48.4	17.9	0.3
64.2	9.9	0.3
95.0	1.4	0.5
<u>29-MeV Protons Incident</u>		
12.1	935	0.2
32.4	268	0.2

^aUncertainty from excess tail correction.

Table b. Differential Cross Sections For $^{12}\text{C}(\text{p},\text{p}')$, $E_{\text{p}} = 61 \text{ MeV}$

c.m. Angle (deg)	Cross Section c.m. (mb/sr)	Statistical Uncertainty (%)	c.m. Angle (deg)	Cross Section c.m. (mb/sr)	Statistical Uncertainty (%)
<u>4.44-MeV Level</u>			<u>7.65-MeV Level (cont'd.)</u>		
13.0	7.32	2.0	75.0	0.038	18
16.3	7.91	2.1	80.2	0.022	11
22.6	9.54	2.5	85.3	0.012	24
32.5	9.59	0.9	95.4	0.0121	19
38.0	8.17	0.7	115.1	0.012	11
43.3	4.97	1.7	138.8	0.0059	23
48.5	3.67	1.0	162.0	0.0025	44
53.8	1.76	2.8	<u>9.64-MeV Level</u>		
59.1	1.26	2.8	13.3	0.668	10.3
64.5	1.06	1.4	16.3	0.884	7.1
69.7	0.669	3	32.6	2.04	2.4
74.9	0.405	5.4	38.2	2.50	1.4
80.0	0.327	3	43.6	2.20	2.7
85.1	0.200	5.6	48.8	2.03	1
95.3	0.054	8	54.1	1.222	3
114.9	0.033	7	59.5	0.840	3
138.8	0.037	9	64.7	0.846	1
161.7	0.034	11.3	70.0	0.498	4
<u>7.65-MeV Level</u>			75.1	0.362	6
13.2	0.665	8.3	80.3	0.319	3
16.4	0.309	11.7	85.4	0.247	5
27.3	0.488	8.4	95.5	0.093	5
32.6	0.703	4.2	115.2	0.018	10
38.1	0.764	2.4	138.9	0.016	15
43.4	0.501	5.8	162.0	0.017	17
48.7	0.367	2			
54.1	0.192	7			
59.4	0.143	7			
64.6	0.120	4			
69.8	0.068	10			

Table 6 (cont'd.)

c.m. Angle (deg)	Cross Section c.m. (mb/sr)	Statistical Uncertainty (%)	c.m. Angle (deg)	Cross Section c.m. (mb/sr)	Statistical Uncertainty (%)
<u>12.71-MeV Level</u>			<u>16.1-MeV Level^a</u>		
13.1	0.545	10	13.3	0.44	20
16.4	0.896	7	16.5	0.54	20
27.4	0.636	7	27.5	0.67	15
32.8	0.429	6	32.9	0.53	15
38.3	0.294	5	38.4	0.36	15
43.6	0.277	10	43.7	0.29	15
48.9	0.257	3	49.1	0.24	15
54.3	0.213	8	54.4	0.14	15
59.6	0.126	10			
70.1	0.096	10			
<u>15.1-MeV Level^a</u>					
13.2	1.17	10			
16.5	1.36	10			
27.5	0.99	25			
32.9	0.76	20			
38.3	0.51	20			
43.7	0.36	20			
49.0	0.24	15			

^aIncludes, for this level, an uncertainty contribution from difficulty in separating those counts originating from excitation of the stated level.

Table 7. Differential Cross Sections For $^{12}\text{C}(\text{p},\text{d})^{11}\text{C}$, $E_{\text{p}} = 61 \text{ MeV}$

c.m. Angle (deg)	Cross Section c.m. (mb/sr)	Statistical Uncertainty (%)	c.m. Angle (deg)	Cross Section c.m. (mb/sr)	Statistical Uncertainty (%)
<u>Ground State</u>			<u>1.995-MeV Level (cont'd)</u>		
13.8	14.08	1.3	56.7	0.16	7
17.3	12.00	2	62.3	0.14	7
23.8	6.24	2	67.6	0.13	3
28.6	4.02	2	73.0	0.071	10
34.3	3.59	1.5	78.3	0.034	21
40.0	3.26	1.1	83.5	0.025	11
45.5	2.36	2.4	88.7	0.023	17
51.0	1.80	1	98.9	0.019	14
56.5	0.97	3	118.4	0.011	12
62.0	0.90	3	141.3	0.005	25
67.5	0.87	1	<u>4.37-MeV Level</u>		
72.8	0.58	3	13.9	0.20	12
78.1	0.41	5	17.4	0.20	13
83.3	0.28	3	28.9	0.37	8
88.5	0.20	6	34.5	0.36	5
98.7	0.099	6	40.3	0.35	3.4
118.2	0.063	5	45.8	0.26	8
141.1	0.019	14	51.4	0.23	3
163.0	0.029	13	56.9	0.12	9
<u>1.995-MeV Level</u>			62.4	0.095	8
13.9	2.66	3	73.2	0.069	10
17.3	2.42	4	88.9	0.042	13
23.9	1.08	5	118.6	0.022	9
28.8	0.82	5	141.4	0.010	20
34.3	0.68	4	163.2	0.0081	24
40.1	0.49	3			
45.6	0.26	7			
51.2	0.22	3			

Table 7 (cont'd.)

c.m. Angle (deg)	Cross Section c.m. (mb/sr)	Statistical Uncertainty (%)	c.m. Angle (deg)	Cross Section c.m. (mb/sr)	Statistical Uncertainty (%)
<u>4.79 MeV Level</u>			<u>6.91-MeV Level</u>		
14.0	1.51	4	14.1	0.115	16
17.4	1.36	5	17.5	0.089	25
28.8	0.61	6	29.0	0.13	20
34.5	0.48	4	34.7	0.12	8
40.3	0.41	3	40.5	0.12	6
45.8	0.26	7	51.6	0.049	30
51.5	0.16	3	57.2	0.050	30
56.9	0.10	10	62.7	0.026	30
62.5	0.089	8	68.2	0.016	40
73.3	0.065	10	73.6	0.016	40
89.1	0.037	13	<u>7.51-MeV Level</u>		
118.8	0.0094	13	14.1	0.040	29
141.5	0.0080	21	17.5	0.025	30
163.0	0.0074	26	29.0	0.046	25
<u>6.34- + 6.48-MeV Level</u>			34.7	0.039	15
14.1	0.491	7	40.5	0.023	16
17.4	0.45	9	46.0	0.013	46
29.0	0.30	9	51.7	0.018	10
34.7	0.22	6	62.9	0.011	24
40.5	0.24	4	68.3	0.0060	18
46.0	0.20	9	73.7	0.0062	34
51.6	0.21	3	<u>8.11-MeV Level</u>		
57.2	0.132	8	14.3	0.086	20
62.7	0.139	7	17.5	0.089	50
68.1	0.119	3	29.1	0.070	30
73.5	0.083	9	34.8	0.059	15
78.8	0.071	14	40.5	0.060	15
89.3	0.040	13	51.8	0.036	25
99.4	0.018	16	119.2	0.0070	17
119.0	0.015	11			
141.7	0.016	15			

Table 8. Differential Cross Sections For $^{12}\text{C}(\text{p},\text{t})^{10}\text{C}$,
 $E_{\text{p}} = 61 \text{ MeV}$

c.m. Angle (deg)	Cross Section c.m. (mb/sr)	Statistical Uncertainty (%)
<u>Ground State</u>		
14.8	0.85	5
18.2	0.30	10
25.1	0.18	11
30.1	0.32	8
36.0	0.29	5
42.0	0.179	5
47.7	0.042	18
53.5	0.022	8
59.3	0.021	19
64.9	0.049	11
70.5	0.016	5
76.0	0.029	14
81.5	0.013	30
86.7	0.0069	21
<u>3.36-MeV Level</u>		
15.1	0.28	10
18.3	0.30	10
25.3	0.21	11
30.3	0.13	13
36.4	0.077	10
42.4	0.065	8
48.2	0.088	13
54.1	0.109	4
60.8	0.069	10
65.4	0.031	14
71.1	0.022	7
76.6	0.0095	26
87.4	0.010	16

Table 9. Differential Cross Sections For $^{12}\text{C}(p, ^3\text{He})^{10}\text{B}$,
 $E_p = 61 \text{ MeV}$

c.m. Angle (deg)	Cross Section c.m. (mb/sr)	Statistical Uncertainty (%)
<u>Ground State</u>		
14.6	0.81	6
18.1	0.71	7
24.9	0.49	7
29.9	0.26	10
35.7	0.21	6
41.7	0.18	5
64.4	0.048	12
<u>0.717-MeV Level</u>		
14.6	0.20	12
18.0	0.12	17
29.9	0.11	16
35.8	0.063	12
41.6	0.017	16
64.4	0.017	20
<u>1.740-MeV Level</u>		
14.6	0.33	10
18.0	0.097	20
35.8	0.111	9
41.7	0.066	9
64.6	0.013	22

Table 10. Differential Cross Sections For $^{12}\text{C}(\text{p},\alpha)^9\text{B}$,
 $E_p = 61 \text{ MeV}$

c.m. Angle (deg)	Cross Section c.m. (mb/sr)	Statistical Uncertainty (%)
<u>Ground State</u>		
14.4	0.45	8
18.2	0.34	10
25.1	0.29	9
30.1	0.17	12
36.0	0.11	9
42.0	0.060	8
53.5	0.016	11
<u>2.33-MeV Level</u>		
36.2	0.051	14
42.1	0.054	9
53.7	0.041	7

Table 11. Differential Cross Sections For Elastic Scattering of 61-, 39-, and 29-MeV Protons on ^{16}O

c.m. Angle (deg)	Cross Section c.m. (mb/sr)	Statistical Uncertainty (+%)
<u>61-MeV Incident Protons</u>		
12.7	923.4	0.8
16.0	799.6	0.8
26.6	176.0	4.0 ^a
31.8	50.54	0.4
37.1	14.37	1.8
42.4	7.85	2.9
47.5	7.89	0.7
52.8	5.13	2.6
58.1	3.51	2.9
63.3	1.74	1.5
68.4	0.88	6.0
73.4	0.51	10.1
78.6	0.46	4.7
83.7	0.45	8.7
93.8	0.161	12.6
113.6	0.007	20.8
<u>39-MeV Incident Protons</u>		
21.3	685.0	0.1
47.5	17.4	0.1
63.3	12.3	0.1
93.8	0.94	0.1
<u>29-MeV Incident Protons</u>		
31.8	278.0	0.1

^aUncertainty from excess tail correction.

Table 12. Differential Cross Sections For $^{16}\text{O}(\text{p},\text{p}')$,
 $E_{\text{p}} = 61 \text{ MeV}$

c.m. Angle (deg)	Cross Section c.m. (mb/sr)	Statistical Uncertainty (%)
<u>6.13 MeV (3^-) Level^b</u>		
12.9	1.69	12.1
16.1	1.69	13.5
26.7	5.82	5.5 ^a
31.9	5.95	0.9
37.3	6.15	2.5
42.5	5.13	3.5
47.7	4.10	1.0
53.0	2.57	3.9
58.2	1.77	4.2
63.4	1.44	2.2
68.6	1.01	7.8
73.7	0.74	14.7
78.8	0.38	9.5
83.9	0.16	19.7
94.0	0.086	13.7
113.8	0.023	12.1

^aUncertainty from excess tail correction.

^bCross sections contain any contribution from excitation of 6.052, 0^+ , level.

Table 13. Differential Cross Sections For $^{16}\text{O}(\text{p},\text{d})^{15}\text{O}$,
 $E_p = 61 \text{ MeV}$

c.m. Angle (deg)	Cross Section c.m. (nb/sr)	Statistical Uncertainty (%)
<u>Ground State ($J^\pi = 1/2^-$)</u>		
13.4	9.30	4.2
16.7	7.75	4.6
27.5	2.01	6.9
33.0	1.59	1.7
38.6	1.17	5.4
43.9	0.78	8.3
49.2	0.631	2.5
54.7	0.512	8.4
60.0	0.385	8.8
65.3	0.237	3.9
70.5	0.100	18.6
<u>6.18 MeV ($J^\pi = 3/2^-$) Level</u>		
13.5	10.26	4.0
16.8	9.71	3.9
27.8	2.90	6.0
33.3	2.48	1.4
38.8	2.27	4.0
44.2	0.98	10.9
49.5	0.94	2.5
55.0	0.74	9.3
60.4	0.68	8.6
65.7	0.56	2.8
71.0	0.30	10.3

Table 14. Differential Cross Sections For $^{16}\text{O}(\text{p},\text{t})^{14}\text{O}$,
 $E_p = 61 \text{ MeV}$

Ground State ($J^\pi = 0^+$)		
c.m. Angle (deg)	Cross Section c.m. (mb/sr)	Statistical Uncertainty (%)
13.8	0.43	19.7
17.3	0.24	27.7
28.6	0.21	20.9
34.2	0.143	5.6
39.9	0.045	26.6
50.9	0.003	32.8
61.9	0.031	24.6
67.3	0.010	20.7

Table 15. Energy-Integrated Laboratory Differential Cross Sections and Average Energies for Carbon^a

Lab Angle (deg)	Proton ^b			Deuteron			Triton			Helium-3			α particles		
	$\sigma \pm \Delta\sigma$ (mb/ster)	E (MeV)	COE (MeV)	$\sigma \pm \Delta\sigma$ (mb/ster)	E (MeV)	COE (MeV)	$\sigma \pm \Delta\sigma$ (mb/ster)	E (MeV)	COE (MeV)	$\sigma \pm \Delta\sigma$ (mb/ster)	E (MeV)	COE (MeV)	$\sigma \pm \Delta\sigma$ (mb/ster)	E (MeV)	COE (MeV)
61-MeV Incident Proton Energy															
12	118 $\pm$ 1	28.7	1.6	40.1 $\pm$ 0.4	34.0	1.7	5.2 $\pm$ 0.1	23.9	5.6	7.9 $\pm$ 0.2	25.3	6.2	43.7 $\pm$ 0.4	12.7	3.1
15	110 $\pm$ 1	29.1	1.6	35.6 $\pm$ 0.4	33.2	1.4	4.1 $\pm$ 0.1	21.1	5.6	6.7 $\pm$ 0.2	23.6	6.2	40.7 $\pm$ 0.4	12.7	3.1
20.8	117 $\pm$ 1	29.7	1.4	25.3 $\pm$ 0.3	29.6	1.4	3.3 $\pm$ 0.1	21.1	5.7	6.0 $\pm$ 0.1	23.1	6.3	36.0 $\pm$ 0.4	12.2	3.2
25	114 $\pm$ 1	28.1	3.7 ^c	18.7 $\pm$ 0.2	29.1	4.5 ^c	3.4 $\pm$ 0.1	20.0	5.5	3.7 $\pm$ 0.1	26.2	12.8 ^c	10.0 $\pm$ 0.2	23.5	13.3 ^c
30	83.8 $\pm$ 0.4	30.0	1.4	17.6 $\pm$ 0.1	26.7	1.6	2.8 $\pm$ 0.1	19.9	5.6	4.4 $\pm$ 0.1	20.1	6.2	31.2 $\pm$ 0.2	11.3	3.2
35	71.7 $\pm$ 0.3	28.7	1.4	15.7 $\pm$ 0.1	26.2	1.6	2.4 $\pm$ 0.1	19.0	5.6	3.75 $\pm$ 0.04	17.1	6.2	29.3 $\pm$ 0.1	13.7	3.2
40	65.0 $\pm$ 0.4	25.6	1.3	13.3 $\pm$ 0.2	23.3	1.4	2.1 $\pm$ 0.1	17.4	5.5	3.3 $\pm$ 0.08	18.1	6.1	29.0 $\pm$ 0.2	9.9	3.1
45	49.1 $\pm$ 0.2	24.5	1.8	10.6 $\pm$ 0.05	21.8	1.9	1.6 $\pm$ 0.1	16.6	5.8	2.31 $\pm$ 0.02	17.3	7.0	20.4 $\pm$ 0.1	11.1	4.7
50	44.1 $\pm$ 0.3	21.4	1.3	8.4 $\pm$ 0.1	19.1	1.4	1.3 $\pm$ 0.1	15.4	5.5	2.33 $\pm$ 0.05	16.4	6.1	22.8 $\pm$ 0.1	9.1	3.2
55	30.9 $\pm$ 0.2	20.6	1.6	6.4 $\pm$ 0.1	19.3	1.5	0.91 $\pm$ 0.03	15.0	5.6	1.85 $\pm$ 0.04	15.9	6.2	18.8 $\pm$ 0.1	8.7	3.1
53	30.9 $\pm$ 0.1	19.0	1.8	6.4 $\pm$ 0.03	18.3	1.9	0.85 $\pm$ 0.01	14.4	5.8	1.74 $\pm$ 0.02	16.7	7.0	14.1 $\pm$ 0.05	10.2	4.7
65	23.2 $\pm$ 0.2	17.8	1.6	4.9 $\pm$ 0.1	17.1	1.6	0.64 $\pm$ 0.02	15.4	5.6	1.35 $\pm$ 0.03	15.2	6.2	14.2 $\pm$ 0.1	8.3	3.2
70	23.5 $\pm$ 0.4	15.8	1.4	4.3 $\pm$ 0.1	15.0	1.4	0.53 $\pm$ 0.03	12.8	5.6	1.36 $\pm$ 0.04	14.8	6.2	13.4 $\pm$ 0.1	8.2	3.2
75	22.8 $\pm$ 0.5	14.4	1.4	4.13 $\pm$ 0.03	13.4	1.4	0.48 $\pm$ 0.01	11.6	5.6	1.20 $\pm$ 0.02	13.6	6.2	11.8 $\pm$ 0.1	8.0	3.2
80	16.2 $\pm$ 0.3	13.7	1.4	3.10 $\pm$ 0.03	12.7	1.4	0.33 $\pm$ 0.02	11.3	5.6	0.94 $\pm$ 0.03	13.1	6.2	8.8 $\pm$ 0.1	7.8	3.2
90	14.8 $\pm$ 0.07	11.7	1.6	2.37 $\pm$ 0.03	11.0	1.6	0.26 $\pm$ 0.01	10.8	5.6	0.76 $\pm$ 0.02	12.3	6.3	7.2 $\pm$ 0.1	7.6	3.4
110	11.3 $\pm$ 0.04	9.7	1.7	1.73 $\pm$ 0.02	9.6	2.0	0.144 $\pm$ 0.004	9.6	5.8	0.45 $\pm$ 0.01	11.9	7.1	3.67 $\pm$ 0.02	8.5	4.7
135	10.4 $\pm$ 0.03	8.7	1.3	1.39 $\pm$ 0.02	7.5	1.5	0.101 $\pm$ 0.005	8.7	5.5	0.40 $\pm$ 0.01	10.5	6.1	3.84 $\pm$ 0.03	6.4	3.2
160	9.7 $\pm$ 0.04	8.7	1.5	1.18 $\pm$ 0.02	7.1	1.5	0.090 $\pm$ 0.006	8.4	5.5	0.31 $\pm$ 0.01	10.2	6.1	3.93 $\pm$ 0.04	6.4	3.1
39-MeV Incident Proton Energy															
20	61.6 $\pm$ 0.2	20.1	2.8	22.6 $\pm$ 0.1	17.7	2.6	0.96 $\pm$ 0.03	10.5	5.8				42.7 $\pm$ 0.2	11.8	5.0
30	20.2 $\pm$ 0.1	20.3	3.8 ^c	10.1 $\pm$ 0.1	15.9	4.7 ^c	1.25 $\pm$ 0.02	12.2	5.8				8.7 $\pm$ 0.1	19.8	13.7 ^c
45	41.6 $\pm$ 0.3	17.9	2.6	8.6 $\pm$ 0.1	14.2	2.7	0.46 $\pm$ 0.011	10.6	5.8				25.0 $\pm$ 0.1	10.0	4.9
60	27.4 $\pm$ 0.4	14.2	2.3	5.00 $\pm$ 0.03	12.3	3.0	0.30 $\pm$ 0.01	9.9	5.8				16.2 $\pm$ 0.1	9.6	5.0
90	17.4 $\pm$ 0.03	9.9	1.8	2.92 $\pm$ 0.01	9.6	2.1	0.05 $\pm$ 0.01	7.8	5.9				5.7 $\pm$ 0.02	9.1	5.6
29-MeV Incident Proton Energy															
11	105.0 $\pm$ 0.9	14.0	1.4	13.1 $\pm$ 0.3	9.5	1.4							104.5 $\pm$ 0.9	8.2	2.9
30	65.5 $\pm$ 0.3	13.5	1.2	8.8 $\pm$ 0.1	9.0	2.0							70.9 $\pm$ 0.3	7.8	2.9

^aThese integrals cover the entire spectrum above the experimental cutoff energy (COE). The uncertainties shown were derived from counting uncertainties, and are generally unimportant compared with the systematic uncertainties given in Tables 3 and 4 in the text.

^bElastic proton scattering has been excluded.

^cFlight-time spectra were not obtained for these runs.

Table 16. Energy-Integrated Laboratory Differential Cross Sections and Average Energies For $^{16}\text{O}^a$

Lab Angle (deg)	Proton ^b			Deuteron			Triton			Helium-3			Alpha		
	$\sigma + \Delta\sigma$ (mb/ster)	$\bar{E}$ (MeV)	COE (MeV)	$\sigma + \Delta\sigma$ (mb/ster)	$\bar{E}$ (MeV)	COE (MeV)	$\sigma + \Delta\sigma$ (mb/ster)	$\bar{E}$ (MeV)	COE (MeV)	$\sigma + \Delta\sigma$ (mb/ster)	$\bar{E}$ (MeV)	COE (MeV)	$\sigma + \Delta\sigma$ (mb/ster)	$\bar{E}$ (MeV)	COE (MeV)
<u>61-MeV Incident Proton Energy</u>															
12	148 ± 3	27.7	1.5	42.0 ± 1.9	35.1	1.7	3.4 ± 0.7	20.8	5.5	3.8 ± 0.8	25.6	6.1	34.2 ± 1.9	13.7	3.1
15	141 ± 3	26.2	1.6	37.6 ± 1.8	34.3	1.4	4.3 ± 0.6	21.9	5.6	4.5 ± 0.8	26.2	6.2	34.7 ± 1.9	12.4	3.2
25	--	--	--	18.9 ± 1.0	28.5	4.5	3.2 ± 0.4	20.4	5.6	--	--	--	--	--	--
30	88.1 ± 0.4	27.0	2.1	17.1 ± 0.2	26.7	2.3	2.03 ± 0.08	19.8	5.9	3.1 ± 0.1	20.7	7.5	21.8 ± 0.2	13.4	5.5
35	79.3 ± 1.1	26.2	1.5	15.8 ± 0.5	25.5	1.4	1.70 ± 0.20	19.3	5.6	2.7 ± 0.2	19.4	6.1	28.0 ± 0.7	10.4	3.0
40	75.6 ± 1.5	23.8	1.4	14.1 ± 0.7	21.7	1.6	1.28 ± 0.26	19.1	5.6	2.9 ± 0.3	19.0	6.2	25.5 ± 1.0	10.2	3.2
45	59.3 ± 0.3	23.0	2.1	10.4 ± 0.1	22.5	2.3	1.16 ± 0.05	17.4	5.9	1.92 ± 0.06	19.4	7.5	16.5 ± 0.2	11.9	5.7
50	56.2 ± 0.9	21.2	1.4	10.3 ± 0.4	21.2	1.4	1.12 ± 0.15	15.8	5.6	2.54 ± 0.21	17.4	6.2	22.6 ± 0.7	9.6	3.2
55	46.3 ± 0.7	19.7	1.9	7.9 ± 0.3	19.9	1.6	0.58 ± 0.12	15.8	5.6	1.74 ± 0.17	17.0	6.2	18.0 ± 0.5	9.2	3.2
60	40.8 ± 0.2	18.4	2.2	6.8 ± 0.1	18.2	2.3	0.64 ± 0.03	14.7	5.9	1.30 ± 0.04	17.2	7.5	12.4 ± 0.1	10.9	5.6
65	35.7 ± 0.6	16.3	1.7	3.3 ± 0.3	14.5	1.6	0.45 ± 0.10	17.6	5.5	1.28 ± 0.15	15.7	6.1	14.9 ± 0.5	8.5	3.1
70	31.9 ± 0.8	14.8	1.6	5.1 ± 0.3	13.5	1.4	0.53 ± 0.12	14.0	5.6	1.22 ± 0.18	14.0	6.2	13.4 ± 0.6	7.9	3.2
75	14.8 ± 0.3 ^c	20.0	7.0	3.5 ± 0.1	12.9	1.6	0.28 ± 0.05	14.0	5.6	0.72 ± 0.08	15.0	6.3	9.4 ± 0.2	7.8	3.3
80	29.4 ± 0.5	12.5	1.5	4.2 ± 0.2	12.5	1.6	0.32 ± 0.07	13.5	5.6	0.91 ± 0.12	14.2	6.3	11.4 ± 0.4	7.4	3.2
90	23.5 ± 0.3	11.0	1.6	3.3 ± 0.1	11.5	1.7	0.24 ± 0.04	11.9	5.6	0.61 ± 0.07	12.6	6.4	8.2 ± 0.2	7.5	3.5
110	16.6 ± 0.1	9.1	1.9	2.03 ± 0.04	9.5	2.2	0.113 ± 0.011	11.7	6.0	--	--	--	3.3 ± 0.1	8.7	5.7
135	18.0 ± 0.3	7.8	1.3	2.06 ± 0.09	7.4	1.4	0.197 ± 0.026	9.4	5.5	0.47 ± 0.05	11.3	6.0	5.2 ± 0.2	6.3	3.1
160	16.3 ± 0.4	8.3	1.7	1.54 ± 0.15	6.6	1.7	0.120 ± 0.041	8.7	5.7	0.27 ± 0.07	9.9	6.3	3.2 ± 0.3	6.0	3.3
<u>39-MeV Incident Proton Energy</u>															
20	65.1 ± 0.6	16.3	3.5	21.2 ± 0.4	17.6	3.3	1.05 ± 0.09	13.3	5.8				32.6 ± 0.5	11.7	5.5
45	47.8 ± 0.3	16.8	3.8	8.53 ± 0.13	14.8	3.4	0.34 ± 0.03	11.5	5.8				20.3 ± 0.2	10.0	5.4
60	38.9 ± 0.6	12.6	2.2	4.52 ± 0.07	12.6	3.3	0.28 ± 0.02	12.0	5.8				0.76 ± 0.06 ^c	19.0	13.8
90	23.7 ± 0.1	9.3	2.0	2.53 ± 0.04	9.9	3.1	0.049 ± 0.006	8.5	5.9				5.22 ± 0.06	9.3	6.2
<u>29-MeV Incident Proton Energy</u>															
30	67.4 ± 1.2	10.5	1.27	7.2 ± 0.5	8.7	2.1							55.9 ± 1.3	7.2	3.0

^aThe integral quantities shown cover the entire spectrum above the experimental cutoff energy (COE). The errors shown are only due to counting statistics and must be used with the systematic uncertainties listed on Tables 3 and 4 and in the text.

^bElastic scattering has been excluded.

^cFlight-time spectra were not obtained for these runs.

Table 17. Angle-Integrated Laboratory System Differential Energy Spectra for 61-MeV Protons on Carbon^a

Bin Energy (MeV)	Cross Section (mb/MeV)	Error (mb/MeV)	Bin Energy (MeV)	Cross Section (mb/MeV)	Error (mb/MeV)	Bin Energy (MeV)	Cross Section (mb/MeV)	Error (mb/MeV)
Proton^b			Deuteron			Triton		
1.53	19.65	0.48	1.54	3.85	0.16	5.56	0.73	0.014
2.55	19.78	0.25	1.95	3.63	0.12	7.57	0.57	0.008
3.53	18.11	0.18	2.35	3.61	0.10	9.58	0.46	0.007
4.53	19.61	0.13	2.75	3.43	0.10	11.59	0.39	0.007
5.53	13.68	0.16	3.16	3.30	0.09	13.60	0.318	0.006
6.54	11.98	0.12	3.56	3.25	0.09	15.61	0.282	0.007
7.54	10.89	0.08	3.97	3.30	0.10	17.62	0.231	0.005
8.54	9.67	0.07	4.37	3.25	0.10	19.63	0.206	0.011
9.54	8.62	0.09	4.77	2.93	0.09	20.00	0.204	0.005
10.54	8.06	0.07	5.18	2.75	0.09	22.00	0.203	0.005
11.55	7.84	0.06	5.58	2.78	0.09	24.00	0.197	0.006
12.55	7.35	0.07	5.99	2.61	0.09	26.00	0.190	0.005
13.55	7.08	0.08	6.39	2.48	0.08	28.00	0.190	0.006
14.55	6.77	0.07	6.79	2.22	0.03	30.00	0.132	0.006
15.55	6.44	0.07	8.81	1.89	0.02	32.00	0.126	0.011
16.55	6.43	0.06	10.83	1.58	0.02	34.00	0.239	0.032
17.56	6.26	0.06	12.86	1.31	0.01	36.00	0.173	0.007
18.56	6.04	0.05	14.88	1.16	0.01	37.65		
20.00	5.83	0.06	16.90	1.09	0.01			
22.00	5.43	0.06	18.92	1.02	0.02	Helium-3		
24.00	5.12	0.06	20.00	0.99	0.01	6.21	1.51	0.02
26.00	4.88	0.04	22.00	0.93	0.01	8.22	1.24	0.01
28.00	4.61	0.03	24.00	0.87	0.01	10.23	1.04	0.02
30.00	4.54	0.06	26.00	0.82	0.01	12.24	0.82	0.01
32.00	4.31	0.04	28.00	0.84	0.01	14.25	0.65	0.01
34.00	4.22	0.05	30.00	0.74	0.01	16.26	0.54	0.01
36.00	4.20	0.05	32.00	0.79	0.01	18.27	0.46	0.01
38.00	4.14	0.04	34.00	0.82	0.01	20.00	0.39	0.01
40.00	3.58	0.05	36.00	1.23	0.01	22.00	0.033	0.006
42.00	3.12	0.04	38.00	1.63	0.02	24.00	0.277	0.006
44.00	3.29	0.04	40.00	1.93	0.03	26.00	0.263	0.006
46.00	2.68	0.05	42.00	4.09	0.13	28.00	0.239	0.005
48.00	2.69	0.04	44.00	2.55	0.03	30.00	0.248	0.006
50.00	2.78	0.05	45.27			32.00	0.228	0.011
52.00	2.46	0.06				34.00	0.196	0.006
54.00	3.77	0.07				36.00	0.186	0.005
56.00	5.90	0.07				38.00	0.362	0.009
57.51						40.00	0.287	0.015
						42.02		
			Alpha					
			3.17	30.50	0.49			
			3.58	27.22	0.34			
			3.99	24.40	0.32			
			4.40	22.42	0.31			
			4.82	20.62	0.24			
			5.23	18.74	0.23			
			5.64	17.12	0.22			
			6.05	15.76	0.21			
			6.46	14.44	0.20			
			6.88	13.17	0.19			
			7.29	12.08	0.18			
			7.70	10.37	0.08			
			8.73	8.52	0.07			
			9.76	6.94	0.06			
			10.79	5.67	0.05			
			11.82	4.80	0.05			
			12.85	3.99	0.05			
			13.88	3.28	0.04			
			14.91	2.79	0.04			
			15.94	2.33	0.03			
			16.97	2.03	0.03			
			18.00	1.62	0.02			
			20.00	1.21	0.02			
			22.00	0.90	0.02			
			24.00	0.68	0.01			
			26.00	0.54	0.01			
			28.00	0.40	0.01			
			30.00	0.32	0.01			
			32.00	0.26	0.01			
			34.00	0.242	0.008			
			36.00	0.192	0.007			
			38.00	0.10	0.007			
			40.00	0.232	0.008			
			42.00	0.189	0.008			
			44.00	0.106	0.006			
			46.00	0.130	0.008			
			48.00	0.153	0.008			
			49.79					

^aThe estimated standard errors shown are based on Poisson counting statistics and estimated extrapolation uncertainties and must be combined with the systematic uncertainties in Tables 3 and 4 and in the text to obtain the overall estimated standard errors.

^bElastic proton scattering has been excluded.

Table 18. Angle-Integrated Laboratory System Differential Energy Spectra For 39-MeV Protons on Carbon^a

Bin Energy (MeV)	Cross Section (mb/MeV)	Error (mb/MeV)	Bin Energy (MeV)	Cross Section (mb/MeV)	Error (mb/MeV)	Bin Energy (MeV)	Cross Section (mb/MeV)	Error (mb/MeV)
Proton^b			Deuteron			Triton (Cont'd)		
2.80	26.57	0.11	3.02	4.14	0.04	11.69	0.05	0.01
3.79	24.35	0.11	4.00	3.65	0.04	12.68	0.31	0.02
4.75	20.73	0.19	4.99	3.20	0.04	13.67	0.54	0.09
5.78	17.53	0.40	5.98	3.09	0.04	14.66	0.07	0.01
6.77	15.28	0.50	6.97	2.48	0.03	15.66	0.001	0.001
7.76	13.33	0.47	7.96	2.63	0.03	16.65	0.0	0.0
8.75	11.29	0.40	8.96	2.10	0.03			
9.74	9.71	0.24	9.95	2.24	0.03	Alpha		
10.73	8.66	0.08	10.94	2.51	0.04	5.54	28.92	0.15
11.72	8.43	0.07	11.93	2.04	0.04	6.54	22.21	0.13
12.72	7.95	0.06	12.93	2.23	0.03	7.53	17.70	0.12
13.71	8.52	0.07	13.92	2.14	0.03	8.53	14.45	0.11
14.70	8.85	0.07	14.91	6.66	0.06	9.52	11.82	0.10
15.69	6.94	0.06	15.90	2.49	0.04	10.52	9.33	0.08
16.68	6.35	0.06	16.90	0.94	0.09	11.51	7.19	0.07
17.67	6.55	0.11	17.90	4.67	0.04	12.51	5.87	0.06
18.66	6.10	0.17	18.88	2.82	0.10	13.50	5.16	0.06
20.00	5.47	0.07	20.00	5.90	0.39	14.49	4.28	0.05
22.00	5.51	0.03	22.00	2.37	0.03	15.49	3.77	0.05
24.00	4.40	0.03	23.08	0.0	0.0	16.48	3.54	0.05
26.00	6.35	0.07				17.48	2.98	0.05
28.00	4.24	0.03	Triton			18.47	2.07	0.04
30.00	3.37	0.03	5.73	0.52	0.03	20.00	1.72	0.02
32.00	13.32	0.40	6.72	0.25	0.01	22.00	1.32	0.06
34.00	4.40	0.05	7.72	0.45	0.02	24.00	0.64	0.02
35.58	0.0	0.0	8.71	0.24	0.01	26.00	0.86	0.02
			9.70	0.12	0.01	28.00	1.75	0.08
			10.69	0.64	0.02	28.28	0.0	0.0

^aThe estimated standard errors shown are based on Poisson counting statistics and estimated extrapolation uncertainties, and must be combined with the systematic uncertainties in Tables 3 and 4 and in the text to obtain the overall estimated standard errors. Since measurements were made at only 5 angles through 90°, a quadrature mesh uncertainty of 20% is assigned to the values in this table.

^bElastic proton scattering has been excluded.

Table 19. Angle-Integrated Laboratory System Differential Energy Spectra For 61-MeV Protons on Oxygen^a

Bin Energy (MeV)	Cross Section (mb/MeV)	Error (mb/MeV)	Bin Energy (MeV)	Cross Section (mb/MeV)	Error (mb/MeV)	Bin Energy (MeV)	Cross Section (mb/MeV)	Error (mb/MeV)
Proton^b			Deuteron (cont'd)			Triton		
1.63	33.83	0.31	30.00	0.93	0.04	5.93	0.46	0.02
3.83	26.08	0.23	32.00	0.94	0.03	10.93	0.31	0.01
5.83	19.66	0.20	34.00	1.13	0.04	15.94	0.22	0.01
7.83	15.04	0.17	36.00	1.34	0.06	20.94	0.20	0.02
9.83	11.12	0.26	38.00	2.56	0.06	23.00	0.20	0.02
11.83	9.38	0.14	40.00	2.45	0.10	25.00	0.16	0.02
13.83	8.09	0.14	42.00	0.89	0.08	27.00	0.15	0.01
15.83	7.33	0.13	44.00	0.97	0.07	29.00	0.15	0.01
17.84	7.32	0.14	46.00	2.08	0.04	31.00	0.11	0.01
19.84	6.65	0.13	48.00	0.73	0.05	33.00	0.11	0.01
22.00	6.01	0.12	48.52	0.0	0.0	35.00	0.071	0.015
24.00	5.74	0.13				37.00	0.059	0.015
26.00	5.48	0.12	Helium-3			39.00	0.041	0.015
28.00	5.40	0.12				40.50	0.0	0.0
30.00	5.05	0.13	6.34	1.04	0.03			
32.00	5.23	0.13	11.31	0.62	0.02	Alpha		
34.00	5.29	0.13	16.27	0.38	0.02	3.45	24.5	0.4
36.00	5.49	0.13	21.24	0.34	0.02	5.44	16.2	0.3
38.00	4.95	0.14	24.00	0.33	0.03	7.43	10.4	0.2
40.00	4.83	0.12	26.00	0.22	0.02	9.42	6.79	0.13
42.00	3.92	0.15	28.00	0.197	0.019	11.40	4.45	0.13
44.00	3.24	0.14	30.00	0.194	0.017	13.39	2.76	0.10
46.00	3.00	0.15	32.00	0.182	0.022	15.38	1.94	0.08
48.00	3.15	0.10	34.00	0.179	0.022	17.37	1.42	0.07
50.00	3.35	0.09	36.00	0.111	0.028	19.35	1.04	0.06
52.00	6.02	0.09	38.00	0.089	0.028	22.00	0.79	0.07
54.00	3.55	0.09	40.00	0.094	0.020	24.00	0.63	0.06
55.58	0.0	0.0	42.00	0.076	0.011	26.00	0.47	0.04
			44.00	0.050	0.007	28.00	0.37	0.04
			45.52	0.0	0.0	30.00	0.33	0.03
Deuteron						32.00	0.31	0.03
1.71	3.95	0.06				34.00	0.23	0.03
5.67	2.61	0.04				36.00	0.22	0.03
9.63	1.85	0.03				38.00	0.30	0.03
13.59	1.40	0.03				40.00	0.22	0.03
17.54	1.24	0.03				42.00	0.162	0.033
21.50	0.98	0.04				44.00	0.157	0.027
24.00	0.96	0.04				46.00	0.093	0.028
26.00	0.90	0.03				48.00	0.085	0.028
28.00	0.92	0.03				50.00	0.075	0.023
						52.00	0.052	0.15
						53.03	0.0	0.0

^aThe estimated standard errors shown are based on Poisson counting statistics and estimated extrapolation uncertainties, and must be combined with the systematic uncertainties in Tables 3 and 4 and in the text to obtain the overall estimated standard errors.

^bElastic proton scattering has been excluded.

Table 21. Angle-Integrated Center-of-Mass System Differential Energy Spectra for 61-MeV Protons on Carbon^a

Bin Energy (MeV)	Cross Section (mb/MeV)	Error (mb/MeV)	Bin Energy (MeV)	Cross Section (mb/MeV)	Error (mb/MeV)	Bin Energy (MeV)	Cross Section (mb/MeV)	Error (mb/MeV)	Bin Energy (MeV)	Cross Section (mb/MeV)	Error (mb/MeV)
Protons ^b			Deuterons			Tritons			Alpha		
1.45	23.67	0.45	1.74	5.27	0.51	6.44	0.84	0.04	5.58	21.7	0.6
2.31	21.48	0.31	2.07	4.98	0.23	8.67	0.59	0.01	6.09	19.4	0.5
3.21	19.15	0.24	2.42	4.47	0.29	10.86	0.48	0.01	6.61	17.2	0.5
4.13	17.38	0.15	2.77	4.34	0.28	13.27	0.374	0.006	7.13	16.2	0.3
5.07	15.37	0.17	3.13	3.84	0.12	15.42	0.387	0.006	7.66	14.6	0.3
6.02	13.43	0.14	3.50	3.62	0.18	17.97	0.348	0.006	8.18	13.2	0.3
6.98	11.91	0.11	3.87	3.40	0.17	20.34	0.233	0.007	8.71	12.0	0.3
7.95	10.51	0.08	4.25	3.26	0.10	22.88	0.237	0.008	9.24	10.8	0.3
8.93	9.67	0.08	4.63	2.97	0.09	25.00	0.221	0.008	9.77	9.9	0.3
9.91	8.84	0.08	5.02	2.87	0.08	26.47	0.202	0.008	10.31	9.0	0.3
10.89	8.44	0.08	5.40	2.74	0.07	28.00	0.175	0.008	10.84	8.4	0.2
11.88	7.92	0.08	5.79	2.63	0.07	28.00	0.165	0.008	11.38	7.89	0.16
12.87	7.50	0.08	6.19	2.36	0.03	27.00	0.175	0.008	11.91	6.38	0.09
13.87	7.14	0.07	6.19	1.98	0.02	28.00	0.198	0.019	13.26	5.32	0.06
14.87	7.04	0.07	10.22	1.77	0.02	29.00	0.236	0.013	14.61	4.32	0.06
15.87	6.83	0.07	12.29	1.52	0.01	30.00	0.193	0.013	15.97	3.30	0.05
16.87	6.67	0.06	14.38	1.38	0.02	31.00	0.211	0.015	17.33	2.88	0.05
17.88	6.62	0.06	16.49	1.22	0.01	32.00	0.208	0.018	18.70	2.38	0.04
18.88	6.33	0.07	18.61	1.11	0.01	33.00	0.202	0.018	20.00	2.10	0.04
20.00	6.02	0.08	20.00	1.06	0.02	34.00	0.013	0.004	21.00	1.79	0.04
21.00	5.91	0.08	21.00	0.92	0.02	35.00	0.001	0.000	22.00	1.57	0.03
22.00	5.73	0.08	22.00	0.93	0.02	35.36	0.0	0.0	23.00	1.37	0.03
23.00	5.48	0.08	23.00	0.93	0.02				24.00	1.19	0.03
24.00	5.35	0.07	24.00	0.91	0.02				25.00	1.02	0.03
25.00	5.22	0.07	25.00	0.90	0.02				26.00	0.94	0.03
26.00	5.31	0.08	26.00	0.87	0.02	7.16	1.72	0.05	27.00	0.86	0.03
27.00	5.13	0.08	27.00	0.86	0.02	9.41	1.31	0.03	28.00	0.74	0.02
28.00	5.00	0.08	28.00	0.85	0.02	11.71	0.99	0.02	29.00	0.65	0.02
29.00	5.00	0.07	29.00	0.79	0.02	14.03	0.81	0.01	30.00	0.57	0.02
30.00	4.85	0.07	30.00	0.66	0.01	16.38	0.63	0.01	31.00	0.51	0.02
31.00	4.39	0.07	31.00	0.65	0.01	18.74	0.54	0.01	32.00	0.42	0.02
32.00	4.20	0.08	32.00	0.70	0.02	20.00	0.48	0.01	33.00	0.37	0.02
33.00	4.29	0.08	33.00	0.94	0.02	21.00	0.45	0.01	34.00	0.36	0.02
34.00	4.64	0.07	34.00	1.24	0.04	22.00	0.41	0.01	35.00	0.35	0.02
35.00	4.65	0.06	35.00	1.41	0.02	23.00	0.39	0.01	36.00	0.30	0.02
36.00	4.63	0.06	36.00	1.26	0.04	24.00	0.36	0.01	37.00	0.30	0.02
37.00	4.61	0.07	37.00	1.39	0.03	25.00	0.33	0.01	38.00	0.31	0.02
38.00	3.63	0.07	38.00	1.87	0.11	26.00	0.31	0.01	39.00	0.27	0.01
39.00	2.53	0.06	39.00	6.90	0.11	27.00	0.28	0.01	40.00	0.28	0.01
40.00	2.96	0.05	40.00	6.46	0.05	28.00	0.30	0.01	41.00	0.31	0.02
41.00	3.74	0.06	41.00	0.23	0.01	29.00	0.32	0.01	42.00	0.31	0.01
42.00	3.08	0.09	42.00	0.01	0.00	30.00	0.33	0.01	43.00	0.285	0.012
43.00	2.59	0.07	42.20	0.00	0.00	31.00	0.32	0.01	44.00	0.115	0.009
44.00	2.32	0.05				32.00	0.24	0.01	45.00	0.105	0.009
45.00	2.44	0.05				33.00	0.14	0.01	46.00	0.162	0.011
46.00	4.04	0.06				34.00	0.26	0.02	47.00	0.163	0.014
47.00	4.35	0.07				35.00	0.46	0.01	48.00	0.135	0.019
48.00	1.62	0.05				36.00	0.59	0.02	49.00	0.745	0.016
49.00	1.48	0.07				37.00	0.53	0.02	50.00	0.625	0.007
50.00	0.99	0.04				38.00	0.05	0.01			
51.00	3.81	0.15				39.00	0.01	0.11			
52.00	14.08	0.12									
53.00	5.87	0.17									
53.37	0.0	0.0									

^aThe estimated standard errors shown are based on Poisson counting statistics and estimated extrapolation uncertainties, and must be combined with the systematic uncertainties in Tables 3 and 4 and in the text to obtain the overall estimated standard errors. The c.m. system conversion cannot be valid for energies below ~10 MeV.

^bElastic proton scattering has been excluded.

Table 22. Angle-Integrated Center-of-Mass System Differential Energy Spectra For 39-MeV Protons on Carbon ^a								
Bin Energy (MeV)	Cross Section (mb/MeV)	Error (mb/MeV)	Bin Energy (MeV)	Cross Section (mb/MeV)	Error (mb/MeV)	Bin Energy (MeV)	Cross Section (mb/MeV)	Error (mb/MeV)
Proton ^b			Deuteron			Alpha		
2.17	29.6	0.1	3.05	4.04	0.04	9.34	13.6	0.1
3.24	25.8	0.1	4.23	3.57	0.04	10.78	10.0	0.1
4.32	22.0	0.2	5.40	3.18	0.03	12.21	7.8	0.1
5.40	18.5	0.4	6.58	2.72	0.03	13.65	6.17	0.05
6.48	15.4	0.5	7.76	2.58	0.03	15.09	5.19	0.04
7.56	13.2	0.4	8.93	1.88	0.03	16.52	4.28	0.04
8.63	11.2	0.3	10.11	1.89	0.03	17.96	3.51	0.04
9.71	9.4	0.1	11.29	2.23	0.03	19.40	3.42	0.03
10.79	8.2	0.1	12.46	2.03	0.03	21.00	3.06	0.04
11.87	8.1	0.1	13.64	3.46	0.10	22.00	2.24	0.04
12.94	8.8	0.1	14.82	0.70	0.01	23.00	1.62	0.03
14.02	8.1	0.1	15.99	2.89	0.07	24.00	1.31	0.03
15.10	8.3	0.1	17.17	2.37	0.24	25.00	1.46	0.03
16.18	8.4	0.1	18.35	15.46	0.7	26.00	1.10	0.03
17.26	5.2	0.2	20.00	0.045	0.005	27.00	2.00	0.08
18.34	4.9	0.1	21.00	0.007	0.005	28.00	2.62	0.06
20.33	4.5	0.1	21.3			28.50		
21.00	5.26	0.05						
22.00	5.12	0.05						
23.00	4.43	0.05						
24.00	3.77	0.04						
25.00	8.4	0.1						
26.00	10.0	0.1						
27.00	7.59	0.03						
28.00	1.41	0.04						
29.00	0.32	0.02						
30.00	10.6	1.1						
31.00	34.4	1.9						
32.00	2.21	0.03						
33.00	0.06	0.006						
33.86								

^aThe estimated standard errors shown are based on Poisson counting statistics and estimated extrapolation uncertainties, and must be combined with the systematic uncertainties in Tables 3 and 4 and in the text to obtain the overall estimated standard errors. Since measurements were made at only 5 angles through 90°, a quadrature mesh uncertainty of 20% is assigned to this table. The c.m. system conversion cannot be valid for energies below ~10 MeV.

^bElastic proton scattering has been excluded.

Table 24. Angle-Integrated Center-of-Mass System Differential Energy Spectra For 39-MeV Protons on Oxygen^a

Bin Energy (MeV)	Cross Section (mb/MeV)	Error (mb/MeV)	Bin Energy (MeV)	Cross Section (mb/MeV)	Error (mb/MeV)	Bin Energy (MeV)	Cross Section (mb/MeV)	Error (mb/MeV)
Proton ^b			Deuteron			Alpha		
3.05	36.8	0.2	3.83	3.61	0.06	8.86	14.0	0.1
4.91	30.0	0.4	6.09	2.88	0.05	11.46	6.51	0.09
6.81	22.8	0.4	8.34	2.52	0.05	14.06	3.58	0.07
8.73	16.7	0.1	10.60	2.80	0.05	16.66	2.15	0.06
10.67	13.9	0.1	12.85	1.41	0.05	19.26	1.39	0.06
12.62	11.6	0.1	15.11	7.98	0.15	21.00	1.13	0.07
14.59	10.3	0.1	17.36	0.75	0.08	22.00	1.43	0.06
16.56	9.9	0.1	19.62	0.14	0.13	23.00	1.60	0.06
18.55	7.2	0.1	21.00	4.01	0.15	24.00	1.05	0.06
20.00	6.0	0.1	22.00	6.60	0.15	25.00	0.24	0.04
21.00	6.0	0.1	23.00	4.07	0.07	26.00	0.19	0.05
22.00	5.8	0.1	23.73	0.0	0.0	27.00	1.26	0.07
23.00	6.1	0.1	Triton			28.00	1.10	0.07
24.00	6.0	0.1	7.71	0.325	0.018	29.00	0.43	0.04
25.00	4.6	0.1	10.13	0.047	0.015	30.00	0.230	0.015
26.00	3.2	0.1	12.55	0.192	0.015	31.00	0.165	0.016
27.00	3.4	0.1	14.96	0.315	0.011	32.00	0.097	0.038
28.00	7.4	0.1				32.22		
29.00	16.7	0.1						
30.00	19.7	0.2						
31.00	0.0	0.1						
31.05	0.0	0.0						

^aThe estimated standard errors shown are based on Poisson counting statistics and estimated extrapolation uncertainties, and must be combined with the systematic uncertainties in Tables 3 and 4 and in the text to obtain the overall estimated standard errors. Since measurements were made at only four angles through 90°, a ~20% quadrature mesh uncertainty is assigned to the values in this table. The c.m. system conversion cannot be valid for energies below ~10 MeV.

^bElastic proton scattering has been excluded.

Table 25. Laboratory System Integral Cross Sections
and Averaged Parameters for ^{12}C .^a

Particle	$\sigma + \Delta\sigma^b$ (mb)	$\bar{E}$ (MeV)	$pc \cdot \cos\theta^c$ (MeV)	Lower Energy Limit (MeV)
<u>^{12}C 61 MeV</u>				
Proton ^d	346 ± 1.1	21.0	102	1.53
Deuteron	71.1 ± 0.3	22.0	172	1.54
Triton	9.3 ± 0.1	17.2	203	5.56
Helium-3	18.2 ± 0.1	17.4	169	6.21
Alpha	156 ± 0.4	9.2	116	3.17
<u>^{12}C 39 MeV^e</u>				
Proton ^d	300 ± 1	15.0	55	2.80
Deuteron	64.4 ± 0.8	13.6	99	3.00
Triton	3.16 ± 0.10	10.3	140	5.73
Alpha	149 ± 0.4	10.6	117	5.54

^aAll quantities have been summed above indicated energy.

^bThese uncertainties are statistical only and should be considered with the systematic errors listed in Tables 3 and 4 and in the text.

^cAverage forward momentum.

^dElastic proton scattering has been excluded.

^eSince these integrals for the 39-MeV data are based on only five data runs at angles ≤ 90 deg, an additional quadrature uncertainty of 15% is assigned.

Table 26. Laboratory System Integral Cross Sections
and Averaged Parameters for ^{16}O .^a

Particle	$\sigma + \Delta\sigma$ (mb)	$\bar{E}$ (MeV)	$pc \cdot \cos\theta^b$ (MeV)	Lower Energy Limit (MeV)
		^{16}O 61 MeV		
Proton ^c	448 $\pm$ 2.	18.3	85	1.83
Deuteron	78.7 $\pm$ 0.5	21.4	163	1.71
Triton	7.4 $\pm$ 0.1	17.6	192	5.93
Helium-3	14.5 $\pm$ 0.3	17.5	150	6.34
Alpha	148 $\pm$ 1.	9.4	108	3.45
		^{16}O 39 MeV ^d		
Proton ^c	362 $\pm$ 1	13.9	48	3.75
Deuteron	64.8 $\pm$.5	14.1	112	3.45
Triton	2.63 $\pm$.09	12.1	163	5.94
Alpha	124 $\pm$ 1	10.5	112	6.24

^aAll quantities have been summed above the indicated energy cutoffs. The uncertainties shown must be combined with the systematic uncertainties listed in Tables 3 and 4 and in the text.

^bAverage forward momentum.

^cElastic proton scattering has been excluded.

^dSince these integrals for the 39-MeV data are based on only four data runs at angles ≤ 90 deg, an additional quadrature uncertainty of $\sim 15\%$ is assigned.

Table 27. Center-of-Mass System Integral Cross Sections and Average Spectral Energies for Carbon.^a

Particle	$\sigma \pm \Delta\sigma^b$ (mb)	$\bar{E}$ (MeV)	COE
<u>61 MeV</u>			
Proton ^c	352 $\pm$ 1	19.7	1.45
Deuteron	74 $\pm$ 1	20.9	1.74
Triton	9.6 $\pm$.1	16.9	6.44
Helium-3	19.8 $\pm$.2	17.8	7.16
Alpha	136 $\pm$ 1	12.6	5.58
<u>39 MeV^d</u>			
Proton ^c	318 $\pm$ 2	14.1	2.17
Deuteron	65 $\pm$ 1	13.6	3.05
Triton	2.10 $\pm$.06	11.4	8.5
Alpha	92.1 $\pm$.2	15.3	9.3

^aThe cross sections have been summed above the indicated c.m. system cutoff energies, even though in the cutoff region the c.m. transformation is inaccurate (see text).

^bThe uncertainties shown must be combined with the systematic uncertainties listed in Tables 3 and 4 and in the text.

^cElastic proton scattering is excluded.

^dSince these integrals for the 39-MeV data are based on only five data runs at angles ≤ 90 deg, an additional quadrature uncertainty of $\sim 15\%$ is assigned.

Table 28. Center-of-Mass System Integral Cross Sections and Average Spectral Energies for ^{16}O .^a

Particle	$\sigma \pm \Delta\sigma$	$\bar{E}$	COE
<u>61 MeV</u>			
Proton ^b	406 $\pm$ 2	20.0	3.3
Deuterons	71 $\pm$ 1	23.8	4.3
Triton	4.9 $\pm$.1	21.9	12.1
Helium-3	9.3 $\pm$ 0.2	23.2	13.0
Alpha	53.5 $\pm$.6	17.8	10.4
<u>39 MeV^c</u>			
Proton ^b	386 $\pm$ 13.0	13.0	3.05
Deuteron	63.3 $\pm$ 14	14.1	3.83
Triton	2.20 $\pm$ 12	12.6	7.71
Alpha	79.4 $\pm$ 13.9	13.9	8.86

^aThe cross section has been summed above the indicated c.m. system cutoff energies. The uncertainties shown must be combined with the systematic uncertainties listed in Tables 3 and 4 and in the text.

^bElastic proton scattering has been excluded.

^cSince these integrals for 39-MeV data are based on only four data runs at angles ≤ 90 deg, an additional quadrature uncertainty of $\sim 15\%$ is assigned.

Table 29

PROTON FROM A - 12 BOUNDED BY 62 MEV. PROTONS.

12 220 - 220			15 220 - 220			20 220 - 220			25 220 - 220			30 220 - 220		
ENERGY (MEV)	SIGMA (MB/SE-SEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SE-SEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SE-SEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SE-SEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SE-SEV)	ERROR
2.03	1.99	0.09	2.03	1.68	0.08	2.03	1.68	0.08	2.03	1.68	0.08	2.03	1.68	0.08
2.04	2.29	0.09	2.04	2.00	0.09	2.04	2.00	0.09	2.04	2.00	0.09	2.04	2.00	0.09
2.05	2.65	0.10	2.05	2.28	0.10	2.05	2.28	0.10	2.05	2.28	0.10	2.05	2.28	0.10
2.06	2.41	0.09	2.06	2.17	0.10	2.06	2.17	0.10	2.06	2.17	0.10	2.06	2.17	0.10
2.07	2.57	0.09	2.07	2.20	0.10	2.07	2.20	0.10	2.07	2.20	0.10	2.07	2.20	0.10
2.08	2.39	0.09	2.08	2.10	0.10	2.08	2.10	0.10	2.08	2.10	0.10	2.08	2.10	0.10
2.09	2.41	0.10	2.09	2.22	0.10	2.09	2.22	0.10	2.09	2.22	0.10	2.09	2.22	0.10
2.10	2.00	0.09	2.10	1.91	0.09	2.10	1.91	0.09	2.10	1.91	0.09	2.10	1.91	0.09
2.11	2.39	0.09	2.11	1.92	0.09	2.11	1.92	0.09	2.11	1.92	0.09	2.11	1.92	0.09
2.12	2.07	0.09	2.12	1.97	0.09	2.12	1.97	0.09	2.12	1.97	0.09	2.12	1.97	0.09
2.13	1.92	0.09	2.13	1.92	0.09	2.13	1.92	0.09	2.13	1.92	0.09	2.13	1.92	0.09
2.14	2.09	0.09	2.14	1.76	0.09	2.14	1.76	0.09	2.14	1.76	0.09	2.14	1.76	0.09
2.15	1.94	0.09	2.15	1.83	0.09	2.15	1.83	0.09	2.15	1.83	0.09	2.15	1.83	0.09
2.16	2.07	0.09	2.16	1.92	0.09	2.16	1.92	0.09	2.16	1.92	0.09	2.16	1.92	0.09
2.17	1.91	0.09	2.17	1.86	0.09	2.17	1.86	0.09	2.17	1.86	0.09	2.17	1.86	0.09
2.18	2.10	0.09	2.18	2.02	0.09	2.18	2.02	0.09	2.18	2.02	0.09	2.18	2.02	0.09
2.19	2.12	0.09	2.19	2.04	0.09	2.19	2.04	0.09	2.19	2.04	0.09	2.19	2.04	0.09
2.20	2.30	0.10	2.20	1.82	0.09	2.20	1.82	0.09	2.20	1.82	0.09	2.20	1.82	0.09
2.21	2.19	0.10	2.21	2.00	0.09	2.21	2.00	0.09	2.21	2.00	0.09	2.21	2.00	0.09
2.22	2.23	0.10	2.22	1.85	0.09	2.22	1.85	0.09	2.22	1.85	0.09	2.22	1.85	0.09
2.23	2.17	0.09	2.23	1.97	0.09	2.23	1.97	0.09	2.23	1.97	0.09	2.23	1.97	0.09
2.24	2.26	0.10	2.24	2.05	0.09	2.24	2.05	0.09	2.24	2.05	0.09	2.24	2.05	0.09
2.25	2.17	0.09	2.25	1.97	0.09	2.25	1.97	0.09	2.25	1.97	0.09	2.25	1.97	0.09
2.26	2.38	0.10	2.26	2.13	0.10	2.26	2.13	0.10	2.26	2.13	0.10	2.26	2.13	0.10
2.27	2.17	0.09	2.27	2.07	0.09	2.27	2.07	0.09	2.27	2.07	0.09	2.27	2.07	0.09
2.28	2.22	0.09	2.28	1.93	0.09	2.28	1.93	0.09	2.28	1.93	0.09	2.28	1.93	0.09
2.29	2.26	0.10	2.29	2.13	0.10	2.29	2.13	0.10	2.29	2.13	0.10	2.29	2.13	0.10
2.30	2.40	0.10	2.30	2.13	0.10	2.30	2.13	0.10	2.30	2.13	0.10	2.30	2.13	0.10
2.31	2.20	0.09	2.31	1.92	0.09	2.31	1.92	0.09	2.31	1.92	0.09	2.31	1.92	0.09
2.32	2.22	0.09	2.32	2.23	0.10	2.32	2.23	0.10	2.32	2.23	0.10	2.32	2.23	0.10
2.33	2.40	0.10	2.33	2.23	0.10	2.33	2.23	0.10	2.33	2.23	0.10	2.33	2.23	0.10
2.34	2.22	0.09	2.34	2.23	0.10	2.34	2.23	0.10	2.34	2.23	0.10	2.34	2.23	0.10
2.35	2.40	0.10	2.35	2.28	0.10	2.35	2.28	0.10	2.35	2.28	0.10	2.35	2.28	0.10
2.36	2.19	0.09	2.36	2.11	0.09	2.36	2.11	0.09	2.36	2.11	0.09	2.36	2.11	0.09
2.37	2.41	0.09	2.37	2.11	0.09	2.37	2.11	0.09	2.37	2.11	0.09	2.37	2.11	0.09
2.38	2.31	0.09	2.38	2.03	0.10	2.38	2.03	0.10	2.38	2.03	0.10	2.38	2.03	0.10
2.39	2.72	0.10	2.39	2.07	0.10	2.39	2.07	0.10	2.39	2.07	0.10	2.39	2.07	0.10
2.40	2.22	0.09	2.40	2.07	0.10	2.40	2.07	0.10	2.40	2.07	0.10	2.40	2.07	0.10
2.41	2.21	0.09	2.41	2.09	0.10	2.41	2.09	0.10	2.41	2.09	0.10	2.41	2.09	0.10
2.42	2.32	0.09	2.42	2.08	0.10	2.42	2.08	0.10	2.42	2.08	0.10	2.42	2.08	0.10
2.43	2.23	0.09	2.43	1.72	0.08	2.43	1.72	0.08	2.43	1.72	0.08	2.43	1.72	0.08
2.44	1.35	0.07	2.44	1.34	0.07	2.44	1.34	0.07	2.44	1.34	0.07	2.44	1.34	0.07
2.45	1.39	0.07	2.45	1.43	0.08	2.45	1.43	0.08	2.45	1.43	0.08	2.45	1.43	0.08
2.46	2.23	0.07	2.46	1.43	0.08	2.46	1.43	0.08	2.46	1.43	0.08	2.46	1.43	0.08
2.47	1.02	0.06	2.47	1.03	0.07	2.47	1.03	0.07	2.47	1.03	0.07	2.47	1.03	0.07
2.48	1.26	0.06	2.48	1.38	0.08	2.48	1.38	0.08	2.48	1.38	0.08	2.48	1.38	0.08
2.49	1.14	0.06	2.49	0.82	0.06	2.49	0.82	0.06	2.49	0.82	0.06	2.49	0.82	0.06
2.50	0.92	0.06	2.50	0.68	0.05	2.50	0.68	0.05	2.50	0.68	0.05	2.50	0.68	0.05
2.51	1.26	0.07	2.51	1.81	0.09	2.51	1.81	0.09	2.51	1.81	0.09	2.51	1.81	0.09
2.52	1.44	0.07	2.52	0.77	0.05	2.52	0.77	0.05	2.52	0.77	0.05	2.52	0.77	0.05
2.53	0.97	0.06	2.53	0.65	0.05	2.53	0.65	0.05	2.53	0.65	0.05	2.53	0.65	0.05
2.54	1.05	0.06	2.54	0.51	0.04	2.54	0.51	0.04	2.54	0.51	0.04	2.54	0.51	0.04
2.55	0.43	0.03	2.55	0.46	0.04	2.55	0.46	0.04	2.55	0.46	0.04	2.55	0.46	0.04
2.56	0.66	0.05	2.56	0.52	0.05	2.56	0.52	0.05	2.56	0.52	0.05	2.56	0.52	0.05
2.57	0.66	0.05	2.57	0.52	0.05	2.57	0.52	0.05	2.57	0.52	0.05	2.57	0.52	0.05
2.58	0.66	0.05	2.58	0.52	0.05	2.58	0.52	0.05	2.58	0.52	0.05	2.58	0.52	0.05
2.59	0.66	0.05	2.59	0.52	0.05	2.59	0.52	0.05	2.59	0.52	0.05	2.59	0.52	0.05
2.60	0.66	0.05	2.60	0.52	0.05	2.60	0.52	0.05	2.60	0.52	0.05	2.60	0.52	0.05
2.61	0.66	0.05	2.61	0.52	0.05	2.61	0.52	0.05	2.61	0.52	0.05	2.61	0.52	0.05
2.62	0.66	0.05	2.62	0.52	0.05	2.62	0.52	0.05	2.62	0.52	0.05	2.62	0.52	0.05
2.63	0.66	0.05	2.63	0.52	0.05	2.63	0.52	0.05	2.63	0.52	0.05	2.63	0.52	0.05
2.64	0.66	0.05	2.64	0.52	0.05	2.64	0.52	0.05	2.64	0.52	0.05	2.64	0.52	0.05
2.65	0.66	0.05	2.65	0.52	0.05	2.65	0.52	0.05	2.65	0.52	0.05	2.65	0.52	0.05
2.66	0.66	0.05	2.66	0.52	0.05	2.66	0.52	0.05	2.66	0.52	0.05	2.66	0.52	0.05
2.67	0.66	0.05	2.67	0.52	0.05	2.67	0.52	0.05	2.67	0.52	0.05	2.67	0.52	0.05
2.68	0.66	0.05	2.68	0.52	0.05	2.68	0.52	0.05	2.68	0.52	0.05	2.68	0.52	0.05
2.69	0.66	0.05	2.69	0.52	0.05	2.69	0.52	0.05	2.69	0.52	0.05	2.69	0.52	0.05
2.70	0.66	0.05	2.70	0.52	0.05	2.70	0.52	0.05	2.70	0.52	0.05	2.70	0.52	0.05
2.71	0.66	0.05	2.71	0.52	0.05	2.71	0.52	0.05	2.71	0.52	0.05	2.71	0.52	0.05
2.72	0.66	0.05	2.72	0.52	0.05	2.72	0.52	0.05	2.72	0.52	0.05	2.72	0.52	0.05
2.73	0.66	0.05	2.73	0.52	0.05	2.73	0.52	0.05	2.73	0.52	0.05	2.73	0.52	0.05
2.74	0.66	0.05	2.74	0.52	0.05	2.74	0.52	0.05	2.74	0.52	0.05	2.74	0.52	0.05
2.75	0.66	0.05	2.75	0.52	0.05	2.75	0.52	0.05	2.75	0.52	0.05	2.75	0.52	0.05
2.76	0.66	0.05	2.76	0.52	0.05	2.76	0.52	0.05	2.76	0.52	0.05	2.76	0.52	0.05
2.77	0.66	0.05	2.77	0.52	0.05	2.77	0.52	0.05	2.77	0.52	0.05	2.77	0.52	0.05
2.78	0.66	0.05	2.78	0.52	0.05	2.78	0.52	0.05	2.78	0.52	0.05	2.78	0.52	0.05
2.79	0.66	0.05	2.79	0.52	0.05	2.79	0.52	0.05	2.79	0.52	0.05	2.79	0.52	0.05
2.80	0.66	0.05	2.80	0.52	0.05	2.80	0.52	0.05	2.80	0.52	0.05	2.80	0.52	0.05
2.81	0.66	0.05	2.81	0.52	0.05	2.81	0.52	0.05	2.81	0.52	0.05	2.81	0.52	0.05
2.82	0.66	0.05	2.82	0.52	0.05	2.82	0.52	0.05	2.82	0.52	0.05	2.82	0.52	0.05
2.83	0.66	0.05	2.83	0.52	0.05	2.83	0.52	0.05	2.83	0.52	0.05	2.83	0.52	0.05
2.84	0.66	0.05	2.84	0.52	0.05	2.84	0.52	0.05	2.84	0.52	0.05	2.84	0.52	0.05
2.85	0.66	0.05	2.85	0.52	0.05	2.85	0.52	0.05	2.85	0.52	0.05	2.85	0.52	0.05
2.86	0.66	0.05	2.86	0.52	0.05	2.86	0.52	0.05	2.86	0.52	0.05	2.86	0.52	0.05
2.87	0.66	0.05	2.87	0.52	0.05	2.87	0.52	0.05	2.87</					

Table 29 - Continued

PROTON FROM A - 12 BOMBARDED BY 62 MEV. PROTONS.

35 DEG - RUN 2001			40 DEG - RUN 2033			45 DEG - RUN 7102			50 DEG - RUN 2042			55 DEG - RUN 103		
ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR
1.84	1.70	0.03	1.82	1.89	0.06	2.26	1.84	0.02	1.82	1.77	0.04	2.03	1.50	0.03
2.86	1.84	0.03	2.81	2.03	0.06	3.26	2.04	0.02	2.82	1.89	0.04	3.03	1.61	0.03
3.87	2.12	0.03	3.81	2.14	0.06	4.26	1.92	0.02	3.82	1.98	0.04	4.04	1.57	0.03
4.88	1.83	0.03	4.81	2.09	0.06	5.25	1.76	0.02	4.81	1.71	0.04	5.04	1.36	0.03
5.89	1.79	0.03	5.80	1.92	0.06	6.25	1.59	0.02	5.81	1.63	0.04	6.04	1.27	0.03
6.90	1.65	0.03	6.80	1.80	0.06	7.24	1.43	0.02	6.81	1.50	0.04	7.05	1.11	0.03
7.91	1.50	0.03	7.80	1.70	0.05	8.24	1.32	0.02	7.81	1.37	0.04	8.05	0.97	0.03
8.92	1.258	0.025	8.79	1.706	0.055	9.23	1.260	0.016	8.80	1.387	0.037	9.05	0.776	0.023
9.93	1.312	0.026	9.79	1.343	0.048	10.23	1.106	0.015	9.80	1.056	0.032	10.06	0.819	0.024
10.94	1.241	0.025	10.78	1.278	0.047	11.22	0.993	0.014	10.80	1.074	0.032	11.06	0.738	0.023
11.95	1.256	0.025	11.78	1.287	0.047	12.22	0.936	0.014	11.80	1.003	0.031	12.06	0.727	0.023
12.96	1.187	0.025	12.78	1.206	0.046	13.22	0.919	0.013	12.79	0.976	0.031	13.07	0.686	0.022
13.97	1.193	0.025	13.77	1.308	0.048	14.21	0.888	0.013	13.79	0.974	0.031	14.07	0.682	0.022
14.99	1.161	0.024	14.77	1.136	0.045	15.21	0.933	0.014	14.79	0.924	0.030	15.07	0.678	0.022
16.00	1.141	0.024	15.76	1.214	0.046	16.20	0.899	0.013	15.79	0.949	0.030	16.08	0.651	0.021
17.01	1.149	0.024	16.76	1.238	0.047	17.20	0.898	0.013	16.78	0.883	0.029	17.08	0.634	0.021
18.02	1.164	0.024	17.76	1.231	0.046	18.19	0.884	0.013	17.78	0.980	0.031	18.08	0.648	0.021
19.03	1.15	0.02	18.75	1.14	0.04	19.19	0.87	0.01	18.78	0.96	0.03	19.09	0.58	0.06
20.04	1.18	0.02	19.75	1.05	0.04	20.18	0.88	0.01	19.78	1.05	0.03	20.09	0.57	0.06
21.05	1.17	0.02	20.75	1.28	0.05	21.18	0.87	0.01	20.78	0.99	0.03	21.09	0.56	0.06
22.06	1.18	0.02	21.74	1.19	0.05	22.18	0.87	0.01	21.77	0.92	0.03	22.10	0.51	0.05
23.07	1.159	0.024	22.74	1.108	0.044	23.17	0.850	0.013	22.77	0.867	0.080	23.10	0.550	0.020
24.08	1.137	0.024	23.73	1.110	0.044	24.17	0.849	0.013	23.77	0.830	0.130	24.10	0.491	0.019
25.09	1.162	0.024	24.73	1.163	0.045	25.16	0.813	0.013	24.77	0.790	0.130	25.11	0.509	0.019
26.10	1.126	0.024	25.73	1.098	0.044	26.16	0.837	0.013	25.76	0.750	0.130	26.11	0.503	0.019
27.11	1.190	0.025	26.72	1.096	0.044	27.15	0.801	0.013	26.76	0.703	0.040	27.11	0.487	0.019
28.13	1.171	0.024	27.72	1.045	0.043	28.15	0.835	0.013	27.76	0.671	0.026	28.12	0.462	0.018
29.14	1.135	0.024	28.72	1.025	0.042	29.14	0.807	0.013	28.76	0.621	0.025	29.12	0.488	0.019
30.15	1.215	0.025	29.71	1.089	0.044	30.14	0.784	0.013	29.75	0.655	0.025	30.12	0.454	0.018
31.16	1.197	0.025	30.71	1.096	0.044	31.14	0.775	0.013	30.75	0.587	0.024	31.13	0.422	0.017
32.17	1.272	0.025	31.70	1.351	0.049	32.13	0.735	0.011	31.75	0.528	0.013	32.13	0.439	0.016
33.18	1.215	0.025	32.70	1.373	0.049	33.13	0.666	0.011	32.75	0.532	0.023	33.13	0.345	0.015
34.19	1.156	0.024	33.70	1.042	0.043	34.12	0.620	0.011	33.74	0.549	0.023	34.14	0.339	0.015
35.20	1.011	0.023	34.69	0.725	0.070	35.12	0.634	0.011	34.74	0.484	0.022	35.14	0.364	0.016
36.21	1.074	0.023	35.69	0.725	0.140	36.11	0.782	0.012	35.74	0.485	0.022	36.14	0.470	0.018
37.22	1.090	0.024	36.69	0.725	0.140	37.11	0.856	0.013	36.74	0.608	0.024	37.15	0.446	0.018
38.23	1.404	0.027	37.68	0.907	0.080	38.10	0.821	0.013	37.73	0.631	0.025	38.15	0.526	0.019
39.24	1.362	0.026	38.68	0.865	0.039	39.10	0.761	0.012	38.73	0.655	0.025	39.15	0.397	0.017
40.26	1.818	0.070	39.67	1.083	0.043	40.10	0.583	0.011	39.73	0.591	0.024	40.16	0.165	0.011
41.27	0.677	0.220	40.67	0.904	0.040	41.09	0.331	0.008	40.73	0.370	0.019	41.16	0.231	0.013
42.28	0.415	0.140	41.67	0.680	0.034	42.09	0.556	0.010	41.72	0.280	0.017	42.16	0.266	0.014
43.29	0.640	0.018	42.66	0.475	0.029	43.08	0.563	0.011	42.72	0.404	0.020	43.17	0.302	0.015
44.30	1.033	0.023	43.66	0.844	0.038	44.08	0.498	0.010	43.72	0.406	0.020	44.17	0.233	0.013
45.31	1.039	0.023	44.65	0.789	0.037	45.07	0.532	0.010	44.72	0.349	0.018	45.17	0.271	0.014
46.32	0.611	0.018	45.65	0.597	0.032	46.07	0.363	0.008	45.72	0.428	0.020	46.17	0.209	0.012
47.33	0.645	0.018	46.65	0.603	0.032	47.06	0.462	0.010	46.71	0.275	0.016	47.18	0.260	0.014
48.34	0.46	0.02	47.64	0.54	0.03	48.06	2.11	0.02	47.71	0.35	0.02	48.18	0.89	0.03
49.35	0.681	0.019	48.64	0.543	0.031	49.06	0.349	0.008	48.71	1.416	0.037	49.18	0.035	0.005
50.36	3.006	0.039	49.64	2.613	0.068	50.05	0.387	0.009	49.71	0.078	0.009	50.19	0.148	0.010
51.37	0.188	0.010	50.63	0.262	0.021	51.05	0.054	0.003	50.70	0.258	0.016	51.19	0.007	0.002
52.38	0.941	0.022	51.63	0.620	0.033	52.04	0.014	0.002	51.70	0.041	0.006	52.19	0.022	0.004
53.39	0.08	0.01	52.62	0.09	0.01	53.04	1.77	0.02	52.70	0.04	0.01	53.15	1.56	0.03
54.41	0.163	0.009	53.62	0.085	0.012	54.31	4.417	0.040	53.70	1.981	0.044	54.0	0.0	0.0
55.42	3.395	0.069	54.62	3.057	0.073	55.36	0.0	0.0	54.24	0.056	0.023	55.0	0.0	0.0
56.02	0.178	0.021	55.36	5.439	0.138	0.0	0.0	0.0	0.0	0.0	0.0	56.0	0.0	0.0

Table 29 - Continued

PROTON FROM A - 12 BOMBARDED BY 62 MEV. PROTONS.

60 DEG - RUN 7115			65 DEG - RUN 105			70 DEG - RUN 2032			75 DEG - RUN 2017			80 DEG - RUN 112		
ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR
2.27	1.77	0.02	2.03	1.53	0.04	1.83	1.53	0.04	1.89	1.73	0.10	1.89	1.49	0.22
3.27	1.91	0.02	3.03	1.68	0.05	2.83	1.68	0.05	2.90	1.88	0.30	2.89	1.47	0.22
4.27	1.70	0.02	4.03	1.75	0.05	3.83	1.75	0.05	3.91	1.85	0.30	3.90	1.24	0.04
5.27	1.53	0.01	5.03	1.55	0.04	4.83	1.55	0.04	4.91	1.51	0.10	4.90	1.08	0.03
6.26	1.319	0.014	6.04	1.348	0.260	5.83	1.348	0.260	5.92	1.205	0.018	5.91	0.871	0.024
7.26	1.173	0.013	7.04	0.999	0.200	6.83	0.999	0.200	6.93	1.069	0.017	6.91	0.738	0.022
8.26	1.062	0.012	8.04	0.757	0.080	7.83	0.757	0.080	7.94	0.930	0.016	7.92	0.579	0.019
9.26	1.012	0.011	9.04	0.885	0.034	8.83	0.885	0.034	8.94	0.844	0.015	8.92	0.525	0.019
10.26	0.864	0.011	10.04	0.590	0.028	9.83	0.590	0.028	9.95	0.659	0.014	9.93	0.523	0.019
11.25	0.785	0.011	11.04	0.630	0.060	10.83	0.630	0.060	10.96	0.647	0.013	10.93	0.453	0.017
12.25	0.749	0.020	12.05	0.585	0.030	11.83	0.585	0.030	11.97	0.603	0.013	11.94	0.458	0.017
13.25	0.729	0.070	13.05	0.563	0.020	12.83	0.563	0.020	12.98	0.576	0.013	12.94	0.426	0.017
14.25	0.702	0.070	14.05	0.551	0.02	13.83	0.536	0.026	13.94	0.521	0.012	13.95	0.391	0.016
15.25	0.675	0.070	15.05	0.519	0.019	14.83	0.490	0.025	14.99	0.529	0.012	14.96	0.347	0.015
16.25	0.652	0.050	16.05	0.503	0.019	15.83	0.488	0.025	16.00	0.494	0.012	15.96	0.365	0.015
17.25	0.634	0.010	17.05	0.484	0.018	16.83	0.489	0.025	17.01	0.457	0.011	16.97	0.347	0.015
18.24	0.583	0.009	18.06	0.469	0.018	17.84	0.441	0.023	18.01	0.437	0.011	17.97	0.319	0.014
19.24	0.588	0.009	19.06	0.474	0.018	18.84	0.444	0.024	19.02	0.425	0.011	18.98	0.278	0.014
20.24	0.581	0.009	20.06	0.410	0.017	19.84	0.385	0.022	20.03	0.389	0.010	19.98	0.271	0.013
21.24	0.577	0.009	21.06	0.406	0.017	20.84	0.387	0.022	21.04	0.372	0.010	20.99	0.281	0.014
22.24	0.548	0.009	22.06	0.430	0.017	21.84	0.422	0.023	22.04	0.360	0.010	21.99	0.245	0.013
23.23	0.528	0.009	23.06	0.389	0.017	22.84	0.343	0.021	23.05	0.362	0.010	23.00	0.213	0.012
24.23	0.509	0.009	24.07	0.383	0.016	23.84	0.316	0.020	24.06	0.319	0.009	24.00	0.227	0.012
25.23	0.481	0.008	25.07	0.363	0.016	24.84	0.330	0.021	25.07	0.300	0.009	25.01	0.236	0.012
26.23	0.482	0.008	26.07	0.359	0.016	25.84	0.351	0.021	26.08	0.282	0.009	26.02	0.206	0.011
27.23	0.480	0.008	27.07	0.341	0.015	26.84	0.299	0.020	27.08	0.280	0.009	27.02	0.192	0.011
28.23	0.457	0.008	28.07	0.323	0.015	27.84	0.351	0.021	28.09	0.260	0.009	28.03	0.168	0.011
29.22	0.421	0.008	29.07	0.322	0.015	28.84	0.351	0.021	29.10	0.234	0.008	29.03	0.153	0.010
30.22	0.414	0.008	30.07	0.305	0.015	29.84	0.244	0.018	30.11	0.219	0.008	30.04	0.131	0.009
31.22	0.400	0.008	31.08	0.282	0.014	30.84	0.264	0.018	31.11	0.194	0.007	31.05	0.126	0.009
32.22	0.342	0.007	32.08	0.228	0.013	31.84	0.203	0.016	32.12	0.186	0.007	32.05	0.119	0.009
33.22	0.329	0.007	33.08	0.278	0.014	32.84	0.202	0.016	33.13	0.186	0.007	33.06	0.145	0.010
34.22	0.394	0.008	34.08	0.266	0.014	33.84	0.235	0.017	34.14	0.213	0.008	34.06	0.168	0.010
35.21	0.453	0.008	35.08	0.304	0.015	34.84	0.299	0.020	35.15	0.198	0.007	35.06	0.155	0.009
36.21	0.434	0.008	36.09	0.281	0.014	35.85	0.270	0.019	36.15	0.232	0.008	36.07	0.115	0.009
37.21	0.473	0.008	37.09	0.308	0.015	36.85	0.256	0.018	37.16	0.163	0.007	37.08	0.059	0.006
38.21	0.326	0.007	38.09	0.238	0.013	37.85	0.184	0.015	38.17	0.077	0.005	38.08	0.080	0.007
39.21	0.140	0.004	39.09	0.099	0.008	38.85	0.086	0.011	39.18	0.119	0.006	39.09	0.096	0.008
40.21	0.231	0.006	40.09	0.139	0.010	39.85	0.143	0.014	40.18	0.145	0.006	40.09	0.115	0.009
41.20	0.252	0.006	41.09	0.172	0.011	40.85	0.136	0.013	41.19	0.156	0.007	41.10	0.097	0.008
42.20	0.292	0.006	42.10	0.207	0.012	41.85	0.223	0.017	42.20	0.142	0.006	42.10	0.080	0.007
43.20	0.262	0.006	43.10	0.178	0.011	42.85	0.133	0.013	43.21	0.096	0.005	43.11	0.065	0.013
44.20	0.206	0.005	44.10	0.146	0.010	43.85	0.137	0.013	44.22	0.092	0.005	44.11	0.255	0.003
45.20	0.218	0.006	45.10	0.147	0.010	44.85	0.126	0.013	45.22	0.329	0.010	45.12	0.011	0.003
46.19	0.771	0.011	46.10	0.147	0.010	45.85	0.430	0.024	46.23	0.017	0.002	46.12	0.015	0.003
47.19	0.207	0.005	47.11	0.132	0.010	46.85	0.045	0.008	47.24	0.028	0.003	47.13	0.002	0.001
48.19	0.135	0.004	48.11	0.073	0.007	47.85	0.051	0.008	48.25	0.009	0.002	48.13	0.001	0.001
49.19	0.021	0.002	49.11	0.012	0.003	48.85	0.012	0.004	49.25	0.008	0.002	49.14	0.209	0.012
50.19	0.004	0.001	50.11	0.005	0.002	49.85	0.008	0.003	50.26	0.008	0.010	49.72	0.013	0.007
51.19	0.739	0.010	51.11	0.546	0.020	50.85	0.427	0.024	50.89	0.007	0.003	0.0	0.0	0.0
51.93	0.839	0.015	51.76	0.571	0.037	51.48	0.070	0.019	0.0	0.0	0.0	0.0	0.0	0.0

Table 29 - Continued

PROTON FROM A = 12 BOMBARDED BY 62 MEV. PROTONS.											
90 DEG - RUN 2023				110 DEG - RUN 7113				135 DEG - RUN 2055			
ENERGY (MEV)	SIGMA (NB/SR-MEV)	ERROR		ENERGY (MEV)	SIGMA (NB/SR-MEV)	ERROR		ENERGY (MEV)	SIGMA (NB/SR-MEV)	ERROR	
2.07	1.510	0.024		2.13	1.482	0.014		2.01	1.418	0.023	
3.06	1.531	0.024		3.13	1.402	0.014		3.01	1.245	0.021	
4.06	1.297	0.022		4.14	1.107	0.012		4.00	1.050	0.020	
5.05	1.076	0.020		5.14	0.891	0.011		5.00	0.825	0.017	
6.05	0.887	0.018		6.14	0.705	0.010		5.99	0.664	0.016	
7.04	0.770	0.017		7.14	0.587	0.009		6.99	0.530	0.014	
8.04	0.707	0.016		8.14	0.524	0.008		7.99	0.456	0.013	
9.03	0.611	0.015		9.15	0.520	0.008		8.97	0.392	0.012	
10.03	0.463	0.013		10.15	0.403	0.007		9.97	0.264	0.010	
11.02	0.441	0.013		11.15	0.343	0.007		10.96	0.272	0.010	
12.02	0.432	0.013		12.15	0.307	0.006		11.96	0.270	0.010	
13.01	0.374	0.012		13.16	0.281	0.006		12.95	0.248	0.009	
14.01	0.371	0.012		14.16	0.262	0.006		13.95	0.215	0.009	
15.00	0.332	0.011		15.16	0.243	0.006		14.94	0.228	0.009	
16.00	0.315	0.011		16.16	0.217	0.005		15.94	0.196	0.008	
16.99	0.315	0.011		17.17	0.197	0.005		16.93	0.168	0.008	
17.99	0.294	0.010		18.17	0.172	0.005		17.92	0.152	0.007	
18.98	0.245	0.010		19.17	0.169	0.005		18.92	0.141	0.007	
19.98	0.251	0.010		20.17	0.150	0.005		19.91	0.142	0.007	
20.97	0.211	0.009		21.18	0.136	0.004		20.91	0.102	0.006	
21.97	0.215	0.009		22.18	0.126	0.004		21.90	0.102	0.006	
22.97	0.181	0.008		23.18	0.107	0.004		22.90	0.085	0.006	
23.96	0.182	0.008		24.18	0.103	0.004		23.89	0.079	0.005	
24.96	0.159	0.008		25.19	0.076	0.003		24.88	0.067	0.005	
25.95	0.139	0.007		26.19	0.076	0.003		25.88	0.059	0.005	
26.95	0.143	0.007		27.19	0.074	0.003		26.87	0.056	0.005	
27.94	0.117	0.007		28.19	0.073	0.003		27.87	0.052	0.004	
28.94	0.110	0.006		29.20	0.071	0.003		28.86	0.035	0.003	
29.93	0.091	0.006		30.20	0.072	0.003		29.86	0.022	0.003	
30.93	0.092	0.006		31.20	0.064	0.003		30.85	0.020	0.003	
31.92	0.100	0.006		32.20	0.057	0.003		31.85	0.020	0.003	
32.92	0.106	0.006		33.21	0.026	0.002		32.84	0.023	0.003	
33.91	0.099	0.006		34.21	0.031	0.002		33.83	0.008	0.002	
34.91	0.099	0.006		35.21	0.030	0.002		34.81	0.008	0.002	
35.90	0.048	0.004		36.21	0.036	0.002		35.81	0.004	0.002	
36.90	0.053	0.004		37.22	0.026	0.002		36.82	0.014	0.002	
37.89	0.075	0.005		38.22	0.009	0.001		37.81	0.003	0.001	
38.89	0.076	0.005		39.22	0.011	0.001		38.81	0.000	0.000	
39.88	0.073	0.005		40.22	0.019	0.002		39.80	0.000	0.000	
40.88	0.050	0.004		41.23	0.010	0.001		40.75	0.032	0.004	
41.87	0.026	0.003		42.23	0.002	0.001		41.0	0.0	0.0	
42.87	0.076	0.005		43.23	0.001	0.000		42.51	0.0	0.0	
43.86	0.043	0.004		44.23	0.031	0.002		43.0	0.0	0.0	
44.86	0.016	0.002		45.11	0.000	0.000		44.0	0.0	0.0	
45.86	0.003	0.001		46.0	0.0	0.0		45.0	0.0	0.0	
46.85	0.001	0.001		47.0	0.0	0.0		46.0	0.0	0.0	
47.85	0.000	0.000		48.0	0.0	0.0		47.0	0.0	0.0	
48.47	0.038	0.003		49.0	0.0	0.0		48.0	0.0	0.0	

Table 30

DEUTERON FROM A = 12 BOMBARDED BY 62 MEV. PROTONS.

12 DEG - RUN 121			15 DEG - RUN 114			20 DEG - RUN 206			25 DEG - RUN 2052			30 DEG - RUN 2000		
ENERGY (MEV)	SIGNA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (MB/SR-MEV)	ERROR
1.88	0.48	0.07	1.53	0.49	0.07	1.57	0.36	0.06	4.66	0.55	0.06	1.74	0.50	0.04
2.28	0.55	0.07	1.93	0.54	0.07	1.98	0.42	0.06	5.05	0.50	0.06	2.15	0.44	0.03
2.68	0.55	0.07	2.33	0.54	0.07	2.39	0.46	0.06	5.45	0.40	0.06	2.55	0.48	0.04
3.08	0.51	0.07	2.73	0.45	0.07	2.81	0.41	0.06	5.85	0.58	0.07	2.95	0.49	0.04
3.48	0.51	0.07	3.14	0.44	0.07	3.22	0.38	0.04	6.25	0.41	0.06	3.36	0.43	0.03
3.88	0.50	0.07	3.54	0.58	0.08	3.63	0.42	0.06	6.65	0.46	0.06	3.76	0.50	0.04
4.28	0.58	0.07	3.94	0.57	0.08	4.04	0.53	0.07	7.04	0.49	0.03	4.17	0.53	0.04
4.68	0.58	0.07	4.34	0.53	0.07	4.46	0.55	0.07	7.44	0.49	0.03	4.57	0.51	0.04
5.08	0.52	0.07	4.74	0.55	0.08	4.87	0.47	0.06	7.84	0.37	0.02	4.98	0.52	0.04
5.48	0.54	0.07	5.14	0.62	0.08	5.28	0.45	0.06	8.24	0.30	0.02	5.38	0.43	0.03
5.88	0.64	0.08	5.54	0.47	0.07	5.69	0.44	0.06	8.64	0.28	0.02	5.78	0.44	0.03
6.28	0.58	0.07	5.94	0.41	0.07	6.10	0.55	0.07	9.04	0.30	0.02	6.19	0.39	0.03
6.68	0.50	0.07	6.34	0.41	0.06	6.32	0.47	0.06	9.44	0.29	0.02	6.59	0.40	0.03
7.08	0.522	0.030	6.75	0.483	0.071	7.75	0.463	0.028	9.84	0.323	0.022	6.99	0.398	0.015
7.48	0.432	0.028	7.15	0.462	0.031	7.81	0.395	0.026	10.24	0.278	0.021	7.39	0.343	0.014
7.88	0.456	0.028	7.55	0.469	0.031	8.01	0.320	0.023	10.64	0.305	0.022	7.79	0.304	0.013
8.28	0.331	0.024	7.95	0.365	0.027	8.21	0.369	0.025	11.04	0.278	0.021	8.19	0.300	0.013
8.68	0.357	0.025	8.35	0.395	0.029	8.41	0.362	0.025	11.44	0.251	0.020	8.59	0.274	0.012
9.08	0.403	0.027	8.75	0.358	0.027	8.61	0.351	0.024	11.84	0.271	0.020	8.99	0.275	0.012
9.48	0.370	0.026	9.15	0.344	0.027	8.81	0.335	0.024	12.24	0.212	0.018	9.39	0.281	0.012
9.88	0.367	0.026	9.55	0.325	0.026	9.01	0.359	0.025	12.64	0.185	0.017	9.79	0.283	0.012
10.28	0.391	0.026	9.95	0.368	0.028	9.21	0.352	0.024	13.04	0.342	0.023	10.19	0.271	0.011
10.68	0.373	0.026	10.35	0.399	0.029	9.41	0.304	0.023	13.44	0.663	0.032	10.59	0.233	0.011
11.08	0.371	0.026	10.75	0.314	0.025	9.61	0.327	0.023	13.84	0.578	0.030	10.99	0.234	0.011
11.48	0.399	0.027	11.15	0.320	0.026	9.81	0.325	0.023	14.24	2.772	0.067	11.39	0.212	0.011
11.88	0.379	0.027	11.55	0.343	0.027	10.01	0.294	0.022	14.64	0.0	0.0	11.79	0.234	0.011
12.28	0.241	0.021	11.95	0.355	0.027	10.21	0.323	0.019	15.04	0.0	0.0	12.19	0.150	0.009
12.68	0.459	0.029	12.35	0.291	0.024	10.41	0.386	0.026	15.44	0.0	0.0	12.59	0.293	0.013
13.08	1.174	0.026	12.75	0.215	0.021	10.61	0.663	0.033	15.84	0.0	0.0	12.99	0.518	0.017
13.48	1.864	0.058	13.15	0.393	0.028	10.81	0.588	0.031	16.24	0.0	0.0	13.39	0.124	0.008
13.88	3.33	0.13	13.55	1.044	0.047	11.01	3.620	0.078	16.64	0.0	0.0	13.79	0.943	0.023
14.28	0.039	0.020	13.95	1.64	0.06	11.21	2.20	0.09	17.04	0.0	0.0	14.19	5.61	0.10
			14.35	8.499	0.138	11.41	0.0	0.0	17.44	0.0	0.0	14.59	0.0	0.0

Table 30 - Continued

DEUTERON FROM A = 12 BOMBARDED BY 62 MEV. PROTONS.

35 DEG - RUN 2001	40 DEG - RUN 2033	45 DEG - RUN 7102	50 DEG - RUN 2042	55 DEG - RUN 103
ENERGY (MEV)	ENERGY (MEV)	ENERGY (MEV)	ENERGY (MEV)	ENERGY (MEV)
1.74	1.57	2.12	1.57	1.68
2.15	1.97	2.51	1.97	2.08
2.55	2.37	2.91	2.37	2.48
2.96	2.76	3.31	2.77	2.88
3.36	3.16	3.71	3.17	3.29
3.77	3.56	4.11	3.57	3.69
4.17	3.96	4.50	3.97	4.09
4.57	4.36	4.90	4.36	4.49
4.98	4.76	5.30	4.76	4.89
5.38	5.16	5.70	5.16	5.29
5.79	5.55	6.10	5.56	5.69
6.19	5.95	6.50	5.96	6.09
6.60	6.35	6.90	6.36	6.50
7.01	6.75	7.30	6.76	7.00
7.41	7.14	7.69	7.16	7.71
7.82	7.54	8.09	7.56	8.11
8.22	7.94	8.49	7.96	8.51
8.63	8.34	8.89	8.36	8.91
9.03	8.74	9.29	8.76	9.31
9.44	9.14	9.69	9.16	9.71
9.84	9.54	10.09	9.56	10.11
10.25	9.94	10.49	9.96	10.51
10.65	10.34	10.89	10.36	10.91
11.05	10.74	11.29	10.76	11.31
11.46	11.14	11.69	11.16	11.71
11.86	11.54	12.09	11.56	12.11
12.26	11.94	12.49	11.96	12.51
12.67	12.34	12.89	12.36	12.91
13.07	12.74	13.29	12.76	13.31
13.47	13.14	13.69	13.16	13.71
13.88	13.54	14.09	13.56	14.11
14.28	13.94	14.49	13.96	14.51
14.68	14.34	14.89	14.36	14.91
15.09	14.74	15.29	14.76	15.31
15.49	15.14	15.69	15.16	15.71
15.89	15.54	16.09	15.56	16.11
16.30	15.94	16.49	15.96	16.51
16.70	16.34	16.89	16.36	16.91
17.10	16.74	17.29	16.76	17.31
17.51	17.14	17.69	17.16	17.71
17.91	17.54	18.09	17.56	18.11
18.31	17.94	18.49	17.96	18.51
18.72	18.34	18.89	18.36	18.91
19.12	18.74	19.29	18.76	19.31
19.52	19.14	19.69	19.16	19.71
19.93	19.54	20.09	19.56	20.11
20.33	19.94	20.49	19.96	20.51
20.73	20.34	20.89	20.36	20.91
21.14	20.74	21.29	20.76	21.31
21.54	21.14	21.69	21.16	21.71
21.94	21.54	22.09	21.56	22.11
22.35	21.94	22.49	21.96	22.51
22.75	22.34	22.89	22.36	22.91
23.15	22.74	23.29	22.76	23.31
23.56	23.14	23.69	23.16	23.71
23.96	23.54	24.09	23.56	24.11
24.36	23.94	24.49	23.96	24.51
24.77	24.34	24.89	24.36	24.91
25.17	24.74	25.29	24.76	25.31
25.57	25.14	25.69	25.16	25.71
25.98	25.54	26.09	25.56	26.11
26.38	25.94	26.49	25.96	26.51
26.78	26.34	26.89	26.36	26.91
27.19	26.74	27.29	26.76	27.31
27.59	27.14	27.69	27.16	27.71
27.99	27.54	28.09	27.56	28.11
28.40	27.94	28.49	27.96	28.51
28.80	28.34	28.89	28.36	28.91
29.20	28.74	29.29	28.76	29.31
29.61	29.14	29.69	29.16	29.71
30.01	29.54	30.09	29.56	30.11
30.41	29.94	30.49	29.96	30.51
30.82	30.34	30.89	30.36	30.91
31.22	30.74	31.29	30.76	31.31
31.62	31.14	31.69	31.16	31.71
32.03	31.54	32.09	31.56	32.11
32.43	31.94	32.49	31.96	32.51
32.83	32.34	32.89	32.36	32.91
33.24	32.74	33.29	32.76	33.31
33.64	33.14	33.69	33.16	33.71
34.04	33.54	34.09	33.56	34.11
34.45	33.94	34.49	33.96	34.51
34.85	34.34	34.89	34.36	34.91
35.25	34.74	35.29	34.76	35.31
35.66	35.14	35.69	35.16	35.71
36.06	35.54	36.09	35.56	36.11
36.46	35.94	36.49	35.96	36.51
36.87	36.34	36.89	36.36	36.91
37.27	36.74	37.29	36.76	37.31
37.67	37.14	37.69	37.16	37.71
38.07	37.54	38.09	37.56	38.11
38.48	37.94	38.49	37.96	38.51
38.88	38.34	38.89	38.36	38.91
39.28	38.74	39.29	38.76	39.31
39.68	39.14	39.69	39.16	39.71
40.09	39.54	40.09	39.56	40.11
40.49	39.94	40.49	39.96	40.51
40.89	40.34	40.89	40.36	40.91
41.30	40.74	41.30	40.76	41.31
41.70	41.14	41.70	41.16	41.71
42.10	41.54	42.10	41.56	42.11
42.51	41.94	42.51	41.96	42.51
42.91	42.34	42.91	42.36	42.91
43.31	42.74	43.31	42.76	43.31
43.72	43.14	43.72	43.16	43.71
44.12	43.54	44.12	43.56	44.11
44.52	43.94	44.52	43.96	44.51
44.93	44.34	44.93	44.36	44.91
45.33	44.74	45.33	44.76	45.31
45.73	45.14	45.73	45.16	45.71
46.14	45.54	46.14	45.56	46.11
46.54	45.94	46.54	45.96	46.51
46.94	46.34	46.94	46.36	46.91
47.35	46.74	47.35	46.76	47.31
47.75	47.14	47.75	47.16	47.71
48.15	47.54	48.15	47.56	48.11
48.56	47.94	48.56	47.96	48.51
48.96	48.34	48.96	48.36	48.91
49.36	48.74	49.36	48.76	49.31
49.77	49.14	49.77	49.16	49.71
50.17	49.54	50.17	49.56	50.11
50.57	49.94	50.57	49.96	50.51
50.98	50.34	50.98	50.36	50.91
51.38	50.74	51.38	50.76	51.31
51.78	51.14	51.78	51.16	51.71
52.19	51.54	52.19	51.56	52.11
52.59	51.94	52.59	51.96	52.51
52.99	52.34	52.99	52.36	52.91
53.39	52.74	53.39	52.76	53.31
53.80	53.14	53.80	53.16	53.71
54.20	53.54	54.20	53.56	54.11
54.60	53.94	54.60	53.96	54.51
55.01	54.34	55.01	54.36	54.91
55.41	54.74	55.41	54.76	55.31
55.81	55.14	55.81	55.16	55.71
56.22	55.54	56.22	55.56	56.11
56.62	55.94	56.62	55.96	56.51
57.02	56.34	57.02	56.36	56.91
57.43	56.74	57.43	56.76	57.31
57.83	57.14	57.83	57.16	57.71
58.23	57.54	58.23	57.56	58.11
58.64	57.94	58.64	57.96	58.51
59.04	58.34	59.04	58.36	58.91
59.44	58.74	59.44	58.76	59.31
59.85	59.14	59.85	59.16	59.71
60.25	59.54	60.25	59.56	60.11
60.65	59.94	60.65	59.96	60.51
61.06	60.34	61.06	60.36	60.91
61.46	60.74	61.46	60.76	61.31
61.86	61.14	61.86	61.16	61.71
62.27	61.54	62.27	61.56	62.11
62.67	61.94	62.67	61.96	62.51
63.07	62.34	63.07	62.36	62.91
63.48	62.74	63.48	62.76	63.31
63.88	63.14	63.88	63.16	63.71
64.28	63.54	64.28	63.56	64.11
64.68	63.94	64.68	63.96	64.51
65.09	64.34	65.09	64.36	64.91
65.49	64.74	65.49	64.76	65.31
65.89	65.14	65.89	65.16	65.71
66.30	65.54	66.30	65.56	66.11
66.70	65.94	66.70	65.96	66.51
67.10	66.34	67.10	66.36	66.91
67.51	66.74	67.51	66.76	67.31
67.91	67.14	67.91	67.16	67.71
68.31	67.54	68.31	67.56	68.11
68.72	67.94	68.72	67.96	68.51
69.12	68.34	69.12	68.36	68.91
69.52	68.74	69.52	68.76	69.31
69.93	69.14	69.93	69.16	69.71
70.33	69.54	70.33	69.56	70.11
70.73	69.94	70.73	69.96	70.51
71.14	70.34	71.14	70.36	70.91
71.54	70.74	71.54	70.76	71.31
71.94	71.14	71.94	71.16	71.71
72.35	71.54	72.35	71.56	72.11
72.75	71.94	72.75	71.96	72.51
73.15	72.34	73.15	72.36	72.91
73.56	72.74	73.56	72.76	73.31
73.96	73.14	73.96	73.16	73.71
74.36	73.54	74.36	73.56	74.11
74.77	73.94	74.77	73.96	74.51
75.17	74.34	75.17	74.36	74.91
75.57	74.74	75.57	74.76	75.31
75.98	75.14	75.98	75.16	75.71
76.38	75.54	76.38	75.56	76.11
76.78	75.94	76.78	75.96	76.51
77.19	76.34	77.19	76.36	76.91
77.59	76.74	77.59	76.76	77.31
77.99	77.14	77.99	77.16	77.71
78.40	77.54	78.40	77.56	78.11
78.80	77.94	78.80	77.96	78.51
79.20	78.34	79.20	78.36	78.91
79.61	78.74	79.61	78.76	79.31
80.01	79.14	80.01	79.16	79.71
80.41	79.54	80.41	79.56	80.11
80.82	79.94	80.82	79.96	80.51
81.22	80.34	81.22	80.36	80.91
81.62	80.74	81.62	80.76	81.31
82.03	81.14	82.03	81.16	81.71
82.43	81.54	82.43	81.56	82.11
82.83	81.94	82.83	81.96	82.51
83.24	82.34	83.24	82.36	82.91
83.64	82.74	83.64	82.76	83.31
84.04	83.14	84.04	83.16	83.71
84.45	83.54	84.45	83.56	84.11
84.85	83.94	84.85	83.96	84.51
85.25	84.34	85.25	84.36	84.91
85.66	84.74	85.66	84.76	85.31
86.06	85.14	86.06	85.16	85.71
86.46	85.54	86.46	85.56	86.11
86.87	85.94	86.87	85.96	86.51
87.27	86.34	87.27	86.36	86.91
87.67	86.74	87.67	86.76	87.31
88.08	87.14	88.08	87.16	87.71
88.48	87.54	88.48	87.56	88.11
88.88	87.94	88.88	87.96	88.51
89.28	88.34	89.28	88.3	

Table 30 - Continued

DEUTERON FROM A - 12 BOMBARDED BY 62 MEV. PROTONS.

60 DEG - RUN 7115			65 DEG - RUN 105			70 DEG - RUN 2032			75 DEG - RUN 2017			80 DEG - RUN 112		
ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR
2.12	0.371	0.012	1.73	0.320	0.024	1.58	0.321	0.032	1.59	0.325	0.015	1.58	0.279	0.021
2.52	0.372	0.012	2.13	0.291	0.023	1.98	0.297	0.031	1.99	0.337	0.015	1.99	0.303	0.022
2.92	0.370	0.012	2.53	0.303	0.023	2.38	0.313	0.032	2.39	0.344	0.016	2.39	0.273	0.021
3.32	0.371	0.012	2.93	0.264	0.022	2.78	0.294	0.031	2.80	0.315	0.015	2.79	0.227	0.019
3.72	0.359	0.011	3.33	0.268	0.022	3.18	0.324	0.032	3.20	0.288	0.014	3.19	0.221	0.019
4.12	0.342	0.011	3.73	0.293	0.023	3.58	0.273	0.030	3.60	0.281	0.014	3.59	0.219	0.019
4.52	0.341	0.011	4.13	0.301	0.023	3.98	0.285	0.030	4.01	0.277	0.014	4.00	0.229	0.019
4.92	0.311	0.011	4.53	0.296	0.023	4.38	0.298	0.031	4.41	0.276	0.014	4.40	0.239	0.020
5.32	0.292	0.010	4.93	0.209	0.019	4.78	0.311	0.032	4.81	0.285	0.014	4.80	0.182	0.017
5.72	0.293	0.010	5.33	0.238	0.020	5.18	0.264	0.029	5.22	0.255	0.013	5.20	0.154	0.016
6.11	0.273	0.010	5.73	0.212	0.019	5.58	0.234	0.028	5.62	0.255	0.013	5.61	0.203	0.018
6.51	0.271	0.010	6.14	0.219	0.020	5.98	0.282	0.030	6.02	0.221	0.012	6.01	0.155	0.016
7.71	0.229	0.004	6.54	0.222	0.020	6.38	0.218	0.027	6.42	0.211	0.012	6.4	0.182	0.017
9.71	0.198	0.004	7.74	0.180	0.008	7.58	0.203	0.026	7.63	0.182	0.005	7.62	0.140	0.007
11.70	0.181	0.004	9.74	0.157	0.007	9.58	0.171	0.011	9.65	0.175	0.005	9.63	0.126	0.006
13.70	0.162	0.003	11.74	0.124	0.007	11.58	0.147	0.010	11.66	0.141	0.004	11.64	0.094	0.006
15.70	0.138	0.003	13.75	0.121	0.007	13.58	0.124	0.009	13.68	0.095	0.004	13.65	0.089	0.005
17.69	0.126	0.003	15.75	0.106	0.006	15.58	0.099	0.008	15.70	0.082	0.003	15.66	0.077	0.005
19.69	0.110	0.003	17.76	0.094	0.006	17.58	0.080	0.007	17.71	0.079	0.003	17.67	0.060	0.004
21.68	0.105	0.003	19.76	0.076	0.005	19.58	0.086	0.007	19.73	0.068	0.003	19.68	0.056	0.004
23.68	0.109	0.003	21.76	0.078	0.005	21.58	0.085	0.006	21.74	0.064	0.003	21.69	0.048	0.004
25.68	0.100	0.002	23.77	0.091	0.004	23.58	0.076	0.007	23.76	0.059	0.003	23.70	0.036	0.003
27.68	0.095	0.003	25.77	0.076	0.005	25.58	0.073	0.007	25.77	0.056	0.003	25.71	0.035	0.003
29.67	0.081	0.002	27.77	0.088	0.006	27.58	0.048	0.006	27.79	0.045	0.003	27.72	0.024	0.003
31.67	0.085	0.002	29.78	0.055	0.004	29.58	0.043	0.005	29.80	0.042	0.002	29.74	0.042	0.004
33.67	0.110	0.003	31.78	0.061	0.005	31.58	0.043	0.005	31.82	0.047	0.003	31.75	0.025	0.003
35.66	0.089	0.003	33.78	0.078	0.005	33.58	0.049	0.007	33.84	0.047	0.002	33.76	0.044	0.004
37.58	0.550	0.007	35.79	0.043	0.004	35.58	0.027	0.004	35.85	0.020	0.002	35.74	0.191	0.013
0.0	0.0	0.0	37.39	0.347	0.018	36.00	0.168	0.010	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	37.50	0.194	0.016	0.0	0.0	0.0	0.0	0.0	0.0

Table 30 - Continued

DIVISION FROM A - 12 BOMBARDED BY 62 MEV. PROTONS.

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Table 31 - Continued

TRITON FROM A - 12 BOMBARDED BY 62 MEV. PROTONS.

60 DEG - RUN 7115			65 DEG - RUN 105			70 DEG - RUN 2032			75 DEG - RUN 2017			80 DEG - RUN 112		
ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR
6.76	0.061	0.002	6.54	0.068	0.005	6.33	0.060	0.006	6.58	0.063	0.003	6.56	0.042	0.004
8.76	0.063	0.002	8.54	0.052	0.004	8.53	0.043	0.005	8.59	0.044	0.002	8.57	0.036	0.003
10.76	0.052	0.002	10.54	0.041	0.004	10.53	0.035	0.005	10.61	0.035	0.002	10.58	0.023	0.003
12.75	0.040	0.001	12.53	0.034	0.003	12.53	0.031	0.004	12.62	0.024	0.002	12.59	0.018	0.002
14.75	0.038	0.002	14.53	0.030	0.003	14.53	0.026	0.004	14.64	0.017	0.002	14.60	0.014	0.002
16.75	0.028	0.001	16.53	0.017	0.002	16.53	0.013	0.003	16.65	0.011	0.001	16.61	0.011	0.002
18.74	0.022	0.001	18.56	0.013	0.002	18.54	0.013	0.003	18.67	0.014	0.001	18.63	0.005	0.001
20.74	0.026	0.001	20.54	0.021	0.003	20.54	0.007	0.002	20.68	0.008	0.001	20.64	0.005	0.001
22.74	0.018	0.001	22.56	0.011	0.002	22.54	0.007	0.002	22.70	0.007	0.001	22.65	0.007	0.002
24.73	0.014	0.001	24.57	0.012	0.002	24.54	0.014	0.003	24.72	0.007	0.001	24.66	0.000	0.000
26.73	0.014	0.001	26.57	0.006	0.001	26.54	0.004	0.002	26.73	0.004	0.001	26.64	0.002	0.001
28.73	0.026	0.001	28.57	0.017	0.002	28.52	0.009	0.002	28.12	0.000	0.000	0.0	0.0	0.0
30.12	0.005	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

90 DEG - RUN 2023			110 DEG - RUN 7113			135 DEG - RUN 2055			160 DEG - RUN 2060					
ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR
6.54	0.040	0.003	6.79	0.026	0.001	6.50	0.022	0.002	6.49	0.020	0.002			
8.53	0.026	0.002	8.80	0.019	0.001	8.49	0.014	0.001	8.48	0.013	0.002			
10.52	0.022	0.002	10.80	0.010	0.001	10.48	0.007	0.001	10.47	0.006	0.001			
12.52	0.014	0.002	12.81	0.008	0.001	12.47	0.005	0.001	12.45	0.004	0.001			
14.51	0.009	0.001	14.81	0.004	0.001	14.46	0.003	0.001	14.44	0.001	0.000			
16.50	0.008	0.001	16.82	0.002	0.000	16.45	0.000	0.000	16.21	0.001	0.000			
18.49	0.004	0.001	18.82	0.001	0.000	18.44	0.000	0.000	0.0	0.0	0.0			
20.48	0.003	0.001	20.75	0.001	0.000	0.0	0.0	0.0	0.0	0.0	0.0			
22.47	0.003	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
24.46	0.003	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			

Table 32

HELIUM-3 FROM A - 12 BOMBARDED BY 62 MEV. PROTONS.

12 DEG - RUN 121			15 DEG - RUN 114			20 DEG - RUN 2004			25 DEG - RUN 2052			30 DEG - RUN 2040		
ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR
7.13	0.237	0.021	7.13	0.255	0.023	7.29	0.254	0.021	13.02	0.201	0.010	7.20	0.222	0.011
9.13	0.248	0.021	9.13	0.206	0.024	9.35	0.243	0.020	15.81	0.167	0.016	9.22	0.218	0.011
11.14	0.290	0.023	11.16	0.201	0.020	11.41	0.213	0.019	17.00	0.163	0.016	11.24	0.210	0.011
13.14	0.233	0.020	13.17	0.199	0.020	13.47	0.186	0.018	19.79	0.145	0.015	13.26	0.190	0.010
15.14	0.213	0.019	15.17	0.197	0.020	15.53	0.176	0.017	21.70	0.133	0.014	15.20	0.149	0.009
17.14	0.173	0.018	17.10	0.167	0.019	17.59	0.176	0.017	23.77	0.111	0.012	17.30	0.139	0.009
19.15	0.192	0.018	19.19	0.164	0.019	19.65	0.163	0.017	25.77	0.087	0.012	19.32	0.119	0.008
21.15	0.167	0.017	21.19	0.101	0.019	21.71	0.120	0.014	27.74	0.100	0.012	21.34	0.122	0.008
23.15	0.149	0.016	23.20	0.146	0.017	23.77	0.134	0.013	29.75	0.087	0.012	23.36	0.093	0.007
25.15	0.130	0.016	25.21	0.130	0.016	25.83	0.100	0.013	31.74	0.084	0.012	25.38	0.087	0.007
27.15	0.122	0.015	27.21	0.129	0.016	27.89	0.103	0.013	33.73	0.121	0.014	27.40	0.075	0.006
29.16	0.126	0.015	29.22	0.112	0.015	29.95	0.112	0.014	35.72	0.069	0.009	29.42	0.074	0.006
31.16	0.119	0.015	31.23	0.091	0.014	32.01	0.103	0.013	37.72	0.172	0.016	31.44	0.083	0.007
33.16	0.192	0.018	33.23	0.113	0.015	34.07	0.124	0.014	39.51	0.290	0.024	33.46	0.077	0.006
35.16	0.202	0.019	35.24	0.101	0.019	34.13	0.119	0.014	0.0	0.0	0.0	35.48	0.017	0.003
37.17	0.035	0.008	37.25	0.046	0.010	36.10	0.206	0.019	0.0	0.0	0.0	37.50	0.161	0.009
39.17	0.633	0.034	39.25	0.600	0.030	39.97	0.502	0.034	0.0	0.0	0.0	39.09	0.252	0.015
40.39	1.060	0.047	40.63	0.047	0.016	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

35 DEG - RUN 2001			40 DEG - RUN 2033			45 DEG - RUN 7104			50 DEG - RUN 2002			55 DEG - RUN 103		
ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR
7.20	0.215	0.007	7.10	0.213	0.014	7.39	0.220	0.005	7.11	0.106	0.010	7.15	0.152	0.007
9.22	0.203	0.007	9.09	0.194	0.013	9.90	0.213	0.005	9.10	0.163	0.009	9.15	0.129	0.007
11.25	0.192	0.007	11.00	0.172	0.012	11.97	0.176	0.004	11.10	0.329	0.008	11.16	0.110	0.006
13.27	0.162	0.006	13.06	0.153	0.012	13.96	0.113	0.003	13.09	0.109	0.007	13.17	0.094	0.006
15.29	0.133	0.006	15.07	0.130	0.011	15.95	0.099	0.003	15.09	0.100	0.007	15.17	0.081	0.005
17.31	0.119	0.006	17.06	0.110	0.010	17.94	0.082	0.003	17.02	0.073	0.006	17.18	0.059	0.005
19.33	0.112	0.005	19.05	0.089	0.009	19.94	0.070	0.003	19.08	0.065	0.006	19.19	0.051	0.004
21.35	0.097	0.005	21.04	0.075	0.008	21.93	0.063	0.003	21.07	0.054	0.005	21.19	0.038	0.004
23.37	0.071	0.004	23.04	0.075	0.008	23.92	0.050	0.002	23.07	0.051	0.005	23.20	0.042	0.004
25.40	0.073	0.004	25.03	0.063	0.007	25.91	0.033	0.002	25.06	0.038	0.004	25.21	0.028	0.003
27.42	0.069	0.004	27.02	0.070	0.008	27.90	0.037	0.002	27.06	0.039	0.004	27.21	0.027	0.003
29.44	0.060	0.004	29.01	0.057	0.007	29.89	0.064	0.003	29.06	0.033	0.004	29.22	0.042	0.004
31.46	0.076	0.004	31.01	0.067	0.008	31.88	0.057	0.002	31.05	0.057	0.005	31.23	0.007	0.002
33.48	0.054	0.004	33.00	0.067	0.008	33.87	0.030	0.002	33.05	0.020	0.003	33.23	0.027	0.003
35.50	0.033	0.003	34.99	0.037	0.006	35.89	0.060	0.003	35.04	0.049	0.003	34.61	0.003	0.003
37.53	0.178	0.007	34.98	0.092	0.009	0.0	0.0	0.0	34.36	0.003	0.002	0.0	0.0	0.0
38.92	0.001	0.001	38.48	0.002	0.002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 32 - Continued

RECEIVED FROM A - 12 BONDED BY 62 REV. PROPOS.

[illegible]

	90 DEG - RUN 2023		110 DEG - RUN 7113		135 DEG - RUN 2035		160 DEG - RUN 2060	
TIME	ENERGY (MEV)	SIGMA ERROR (MB/DEG-MEV)	ENERGY (MEV)	SIGMA ERROR (MB/DEG-MEV)	ENERGY (MEV)	SIGMA ERROR (MB/DEG-MEV)	ENERGY (MEV)	SIGMA ERROR (MB/DEG-MEV)
7.20	0.096	0.004	7.00	0.067	7.00	0.055	7.09	0.036
9.20	0.073	0.004	9.00	0.049	9.00	0.036	9.07	0.033
11.27	0.063	0.003	12.00	0.037	11.00	0.034	11.06	0.023
13.20	0.061	0.003	14.00	0.036	13.07	0.019	13.04	0.003
15.20	0.027	0.002	16.00	0.017	15.00	0.014	15.04	0.001
17.20	0.020	0.002	18.07	0.012	17.00	0.011	17.03	0.001
19.23	0.015	0.002	20.07	0.009	19.04	0.003	19.03	0.001
21.22	0.011	0.001	22.00	0.004	20.31	0.010	0.0	0.0
23.20	0.014	0.002	24.03	0.003	0.0	0.0	0.0	0.0
25.20	0.003	0.001	0.0	0.0	0.0	0.0	0.0	0.0
27.19	0.007	0.001	0.0	0.0	0.0	0.0	0.0	0.0

Table 33

ALUMI FROM A - 12 STANDARD AT 62 MEV. PROTONS.

12 DEG - RUN 121			16 DEG - RUN 114			20 DEG - RUN 2006			24 DEG - RUN 2002			30 DEG - RUN 2000		
ENERGY (MEV)	SIGNAL (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (MB/SR-MEV)	ERROR
3.30	4.95	0.21	3.30	4.50	0.22	3.37	4.73	0.20	13.77	0.92	0.05	3.36	4.35	0.11
3.60	4.71	0.20	3.60	4.40	0.21	3.70	4.42	0.19	14.76	0.93	0.05	3.76	4.10	0.10
4.00	4.50	0.20	4.00	4.35	0.21	4.20	4.18	0.19	15.76	0.77	0.05	4.17	3.87	0.10
4.40	4.51	0.20	4.40	4.16	0.21	4.61	4.06	0.18	16.75	0.74	0.05	4.57	3.50	0.10
4.80	4.30	0.20	4.80	3.99	0.20	5.02	3.79	0.18	17.75	0.60	0.04	4.90	3.34	0.09
5.20	4.36	0.20	5.20	3.80	0.20	5.43	3.49	0.17	18.75	0.50	0.04	5.30	3.07	0.09
5.60	4.10	0.19	5.60	3.75	0.20	5.85	3.31	0.16	19.74	0.51	0.04	5.70	2.90	0.09
6.00	3.90	0.19	6.00	3.62	0.19	6.26	3.12	0.16	20.74	0.44	0.04	6.10	2.74	0.09
6.40	3.55	0.18	6.40	3.33	0.19	6.67	2.99	0.16	21.73	0.44	0.04	6.50	2.60	0.08
6.80	3.17	0.17	6.80	3.02	0.18	7.00	2.86	0.16	22.73	0.34	0.03	7.00	2.44	0.08
7.20	2.97	0.16	7.20	2.93	0.17	7.49	2.73	0.15	23.72	0.31	0.03	7.40	2.20	0.08
7.60	2.92	0.16	7.70	2.71	0.17	8.21	2.39	0.09	24.72	0.29	0.03	8.11	2.00	0.05
8.00	2.60	0.16	8.40	2.31	0.16	9.24	1.71	0.08	25.72	0.29	0.03	9.12	1.72	0.04
9.30	2.30	0.09	9.41	2.09	0.09	10.20	1.72	0.08	26.71	0.23	0.03	10.13	1.52	0.04
10.30	1.94	0.08	10.41	1.70	0.09	11.31	1.35	0.07	27.71	0.19	0.02	11.14	1.31	0.04
11.30	1.56	0.07	11.41	1.65	0.08	12.34	1.29	0.07	28.70	0.16	0.02	12.15	1.12	0.03
12.30	1.64	0.08	12.42	1.30	0.08	13.37	0.94	0.06	29.70	0.19	0.02	13.16	1.06	0.03
13.30	1.32	0.07	13.42	1.15	0.07	14.40	0.74	0.05	30.70	0.16	0.02	14.17	0.91	0.03
14.30	1.16	0.06	14.42	1.05	0.07	15.43	0.76	0.05	31.69	0.11	0.02	15.10	0.76	0.03
15.30	1.09	0.06	15.42	0.90	0.06	16.46	0.71	0.05	32.69	0.14	0.02	16.10	0.67	0.03
16.30	0.84	0.05	16.43	0.91	0.06	17.49	0.65	0.05	33.60	0.09	0.02	17.20	0.60	0.03
17.30	0.829	0.054	17.43	0.805	0.050	18.52	0.540	0.043	34.60	0.009	0.017	18.21	0.504	0.023
18.40	0.752	0.052	18.43	0.705	0.054	19.55	0.400	0.041	35.67	0.104	0.010	19.22	0.452	0.022
19.40	0.707	0.050	19.44	0.620	0.051	20.50	0.467	0.040	36.67	0.060	0.014	20.23	0.375	0.020
20.40	0.571	0.045	20.44	0.571	0.048	21.61	0.447	0.039	37.67	0.165	0.023	21.24	0.357	0.020
21.40	0.560	0.045	21.44	0.501	0.045	22.64	0.393	0.036	38.66	0.133	0.020	22.25	0.334	0.019
22.40	0.467	0.041	22.45	0.463	0.044	23.67	0.369	0.036	39.66	0.083	0.016	23.26	0.291	0.018
23.40	0.409	0.030	23.45	0.457	0.043	24.70	0.320	0.020	40.65	0.153	0.022	24.27	0.247	0.016
24.40	0.392	0.027	24.45	0.366	0.039	25.73	0.230	0.020	41.65	0.204	0.025	25.28	0.220	0.016
25.40	0.344	0.035	25.46	0.306	0.040	26.76	0.207	0.026	42.65	0.150	0.021	26.29	0.200	0.015
26.40	0.356	0.036	26.46	0.353	0.030	27.79	0.175	0.024	43.64	0.075	0.015	27.30	0.152	0.013
27.40	0.320	0.034	27.46	0.300	0.040	28.83	0.171	0.024	44.64	0.054	0.013	28.31	0.149	0.013
28.41	0.223	0.020	28.47	0.240	0.032	29.85	0.109	0.023	45.63	0.091	0.017	29.32	0.150	0.013
29.41	0.219	0.020	29.47	0.211	0.030	30.80	0.184	0.020	46.63	0.037	0.011	30.33	0.133	0.012
30.41	0.224	0.020	30.47	0.234	0.031	31.91	0.140	0.023	47.62	0.250	0.020	31.34	0.099	0.010
31.41	0.105	0.026	31.40	0.161	0.026	32.94	0.129	0.021	48.62	0.023	0.011	32.35	0.093	0.010
32.41	0.196	0.026	32.40	0.145	0.024	33.97	0.144	0.022	0.0	0.0	0.0	33.36	0.075	0.009
33.41	0.170	0.025	33.40	0.132	0.023	35.00	0.140	0.022	0.0	0.0	0.0	34.37	0.082	0.009
34.41	0.190	0.027	34.40	0.102	0.020	36.03	0.100	0.019	0.0	0.0	0.0	35.30	0.100	0.010
35.41	0.141	0.022	35.40	0.102	0.021	37.06	0.076	0.016	0.0	0.0	0.0	36.30	0.054	0.008
36.41	0.096	0.010	36.40	0.091	0.019	38.09	0.121	0.021	0.0	0.0	0.0	37.40	0.066	0.009
37.42	0.131	0.022	37.50	0.127	0.023	39.12	0.104	0.023	0.0	0.0	0.0	38.41	0.120	0.011
38.42	0.160	0.024	38.50	0.137	0.024	40.15	0.133	0.021	0.0	0.0	0.0	39.42	0.089	0.010
39.42	0.137	0.022	39.50	0.124	0.023	41.10	0.195	0.026	0.0	0.0	0.0	40.43	0.131	0.012
40.42	0.160	0.024	40.51	0.139	0.024	42.21	0.254	0.029	0.0	0.0	0.0	41.44	0.103	0.014
41.42	0.170	0.025	41.51	0.195	0.020	43.24	0.199	0.026	0.0	0.0	0.0	42.45	0.082	0.009
42.42	0.212	0.027	42.51	0.200	0.034	44.27	0.102	0.019	0.0	0.0	0.0	43.46	0.031	0.006
43.42	0.201	0.032	43.52	0.240	0.032	45.30	0.072	0.016	0.0	0.0	0.0	44.47	0.036	0.006
44.42	0.161	0.024	44.52	0.105	0.021	46.33	0.112	0.019	0.0	0.0	0.0	45.40	0.002	0.009
45.42	0.080	0.010	45.52	0.085	0.019	47.36	0.003	0.017	0.0	0.0	0.0	46.40	0.017	0.004
46.43	0.137	0.022	46.53	0.149	0.025	48.39	0.401	0.037	0.0	0.0	0.0	47.40	0.107	0.016
47.43	0.146	0.023	47.53	0.045	0.014	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48.43	0.142	0.022	48.53	0.516	0.046	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49.35	0.676	0.053	49.41	0.016	0.009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 33 - Continued

ALPHA FROM A - 12 BOMBARD BY 62 MEV. PROTONS.

35 230 - RUN 2001	40 DBE - RUN 2033	45 DBE - RUN 7102	50 DBE - RUN 2042	55 DBE - RUN 103
ENERGY (MEV)	ENERGY (MEV)	ENERGY (MEV)	ENERGY (MEV)	ENERGY (MEV)
3.36	3.31	4.90	3.37	3.29
3.77	3.71	5.30	3.77	3.69
4.17	4.11	5.70	4.16	4.09
4.57	4.51	6.10	4.56	4.49
4.98	4.91	6.50	4.96	4.89
5.38	5.30	6.90	5.36	5.29
5.79	5.70	7.29	5.76	5.69
6.19	6.10	7.69	6.16	6.09
6.60	6.50	8.09	6.56	6.50
7.00	6.90	8.49	6.96	6.90
7.40	7.30	8.89	7.36	7.30
7.81	7.70	9.29	7.76	7.70
8.21	8.09	9.69	8.16	8.10
8.61	8.49	10.09	8.56	8.50
9.01	8.89	10.49	8.96	8.90
9.41	9.29	10.89	9.36	9.30
9.81	9.69	11.29	9.76	9.70
10.21	10.09	11.69	10.16	10.10
10.61	10.49	12.09	10.56	10.50
11.01	10.89	12.49	10.96	10.90
11.41	11.29	12.89	11.36	11.30
11.81	11.69	13.29	11.76	11.70
12.21	12.09	13.69	12.16	12.10
12.61	12.49	14.09	12.56	12.50
13.01	12.89	14.49	12.96	12.90
13.41	13.29	14.89	13.36	13.30
13.81	13.69	15.29	13.76	13.70
14.21	14.09	15.69	14.16	14.10
14.61	14.49	16.09	14.56	14.50
15.01	14.89	16.49	14.96	14.90
15.41	15.29	16.89	15.36	15.30
15.81	15.69	17.29	15.76	15.70
16.21	16.09	17.69	16.16	16.10
16.61	16.49	18.09	16.56	16.50
17.01	16.89	18.49	16.96	16.90
17.41	17.29	18.89	17.36	17.30
17.81	17.69	19.29	17.76	17.70
18.21	18.09	19.69	18.16	18.10
18.61	18.49	20.09	18.56	18.50
19.01	18.89	20.49	18.96	18.90
19.41	19.29	20.89	19.36	19.30
19.81	19.69	21.29	19.76	19.70
20.21	20.09	21.69	20.16	20.10
20.61	20.49	22.09	20.56	20.50
21.01	20.89	22.49	20.96	20.90
21.41	21.29	22.89	21.36	21.30
21.81	21.69	23.29	21.76	21.70
22.21	22.09	23.69	22.16	22.10
22.61	22.49	24.09	22.56	22.50
23.01	22.89	24.49	22.96	22.90
23.41	23.29	24.89	23.36	23.30
23.81	23.69	25.29	23.76	23.70
24.21	24.09	25.69	24.16	24.10
24.61	24.49	26.09	24.56	24.50
25.01	24.89	26.49	24.96	24.90
25.41	25.29	26.89	25.36	25.30
25.81	25.69	27.29	25.76	25.70
26.21	26.09	27.69	26.16	26.10
26.61	26.49	28.09	26.56	26.50
27.01	26.89	28.49	26.96	26.90
27.41	27.29	28.89	27.36	27.30
27.81	27.69	29.29	27.76	27.70
28.21	28.09	29.69	28.16	28.10
28.61	28.49	30.09	28.56	28.50
29.01	28.89	30.49	28.96	28.90
29.41	29.29	30.89	29.36	29.30
29.81	29.69	31.29	29.76	29.70
30.21	30.09	31.69	30.16	30.10
30.61	30.49	32.09	30.56	30.50
31.01	30.89	32.49	30.96	30.90
31.41	31.29	32.89	31.36	31.30
31.81	31.69	33.29	31.76	31.70
32.21	32.09	33.69	32.16	32.10
32.61	32.49	34.09	32.56	32.50
33.01	32.89	34.49	32.96	32.90
33.41	33.29	34.89	33.36	33.30
33.81	33.69	35.29	33.76	33.70
34.21	34.09	35.69	34.16	34.10
34.61	34.49	36.09	34.56	34.50
35.01	34.89	36.49	34.96	34.90
35.41	35.29	36.89	35.36	35.30
35.81	35.69	37.29	35.76	35.70
36.21	36.09	37.69	36.16	36.10
36.61	36.49	38.09	36.56	36.50
37.01	36.89	38.49	36.96	36.90
37.41	37.29	38.89	37.36	37.30
37.81	37.69	39.29	37.76	37.70
38.21	38.09	39.69	38.16	38.10
38.61	38.49	40.09	38.56	38.50
39.01	38.89	40.49	38.96	38.90
39.41	39.29	40.89	39.36	39.30
39.81	39.69	41.29	39.76	39.70
40.21	40.09	41.69	40.16	40.10
40.61	40.49	42.09	40.56	40.50
41.01	40.89	42.49	40.96	40.90
41.41	41.29	42.89	41.36	41.30
41.81	41.69	43.29	41.76	41.70
42.21	42.09	43.69	42.16	42.10
42.61	42.49	44.09	42.56	42.50
43.01	42.89	44.49	42.96	42.90
43.41	43.29	44.89	43.36	43.30
43.81	43.69	45.29	43.76	43.70
44.21	44.09	45.69	44.16	44.10
44.61	44.49	46.09	44.56	44.50
45.01	44.89	46.49	44.96	44.90
45.41	45.29	46.89	45.36	45.30
45.81	45.69	47.29	45.76	45.70
46.21	46.09	47.69	46.16	46.10
46.61	46.49	48.09	46.56	46.50
47.01	46.89	48.49	46.96	46.90
47.41	47.29	48.89	47.36	47.30
47.81	47.69	49.29	47.76	47.70
48.21	48.09	49.69	48.16	48.10
48.61	48.49	50.09	48.56	48.50
49.01	48.89	50.49	48.96	48.90
49.41	49.29	50.89	49.36	49.30
49.81	49.69	51.29	49.76	49.70
50.21	50.09	51.69	50.16	50.10
50.61	50.49	52.09	50.56	50.50
51.01	50.89	52.49	50.96	50.90
51.41	51.29	52.89	51.36	51.30
51.81	51.69	53.29	51.76	51.70
52.21	52.09	53.69	52.16	52.10
52.61	52.49	54.09	52.56	52.50
53.01	52.89	54.49	52.96	52.90
53.41	53.29	54.89	53.36	53.30
53.81	53.69	55.29	53.76	53.70
54.21	54.09	55.69	54.16	54.10
54.61	54.49	56.09	54.56	54.50
55.01	54.89	56.49	54.96	54.90
55.41	55.29	56.89	55.36	55.30
55.81	55.69	57.29	55.76	55.70
56.21	56.09	57.69	56.16	56.10
56.61	56.49	58.09	56.56	56.50
57.01	56.89	58.49	56.96	56.90
57.41	57.29	58.89	57.36	57.30
57.81	57.69	59.29	57.76	57.70
58.21	58.09	59.69	58.16	58.10
58.61	58.49	60.09	58.56	58.50
59.01	58.89	60.49	58.96	58.90
59.41	59.29	60.89	59.36	59.30
59.81	59.69	61.29	59.76	59.70
60.21	60.09	61.69	60.16	60.10
60.61	60.49	62.09	60.56	60.50
61.01	60.89	62.49	60.96	60.90
61.41	61.29	62.89	61.36	61.30
61.81	61.69	63.29	61.76	61.70
62.21	62.09	63.69	62.16	62.10
62.61	62.49	64.09	62.56	62.50
63.01	62.89	64.49	62.96	62.90
63.41	63.29	64.89	63.36	63.30
63.81	63.69	65.29	63.76	63.70
64.21	64.09	65.69	64.16	64.10
64.61	64.49	66.09	64.56	64.50
65.01	64.89	66.49	64.96	64.90
65.41	65.29	66.89	65.36	65.30
65.81	65.69	67.29	65.76	65.70
66.21	66.09	67.69	66.16	66.10
66.61	66.49	68.09	66.56	66.50
67.01	66.89	68.49	66.96	66.90
67.41	67.29	68.89	67.36	67.30
67.81	67.69	69.29	67.76	67.70
68.21	68.09	69.69	68.16	68.10
68.61	68.49	70.09	68.56	68.50
69.01	68.89	70.49	68.96	68.90
69.41	69.29	70.89	69.36	69.30
69.81	69.69	71.29	69.76	69.70
70.21	70.09	71.69	70.16	70.10
70.61	70.49	72.09	70.56	70.50
71.01	70.89	72.49	70.96	70.90
71.41	71.29	72.89	71.36	71.30
71.81	71.69	73.29	71.76	71.70
72.21	72.09	73.69	72.16	72.10
72.61	72.49	74.09	72.56	72.50
73.01	72.89	74.49	72.96	72.90
73.41	73.29	74.89	73.36	73.30
73.81	73.69	75.29	73.76	73.70
74.21	74.09	75.69	74.16	74.10
74.61	74.49	76.09	74.56	74.50
75.01	74.89	76.49	74.96	74.90
75.41	75.29	76.89	75.36	75.30
75.81	75.69	77.29	75.76	75.70
76.21	76.09	77.69	76.16	76.10
76.61	76.49	78.09	76.56	76.50
77.01	76.89	78.49	76.96	76.90
77.41	77.29	78.89	77.36	77.30
77.81	77.69	79.29	77.76	77.70
78.21	78.09	79.69	78.16	78.10
78.61	78.49	80.09	78.56	78.50
79.01	78.89	80.49	78.96	78.90
79.41	79.29	80.89	79.36	79.30
79.81	79.69	81.29	79.76	79.70
80.21	80.09	81.69	80.16	80.10
80.61	80.49	82.09	80.56	80.50
81.01	80.89	82.49	80.96	80.90
81.41	81.29	82.89	81.36	81.30
81.81	81.69	83.29	81.76	81.70
82.21	82.09	83.69	82.16	82.10
82.61	82.49	84.09	82.56	82.50
83.01	82.89	84.49	82.96	82.90
83.41	83.29	84.89	83.36	83.30
83.81	83.69	85.29	83.76	83.70
84.21	84.09	85.69	84.16	84.10
84.61	84.49	86.09	84.56	84.50
85.01	84.89	86.49	84.96	84.90
85.41	85.29	86.89	85.36	85.30
85.81	85.69	87.29	85.76	85.70
86.21	86.09	87.69	86.16	86.10
86.61	86.49	88.09	86.56	86.50
87.01	86.89	88.49	86.96	86.90
87.41	87.29	88.89	87.36	87.30
87.81	87.69	89.29	87.76	87.70
88.21	88.09	89.69	88.16	88.10
88.61	88.49	90.09	88.56	88.50
89.01	88.89	90.49	88.96	88.90
89.41	89.29	90.89	89.36	89.30
89.81	89.69	91.29	89.76	89.70
90.21</				

Table 33 - Continued

ALPHA FROM A = 12 DOWNGRADED BY 62 MEV. PHOTONS.

60 DEG - RUN 7115	65 DEG - RUN 105	70 DEG - RUN 2032	75 DEG - RUN 2017	80 DEG - RUN 112
ENERGY (MEV)	ENERGY (MEV)	ENERGY (MEV)	ENERGY (MEV)	ENERGY (MEV)
4.92	3.33	3.23	3.43	3.34
5.32	3.73	3.73	3.83	3.75
5.72	4.13	4.13	4.21	4.15
6.11	4.53	4.53	4.61	4.55
6.51	4.93	4.93	5.01	4.95
6.91	5.33	5.33	5.42	5.35
7.31	5.73	5.73	5.82	5.76
7.71	6.13	6.13	6.22	6.16
8.11	6.53	6.53	6.63	6.56
8.51	6.93	6.93	7.03	6.96
8.91	7.33	7.33	7.43	7.36
9.31	7.73	7.73	7.83	7.77
9.71	8.13	8.13	8.23	8.16
10.11	8.53	8.53	8.63	8.56
10.51	8.93	8.93	9.03	8.96
10.91	9.33	9.33	9.43	9.36
11.31	9.73	9.73	9.83	9.76
11.71	10.13	10.13	10.23	10.16
12.11	10.53	10.53	10.63	10.56
12.51	10.93	10.93	11.03	10.96
12.91	11.33	11.33	11.43	11.36
13.31	11.73	11.73	11.83	11.76
13.71	12.13	12.13	12.23	12.16
14.11	12.53	12.53	12.63	12.56
14.51	12.93	12.93	13.03	12.96
14.91	13.33	13.33	13.43	13.36
15.31	13.73	13.73	13.83	13.76
15.71	14.13	14.13	14.23	14.16
16.11	14.53	14.53	14.63	14.56
16.51	14.93	14.93	15.03	14.96
16.91	15.33	15.33	15.43	15.36
17.31	15.73	15.73	15.83	15.76
17.71	16.13	16.13	16.23	16.16
18.11	16.53	16.53	16.63	16.56
18.51	16.93	16.93	17.03	16.96
18.91	17.33	17.33	17.43	17.36
19.31	17.73	17.73	17.83	17.76
19.71	18.13	18.13	18.23	18.16
20.11	18.53	18.53	18.63	18.56
20.51	18.93	18.93	19.03	18.96
20.91	19.33	19.33	19.43	19.36
21.31	19.73	19.73	19.83	19.76
21.71	20.13	20.13	20.23	20.16
22.11	20.53	20.53	20.63	20.56
22.51	20.93	20.93	21.03	20.96
22.91	21.33	21.33	21.43	21.36
23.31	21.73	21.73	21.83	21.76
23.71	22.13	22.13	22.23	22.16
24.11	22.53	22.53	22.63	22.56
24.51	22.93	22.93	23.03	22.96
24.91	23.33	23.33	23.43	23.36
25.31	23.73	23.73	23.83	23.76
25.71	24.13	24.13	24.23	24.16
26.11	24.53	24.53	24.63	24.56
26.51	24.93	24.93	25.03	24.96
26.91	25.33	25.33	25.43	25.36
27.31	25.73	25.73	25.83	25.76
27.71	26.13	26.13	26.23	26.16
28.11	26.53	26.53	26.63	26.56
28.51	26.93	26.93	27.03	26.96
28.91	27.33	27.33	27.43	27.36
29.31	27.73	27.73	27.83	27.76
29.71	28.13	28.13	28.23	28.16
30.11	28.53	28.53	28.63	28.56
30.51	28.93	28.93	29.03	28.96
30.91	29.33	29.33	29.43	29.36
31.31	29.73	29.73	29.83	29.76
31.71	30.13	30.13	30.23	30.16
32.11	30.53	30.53	30.63	30.56
32.51	30.93	30.93	31.03	30.96
32.91	31.33	31.33	31.43	31.36
33.31	31.73	31.73	31.83	31.76
33.71	32.13	32.13	32.23	32.16
34.11	32.53	32.53	32.63	32.56
34.51	32.93	32.93	33.03	32.96
34.91	33.33	33.33	33.43	33.36
35.31	33.73	33.73	33.83	33.76
35.71	34.13	34.13	34.23	34.16
36.11	34.53	34.53	34.63	34.56
36.51	34.93	34.93	35.03	34.96
36.91	35.33	35.33	35.43	35.36
37.31	35.73	35.73	35.83	35.76
37.71	36.13	36.13	36.23	36.16
38.11	36.53	36.53	36.63	36.56
38.51	36.93	36.93	37.03	36.96
38.91	37.33	37.33	37.43	37.36
39.31	37.73	37.73	37.83	37.76
39.71	38.13	38.13	38.23	38.16
40.11	38.53	38.53	38.63	38.56
40.51	38.93	38.93	39.03	38.96
40.91	39.33	39.33	39.43	39.36
41.31	39.73	39.73	39.83	39.76
41.71	40.13	40.13	40.23	40.16
42.11	40.53	40.53	40.63	40.56
42.51	40.93	40.93	41.03	40.96
42.91	41.33	41.33	41.43	41.36
43.31	41.73	41.73	41.83	41.76
43.71	42.13	42.13	42.23	42.16
44.11	42.53	42.53	42.63	42.56
44.51	42.93	42.93	43.03	42.96
44.91	43.33	43.33	43.43	43.36
45.31	43.73	43.73	43.83	43.76
45.71	44.13	44.13	44.23	44.16
46.11	44.53	44.53	44.63	44.56
46.51	44.93	44.93	45.03	44.96
46.91	45.33	45.33	45.43	45.36
47.31	45.73	45.73	45.83	45.76
47.71	46.13	46.13	46.23	46.16
48.11	46.53	46.53	46.63	46.56
48.51	46.93	46.93	47.03	46.96
48.91	47.33	47.33	47.43	47.36
49.31	47.73	47.73	47.83	47.76
49.71	48.13	48.13	48.23	48.16
50.11	48.53	48.53	48.63	48.56
50.51	48.93	48.93	49.03	48.96
50.91	49.33	49.33	49.43	49.36
51.31	49.73	49.73	49.83	49.76
51.71	50.13	50.13	50.23	50.16
52.11	50.53	50.53	50.63	50.56
52.51	50.93	50.93	51.03	50.96
52.91	51.33	51.33	51.43	51.36
53.31	51.73	51.73	51.83	51.76
53.71	52.13	52.13	52.23	52.16
54.11	52.53	52.53	52.63	52.56
54.51	52.93	52.93	53.03	52.96
54.91	53.33	53.33	53.43	53.36
55.31	53.73	53.73	53.83	53.76
55.71	54.13	54.13	54.23	54.16
56.11	54.53	54.53	54.63	54.56
56.51	54.93	54.93	55.03	54.96
56.91	55.33	55.33	55.43	55.36
57.31	55.73	55.73	55.83	55.76
57.71	56.13	56.13	56.23	56.16
58.11	56.53	56.53	56.63	56.56
58.51	56.93	56.93	57.03	56.96
58.91	57.33	57.33	57.43	57.36
59.31	57.73	57.73	57.83	57.76
59.71	58.13	58.13	58.23	58.16
60.11	58.53	58.53	58.63	58.56
60.51	58.93	58.93	59.03	58.96
60.91	59.33	59.33	59.43	59.36
61.31	59.73	59.73	59.83	59.76
61.71	60.13	60.13	60.23	60.16
62.11	60.53	60.53	60.63	60.56
62.51	60.93	60.93	61.03	60.96
62.91	61.33	61.33	61.43	61.36
63.31	61.73	61.73	61.83	61.76
63.71	62.13	62.13	62.23	62.16
64.11	62.53	62.53	62.63	62.56
64.51	62.93	62.93	63.03	62.96
64.91	63.33	63.33	63.43	63.36
65.31	63.73	63.73	63.83	63.76
65.71	64.13	64.13	64.23	64.16
66.11	64.53	64.53	64.63	64.56
66.51	64.93	64.93	65.03	64.96
66.91	65.33	65.33	65.43	65.36
67.31	65.73	65.73	65.83	65.76
67.71	66.13	66.13	66.23	66.16
68.11	66.53	66.53	66.63	66.56
68.51	66.93	66.93	67.03	66.96
68.91	67.33	67.33	67.43	67.36
69.31	67.73	67.73	67.83	67.76
69.71	68.13	68.13	68.23	68.16
70.11	68.53	68.53	68.63	68.56
70.51	68.93	68.93	69.03	68.96
70.91	69.33	69.33	69.43	69.36
71.31	69.73	69.73	69.83	69.76
71.71	70.13	70.13	70.23	70.16
72.11	70.53	70.53	70.63	70.56
72.51	70.93	70.93	71.03	70.96
72.91	71.33	71.33	71.43	71.36
73.31	71.73	71.73	71.83	71.76
73.71	72.13	72.13	72.23	72.16
74.11	72.53	72.53	72.63	72.56
74.51	72.93	72.93	73.03	72.96
74.91	73.33	73.33	73.43	73.36
75.31	73.73	73.73	73.83	73.76
75.71	74.13	74.13	74.23	74.16
76.11	74.53	74.53	74.63	74.56
76.51	74.93	74.93	75.03	74.96
76.91	75.33	75.33	75.43	75.36
77.31	75.73	75.73	75.83	75.76
77.71	76.13	76.13	76.23	76.16
78.11	76.53	76.53	76.63	76.56
78.51	76.93	76.93	77.03	76.96
78.91	77.33	77.33	77.43	77.36
79.31	77.73	77.73	77.83	77.76
79.71	78.13	78.13	78.23	78.16
80.11	78.53	78.53	78.63	78.56
80.51	78.93	78.93	79.03	78.96
80.91	79.33	79.33	79.43	79.36
81.31	79.73	79.73	79.83	79.76
81.71	80.13	80.13	80.23	80.16
82.11	80.53	80.53	80.63	80.56
82.51	80.93	80.93	81.03	80.96
82.91	81.33	81.33	81.43	81.36
83.31	81.73	81.73	81.83	81.76
83.71	82.13	82.13	82.23	82.16
84.11	82.53	82.53	82.63	82.56
84.51	82.93	82.93	83.03	82.96
84.91	83.33	83.33	83.43	83.36
85.31	83.73	83.73	83.83	83.76
85.71	84.13	84.13	84.23	84.16
86.11	84.53	84.53	84.63	84.56
86.51	84.93	84.93	85.03	84.96
86.91	85.33	85.33	85.43	85.36
87.31	85.73	85.73	85.83	85.76
87.71	86.13	86.13	86.23	86.16
88.11	86.53	86.53	86.63	86.56
88.51	86.93	86.93	87.03	86.96
88.91	87.33	87.33	87.43	87.36
89.31	87.73	87.73	87.83	87.76
89.71	88.13	88.13	88.23	88.16
90.11	88.53	88.53	88.63	88.56
90.51	88.93	88.93	89.03	88.96
90.91	89.33	89.33	89.43	89.36
91.31	89.73	89.73	89.83	89.76
91.71	90			

Table 33 - Continued

ALPHA FROM A - 12 IONIZED BY 62 KEV. PROTONS.

90 DEG - RUN 2023				110 DEG - RUN 7113				135 DEG - RUN 2055				160 DEG - RUN 2060			
ENERGY (MEV)	SIGMA (MB/SR-MEV)	SIGMA ERROR		ENERGY (MEV)	SIGMA (MB/SR-MEV)	SIGMA ERROR		ENERGY (MEV)	SIGMA (MB/SR-MEV)	SIGMA ERROR		ENERGY (MEV)	SIGMA (MB/SR-MEV)	SIGMA ERROR	
3.61	1.78	0.04		4.99	0.38	0.02		3.41	1.29	0.03		3.31	1.24	0.02	
4.01	1.57	0.04		5.29	0.86	0.02		3.81	1.02	0.03		3.70	1.01	0.03	
4.40	1.40	0.04		5.69	0.75	0.02		4.21	0.84	0.02		4.10	0.86	0.03	
4.80	1.25	0.03		6.09	0.66	0.02		4.60	0.73	0.02		4.50	0.74	0.03	
5.20	1.104	0.032		6.49	0.595	0.014		5.00	0.649	0.021		4.90	0.667	0.025	
5.60	0.994	0.030		6.89	0.534	0.013		5.40	0.582	0.020		5.30	0.576	0.023	
6.00	0.901	0.029		7.29	0.478	0.013		5.80	0.513	0.019		5.69	0.507	0.021	
6.39	0.836	0.028		7.69	0.426	0.012		6.20	0.448	0.018		6.09	0.461	0.020	
6.79	0.771	0.027		8.09	0.351	0.007		6.60	0.396	0.016		6.49	0.413	0.019	
7.19	0.686	0.025		8.49	0.267	0.006		6.99	0.339	0.015		6.89	0.352	0.018	
7.59	0.609	0.024		10.40	0.209	0.005		7.39	0.303	0.014		7.28	0.329	0.017	
8.29	0.524	0.014		11.40	0.163	0.005		7.79	0.289	0.014		7.68	0.311	0.017	
9.28	0.416	0.012		12.41	0.123	0.004		8.49	0.235	0.008		8.38	0.252	0.010	
10.28	0.309	0.011		13.41	0.097	0.004		9.48	0.176	0.007		9.37	0.188	0.008	
11.27	0.248	0.010		14.41	0.071	0.003		10.43	0.114	0.006		10.37	0.138	0.007	
12.27	0.192	0.008		15.41	0.058	0.003		11.47	0.096	0.005		11.36	0.107	0.006	
13.26	0.156	0.008		16.42	0.046	0.002		12.47	0.071	0.004		12.36	0.076	0.005	
14.26	0.121	0.007		17.42	0.036	0.002		13.47	0.063	0.004		13.35	0.059	0.005	
15.25	0.103	0.006		18.42	0.028	0.002		14.46	0.040	0.003		14.34	0.041	0.004	
16.25	0.086	0.006		19.42	0.026	0.002		15.46	0.031	0.003		15.34	0.034	0.004	
17.24	0.072	0.005		20.43	0.020	0.001		16.45	0.021	0.002		16.33	0.028	0.003	
18.24	0.055	0.004		21.43	0.013	0.001		17.45	0.018	0.002		17.33	0.018	0.003	
19.23	0.062	0.004		22.43	0.011	0.001		18.44	0.009	0.002		18.32	0.011	0.002	
20.23	0.032	0.003		23.43	0.009	0.001		19.44	0.009	0.002		19.32	0.003	0.001	
21.22	0.027	0.003		24.43	0.004	0.001		20.43	0.004	0.001		20.31	0.007	0.002	
22.22	0.023	0.003		25.44	0.003	0.001		21.43	0.001	0.001		21.31	0.002	0.001	
23.21	0.020	0.003		26.44	0.003	0.001		22.43	0.003	0.001		22.31	0.002	0.001	
24.21	0.015	0.002		27.44	0.001	0.000		23.42	0.000	0.000		23.31	0.002	0.001	
25.20	0.012	0.002		28.44	0.001	0.000		0.00	0.00	0.000		0.00	0.00	0.00	
26.20	0.008	0.002		0.00	0.00	0.00		0.00	0.00	0.00		0.00	0.00	0.00	
27.19	0.007	0.002		0.00	0.00	0.00		0.00	0.00	0.00		0.00	0.00	0.00	
28.19	0.007	0.002		0.00	0.00	0.00		0.00	0.00	0.00		0.00	0.00	0.00	
29.19	0.002	0.001		0.00	0.00	0.00		0.00	0.00	0.00		0.00	0.00	0.00	
30.18	0.003	0.001		0.00	0.00	0.00		0.00	0.00	0.00		0.00	0.00	0.00	
31.18	0.003	0.001		0.00	0.00	0.00		0.00	0.00	0.00		0.00	0.00	0.00	
32.17	0.001	0.001		0.00	0.00	0.00		0.00	0.00	0.00		0.00	0.00	0.00	
33.17	0.002	0.001		0.00	0.00	0.00		0.00	0.00	0.00		0.00	0.00	0.00	

Table 34

20 DEG - RUN 6011			30 DEG - RUN 6000			45 DEG - RUN 6014			60 DEG - RUN 6015			90 DEG - RUN 6020		
ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR
3.30	2.907	0.048	9.29	2.761	0.029	3.10	2.643	0.025	2.75	2.230	0.020	2.26	2.268	0.010
4.29	3.113	0.050	5.28	2.462	0.027	4.09	2.474	0.025	3.75	2.241	0.020	3.26	1.917	0.010
5.28	2.810	0.047	6.27	2.230	0.025	5.09	2.246	0.024	4.74	1.996	0.019	4.25	1.643	0.009
6.27	2.621	0.046	7.26	2.016	0.024	6.07	1.930	0.022	5.73	1.641	0.100	5.25	1.354	0.008
7.26	2.367	0.043	8.26	1.878	0.023	7.06	1.748	0.021	6.72	1.399	0.220	6.24	1.114	0.007
8.25	2.200	0.042	9.25	1.573	0.021	8.05	1.511	0.019	7.72	1.236	0.220	7.23	0.951	0.007
9.24	1.889	0.039	10.24	1.446	0.020	9.04	1.318	0.018	8.71	1.074	0.200	8.23	0.808	0.006
10.24	1.757	0.037	11.23	1.280	0.019	10.03	1.168	0.017	9.70	0.914	0.150	9.22	0.672	0.006
11.23	1.538	0.035	12.22	1.153	0.018	11.02	1.069	0.016	10.69	0.759	0.030	10.22	0.559	0.005
12.22	1.419	0.034	13.21	1.069	0.018	12.02	0.880	0.015	11.69	0.669	0.011	11.21	0.513	0.005
13.21	1.210	0.031	14.21	1.005	0.018	13.01	0.871	0.015	12.68	0.684	0.011	12.21	0.532	0.005
14.20	1.326	0.032	15.20	1.276	0.019	14.00	0.873	0.015	13.67	0.810	0.012	13.20	0.473	0.005
15.19	1.501	0.034	16.19	1.265	0.019	15.99	1.088	0.017	14.66	0.764	0.011	14.20	0.519	0.005
16.18	1.506	0.035	17.18	1.107	0.018	16.98	1.032	0.016	15.66	0.727	0.011	15.19	0.520	0.005
17.18	1.384	0.033	18.17	1.217	0.019	18.97	1.032	0.016	16.65	0.822	0.012	16.19	0.274	0.004
18.17	1.267	0.032	19.16	1.239	0.019	17.96	1.020	0.016	17.64	0.755	0.011	17.18	0.219	0.003
19.16	1.336	0.033	20.15	0.589	0.013	18.95	0.907	0.180	18.63	0.300	0.007	18.17	0.330	0.004
20.15	1.070	0.029	21.15	0.919	0.016	19.94	0.694	0.180	19.63	0.462	0.009	19.17	0.363	0.004
21.14	0.825	0.029	22.14	1.234	0.019	20.93	0.953	0.070	20.62	0.588	0.010	20.16	0.287	0.004
22.13	1.063	0.029	23.13	1.138	0.018	21.92	1.078	0.014	21.61	0.499	0.009	21.16	0.292	0.004
23.12	1.163	0.030	24.12	0.648	0.014	22.92	0.667	0.013	22.60	0.408	0.009	22.15	0.191	0.003
24.11	0.647	0.023	25.11	0.977	0.017	23.91	0.771	0.014	23.60	0.515	0.009	23.15	0.257	0.004
25.11	0.971	0.028	26.10	0.510	0.013	24.90	0.562	0.012	24.59	0.406	0.008	24.14	0.486	0.004
26.10	0.673	0.019	27.10	0.613	0.013	25.89	0.567	0.012	25.58	0.522	0.010	25.14	0.091	0.002
27.09	0.516	0.020	28.09	2.559	0.027	26.88	2.713	0.046	26.57	2.1	0.013	26.13	0.040	0.001
28.09	0.987	0.028	29.08	0.048	0.004	27.87	0.843	0.015	27.57	0.065	0.003	27.12	0.003	0.000
29.07	1.259	0.032	30.07	0.335	0.010	28.86	0.403	0.010	28.54	0.276	0.007	28.12	0.538	0.005
30.06	0.137	0.011	31.06	0.064	0.006	29.83	0.139	0.006	29.53	0.008	0.001	29.11	0.244	0.003
31.06	0.402	0.018	32.05	0.113	0.006	30.84	0.027	0.003	30.54	0.030	0.002	30.11	0.003	0.000
32.05	0.172	0.012	33.05	14.611	0.063	31.84	0.281	0.008	31.54	2.704	0.022	30.80	0.001	0.000
33.04	0.626	0.022	34.04	1.001	0.017	32.83	0.015	0.007	32.53	0.016	0.002	0.0	0.0	0.0
34.03	19.828	0.150	35.03	0.129	0.006	33.83	0.024	0.002	33.22	0.001	0.001	0.0	0.0	0.0
34.67	0.422	0.033	35.53	0.013	0.008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 35

DIFFERENCES FROM A - 12 BONDARED BY 39 "IV. PROTONS.

[illegible]

Table 36

RAITON FROM A - 12 DOWNGRADED BY 30 MSV. PROTONS.

[illegible]

Table 37

ALPHA FROM A = 12 FORMED BY 39 NEV. PROTONS.

20 DEG - RUN 6011			30 DEG - RUN 6000			45 DEG - RUN 6010			60 DEG - RUN 6015			90 DEG - RUN 6020		
ENERGY (MEV)	SIGMA (MB/SR-NEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-NEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-NEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-NEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-NEV)	ERROR
5.43	4.277	0.070	14.35	1.012	0.017	5.35	4.548	0.034	5.43	3.394	0.024	6.04	1.360	0.038
6.42	5.262	0.044	15.35	0.901	0.016	6.32	3.619	0.030	6.43	2.544	0.021	7.04	0.987	0.007
7.41	4.418	0.059	16.34	0.818	0.015	7.31	2.886	0.027	7.42	1.921	0.018	8.03	0.758	0.006
8.40	3.717	0.054	17.33	0.794	0.015	8.30	2.449	0.025	8.41	1.498	0.016	9.02	0.549	0.005
9.39	3.246	0.051	18.32	0.605	0.013	9.29	2.008	0.022	9.40	1.223	0.015	10.02	0.475	0.005
10.39	2.740	0.047	19.31	0.546	0.013	10.29	1.654	0.020	10.40	0.971	0.013	11.01	0.369	0.004
11.39	2.104	0.041	20.30	0.671	0.014	11.27	1.290	0.018	11.39	0.764	0.011	12.01	0.205	0.004
12.37	1.595	0.036	21.30	0.770	0.015	12.26	0.995	0.016	12.39	0.590	0.010	13.00	0.244	0.003
13.36	1.303	0.032	22.29	0.549	0.013	13.25	0.772	0.014	13.37	0.523	0.010	14.00	0.203	0.003
14.35	1.236	0.031	23.28	0.345	0.010	14.25	0.685	0.013	14.37	0.426	0.009	15.99	0.132	0.002
15.34	1.147	0.030	24.27	0.285	0.009	15.24	0.617	0.012	15.36	0.426	0.009	16.98	0.095	0.002
16.33	1.073	0.029	25.26	0.293	0.009	16.23	0.616	0.012	16.35	0.393	0.008	17.98	0.061	0.002
17.32	0.993	0.028	26.25	0.172	0.007	17.22	0.495	0.011	17.34	0.450	0.009	18.60	0.060	0.004
18.32	0.892	0.027	27.15	1.776	0.021	18.21	0.465	0.011	18.34	0.178	0.006			
19.31	0.739	0.024				19.20	0.513	0.011	19.33	0.129	0.005			
20.30	0.730	0.024				20.19	0.444	0.010	20.32	0.129	0.005			
21.29	0.663	0.025				21.18	0.241	0.008	21.31	0.207	0.006			
22.28	0.624	0.027				22.17	0.161	0.006	22.31	0.091	0.006			
23.27	0.695	0.023				23.16	0.080	0.004	23.07	0.352	0.011			
24.26	0.476	0.019				24.15	0.290	0.009						
25.26	0.339	0.016				25.12	0.0	0.0						
26.25	0.395	0.018				0.0	0.0	0.0						
27.24	0.408	0.018				0.0	0.0	0.0						
28.01	2.859	0.064				0.0	0.0	0.0						

Table 38

PROTON FROM 1 - 12 BOMBARDED BY 20 MEV. PROTONS.

11 DEG - RUN 31			30 DEG - RUN 24		
ENERGY (MEV)	SIGMA ERROR (MB/SR-MEV)		ENERGY (MEV)	SIGMA ERROR (MB/SR-MEV)	
1.03	2.79	0.14	1.68	2.46	0.06
2.03	3.79	0.17	2.68	3.7	0.07
3.03	5.98	0.20	3.68	4.33	0.08
4.03	5.34	0.20	4.69	3.91	0.07
5.03	5.93	0.21	5.69	4.00	0.07
6.03	6.32	0.24	6.69	3.80	0.07
7.03	4.73	0.19	7.69	2.97	0.06
8.03	3.89	0.17	8.70	2.12	0.05
9.03	4.36	0.18	9.70	2.47	0.06
10.03	3.07	0.15	10.70	1.41	0.04
11.03	3.90	0.17	11.70	2.17	0.05
12.04	3.14	0.15	12.70	1.83	0.05
13.04	3.14	0.15	13.71	1.33	0.04
14.04	2.65	0.14	14.71	1.15	0.04
15.04	2.80	0.14	15.71	1.31	0.04
16.04	2.19	0.13	16.71	1.02	0.04
17.04	2.41	0.13	17.72	0.97	0.04
18.04	4.94	0.19	18.72	3.48	0.07
19.04	1.904	0.119	19.72	0.394	0.023
20.04	2.77	0.14	20.73	0.57	0.03
21.04	1.381	0.101	21.73	0.297	0.020
22.04	1.204	0.094	22.73	0.299	0.020
23.04	24.6	0.43	23.71	20.92	0.17
24.67	2.995	0.185	0.0	0.0	0.0

Table 39

ALPHA FROM 1 - 12 BOMBARDED BY 20 MEV. PROTONS.

11 DEG - RUN 31			30 DEG - RUN 24		
ENERGY (MEV)	SIGMA ERROR (MB/SR-MEV)		ENERGY (MEV)	SIGMA ERROR (MB/SR-MEV)	
3.38	14.16	0.32	3.38	10.06	0.13
4.38	12.99	0.31	4.38	9.45	0.11
5.38	12.12	0.30	5.38	8.59	0.11
6.38	10.60	0.28	6.38	7.18	0.10
7.38	9.01	0.26	7.38	5.87	0.09
8.38	8.09	0.24	8.38	5.50	0.09
9.38	6.21	0.21	9.40	4.21	0.08
10.38	5.01	0.19	10.40	3.50	0.07
11.38	4.50	0.19	11.40	3.11	0.06
12.38	5.03	0.19	12.40	3.33	0.07
13.38	4.27	0.18	13.41	2.33	0.06
14.38	3.35	0.16	14.41	1.46	0.06
15.38	2.81	0.13	15.41	1.10	0.06
16.38	1.67	0.11	16.41	1.14	0.06
17.38	1.503	0.103	17.43	0.338	0.021
18.38	0.65	0.07	18.37	2.82	0.06
19.32	2.943	0.160	0.0	0.0	0.0

Table 40

PROTON FROM A = 16 BOMBARDED BY 62 MEV. PROTONS.

12 DEG - RUN 122			15 DEG - RUN 113			30 DEG - RUN 7105			35 DEG - RUN 2002			40 DEG - RUN 2034		
ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR
2.48	3.05	0.32	2.58	3.18	0.32	3.06	3.25	0.05	2.45	2.99	0.13	2.41	3.47	0.20
4.48	2.99	0.36	4.59	3.48	0.34	5.08	3.94	0.05	4.48	2.75	0.13	4.41	3.32	0.20
6.49	3.52	0.35	6.60	3.27	0.34	7.04	2.29	0.05	6.50	2.24	0.12	6.40	2.60	0.18
8.49	3.24	0.33	8.60	3.97	0.32	9.03	2.02	0.04	8.53	1.80	0.11	8.39	2.24	0.18
10.49	2.38	0.31	10.61	3.56	0.31	11.02	1.59	0.04	10.55	1.51	0.11	10.34	1.53	0.15
12.50	2.44	0.30	12.62	2.48	0.31	13.00	1.41	0.04	12.59	1.23	0.10	12.37	1.38	0.15
14.50	2.07	0.31	14.62	2.68	0.31	14.99	1.38	0.04	14.50	1.19	0.10	14.36	1.40	0.14
16.51	2.19	0.30	16.63	2.18	0.30	16.98	1.37	0.04	16.63	1.23	0.10	16.36	1.10	0.14
18.51	3.31	0.32	18.63	2.52	0.32	19.97	1.33	0.04	18.65	1.18	0.10	18.35	1.11	0.14
20.51	2.46	0.31	20.64	3.10	0.32	20.96	1.39	0.04	20.67	1.39	0.10	20.34	1.02	0.14
22.52	2.59	0.32	22.65	2.51	0.31	23.98	1.39	0.04	22.70	1.04	0.10	22.33	1.27	0.14
24.52	2.59	0.32	24.65	2.61	0.32	24.94	1.37	0.04	24.72	1.32	0.10	24.32	0.95	0.14
26.53	2.85	0.32	26.66	2.52	0.32	26.93	1.35	0.04	26.75	1.35	0.10	26.31	1.00	0.14
28.53	2.59	0.32	28.67	2.69	0.32	28.92	1.34	0.04	28.77	1.24	0.10	28.30	1.15	0.13
30.53	2.80	0.33	30.67	2.09	0.32	30.91	1.37	0.04	30.80	1.33	0.10	30.30	0.86	0.13
32.54	2.70	0.32	32.68	3.26	0.33	32.90	1.17	0.04	32.82	1.17	0.10	32.29	0.51	0.14
34.54	3.03	0.36	34.69	3.55	0.33	34.89	1.48	0.04	34.84	1.13	0.10	34.28	1.06	0.12
36.54	3.78	0.34	36.69	3.35	0.33	36.87	1.75	0.04	36.84	1.11	0.10	36.27	0.99	0.12
38.55	3.80	0.34	38.70	3.26	0.34	38.86	1.63	0.04	38.89	1.07	0.10	38.26	1.50	0.13
40.55	3.56	0.33	40.70	3.41	0.35	40.85	1.96	0.04	40.92	1.22	0.09	40.25	1.10	0.13
42.56	3.65	0.34	42.71	2.71	0.32	42.84	1.18	0.03	42.94	1.03	0.08	42.28	1.22	0.11
44.56	2.49	0.26	44.72	1.70	0.26	44.83	0.89	0.03	44.97	0.89	0.09	44.24	0.42	0.11
46.56	2.33	0.26	46.73	1.31	0.25	46.82	0.92	0.03	46.99	0.95	0.08	46.23	0.92	0.11
48.57	2.75	0.26	48.73	2.38	0.25	48.81	1.20	0.04	49.02	0.90	0.07	48.22	0.79	0.10
50.57	1.51	0.23	50.74	1.26	0.24	50.80	0.97	0.03	51.04	0.33	0.10	50.21	0.33	0.14
52.57	1.08	0.23	52.74	0.85	0.19	52.79	4.74	0.04	53.06	1.57	0.08	52.20	0.66	0.09
54.58	3.01	0.24	54.62	3.26	0.24	53.43	4.29	0.04	54.48	0.33	0.21	53.80	5.27	0.18

Table 40 - Continued

PROTON FROM A = 16 BONDED BY 62 MEV. PROTONS.

45 DEG - RUN 7103				50 DEG - RUN 2041				55 DEG - RUN 102				60 DEG - RUN 7114				65 DEG - RUN 106			
ENERGY (MEV)	SIGMA (MB/SP-REV)	ERROR		ENERGY (MEV)	SIGMA (MB/SP-REV)	ERROR		ENERGY (MEV)	SIGMA (MB/SP-REV)	ERROR		ENERGY (MEV)	SIGMA (MB/SP-REV)	ERROR		ENERGY (MEV)	SIGMA (MB/SP-REV)	ERROR	
3.06	3.11	0.04		2.42	3.22	0.14		2.83	3.01	0.12		3.22	2.96	0.04		2.63	3.03	0.12	
4.05	2.54	0.04		4.81	2.93	0.14		4.44	2.42	0.11		5.22	2.26	0.03		4.43	2.26	0.11	
7.04	2.01	0.04		6.40	2.05	0.13		6.85	1.76	0.10		7.21	1.73	0.03		6.64	1.64	0.09	
8.04	1.68	0.03		8.40	1.91	0.12		8.85	1.46	0.04		9.21	1.41	0.03		8.44	1.21	0.08	
11.03	1.27	0.03		10.39	1.20	0.10		10.46	1.13	0.08		11.20	1.10	0.02		10.44	0.96	0.08	
13.02	1.19	0.03		12.38	1.16	0.10		12.86	0.99	0.08		13.20	0.95	0.02		12.43	0.86	0.07	
15.01	1.04	0.03		14.34	0.85	0.10		14.87	0.41	0.08		15.20	0.83	0.02		14.65	0.63	0.07	
17.00	1.02	0.03		16.37	0.98	0.05		16.88	0.88	0.07		17.19	0.77	0.02		16.45	0.63	0.04	
18.99	0.99	0.03		18.36	0.83	0.10		18.88	0.77	0.07		19.19	0.72	0.02		18.66	0.70	0.06	
20.98	0.99	0.03		20.36	0.73	0.10		20.89	0.68	0.07		21.19	0.67	0.02		20.66	0.68	0.06	
22.97	0.97	0.03		22.35	0.67	0.09		22.89	0.81	0.07		23.18	0.65	0.02		22.66	0.38	0.06	
24.96	0.90	0.03		24.34	0.76	0.09		24.90	0.78	0.07		25.18	0.63	0.02		24.67	0.51	0.05	
26.96	0.91	0.03		26.33	0.90	0.09		26.91	0.68	0.07		27.18	0.57	0.02		26.67	0.47	0.05	
28.95	0.92	0.03		28.33	0.76	0.08		28.91	0.74	0.06		29.17	0.52	0.02		28.67	0.41	0.05	
30.94	0.87	0.02		30.32	0.80	0.08		30.92	0.64	0.06		31.17	0.52	0.02		30.68	0.41	0.05	
32.93	0.89	0.02		32.31	0.89	0.08		32.92	0.62	0.04		33.17	0.54	0.02		32.68	0.35	0.05	
34.92	0.93	0.02		34.31	0.73	0.07		34.93	0.74	0.06		35.16	0.51	0.02		34.69	0.40	0.05	
36.91	0.93	0.03		36.30	0.86	0.08		36.93	0.50	0.06		37.16	0.46	0.02		36.69	0.37	0.04	
38.90	0.95	0.03		38.29	0.85	0.08		38.94	0.64	0.06		39.15	0.53	0.01		38.69	0.42	0.04	
40.89	0.82	0.02		40.29	0.77	0.07		40.95	0.43	0.04		41.15	0.30	0.01		40.70	0.29	0.04	
42.89	0.68	0.02		42.28	0.49	0.06		42.95	0.32	0.05		43.15	0.28	0.01		42.70	0.13	0.04	
44.88	0.54	0.02		44.27	0.69	0.07		44.96	0.36	0.05		45.14	0.24	0.01		44.70	0.20	0.03	
46.87	0.48	0.02		46.27	0.58	0.06		46.96	0.28	0.06		47.14	0.15	0.02		46.71	0.17	0.03	
48.86	0.230	0.026		48.26	0.490	0.083		48.97	0.148	0.037		49.14	0.177	0.008		48.71	0.160	0.019	
50.85	0.69	0.02		50.25	0.17	0.04		50.98	0.40	0.03		50.91	1.21	0.02		50.71	0.13	0.06	
52.82	4.05	0.04		52.25	1.81	0.06		52.93	2.79	0.12		50.0	0.3	0.02		50.0	-0.10	0.11	
0.0	0.0	0.0		53.37	1.079	0.162		0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	

Table 40 - Continued

PROTON FROM A - 16 BOMBARDED BY 62 MEV. PROTONS.

70 DEG - RUN 2031			75 DEG - RUN 2020			80 DEG - RUN 111			90 DEG - RUN 2024			110 DEG - RUN 7114		
ENERGY (MEV)	SIGMA (MB/SP-NEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SP-NEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SP-NEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SP-NEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SP-NEV)	ERROR
2.62	2.75	0.15	9.02	1.27	0.05	2.49	2.85	0.12	2.61	2.73	0.08	2.43	2.34	0.03
4.62	2.183	0.148	10.03	0.747	0.042	4.50	2.293	0.105	4.60	1.984	0.070	4.63	1.575	0.024
6.62	1.824	0.125	12.05	0.681	0.040	6.51	1.764	0.089	6.58	1.438	0.059	6.83	1.082	0.019
8.61	1.441	0.108	14.06	0.601	0.038	8.52	1.142	0.073	8.57	1.059	0.052	8.83	0.746	0.017
10.61	0.799	0.092	16.07	0.506	0.036	10.53	0.956	0.068	10.56	0.722	0.043	10.83	0.534	0.014
12.61	0.525	0.088	18.08	0.479	0.034	12.54	0.810	0.064	12.55	0.633	0.041	12.83	0.409	0.013
14.61	0.668	0.083	20.09	0.392	0.032	14.55	0.579	0.057	14.53	0.454	0.037	14.83	0.309	0.011
16.61	0.653	0.081	22.10	0.344	0.031	16.56	0.499	0.055	16.12	0.380	0.035	16.84	0.237	0.010
18.60	0.653	0.077	24.12	0.278	0.029	18.56	0.366	0.053	18.51	0.391	0.033	18.84	0.231	0.010
20.60	0.500	0.073	26.13	0.292	0.027	20.57	0.352	0.048	20.50	0.296	0.030	20.84	0.167	0.009
22.60	0.531	0.071	28.14	0.227	0.026	22.58	0.481	0.047	22.48	0.231	0.027	22.84	0.137	0.008
24.60	0.408	0.066	30.15	0.206	0.024	24.59	0.270	0.044	24.47	0.204	0.025	24.84	0.119	0.007
26.59	0.327	0.065	32.16	0.222	0.022	26.60	0.195	0.039	26.46	0.195	0.024	26.84	0.094	0.006
28.59	0.250	0.061	34.17	0.200	0.023	28.61	0.379	0.040	28.45	0.188	0.022	28.84	0.078	0.006
30.59	0.245	0.056	36.19	0.154	0.023	30.62	0.200	0.034	30.44	0.171	0.022	30.84	0.063	0.006
32.59	0.315	0.054	38.20	0.187	0.017	32.63	0.332	0.036	32.42	0.144	0.020	32.84	0.049	0.005
34.58	0.298	0.059	40.21	0.110	0.019	34.64	0.165	0.035	34.41	0.118	0.019	34.85	0.043	0.004
36.58	0.226	0.056	42.22	0.085	0.018	36.65	0.182	0.024	36.40	0.139	0.016	36.85	0.022	0.004
38.58	0.242	0.044	44.23	0.027	0.017	38.66	0.125	0.028	38.39	0.093	0.017	38.85	0.029	0.003
40.58	0.158	0.043	46.25	0.091	0.011	40.67	0.117	0.030	40.37	0.039	0.014	40.85	0.017	0.003
42.58	0.137	0.046	48.26	0.028	0.006	42.68	0.053	0.023	42.36	0.039	0.014	42.85	0.004	0.001
44.57	0.077	0.038	50.19	0.000	0.000	44.69	0.097	0.031	44.35	0.033	0.010	44.85	0.027	0.003
46.57	0.162	0.052	0.0	0.0	0.0	46.70	0.035	0.010	46.34	0.007	0.003	46.18	0.002	0.001
48.57	0.010	0.018	0.0	0.0	0.0	48.71	0.189	0.031	48.32	0.154	0.013	0.0	0.0	0.0
50.59	0.620	0.066	0.0	0.0	0.0	49.87	0.035	0.021	0.0	0.0	0.0	0.0	0.0	0.0

Table 40 - Continued

PROTON FROM A = 16 BOMBARDED BY 62 MEV. PROTONS.									
135 DEG - RUN 2056					160 DEG - RUN 2061				
ENERGY (MEV)	SIGMA (MB/SP-MEV)	SIGMA ERROR	ENERGY (MEV)	SIGMA (MB/SP-MEV)	SIGMA ERROR	ENERGY (MEV)	SIGMA (MB/SP-MEV)	SIGMA ERROR	ENERGY (MEV)
2.27	2.50	0.07	2.70	2.57	0.12	2.70	2.57	0.12	2.70
4.26	1.96	0.06	4.68	1.50	0.10	4.68	1.50	0.10	4.68
6.25	1.23	0.05	6.66	1.07	0.08	6.66	1.07	0.08	6.66
8.25	0.91	0.04	8.68	0.80	0.07	8.68	0.80	0.07	8.68
10.24	0.52	0.03	10.62	0.54	0.05	10.62	0.54	0.05	10.62
12.23	0.41	0.03	12.60	0.40	0.05	12.60	0.40	0.05	12.60
14.22	0.31	0.03	14.57	0.29	0.05	14.57	0.29	0.05	14.57
16.22	0.27	0.02	16.55	0.21	0.04	16.55	0.21	0.04	16.55
18.21	0.20	0.02	18.53	0.22	0.04	18.53	0.22	0.04	18.53
20.20	0.16	0.02	20.51	0.12	0.03	20.51	0.12	0.03	20.51
22.19	0.11	0.02	22.89	0.10	0.03	22.89	0.10	0.03	22.89
24.19	0.10	0.02	24.87	0.05	0.03	24.87	0.05	0.03	24.87
26.18	0.073	0.014	26.85	0.072	0.024	26.85	0.072	0.024	26.85
28.17	0.059	0.013	28.82	0.086	0.023	28.82	0.086	0.023	28.82
30.17	0.035	0.012	30.81	0.086	0.018	30.81	0.086	0.018	30.81
32.16	0.053	0.009	32.39	0.028	0.014	32.39	0.028	0.014	32.39
34.15	0.035	0.008	34.37	0.038	0.013	34.37	0.038	0.013	34.37
36.14	0.028	0.007	36.35	0.039	0.012	36.35	0.039	0.012	36.35
38.14	0.007	0.005	38.33	0.006	0.005	38.33	0.006	0.005	38.33
40.13	0.004	0.003	40.31	0.003	0.010	40.31	0.003	0.010	40.31
42.12	0.005	0.006	42.29	0.012	0.005	42.29	0.012	0.005	42.29
44.02	0.017	0.003	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 41

DEUTERON FROM A = 16 BOMBARDED BY 62 MEV. PROTONS.

12 DEG - RUN 122			15 DEG - RUN 115			25 DEG - RUN 2051			30 DEG - RUN 7105			35 DEG - RUN 2002		
ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR
3.63	0.45	0.11	3.39	0.38	0.11	6.49	0.47	0.08	4.30	0.43	0.02	3.42	0.39	0.04
7.68	0.40	0.10	7.40	0.49	0.11	10.48	0.48	0.08	8.28	0.36	0.01	7.46	0.37	0.04
11.65	0.30	0.10	11.41	0.27	0.09	14.46	0.35	0.07	12.26	0.33	0.01	11.51	0.30	0.03
15.65	0.40	0.09	15.42	0.35	0.09	18.44	0.33	0.07	16.24	0.28	0.01	15.56	0.29	0.03
19.66	0.39	0.09	19.44	0.41	0.09	22.42	0.28	0.07	20.22	0.29	0.01	19.61	0.29	0.03
23.67	0.39	0.09	23.45	0.24	0.09	26.40	0.29	0.07	24.19	0.28	0.01	23.66	0.30	0.03
27.68	0.42	0.09	27.46	0.41	0.09	30.38	0.34	0.06	28.17	0.28	0.01	27.71	0.21	0.03
31.68	0.45	0.10	31.48	0.31	0.09	34.37	0.28	0.06	32.15	0.24	0.01	31.76	0.21	0.03
35.67	0.43	0.08	35.49	0.62	0.09	38.35	0.21	0.08	36.13	0.33	0.01	35.81	0.34	0.03
39.70	3.56	0.18	39.50	3.21	0.17	42.33	1.06	0.15	40.11	0.93	0.02	39.86	0.81	0.05
43.71	0.39	0.31	43.51	0.25	0.30	46.06	0.48	0.05	44.09	0.53	0.02	43.90	0.05	0.06
47.11	4.14	0.17	46.75	3.96	0.18	0.0	0.0	0.0	46.20	0.01	0.01	46.36	1.51	0.09

40 DEG - RUN 2034			45 DEG - RUN 7103			50 DEG - RUN 2041			55 DEG - RUN 1011			60 DEG - RUN 7116		
ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR
3.56	0.606	0.067	4.31	0.371	0.012	3.41	0.391	0.045	3.59	0.355	0.036	4.32	0.352	0.010
7.54	0.401	0.056	8.29	0.308	0.011	7.40	0.328	0.038	7.50	0.236	0.030	8.31	0.257	0.009
11.53	0.308	0.050	12.27	0.272	0.010	11.39	0.274	0.034	11.61	0.186	0.026	12.30	0.204	0.008
15.51	0.267	0.044	16.25	0.200	0.009	15.37	0.172	0.028	15.62	0.210	0.025	16.30	0.156	0.007
19.49	0.230	0.043	20.24	0.188	0.008	19.36	0.206	0.027	19.63	0.195	0.023	20.29	0.143	0.006
23.48	0.261	0.041	24.22	0.188	0.008	23.35	0.172	0.026	23.65	0.109	0.021	24.28	0.099	0.006
27.46	0.206	0.040	28.20	0.163	0.008	27.33	0.202	0.025	27.66	0.133	0.020	28.27	0.071	0.005
31.44	0.214	0.039	32.18	0.209	0.008	31.32	0.147	0.023	31.67	0.098	0.020	32.27	0.129	0.006
35.42	0.381	0.046	36.17	0.178	0.008	35.30	0.152	0.026	35.64	0.175	0.021	36.24	0.206	0.009
39.41	0.569	0.051	40.15	0.332	0.014	39.29	0.367	0.042	39.59	0.175	0.032	40.25	0.036	0.002
43.39	-0.132	0.070	43.71	0.241	0.006	43.28	0.162	0.013	43.00	0.171	0.012	42.72	0.146	0.008
46.03	0.722	0.063	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 41 - Continued

DEUTERON FROM A = 16 BOMBARDED BY 62 MEV. PROTONS.

65 DEG - RUN 106			70 DEG - RUN 2031			75 DEG - RUN 2020			80 DEG - RUN 111			90 DEG - RUN 2024		
ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR
3.58	0.325	0.034	3.42	0.318	0.044	3.60	0.243	0.019	3.59	0.348	0.032	3.65	0.305	0.021
7.59	0.252	0.028	7.42	0.236	0.036	7.62	0.202	0.016	7.61	0.200	0.025	7.63	0.160	0.016
11.60	0.188	0.024	11.41	0.230	0.031	11.64	0.128	0.013	11.53	0.133	0.020	11.60	0.112	0.013
15.60	0.131	0.021	15.41	0.121	0.026	15.67	0.068	0.010	15.65	0.098	0.014	15.58	0.069	0.010
19.61	0.137	0.019	19.40	0.094	0.023	19.69	0.062	0.009	19.67	0.067	0.015	19.55	0.068	0.009
23.62	0.060	0.018	23.40	0.021	0.020	23.71	0.057	0.009	23.59	0.070	0.013	23.51	0.028	0.007
27.62	0.040	0.016	27.39	0.053	0.019	27.74	0.018	0.007	27.71	0.038	0.011	27.50	0.021	0.006
31.63	0.055	0.017	31.39	0.032	0.019	31.76	0.031	0.007	31.73	0.040	0.011	31.48	0.050	0.008
35.64	0.111	0.024	35.38	0.102	0.024	35.78	0.050	0.010	35.75	0.047	0.014	35.45	0.017	0.003
39.64	-0.010	0.011	39.38	0.004	0.003	39.66	0.008	0.002	39.14	0.010	0.004	38.68	0.006	0.002
42.17	0.117	0.019	41.83	0.060	0.018	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

110 DEG - RUN 7114			135 DEG - RUN 2056			160 DEG - RUN 2061			ENERGY SIGMA ERROR			ENERGY SIGMA ERROR		
ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR
4.13	0.22	0.01	3.41	0.25	0.02	3.69	0.22	0.03						
8.13	0.118	0.005	7.40	0.131	0.012	7.65	0.123	0.020						
12.13	0.072	0.004	11.38	0.068	0.008	11.61	0.023	0.012						
16.13	0.041	0.003	15.37	0.031	0.006	15.56	0.006	0.008						
20.14	0.026	0.002	19.36	0.017	0.004	19.52	0.013	0.007						
24.14	0.015	0.002	23.34	0.011	0.003	23.48	0.000	0.005						
28.14	0.014	0.002	27.33	0.003	0.003	27.44	0.002	0.003						
32.14	0.003	0.000	31.31	0.001	0.001	0.0	0.0	0.0						
36.25	0.003	0.001	33.88	0.002	0.001	0.0	0.0	0.0						

Table 42

TRITON FROM A - 16 BOMBARDED BY 62 MEV. PROTONS.

12 DEG - RUN 122			15 DEG - RUN 115			25 DEG - RUN 2051			30 DEG - RUN 7105			35 DEG - RUN 2002		
ENERGY (MEV)	SIGNA (MB/SR-NEV)	ERROR	ENERGY (MEV)	SIGNA (MB/SR-NEV)	ERROR	ENERGY (MEV)	SIGNA (MB/SR-NEV)	ERROR	ENERGY (MEV)	SIGNA (MB/SR-NEV)	ERROR	ENERGY (MEV)	SIGNA (MB/SR-NEV)	ERROR
7.99	0.132	0.051	8.10	0.154	0.056	8.04	0.096	0.042	8.38	0.085	0.007	8.07	0.065	0.019
13.00	0.107	0.049	13.12	0.144	0.050	13.01	0.156	0.038	13.35	0.093	0.007	13.13	0.066	0.017
18.01	0.083	0.046	18.13	0.098	0.047	17.99	0.097	0.032	18.33	0.068	0.006	18.19	0.070	0.015
23.02	0.143	0.047	23.15	0.144	0.045	22.97	0.094	0.032	23.30	0.343	0.006	23.26	0.041	0.014
28.03	0.093	0.043	28.16	0.120	0.040	27.95	0.073	0.029	28.27	0.055	0.003	28.32	0.058	0.014
33.04	0.085	0.048	33.18	0.108	0.049	32.92	0.085	0.027	33.24	0.028	0.006	33.38	0.024	0.014
38.02	0.044	0.061	38.10	0.101	0.043	37.70	0.045	0.034	37.37	0.353	0.003	37.60	0.016	0.004

40 DEG - RUN 2034			45 DEG - RUN 7103			50 DEG - RUN 2041			55 DEG - RUN 102			60 DEG - RUN 7116		
ENERGY (MEV)	SIGNA (MB/SR-NEV)	ERROR	ENERGY (MEV)	SIGNA (MB/SR-NEV)	ERROR	ENERGY (MEV)	SIGNA (MB/SR-NEV)	ERROR	ENERGY (MEV)	SIGNA (MB/SR-NEV)	ERROR	ENERGY (MEV)	SIGNA (MB/SR-NEV)	ERROR
8.04	0.067	0.027	8.39	0.063	0.005	8.05	0.071	0.018	8.10	0.231	0.014	8.41	0.048	0.004
13.02	0.061	0.023	13.37	0.053	0.004	13.03	0.060	0.015	13.11	0.025	0.011	13.40	0.035	0.003
18.00	0.013	0.019	18.34	0.032	0.004	18.01	0.032	0.012	18.13	0.034	0.003	18.39	0.021	0.002
22.98	0.034	0.019	23.32	0.034	0.004	23.00	0.042	0.011	23.14	0.021	0.008	23.38	0.009	0.002
27.96	0.029	0.019	28.30	0.049	0.004	27.98	0.004	0.010	28.16	0.226	0.006	28.37	0.009	0.002
32.93	0.053	0.017	33.28	0.001	0.001	32.96	0.014	0.005	33.17	-0.201	0.005	32.94	0.003	0.001
0.0	-0.003	0.003	36.29	0.003	0.002	36.55	0.005	0.004	36.13	0.006	0.005	0.0	0.0	0.0

Table 42 - Continued

TRITON FROM A = 16 BOMBARDED BY 62 MEV. PROTONS.

55 DEG - RUN 106			70 DEG - RUN 2031			75 DEG - RUN 2020			80 DEG - RUN 111			90 DEG - RUN 2024		
ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR
7.99	0.022	0.012	8.07	0.052	0.016	8.12	0.022	0.007	8.11	0.032	0.011	8.07	0.026	0.007
13.07	0.011	0.010	13.06	0.014	0.011	13.15	0.015	0.005	13.14	0.013	0.007	13.04	0.012	0.004
18.01	0.025	0.007	18.05	0.017	0.008	18.18	0.006	0.003	18.16	0.008	0.005	18.01	0.007	0.003
23.02	0.013	0.007	23.05	0.012	0.007	23.21	0.008	0.003	23.19	0.005	0.004	22.98	0.004	0.002
28.02	0.016	0.006	28.08	0.010	0.006	28.24	0.002	0.001	28.21	0.005	0.002	0.0	-0.000	0.000
32.76	0.001	0.001	0.0	0.0	0.0	32.24	0.001	0.001	31.65	0.002	0.002	0.0	0.0	0.0

110 DEG - RUN 7114			135 DEG - RUN 2056			160 DEG - RUN 2061								
ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-MEV)	ERROR
8.43	0.012	0.002	7.95	0.030	0.005	8.14	0.021	0.008						
13.43	0.007	0.001	12.93	0.007	0.002	13.09	0.003	0.003						
18.44	0.003	0.001	17.91	0.002	0.001	0.0	-0.001	0.000						
23.44	0.000	0.000	22.89	0.000	0.000	0.0	-0.000	0.000						
28.77	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0						

Table 43

HELIUM-3 FROM A = 16 BOMBARDED BY 62 MEV. PROTONS.

13 DEG - RUN 122			15 DEG - RUN 115			30 DEG - RUN 7105			35 DEG - RUN 2002			40 DEG - RUN 2034		
ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR
8.59	0.12	0.06	8.70	0.10	0.07	9.97	0.17	0.01	8.58	0.15	0.03	8.64	0.15	0.04
13.60	0.05	0.06	13.72	0.15	0.06	14.94	0.10	0.01	13.64	0.08	0.02	13.62	0.09	0.03
18.61	0.05	0.05	18.73	0.13	0.06	19.92	0.10	0.01	18.70	0.08	0.02	18.60	0.13	0.03
23.62	0.202	0.052	23.75	0.080	0.050	24.89	0.078	0.006	23.76	0.078	0.016	23.57	0.085	0.022
28.63	0.103	0.046	28.77	0.027	0.044	29.86	0.069	0.006	28.82	0.055	0.015	28.55	0.041	0.020
33.64	0.061	0.052	33.78	0.174	0.051	34.84	0.056	0.007	33.68	0.060	0.013	33.53	0.072	0.020
38.65	0.037	0.080	38.80	0.181	0.072	39.91	0.037	0.004	38.94	0.037	0.014	38.51	0.002	0.014
43.33	0.142	0.025	43.41	0.071	0.018	43.12	0.007	0.002	42.59	0.024	0.007	42.10	0.025	0.010

45 DEG - RUN 103			50 DEG - RUN 2041			55 DEG - RUN 102			60 DEG - RUN 7116			65 DEG - RUN 106		
ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNA (NB/SR-MEV)	ERROR
9.98	0.089	0.007	8.65	0.152	0.025	8.70	0.125	0.020	10.01	0.104	0.006	8.59	0.104	0.018
14.96	0.094	0.006	13.63	0.124	0.021	13.72	0.069	0.017	15.00	0.053	0.004	13.60	0.063	0.014
19.94	0.062	0.005	18.61	0.088	0.017	18.73	0.046	0.013	19.99	0.037	0.003	18.61	0.019	0.011
24.91	0.050	0.004	23.59	0.064	0.014	23.75	0.044	0.011	24.98	0.027	0.003	23.62	0.029	0.009
29.89	0.037	0.004	28.58	0.025	0.012	28.76	0.034	0.010	29.97	0.024	0.003	28.62	0.027	0.009
34.87	0.029	0.003	33.56	0.038	0.012	33.78	0.019	0.009	34.96	0.011	0.002	33.63	0.010	0.006
39.83	0.007	0.001	38.54	0.015	0.004	38.72	0.008	0.002	38.48	0.005	0.001	37.57	0.004	0.002
0.0	0.0	0.0	41.51	0.019	0.009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 43 - Continued

HELIUM-3 FROM A = 16 BOMBARDED BY 62 MEV. PROTONS.

70 DEG - RUN 2031			75 DEG - RUN 2020			80 DEG - RUN 111			90 DEG - RUN 2024			135 DEG - RUN 2056		
ENERGY (MEV)	SIGMA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (NB/SR-MEV)	ERROR
8.71	0.119	0.024	8.78	0.053	0.010	8.77	0.078	0.017	8.82	0.064	0.011	8.49	0.058	0.008
13.71	0.056	0.019	13.81	0.046	0.008	13.79	0.047	0.012	13.79	0.035	0.007	13.48	0.024	0.005
18.70	0.022	0.014	18.84	0.021	0.006	18.82	0.029	0.009	18.76	0.014	0.005	18.46	0.006	0.003
23.70	0.032	0.011	23.86	0.009	0.004	23.84	0.019	0.007	23.73	0.007	0.004	23.44	0.004	0.001
28.69	0.015	0.009	28.89	0.012	0.003	28.86	0.006	0.005	28.70	0.002	0.002	27.65	0.002	0.001
0.0	-0.008	0.007	33.92	0.002	0.001	33.89	0.002	0.001	33.37	0.001	0.000	0.0	0.0	0.0
0.0	0.0	0.0	37.22	0.003	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

160 DEG - RUN 2061														
ENERGY (MEV)	SIGMA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGMA (NB/SR-MEV)	ERROR
8.73	0.037	0.012												
13.68	0.021	0.007												
18.63	-0.005	0.003												
23.58	0.001	0.001												

Table 44

ALPHA FROM 1 - 16 BOMBARDED BY 62 MEV. PROTONS.

[illegible]

Table 44 - Continued

ALPHA FROM A - 16 BOMBARDED BY 62 MEV. PROTONS.

45 DEG - FROM 7103			50 DEG - FROM 2041			55 DEG - FROM 102			60 DEG - FROM 7116			65 DEG - FROM 106		
ENERGY (MEV)	SIGMA (MB/SP-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SP-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SP-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SP-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SP-MEV)	ERROR
6.65	2.56	0.04	8.21	3.32	0.18	8.14	2.56	0.15	6.61	2.25	0.04	4.08	2.53	0.14
8.64	1.76	0.04	6.20	2.32	0.15	6.14	2.12	0.12	8.61	1.33	0.03	6.09	1.80	0.11
10.63	1.14	0.03	8.20	1.72	0.12	8.15	1.37	0.10	10.61	0.84	0.02	8.09	0.96	0.09
12.62	0.73	0.02	10.19	1.01	0.10	10.16	0.83	0.08	12.60	0.53	0.02	10.04	0.64	0.07
14.61	0.48	0.02	12.18	0.80	0.09	12.16	0.55	0.07	14.60	0.32	0.02	12.10	0.38	0.06
16.60	0.35	0.02	14.17	0.54	0.07	14.17	0.30	0.06	16.60	0.23	0.01	14.10	0.28	0.05
18.59	0.27	0.02	16.17	0.35	0.06	16.17	0.16	0.05	18.59	0.17	0.01	16.10	0.20	0.04
20.58	0.19	0.01	18.16	0.31	0.05	18.16	0.18	0.04	20.59	0.12	0.01	18.11	0.15	0.03
22.57	0.16	0.01	20.16	0.19	0.04	20.19	0.15	0.04	22.58	0.09	0.01	20.11	0.12	0.03
24.56	0.146	0.010	22.15	0.120	0.037	22.19	0.096	0.033	24.58	0.072	0.007	22.11	0.05	0.023
26.55	0.091	0.009	24.14	0.114	0.034	24.20	0.093	0.026	26.58	0.063	0.006	24.12	0.071	0.021
28.54	0.083	0.008	26.14	0.104	0.030	26.20	0.078	0.022	28.57	0.035	0.005	26.12	0.041	0.019
30.53	0.068	0.007	28.13	0.123	0.026	28.21	0.086	0.019	30.57	0.032	0.005	28.12	0.015	0.016
32.52	0.059	0.006	30.12	0.063	0.020	30.21	0.035	0.017	32.57	0.025	0.004	30.13	0.061	0.016
34.51	0.047	0.005	32.12	0.064	0.020	32.22	0.039	0.017	34.56	0.030	0.004	32.13	0.036	0.014
36.50	0.043	0.006	34.11	0.051	0.019	34.23	0.030	0.016	36.56	0.017	0.003	34.13	0.04	0.013
38.49	0.022	0.006	36.10	0.031	0.018	36.23	0.043	0.014	38.56	0.029	0.004	36.14	0.008	0.006
40.48	0.059	0.004	38.09	0.088	0.017	38.24	0.023	0.011	40.55	0.037	0.001	38.14	0.019	0.011
42.47	0.008	0.003	40.09	0.026	0.013	40.24	0.016	0.011	42.55	0.005	0.001	40.14	-0.002	0.001
44.46	0.008	0.003	42.08	0.053	0.014	42.25	0.001	0.007	44.57	0.030	0.001	42.15	0.009	0.004
46.45	0.001	0.001	44.07	0.000	0.005	44.26	0.015	0.005	0.0	0.0	0.0	0.0	0.0	0.0
48.44	0.001	0.000	46.07	0.002	0.002	46.14	0.002	0.002	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	47.94	0.002	0.002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 44 - Continued

ALPHA FROM A - 16 BOMBARDED BY 62 MEV. PROTONS.

70 DEG - RUN 2031			75 DEG - RUN 2020			80 DEG - RUN 111			90 DEG - RUN 2024			110 DEG - RUN 7114		
ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR
4.17	2.422	0.173	4.25	1.604	0.072	4.20	2.122	0.116	4.43	1.730	0.073	6.63	0.863	0.018
6.17	1.564	0.137	6.26	1.210	0.058	6.21	1.459	0.093	6.43	0.912	0.056	8.63	0.387	0.013
8.17	0.879	0.110	8.27	0.724	0.046	8.21	0.801	0.073	8.42	0.583	0.044	10.63	0.191	0.010
10.16	0.585	0.087	10.29	0.378	0.036	10.22	0.479	0.056	10.41	0.386	0.034	12.63	0.094	0.007
12.16	0.464	0.071	12.30	0.292	0.029	12.23	0.321	0.049	12.40	0.189	0.026	14.63	0.056	0.006
14.16	0.292	0.059	14.31	0.164	0.024	14.24	0.239	0.038	14.39	0.119	0.021	16.63	0.027	0.004
16.16	0.152	0.047	16.32	0.110	0.020	16.25	0.128	0.030	16.37	0.054	0.017	18.63	0.018	0.004
18.15	0.056	0.039	18.33	0.064	0.016	18.26	0.052	0.023	18.36	0.037	0.014	20.64	0.014	0.003
20.15	0.078	0.035	20.34	0.036	0.013	20.27	0.025	0.020	20.35	0.040	0.011	22.64	0.007	0.002
22.15	0.050	0.029	22.36	0.036	0.011	22.28	0.023	0.016	22.34	0.022	0.009	24.64	0.004	0.001
24.15	0.057	0.025	24.37	0.010	0.009	24.29	0.011	0.014	24.32	0.013	0.007	26.64	0.002	0.001
26.16	0.034	0.022	26.38	0.014	0.008	26.30	0.002	0.012	26.31	0.017	0.006	28.64	0.001	0.001
28.16	-0.021	0.017	28.39	0.004	0.007	28.31	-0.009	0.009	28.30	0.010	0.005	30.64	0.001	0.000
30.16	0.016	0.016	30.40	-0.001	0.006	30.32	0.007	0.007	30.29	0.004	0.003	0.0	0.0	0.0
32.16	0.016	0.013	32.41	0.012	0.004	32.33	0.012	0.008	32.27	0.005	0.003	0.0	0.0	0.0
34.16	0.027	0.012	34.43	0.005	0.004	34.34	0.007	0.006	34.26	0.001	0.001	0.0	0.0	0.0
36.13	0.009	0.012	36.44	0.005	0.002	36.35	-0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0
38.13	0.010	0.009	38.45	0.001	0.001	38.36	0.002	0.002	0.0	0.0	0.0	0.0	0.0	0.0
40.13	0.0	0.0	40.46	0.000	0.000	40.37	0.001	0.002	0.0	0.0	0.0	0.0	0.0	0.0
42.13	-0.000	0.001	42.47	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43.90	0.002	0.003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

135 DEG - RUN 2056			160 DEG - RUN 2061											
ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR	ENERGY (MEV)	SIGNAL (NB/SR-MEV)	ERROR
4.11	1.22	0.05	4.28	0.91	0.09									
6.10	0.69	0.04	6.26	0.44	0.06									
8.10	0.35	0.03	8.24	0.10	0.04									
10.09	0.18	0.02	10.22	0.08	0.03									
12.08	0.09	0.02	12.20	0.06	0.03									
14.07	0.032	0.011	14.18	0.032	0.019									
16.07	0.032	0.009	16.16	-0.007	0.014									
18.06	0.017	0.006	18.14	0.008	0.010									
20.05	0.008	0.004	20.12	0.007	0.007									
22.05	0.003	0.002	22.10	0.002	0.004									
24.04	0.003	0.001	24.08	0.002	0.002									
26.03	0.001	0.001	0.0	0.0	0.0									

Table 45

PROTON FROM A = 16 BONDED BY 39 NE%. PROTONS.

20 DEG - RUN 6012			45 DEG - PIN 4013			60 DEG - RUN 6016			90 DEG - RUN 6017		
ENERGY (MEV)	SIGMA (MB/SR-HEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-HEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-HEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SR-HEV)	ERROR
9.54	6.08	0.11	6.74	3.82	0.05	3.20	3.05	0.03	3.01	2.98	0.03
6.52	3.587	0.103	6.72	2.767	0.041	5.19	2.611	0.031	4.99	2.243	0.024
4.50	2.983	0.093	8.71	2.186	0.040	7.17	2.021	0.030	6.98	1.544	0.020
10.88	2.284	0.084	10.69	1.653	0.035	9.15	2.015	0.024	8.97	1.085	0.017
12.47	2.182	0.077	12.68	1.565	0.033	11.18	1.302	0.020	10.96	0.857	0.015
14.85	2.120	0.077	14.66	1.452	0.034	13.12	1.078	0.019	12.95	0.662	0.013
16.43	1.999	0.077	16.64	1.253	0.033	15.11	0.845	0.019	14.93	0.529	0.013
18.62	1.933	0.077	18.63	1.410	0.033	17.09	0.953	0.020	16.92	0.504	0.010
20.60	1.805	0.064	20.61	0.763	0.028	19.08	0.703	0.014	18.91	0.277	0.011
22.38	1.235	0.064	22.60	1.004	0.030	21.06	0.609	0.016	20.90	0.252	0.039
24.34	1.235	0.053	24.58	1.038	0.028	23.05	0.521	0.015	22.89	0.268	0.011
26.35	1.592	0.060	26.57	0.907	0.042	25.03	0.413	0.014	24.87	0.107	0.006
28.33	0.644	0.062	28.55	0.486	0.019	27.02	0.325	0.021	26.86	0.235	0.005
30.31	0.714	0.040	30.53	5.190	0.038	29.00	0.541	0.021	28.83	0.619	0.020
32.00	6.045	0.099	31.78	0.030	0.012	30.39	4.491	0.034	0.0	0.0	0.0

Table 46

DEUTERON FROM $\lambda = 16$ BONDED BY 39 KEV. PROTONS.

[illegible]

Table 47

TITRON FROM A - 14 BOMBARDED BY 39 MEV. PROTONS.

20 DEG - RUN 6012			45 DEG - RUN 6013			60 DEG - RUN 6016			90 DEG - RUN 6017		
ENERGY (MEV)	SIGMA (MB/SP-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SP-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SP-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SP-MEV)	ERROR
4.82	0.037	0.019	6.82	0.036	0.007	6.82	0.018	0.003	6.93	0.017	0.002
8.80	0.066	0.019	8.81	0.019	0.006	8.81	0.040	0.003	8.92	0.001	0.002
10.78	0.113	0.021	10.79	0.058	0.006	10.79	-0.001	0.006	10.91	0.003	0.000
12.76	0.012	0.003	12.77	0.004	0.009	12.78	0.002	0.001	12.70	0.008	0.001
14.74	0.017	0.019	14.76	0.004	0.002	14.76	0.082	0.003	0.0	0.0	0.0
16.73	0.254	0.017	16.37	0.081	0.006	15.83	0.003	0.002	0.0	0.0	0.0
17.97	0.040	0.017	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 48

ALPHA FROM A - 16 BOMBARDED BY 39 MEV. PROTONS.

20 DEG - RUN 6012			45 DEG - RUN 6013			60 DEG - RUN 6016			90 DEG - RUN 6017		
ENERGY (MEV)	SIGMA (MB/SP-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SP-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SP-MEV)	ERROR	ENERGY (MEV)	SIGMA (MB/SP-MEV)	ERROR
6.87	1.118	0.140	6.82	5.011	0.041	14.27	0.052	0.020	7.23	1.375	0.019
8.85	3.440	0.117	8.81	2.326	0.049	15.26	0.088	0.018	9.22	0.577	0.014
10.83	2.007	0.097	10.39	1.365	0.040	16.25	0.089	0.017	11.21	0.283	0.011
12.82	1.332	0.076	12.38	0.783	0.031	17.24	0.081	0.018	13.20	0.154	0.008
14.80	0.912	0.045	14.36	0.565	0.025	18.24	0.041	0.016	15.18	0.092	0.006
16.38	0.678	0.060	16.35	0.326	0.023	19.23	0.049	0.012	17.17	0.112	0.006
18.37	0.707	0.056	18.33	0.314	0.021	20.22	0.092	0.010	19.16	0.013	0.003
20.35	0.603	0.051	20.32	0.181	0.018	21.21	0.144	0.013	21.15	0.014	0.001
22.33	0.360	0.051	22.30	0.251	0.014	22.20	0.055	0.008	23.11	0.006	0.001
24.31	0.401	0.041	24.28	0.039	0.011	23.20	-0.044	0.018	0.0	0.0	0.0
26.30	0.070	0.030	26.27	0.128	0.011	24.19	0.132	0.006	0.0	0.0	0.0
28.24	0.775	0.063	28.25	0.042	0.004	25.18	0.020	0.002	0.0	0.0	0.0
30.26	0.121	0.012	29.44	0.021	0.005	26.17	0.002	0.001	0.0	0.0	0.0
31.38	0.047	0.016	0.0	0.0	0.0	26.86	0.017	0.003	0.0	0.0	0.0

Table 49

PHOTON FROM A - 16 BOMBARDED BY 29 MEV. PROTONS.

30 DEG - RUN	25	ENERGY (MEV)	SIGMA ERROR (MB/52-MEV)	ENERGY (MEV)	SIGMA ERROR (MB/52-MEV)	ENERGY (MEV)	SIGMA ERROR (MB/52-MEV)	ENERGY (MEV)	SIGMA ERROR (MB/52-MEV)																				
2.27	5.15	0.21	4.27	6.70	0.24	8.27	3.99	0.19	10.27	2.92	0.17	12.27	2.27	0.17	14.27	1.76	0.13	16.27	1.99	0.13	18.26	1.03	0.16	20.26	0.73	0.09	22.01	6.89	0.18

Table 50

ALPHA FROM A - 16 BOMBARDED BY 29 MEV. PROTONS.

30 DEG - RUN	25	ENERGY (MEV)	SIGMA ERROR (MB/52-MEV)	ENERGY (MEV)	SIGMA ERROR (MB/52-MEV)	ENERGY (MEV)	SIGMA ERROR (MB/52-MEV)	ENERGY (MEV)	SIGMA ERROR (MB/52-MEV)
		3.97	9.39	0.37		5.97	6.39	0.32	
		5.97	5.40	0.27		7.97	3.06	0.22	
		9.97	1.80	0.20		11.97	0.60	0.15	
		13.97	0.37	0.11		15.97	0.67	0.14	
		17.96	-0.028	0.015		19.96	0.66	0.07	
		21.01							