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PROTON AND DEUTERON DOUBLE DIFFERENTIAL CROSS SECTIONS AT ANGLES FROM 10° TO 60° FROM Be, C, Al, Fe, Cu, Ge, W, AND Pb UNDER 558-MeV-PROTON IRRADIATION

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16. Abstract

The double differential cross sections (mb/sr-MeV) for the production of protons and deuterons from targets of Be, C, Al, Fe, Cu, Ge, W, and Pb have been obtained at laboratory angles of scatter of 10^{o}, 20^{o}, 30^{o}, 40^{o}, 50^{o}, and 60^{o} for 558-MeV incident protons. The position of the quasi-elastic peak, discernible in the cross sections up to approximately 40^{o}, corresponds closely to the theoretical predictions for proton-proton elastic scattering at 558 MeV.

The mean ratio of deuteron to proton energy-integrated cross sections (mb/sr) is 0.056 ± 0.008. The dependence of energy-integrated cross sections for both protons and deuterons on target mass number A varies from $A^{1/3}$ at 10^{o} to $A^{2/3}$ above approximately 30^{o}. The ratio of energy-integrated deuteron cross sections for quasi-elastic processes to that for reactions yielding a deuteron—pi-meson pair is approximately 10 percent. The shape of the deuteron cross-section spectra at angles above 20^{o} is generally described by an exponential law in the kinetic energy of the deuteron.

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SUMMARY

The double differential cross sections (mb/sr-MeV) for the production of protons and deuterons from targets of Be, C, Al, Fe, Cu, Ge, W, and Pb have been obtained at laboratory angles of scatter of 10°, 20°, 30°, 40°, 50°, and 60° for 558-MeV incident protons. A quasi-elastic peak is discernible in the cross sections up to approximately 40° for all targets used. The position of the peak corresponds closely to the theoretical predictions for proton-proton elastic scattering at an incident proton energy of 558 MeV.

The mean ratio of deuteron to proton energy-integrated cross sections (mb/sr) is 0.056 ± 0.008. The dependence of energy-integrated cross sections (mb/sr) for both protons and deuterons on target mass number A varies from $A^{1/3}$ at an angle of scatter of 10° to $A^{2/3}$ above approximately 30°.

The ratio of energy-integrated deuteron cross sections (mb/sr) for quasi-elastic processes to deuteron cross sections for reactions yielding a deuteron—pi-meson pair is approximately 10 percent. The shape of the deuteron cross-section spectra at angles above 20° is generally better described by an exponential law in the kinetic energy of the deuteron in contrast to a power law reported for deuterons produced in the interaction of 300-MeV protons with nuclei.

INTRODUCTION

This report contains experimental cross sections from a research program to study the particle types emitted from materials under proton irradiation at the NASA Space Radiation Effects Laboratory (SREL). This program was designed to supplement the experimental space shielding studies performed by the Oak Ridge National Laboratory (ORNL) and partially sponsored by NASA. (See refs. 1 to 5.) The principal motivation for the ORNL and NASA in-house experimental studies was to obtain cross-section data to determine the shield effectiveness of spacecraft structural materials against the space radiation environment and to identify biologically important secondary particles produced in nuclear reactions.

In the interaction of high-energy particles with nuclei of materials or biological systems, a large number of secondary particles are produced which interact with other nuclei to produce additional secondary particles. To understand the extent of particle buildup, the particle types, numbers, angular distributions, and energy spectra must be measured. The data of this report consist of secondary proton and deuteron cross sections differential in energy and angle for targets bombarded by 558-MeV protons at various scattering angles.

At the beginning of this program, little experimental proton-nucleus interaction data were available at proton energies between 300 and 1000 MeV. For 300-MeV incident protons, some proton, deuteron, and triton cross-section data had been obtained at angles of 26°, 40°, and 60° for targets of Li, C, Al, Cu, Cd, Pb, and U. (See ref. 6.) In Russia, at the Joint Institute for Nuclear Research in Dubna, one experiment had been performed to measure the proton secondaries emitted at laboratory angles of 7°, 12.2°, 18°, 24°, and 30° from targets of Be, C, Cu, and U under 660-MeV-proton irradiation. (See ref. 7.) However, the present program was designed to measure both secondary protons and deuterons at angles up to 60° to assess the contribution of deuterons to the total radiation dose within a vehicle in the space environment. During the course of these experiments at SREL, researchers at the Dubna synchrocyclotron reported their additional measurements of secondary protons and heavier particles up to angles of 16° from materials irradiated with approximately 660-MeV protons. (See refs. 8 to 11.)

Three sets of scattering data were obtained at the SREL synchrocyclotron. The first set of data, which is the basis of this report, consisted of the energy distributions of secondary protons and deuterons from targets of Be, C, Al, Fe, Cu, Ge, W, and Pb irradiated with 558-MeV protons at laboratory angles of 10°, 20°, 30°, 40°, 50°, and 60°. The second data set was obtained by using 558-MeV protons on thin targets (approximately 2 g/cm^2) of Be, C, Mg, Al, Ti, Fe, Ni, Cu, Zr, Ag, Sn, Nd, W, Au, and Pb at angles of 10°, 20°, 30°, 40°, and 50°. In the third experiment, thin targets (1 to 2 g/cm^2) of Be, Al, Fe, Ag, and Au were bombarded by 700-MeV alpha particles, and the energy distributions of secondary protons, deuterons, tritons, helium-3 particles, and helium-4 particles were obtained at angles of 6°, 10°, 15°, 20°, 30°, and 40°.

In this report the differential cross sections derived from the first set of measurements are given for secondary proton and deuteron production. The cross sections are presented in tabular and graphic form.

SYMBOLS

A	mass number
a,b	constants
E	scattered-particle kinetic energy, MeV
E_o	incident proton kinetic energy, MeV
m,n	constants
m_p	proton rest mass, 938.256 MeV
α,β	constants
θ	laboratory angle of scatter, deg
σ	cross section, mb
Ω	solid angle, sr

EXPERIMENTAL CONDITIONS

The proton beam from the synchrocyclotron at the NASA Space Radiation Effects Laboratory (SREL) was transported to the proton target area by a 25-element magnetic system. (See fig. 1.) The beam spot at the target was circular in cross section with a diameter of 2.6 cm. The divergence of the beam measured over a 6-m length was less than 0.003 rad. The proton beam energy was measured to be 558 ± 7 MeV by using a focused Čerenkov radiation detection system. (See ref. 12.) The extracted proton beam characteristics of the SREL synchrocyclotron are given in reference 13. In brief, the proton beam had macrobursts at frequency $F \approx 55$ Hz of duration $T = 20$ to 110 μsec and microbursts of approximately $t = 8$ nsec at a frequency $f \approx 17.5$ MHz which gave a duty cycle of $FTtf = 1.5 \times 10^{-4}$ to 6.2×10^{-4} $\text{Hz}^2\text{-sec}^2$. The incident proton beam current was measured with two identical helium-filled ion chambers (ref. 14). The ion chambers were calibrated against the SREL Faraday cup (ref. 15).

Secondary charged particles from the target were detected with a two-parameter scintillation spectrometer system shown in figure 2 and explained in detail in reference 13. The system measured both the time of flight of secondary charged particles over a 488-cm flight path and the energy deposited in a plastic scintillator, 12.7 cm in diameter and 30.48 cm long. The time resolution of the system was 0.39 nsec, which gave a calculated energy resolution of 7.75 percent at 558 MeV and 1.6 percent at 50 MeV for protons. The energy resolution of the large scintillator was approximately 9 percent up to 200 MeV for protons. The system clearly separated protons from deuterons up to a deuteron energy of approximately 370 MeV.

In order to eliminate, as far as possible, the effects of beam pileup in the detection system, the average proton beam current for a given target and angle was adjusted to give an average system count rate between 50 and 60 counts per second, or approximately 1 count per macroburst. The arrangement and performance of the detector system are given in reference 13.

The thicknesses of the targets used are listed in table 1 along with the angles. All targets were commercially available and were of natural isotopic abundance. The targets were approximately 10 cm square or larger with the exception of the beryllium and germanium targets which were 5.08 cm by 7.62 cm and 3.8 cm by 5.2 cm, respectively. All targets were of uniform thickness.

DATA ANALYSIS

Details of data analysis and correction to the experimental data are given in reference 13. The largest correction to the data involved a calculation of the multiple scattering from the first set of detectors shown in figure 2. The data were also corrected for energy loss through the spectrometer. Both corrections were obtained through Monte Carlo calculations. The uncertainty in the cross-section values varies with particle energy from ±9.3 percent at 50 MeV to ±11.4 percent at 558 MeV for protons, and from ±8.0 percent at 90 MeV to ±8.3 percent at 350 MeV for deuterons.

RESULTS AND DISCUSSION

The proton and deuteron double differential cross sections are shown in figures 3 to 10 as composite graphs for each target element. The most prominent feature of the proton cross sections is the quasi-elastic scattering peak which is discernible up to 30° to 40°. In figure 11 the energy of the quasi-elastic peak is plotted as a function of laboratory angle of scatter with aluminum as the target. The solid curve represents relativistic elastic proton-proton scattering for incident proton energy E_0 of 558 MeV. The relation is

$$E = \frac{E_0 \cos^2 \theta}{1 + \frac{E_0}{2m_p} \sin^2 \theta}$$

where θ is laboratory angle of scatter, m_p is the rest mass of the proton (938.256 MeV), and E is the kinetic energy of the proton scattered at angle θ.

The excellent agreement of the data with free proton-proton scattering theory indicates that the incident protons, after suffering one collision within the nucleus, can then escape without further interactions. One is then led to the conclusion that, at an incident energy of 558 MeV and forward scattering angles, the observed protons arise from proton-nucleon collisions on or near the nuclear periphery.

In figure 12 the widths of the quasi-elastic peaks, expressed as the peak full width at half maximum in MeV, are given as a function of target mass number. The large uncertainty in the widths at 10° is related to the energy resolution of the detection system. The data at 20° and 30° indicate a slight increase with increasing atomic weight; however, the data at 10° are too poor to draw conclusions. The solid lines are used as a guide only.

The continuum spectra below the quasi-elastic peak for beryllium (fig. 3(a)) and carbon (fig. 4(a)) are assumed to arise predominantly from the inelastic scattering processes of pi-meson production with some admixture of multiple scattering processes. Note that the rate of increase in the cross section with decreasing energy is relatively slow for both elements from 10° to 60°. This indicates a minor degree of thermalization via multiple scattering within these light nuclei. However, in aluminum (fig. 5(a)) and heavier nuclei the increasing rate of growth of the continuum spectra with the size of the nucleus indicates the increasing importance of multiple scattering processes.

The energy-integrated cross sections for the emission of secondary protons as a function of laboratory angle of scatter are given in table 2 and the same data are shown in figure 13. The values of $d\sigma/d\Omega$ smoothly decrease with increasing emission angle.

The approximate dependence of $d\sigma/d\Omega$ on the mass number A was assumed to be αA^{β} where α and β are constants. The values of the constants were obtained by a least-squares fit to the data as shown in figure 14. These values of α and β are tabulated in table 3 along with similar values from reference 7. In figure 15 the data of table 3 are plotted as a function of laboratory angle of scatter to show the dependence of the energy-integrated cross sections on the exponent β. The exponential dependence on mass number is nearly the same for angles from 20° to 40° for both sets of data. The values of β at 10° are close to 1/3 which indicates that the cross section for quasi-free scattering is proportional to the nuclear circumference. The value of β increases with increasing angle to approximately 2/3 near 40° and remains nearly constant at higher angles. The approximate $\beta = 2/3$ dependence of the cross sections on the mass number indicates that the secondary particles at higher angles are produced by interactions within the nucleus.

The energy-integrated deuteron cross sections are listed in table 4 and plotted as a function of laboratory angle of scatter in figure 16. The same dependence on mass number, αA^{β}, was assumed for the deuteron cross sections, and α and β were obtained by a least-squares fit to the data as shown in figure 17. The values of α and β from this experiment and values of β from reference 11 are given in table 5. Values of β are plotted as a function of laboratory angle of scatter in figure 18. Again, the exponential dependence on mass number agrees with the present data. The variation of β with laboratory angle appears to be the same for both protons (fig. 15) and deuterons up to approximately 25°; however, the value of β for deuterons appears to increase with increasing angle, whereas the proton data indicate a nearly constant value of β above 40°. The deuteron cross sections used to obtain values of β in reference 11 and for the data of this experiment correspond to proton-nucleus interactions which are assumed to produce a deuteron—pi-meson pair.

The quasi-elastic scattering of protons by two-nucleon clusters to produce fast deuterons is shown in figure 19. This deuteron energy spectrum at a laboratory angle of scatter of 10° for a beryllium target contains a small peak close to the energy of elastically scattered deuterons (493 MeV). In table 6 the cross sections for the quasi-elastic production of deuterons obtained in this experiment at 10° are listed along with data from reference 11 for deuterons produced at 9.5°. The cross-section values obtained in the two experiments on the same elements are the same within the quoted errors. The ratio of deuteron cross sections for quasi-elastic processes to cross sections for deuterons from reactions yielding a deuteron—pi-meson pair is approximately 10 percent which is also in agreement with the results of reference 11.

In table 7 cross sections of this experiment are listed with data from other experiments on the same or similar targets with incident proton energies from 160 MeV to 660 Mev. In every case where data are available at the same angle for the same target material, the results at 660 MeV are higher than the data at 558 MeV, and the cross sections at 450 MeV are always less than those at 558 MeV. In figure 20 the available cross sections for aluminum, carbon, and beryllium at a laboratory angle of 30° are plotted as a function of incident proton energy. From these data the cross sections for secondary proton production go through a shallow minimum for incident proton energies near 400 MeV and then increase rapidly with increasing incident energy.

In table 8 the ratio of deuteron to proton energy-integrated cross sections (mb/sr) is given for each element and angle used in this experiment. The ratio varies from a minimum of 3.5 percent for beryllium at 60° to a maximum of 7.6 percent for tungsten at 50°. The average of all ratios is 0.056 ± 0.008. With the exception of beryllium and aluminum the ratio goes through a broad maximum near 30°, and, in each case, the value of the ratio is less at 60° than at 10°. In addition, the ratio at each angle increases slightly with atomic weight.

The deuteron production observed in reference 6 from targets bombarded by 300-MeV protons was attributed to an incident pickup process where the energy dependence of the pickup probability was assumed to vary as a power law in the kinetic energy of the scattered nucleon, mE^{-n}. From their data the authors of reference 6 concluded that the energy dependence of the pickup probability was best given by E^{-2} or E^{-3} at angles of 26°, 40°, and 60°. By way of comparison, the deuteron cross-section data of this report show that the exponent n varies with angle from approximately 1.1 at 20° to 3.1 at 60°. However, the data at angles above 20° are not generally well matched by a power-law curve as shown in figure 21. The exponential curves shown in the same figure have the form $ae^{-E/b}$ where a and b are constants. For the data shown the exponential curves give superior fits to the cross-section data. The parameters n and b for the power-law and exponential curves are given in table 9 for all proton and deuteron data obtained in this study. The curve associated with a footnoted entry gives a superior fit to the data on the basis of the following criteria. The goodness-of-fit parameter is for the power-law curve,

$$X_p = \sum_i \frac{\left[\left(\frac{d^2\sigma}{dE\,d\Omega}\right)_i - mE_i^{-n}\right]^2}{mE_i^{-n}}$$

and for the exponential curve,

$$X_e = \sum_i \frac{\left[\left(\frac{d^2\sigma}{dE\,d\Omega}\right)_i - ae^{-E_i/b}\right]^2}{ae^{-E_i/b}}$$

where the summation is performed over the cross-section data for a particular angle and target. The curve that more closely matches the data has the smallest value of X.

Because of scatter in the data, the curve that yields a value of X at least a factor of 2 smaller than the value for the other curve is considered a superior fit to the data. If the difference between the two values of X is less than a factor of 2, then both curves are considered equally good fits to the data.

As indicated in table 9(a), the proton data below the quasi-elastic peak can generally be described by either a power-law curve or an exponential curve. However, the deuteron data in table 9(b) for aluminum and heavier elements are generally better described by an exponential curve, decreasing with increasing particle energy. The disagreement between the shapes of the deuteron spectra in this report and those of reference 6 is probably the result of deuterons produced in the pi-meson production process.

The double differential cross sections (mb/sr-Mev) for the production of secondary protons and deuterons from targets of Be, C, Al, Fe, Cu, Ge, W, and Pb are given in tabular and graphic form as follows:

	Table	Figure
Proton cross sections:		
Beryllium (Be)	10	3(a)
Carbon (C)	11	4(a)
Aluminum (Al)	12	5(a)
Iron (Fe)	13	6(a)
Copper (Cu)	14	7(a)
Germanium (Ge)	15	8(a)
Tungsten (W)	16	9(a)
Lead (Pb)	17	10(a)
Deuteron cross sections:		
Beryllium (Be)	18	3(b)
Carbon (C)	19	4(b)
Aluminum (Al)	20	5(b)
Iron (Fe)	21	6(b)
Copper (Cu)	22	7(b)
Germanium (Ge)	23	8(b)
Tungsten (W)	24	9(b)
Lead (Pb)	25	10(b)

In the proton data tables, cross-section values greater than zero are shown at energies greater than the incident proton energy of 558 MeV. This apparent discrepancy is due to the large uncertainty in the secondary proton energy at higher energies and, to a much smaller extent, to pi-meson contamination of the high-energy proton spectra.

SUMMARY OF RESULTS

Double differential cross sections (mb/sr-MeV) for the production of protons and deuterons from Be, C, Al, Fe, Cu, Ge, Pb, and W have been obtained at laboratory angles of scatter of 10°, 20°, 30°, 40°, 50°, and 60° for 558-MeV incident protons.

The following results have been obtained from this investigation:

1. A quasi-elastic proton peak is discernible in the cross sections up to approximately 40° for all elements used. If the energy corresponding to the quasi-elastic peak is plotted as a function of angle of scatter, the points lie almost exactly on the theoretical curve for proton-proton elastic scattering at an incident proton energy of 558 MeV.

2. A comparison of proton and deuteron energy-integrated cross sections obtained at 660 MeV with those of this report shows that both sets of data give nearly the same dependence on the mass number of the target element. The data indicate that at 10° the secondary proton and deuteron spectra arise primarily from interactions on the nuclear periphery. At larger angles the dependence of the cross section (mb/sr) on the target mass number A changes rapidly from a 1/3 power of A to a 2/3 power of A.

3. The ratio of deuteron energy-integrated cross sections (mb/sr) for quasi-elastic processes to deuteron cross sections for reactions yielding a deuteron—pi-meson pair is approximately 10 percent.

4. The mean ratio of the deuteron to proton energy-integrated cross sections (mb/sr) is 0.056 ± 0.008. The individual ratios show a weak dependence on the atomic weight.

5. The shape of the deuteron cross-section spectra at angles of scatter above 20° is generally better described by an exponential law in the kinetic energy of the deuteron in contrast to a power law reported for deuterons produced in the interaction of 300-MeV protons with nuclei.

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TABLE 1.- PARAMETERS OF CHARGED-PARTICLE MEASUREMENTS

Element	Thickness, g/cm^2	Angle of scatter, deg (a)
Beryllium (Be)	2.35	10, 20, 30, 50, 60
Carbon (C)	.95	10, 20, 30, 40, 50, 60
Aluminum (Al)	1.82	10, 20, 30, 40, 50, 60
Iron (Fe)	3.77	10, 20, 30, 40, 50, 60
Copper (Cu)	2.79	10, 20, 30, 40, 50, 60
Germanium (Ge)	5.26	10, 20, 30, 40
Tungsten (W)	3.05	10, 20, 30, 40, 50, 60
Lead (Pb)	3.91	10, 20, 30, 40, 50, 60

[a]Angles are measured between the incident proton beam center line and the spectrometer axis. The beam, target, and spectrometer axes are in the same plane.

TABLE 2.- SUMMARY OF ENERGY-INTEGRATED PROTON CROSS SECTIONS

θ, deg	$d\sigma/d\Omega$, mb/sr, for –							
	Be	C	Al	Fe	Cu	Ge	Pb	W
10	365.6 ± 25.59	422.5 ± 29.57	455.4 ± 31.87	713.7 ± 49.95	845.5 ± 59.18	798.8 ± 55.91	1130.0 ± 79.10	1177.0 ± 82.39
20	122.4 ± 8.56	136.5 ± 9.55	236.0 ± 16.52	347.2 ± 24.30	381.9 ± 26.73	351.1 ± 24.57	608.0 ± 42.56	618.9 ± 43.32
30	64.7 ± 4.53	80.4 ± 5.62	146.3 ± 10.24	204.6 ± 14.32	239.4 ± 16.75	232.1 ± 16.24	447.6 ± 31.33	422.8 ± 29.59
40		57.5 ± 4.02	108.1 ± 7.56	181.4 ± 12.69	204.9 ± 14.34	186.8 ± 13.07	340.1 ± 23.80	362.7 ± 25.38
50	36.6 ± 2.56	47.9 ± 3.35	86.2 ± 6.03	133.7 ± 9.35	151.2 ± 10.58		242.7 ± 16.98	267.5 ± 18.72
60	19.9 ± 1.39	31.9 ± 2.23	57.9 ± 4.05	89.1 ± 6.24			191.7 ± 13.41	186.3 ± 13.04

TABLE 3.- CONSTANTS OF EQUATION $d\sigma/d\Omega = \alpha A^{\beta}$ FOR PROTONS

θ, deg	Present data		Reference 7	
	α	β	α	β
10	154	0.38		
18			61.2	0.53
20	39	.53		
24			36.2	.58
30	18	.61	21.2	.67
40	13	.63	12.0	.71
50	10	.62		
60	5.3	.68		

TABLE 4.- SUMMARY OF ENERGY-INTEGRATED DEUTERON CROSS SECTIONS

θ, deg	$d\sigma/d\Omega$, mb/sr, for –							
	Be	C	Al	Fe	Cu	Ge	Pb	W
10	17.5 ± 1.40	18.3 ± 1.47	27.9 ± 2.23	38.9 ± 3.11	43.3 ± 3.47	38.5 ± 3.08	61.9 ± 4.95	66.0 ± 5.28
20	6.0 ± .48	7.6 ± .61	14.4 ± 1.15	21.3 ± 1.71	24.4 ± 1.95	21.9 ± 1.75	36.9 ± 2.95	40.1 ± 3.21
30	3.1 ± .25	4.5 ± .36	8.7 ± .69	12.0 ± .96	14.7 ± 1.18	14.8 ± 1.19	27.3 ± 2.18	30.7 ± 2.45
40		3.4 ± .27	6.7 ± .54	9.9 ± .79	11.9 ± .95	10.7 ± .85	21.2 ± 1.69	22.1 ± 1.76
50	1.7 ± .14	2.3 ± .18	4.7 ± .37	7.0 ± .56	7.9 ± .63		13.7 ± 1.09	20.5 ± 1.64
60	.7 ± .05	1.3 ± .10	2.6 ± .21	3.7 ± .30			9.9 ± .79	10.8 ± .86

TABLE 5.- CONSTANTS OF EQUATION $d\sigma/d\Omega = \alpha A^{\beta}$ FOR DEUTERONS

θ, deg	Present data		β from reference 11 (a)
	α	β	
6.5			0.34
9.5			.40
10	6.6	0.43	
13.5			.46
16.0			.52
20	1.8	.59	
30	.78	.69	
40	.74	.64	
50	.39	.72	
60	.16	.80	

[a]Data taken from figure 6 of reference 11 for $(p,d\pi)$ reaction.

TABLE 6.- ENERGY-INTEGRATED CROSS SECTIONS FOR THE QUASI-ELASTIC SCATTERING OF DEUTERONS

Target element	Energy-integrated cross section, mb/sr, at angle of scatter of –	
	10^{o}	9.5^{o} (a)
Be	2.9 ±0.5	
C	2.6 ± .4	2.6 ±0.3
Al	3.7 ± .6	3.7 ± .5
Fe	4.5 ± .8	
Ge	3.4 ± .6	
Cu	3.8 ± .6	5.2 ± .7
Pb	7.0 ±1.2	6.9 ± .9
W	8.2 ±1.4	

[a]Data from reference 11 for $p\langle 2N\rangle \rightarrow Nd$ reaction.

TABLE 7.- SUMMARY OF AVAILABLE DATA ON SELECTED ELEMENTS FOR INCIDENT PROTON ENERGIES FROM 160 MeV TO 660 MeV

Element	Energy, MeV (a)	Energy-integrated cross section, mb/sr, at angle of scatter of –									
		10^{o}	18^{o}	20^{o}	24^{o}	26^{o}	30^{o}	40^{o}	45^{o}	50^{o}	60^{o}
Be	160						70.0 ± 2.0				
	450						53.4 ± 7.2		20.0 ± 1.7		3.4 ± 0.2
	558	365.6 ± 25.5		122.4 ± 8.5			64.7 ± 4.5			36.6 ± 2.5	19.9 ± 1.3
	660	376.0 ± 19.0	195.0 ± 10.0		125.0 ± 6.0		89.0 ± 4.0	54.0 ± 3.0			
C	160						75.0 ± 3.0				
	300					70.0 ± 4.0		52.3 ± 4.0			
	450						59.4 ± 7.4		22.4 ± 2.2		4.7 ± 0.4
	558	422.5 ± 29.5		136.5 ± 9.5			80.4 ± 5.6	57.5 ± 4.0		47.9 ± 3.3	31.9 ± 2.2
	660	492.0 ± 15.0	230.0 ± 11.0		158.0 ± 8.0		114.0 ± 6.0	74.0 ± 4.0			
Al	160						124.0 ± 4.0		80.0 ± 3.0		43.0 ± 1.5
	300					130.1 ± 5.0		89.0 ± 4.0			
	450						94.2 ± 13.5		36.6 ± 3.6		8.7 ± 0.6
	558	455.4 ± 31.8		236.0 ± 16.5			146.3 ± 10.2	108.1 ± 7.5		86.2 ± 6.0	57.9 ± 4.0
Fe	558	713.7 ± 49.9		347.2 ± 24.3			204.6 ± 14.3	181.4 ± 12.7		133.7 ± 9.3	89.1 ± 6.2
Cu	300					188.5 ± 7.0		142.8 ± 6.0			
	558	845.5 ± 59.1		381.9 ± 26.7			239.4 ± 16.7	204.9 ± 14.3		151.2 ± 10.5	
	660	1052.0 ± 53.0	556.0 ± 28.0		400.0 ± 20.0		335.0 ± 17.0	228.0 ± 11.0			
Pb	300					290.0 ± 12.0		234.0 ± 12.0			
	558	1130.0 ± 79.1		608.0 ± 42.5			447.6 ± 31.3	340.1 ± 23.8		242.7 ± 16.9	191.7 ± 13.4

[a]Data at various incident proton energies were obtained from the literature as follows:

160 MeV . . . . Reference 2
300 MeV . . . . Reference 6
450 MeV . . . . Reference 5
558 MeV . . . . Present data
660 MeV . . . . Reference 7

TABLE 8.- RATIO OF DEUTERON TO PROTON ENERGY-INTEGRATED CROSS SECTIONS

Angle of scatter, deg	Ratio of deuteron to proton energy-integrated cross sections for –							
	Be	C	Al	Fe	Cu	Ge	Pb	W
10	0.048 ±0.004	0.043 ±0.004	0.061 ±0.005	0.054 ±0.005	0.051 ±0.004	0.048 ±0.004	0.054 ±0.005	0.056 ±0.005
20	.049 ± .004	.056 ± .005	.061 ± .005	.061 ± .005	.064 ± .005	.062 ± .005	.060 ± .005	.064 ± .005
30	.048 ± .004	.056 ± .005	.059 ± .005	.058 ± .005	.061 ± .005	.064 ± .005	.061 ± .005	.072 ± .006
40		.059 ± .005	.062 ± .005	.054 ± .005	.058 ± .005	.057 ± .005	.062 ± .005	.060 ± .005
50	.048 ± .004	.048 ± .004	.054 ± .005	.052 ± .004	.052 ± .004		.056 ± .005	.076 ± .007
60	.035 ± .003	.042 ± .003	.046 ± .004	.042 ± .003			.051 ± .004	.058 ± .005

TABLE 9.- PARAMETERS n AND b FROM POWER-LAW CURVE E^{-n} AND EXPONENTIAL CURVE $e^{-E/b}$ FITTED BY METHOD OF LEAST SQUARES TO CONTINUUM PART OF CROSS-SECTION DATA

(a) Proton cross-section data

θ, deg	Be		C		Al		Fe		Cu		Ge		W		Pb	
	n	b, MeV	n	b, MeV	n	b, MeV	n	b, MeV	n	b, MeV	n	b, MeV	n	b, MeV	n	b, MeV
20	0.26	489	0.21	483	0.40	265	0.48	233	0.45	229	0.51	202	0.81	188	0.63	164
30	.45	267	.47	264	.58	208	.67	179	.73	166	.64	188	.83	156	[a].73	141
40			.33	272	.48	215	.53	197	.54	[a]198	[a].61	173	.70	147	.73	141
50	.37	254	.33	273	.50	180	.48	[a]199	.56	186			.60	136	.87	[a]128
60	.63	133	.54	153	.64	134	.52	150	.51	158			.69	119	.70	123

(b) Deuteron cross-section data

θ, deg	Be		C		Al		Fe		Cu		Ge		W		Pb	
	n	b, MeV	n	b, MeV	n	b, MeV	n	b, MeV	n	b, MeV	n	b, MeV	n	b, MeV	n	b, MeV
20	1.1	169	1.0	[a]187	1.2	159	1.3	[a]142	1.3	[a]144	1.4	[a]140	1.60	120	1.6	123
30	1.4	138	1.3	138	1.7	115	1.8	[a]109	1.7	115	1.8	[a]104	2.1	[a]93	2.1	[a]91
40			1.8	[a]104	2.1	[a]86	2.1	[a]88	2.2	[a]86	2.2	[a]88	2.4	[a]79	2.4	[a]78
50	1.9	[a]91	2.2	80	2.3	[a]75	2.7	[a]69	2.7	[a]69			2.6	[a]65	[a]1.5	134
60	3.0	[a]52	2.8	[a]58	2.8	[a]56	2.9	[a]56	3.0	[a]56			3.1	[a]54	3.0	[a]55

[a]The curve associated with this parameter gives a superior fit to the data. Entries not footnoted give equally good fits.

TABLE 10.- DOUBLE DIFFERENTIAL CROSS SECTIONS FOR PRODUCTION OF SECONDARY PROTONS FROM BERYLLIUM TARGET, 2.35 g/cm^2 THICK

[Incident proton energy, 558 MeV]

(a) Angle of scatter of 10^o

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
47.9 ± .6	.000 ± .000	93.1 ± 1.7	.264 ± .023	279.5 ± 10.3	.230 ± .021
48.5 ± .6	.000 ± .000	94.9 ± 1.7	.274 ± .024	290.2 ± 11.0	.222 ± .020
49.2 ± .6	.398 ± .032	96.7 ± 1.8	.254 ± .022	301.6 ± 11.8	.206 ± .018
49.8 ± .6	.370 ± .030	98.6 ± 1.9	.249 ± .022	313.8 ± 12.6	.197 ± .018
50.5 ± .6	.384 ± .032	100.5 ± 1.9	.272 ± .024	326.9 ± 13.5	.190 ± .017
51.2 ± .6	.249 ± .021	102.5 ± 2.0	.258 ± .023	340.9 ± 14.5	.176 ± .016
51.9 ± .7	.268 ± .022	104.6 ± 2.0	.261 ± .023	356.1 ± 15.7	.158 ± .014
52.6 ± .7	.280 ± .023	106.7 ± 2.1	.241 ± .021	372.4 ± 16.9	.158 ± .014
53.3 ± .7	.286 ± .024	108.9 ± 2.2	.276 ± .023	390.1 ± 18.4	.210 ± .019
54.0 ± .7	.273 ± .023	111.2 ± 2.3	.269 ± .022	409.3 ± 20.0	.230 ± .021
54.8 ± .7	.307 ± .026	113.5 ± 2.3	.278 ± .022	430.3 ± 21.9	.189 ± .018
55.6 ± .7	.214 ± .018	115.9 ± 2.4	.273 ± .022	453.3 ± 24.0	.198 ± .019
56.3 ± .7	.231 ± .020	118.4 ± 2.5	.258 ± .021	478.5 ± 26.5	.358 ± .034
57.2 ± .8	.271 ± .023	121.0 ± 2.6	.263 ± .022	506.5 ± 29.4	1.021 ± .100
58.0 ± .8	.256 ± .022	123.7 ± 2.7	.284 ± .024	537.5 ± 32.7	3.366 ± .335
58.8 ± .8	.260 ± .023	126.5 ± 2.8	.271 ± .023	572.2 ± 36.8	2.668 ± .270
59.7 ± .8	.287 ± .025	129.4 ± 2.9	.270 ± .022	611.3 ± 41.6	.256 ± .026
60.6 ± .8	.272 ± .024	132.3 ± 3.0	.276 ± .023	655.7 ± 47.4	.060 ± .006
61.5 ± .9	.291 ± .026	135.4 ± 3.1	.275 ± .023		
62.4 ± .9	.299 ± .026	138.7 ± 3.2	.295 ± .025		
63.3 ± .9	.255 ± .022	142.0 ± 3.4	.288 ± .024		
64.3 ± .9	.231 ± .020	145.5 ± 3.5	.285 ± .024		
65.3 ± 1.0	.239 ± .021	149.1 ± 3.6	.292 ± .024		
66.3 ± 1.0	.267 ± .023	152.8 ± 3.8	.289 ± .024		
67.3 ± 1.0	.294 ± .026	156.7 ± 3.9	.296 ± .025		
68.4 ± 1.0	.249 ± .022	160.8 ± 4.1	.302 ± .025		
69.5 ± 1.1	.231 ± .020	165.1 ± 4.3	.284 ± .024		
70.6 ± 1.1	.260 ± .023	169.5 ± 4.5	.284 ± .024		
71.8 ± 1.1	.279 ± .025	174.1 ± 4.7	.289 ± .024		
72.9 ± 1.1	.260 ± .023	179.0 ± 4.9	.274 ± .023		
74.1 ± 1.2	.252 ± .022	184.0 ± 5.1	.243 ± .021		
75.4 ± 1.2	.272 ± .024	189.3 ± 5.4	.305 ± .027		
76.6 ± 1.2	.254 ± .023	194.9 ± 5.6	.310 ± .027		
77.9 ± 1.3	.236 ± .021	200.7 ± 5.9	.275 ± .024		
79.3 ± 1.3	.278 ± .025	206.8 ± 6.2	.257 ± .023		
80.7 ± 1.3	.276 ± .025	213.2 ± 6.5	.256 ± .023		
82.1 ± 1.4	.246 ± .022	220.0 ± 6.9	.266 ± .023		
83.5 ± 1.4	.299 ± .026	227.1 ± 7.3	.288 ± .025		
85.0 ± 1.5	.259 ± .023	234.7 ± 7.7	.301 ± .027		
86.5 ± 1.5	.240 ± .021	242.6 ± 8.1	.303 ± .027		
88.1 ± 1.5	.256 ± .022	251.0 ± 8.6	.295 ± .026		
89.7 ± 1.6	.245 ± .022	259.9 ± 9.1	.270 ± .024		
91.4 ± 1.6	.275 ± .024	269.4 ± 9.7	.238 ± .021		

TABLE 10.- Continued

(b) Angle of scatter of 20^{o}

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
60.7 ± .8	.241 ± .021	132.4 ± 3.0	.194 ± .016	650.5 ± 46.6	.011 ± .001
61.6 ± .9	.240 ± .021	135.5 ± 3.1	.188 ± .015	700.4 ± 53.6	.006 ± .000
62.5 ± .9	.232 ± .020	138.7 ± 3.2	.196 ± .016		
63.5 ± .9	.194 ± .017	142.1 ± 3.3	.204 ± .017		
64.5 ± .9	.189 ± .016	145.5 ± 3.5	.196 ± .016		
65.4 ± 1.0	.213 ± .018	149.1 ± 3.6	.194 ± .016		
66.5 ± 1.0	.181 ± .016	152.9 ± 3.8	.197 ± .016		
67.5 ± 1.0	.204 ± .018	156.8 ± 3.9	.196 ± .016		
68.6 ± 1.0	.223 ± .020	160.8 ± 4.1	.185 ± .015		
69.7 ± 1.1	.229 ± .020	165.1 ± 4.3	.181 ± .015		
70.8 ± 1.1	.187 ± .016	169.5 ± 4.5	.179 ± .015		
71.9 ± 1.1	.265 ± .023	174.1 ± 4.7	.183 ± .015		
73.1 ± 1.1	.250 ± .022	178.9 ± 4.9	.175 ± .015		
74.3 ± 1.2	.246 ± .022	184.0 ± 5.1	.182 ± .015		
75.5 ± 1.2	.239 ± .021	189.2 ± 5.4	.182 ± .016		
76.8 ± 1.2	.241 ± .021	194.8 ± 5.6	.174 ± .015		
78.1 ± 1.3	.205 ± .018	200.6 ± 5.9	.178 ± .016		
79.4 ± 1.3	.222 ± .020	206.7 ± 6.2	.183 ± .016		
80.8 ± 1.3	.202 ± .018	213.1 ± 6.5	.176 ± .015		
82.2 ± 1.4	.235 ± .021	219.8 ± 6.9	.178 ± .016		
83.7 ± 1.4	.242 ± .021	226.9 ± 7.2	.174 ± .015		
85.2 ± 1.5	.226 ± .020	234.4 ± 7.6	.161 ± .014		
86.7 ± 1.5	.226 ± .020	242.3 ± 8.1	.159 ± .014		
88.3 ± 1.5	.229 ± .020	250.6 ± 8.6	.152 ± .013		
89.9 ± 1.6	.222 ± .019	259.5 ± 9.1	.148 ± .013		
91.6 ± 1.6	.225 ± .020	268.9 ± 9.6	.134 ± .012		
93.3 ± 1.7	.224 ± .019	278.9 ± 10.3	.135 ± .012		
95.0 ± 1.7	.206 ± .018	289.5 ± 10.9	.123 ± .011		
96.9 ± 1.8	.195 ± .017	300.9 ± 11.7	.123 ± .011		
98.7 ± 1.9	.215 ± .019	313.0 ± 12.5	.118 ± .010		
100.7 ± 1.9	.226 ± .020	326.0 ± 13.4	.119 ± .011		
102.7 ± 2.0	.202 ± .018	339.9 ± 14.4	.131 ± .012		
104.7 ± 2.0	.205 ± .018	354.9 ± 15.5	.155 ± .014		
106.8 ± 2.1	.210 ± .018	371.1 ± 16.8	.179 ± .016		
109.0 ± 2.2	.209 ± .017	388.6 ± 18.2	.226 ± .021		
111.3 ± 2.3	.206 ± .017	407.7 ± 19.8	.311 ± .029		
113.6 ± 2.3	.225 ± .018	428.4 ± 21.6	.456 ± .043		
116.1 ± 2.4	.205 ± .017	451.1 ± 23.7	.656 ± .062		
118.6 ± 2.5	.204 ± .017	476.1 ± 26.2	.760 ± .073		
121.1 ± 2.6	.206 ± .017	503.6 ± 29.0	.598 ± .058		
123.8 ± 2.7	.198 ± .017	534.2 ± 32.3	.302 ± .030		
126.6 ± 2.8	.203 ± .017	568.4 ± 36.2	.081 ± .008		
129.5 ± 2.9	.195 ± .016	606.9 ± 40.9	.018 ± .001		

TABLE 10.- Continued

(c) Angle of scatter of 30°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
64.5 ± .9	.192 ± .017	145.5 ± 3.5	.152 ± .012		
65.4 ± 1.0	.199 ± .017	149.1 ± 3.6	.150 ± .012		
66.5 ± 1.0	.185 ± .016	152.9 ± 3.8	.153 ± .013		
67.5 ± 1.0	.216 ± .019	156.8 ± 3.9	.140 ± .012		
68.6 ± 1.0	.189 ± .017	160.8 ± 4.1	.142 ± .012		
69.7 ± 1.1	.192 ± .017	165.1 ± 4.3	.141 ± .012		
70.8 ± 1.1	.200 ± .018	169.5 ± 4.5	.135 ± .011		
71.9 ± 1.1	.205 ± .018	174.1 ± 4.7	.133 ± .011		
73.1 ± 1.1	.197 ± .017	178.9 ± 4.9	.130 ± .011		
74.3 ± 1.2	.213 ± .019	184.0 ± 5.1	.126 ± .010		
75.5 ± 1.2	.208 ± .018	189.2 ± 5.4	.127 ± .011		
76.8 ± 1.2	.191 ± .017	194.8 ± 5.6	.133 ± .011		
78.1 ± 1.3	.207 ± .018	200.6 ± 5.9	.124 ± .011		
79.4 ± 1.3	.194 ± .017	206.7 ± 6.2	.125 ± .011		
80.8 ± 1.3	.194 ± .017	213.1 ± 6.5	.119 ± .010		
82.2 ± 1.4	.192 ± .017	219.8 ± 6.9	.116 ± .010		
83.7 ± 1.4	.176 ± .015	226.9 ± 7.2	.118 ± .010		
85.2 ± 1.5	.186 ± .016	234.4 ± 7.6	.112 ± .010		
86.7 ± 1.5	.198 ± .017	242.3 ± 8.1	.114 ± .010		
88.3 ± 1.5	.174 ± .015	250.6 ± 8.6	.118 ± .010		
89.9 ± 1.6	.192 ± .017	259.5 ± 9.1	.118 ± .010		
91.6 ± 1.6	.173 ± .015	268.9 ± 9.6	.121 ± .010		
93.3 ± 1.7	.174 ± .015	278.9 ± 10.3	.135 ± .012		
95.0 ± 1.7	.180 ± .016	289.5 ± 10.9	.147 ± .013		
96.9 ± 1.8	.176 ± .015	300.9 ± 11.7	.158 ± .014		
98.7 ± 1.9	.173 ± .015	313.0 ± 12.5	.178 ± .016		
100.7 ± 1.9	.171 ± .015	326.0 ± 13.4	.202 ± .018		
102.7 ± 2.0	.164 ± .014	339.9 ± 14.4	.237 ± .021		
104.7 ± 2.0	.169 ± .015	354.9 ± 15.5	.266 ± .024		
106.8 ± 2.1	.183 ± .016	371.1 ± 16.8	.293 ± .027		
109.0 ± 2.2	.188 ± .016	388.6 ± 18.2	.302 ± .028		
111.3 ± 2.3	.162 ± .014	407.7 ± 19.8	.278 ± .026		
113.6 ± 2.3	.173 ± .015	428.4 ± 21.6	.227 ± .021		
116.1 ± 2.4	.169 ± .014	451.1 ± 23.7	.151 ± .014		
118.6 ± 2.5	.163 ± .014	476.1 ± 26.2	.083 ± .008		
121.1 ± 2.6	.155 ± .013	503.6 ± 29.0	.043 ± .004		
123.8 ± 2.7	.160 ± .014	534.2 ± 32.3	.021 ± .002		
126.6 ± 2.8	.159 ± .014	568.4 ± 36.2	.005 ± .000		
129.5 ± 2.9	.160 ± .013	606.9 ± 40.9	.002 ± .000		
132.4 ± 3.0	.168 ± .014	650.5 ± 46.6	.002 ± .000		
135.5 ± 3.1	.151 ± .012	700.4 ± 53.6	.002 ± .000		
138.7 ± 3.2	.161 ± .013	758.2 ± 62.4	.002 ± .000		
142.1 ± 3.3	.159 ± .013	826.0 ± 73.8	.002 ± .000		

TABLE 10.- Continued

(d) Angle of scatter of 50°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.4 ± .6	.000 ± .000	94.1 ± 1.7	.175 ± .015	283.6 ± 10.5	.052 ± .004
49.0 ± .6	.000 ± .000	95.9 ± 1.8	.173 ± .015	294.5 ± 11.2	.046 ± .004
49.6 ± .6	.000 ± .000	97.8 ± 1.8	.170 ± .015	306.2 ± 12.0	.039 ± .003
50.3 ± .6	.280 ± .023	99.7 ± 1.9	.164 ± .014	318.6 ± 12.9	.034 ± .003
51.0 ± .6	.268 ± .022	101.6 ± 1.9	.171 ± .015	332.0 ± 13.8	.029 ± .002
51.7 ± .6	.231 ± .019	103.6 ± 2.0	.165 ± .014	346.4 ± 14.9	.025 ± .002
52.4 ± .7	.229 ± .019	105.7 ± 2.1	.169 ± .015	361.9 ± 16.1	.021 ± .001
53.1 ± .7	.232 ± .019	107.9 ± 2.1	.171 ± .015	378.6 ± 17.4	.016 ± .001
53.8 ± .7	.244 ± .021	110.1 ± 2.2	.176 ± .015	396.8 ± 18.9	.012 ± .001
54.6 ± .7	.230 ± .019	112.4 ± 2.3	.165 ± .014	416.5 ± 20.6	.007 ± .000
55.3 ± .7	.198 ± .017	114.8 ± 2.4	.168 ± .014	438.1 ± 22.5	.004 ± .000
56.1 ± .7	.208 ± .018	117.2 ± 2.4	.171 ± .015	461.7 ± 24.7	.002 ± .000
56.9 ± .8	.205 ± .017	119.8 ± 2.5	.168 ± .014	487.7 ± 27.3	.001 ± .000
57.7 ± .8	.199 ± .017	122.4 ± 2.6	.165 ± .014	516.5 ± 30.3	.000 ± .000
58.6 ± .8	.216 ± .019	125.1 ± 2.7	.162 ± .014	548.6 ± 33.9	.000 ± .000
59.4 ± .8	.191 ± .016	127.9 ± 2.8	.158 ± .013	584.5 ± 38.1	.000 ± .000
60.3 ± .8	.199 ± .017	130.9 ± 2.9	.161 ± .013	625.1 ± 43.2	.001 ± .000
61.2 ± .9	.196 ± .017	133.9 ± 3.0	.153 ± .012	671.2 ± 49.4	.001 ± .000
62.1 ± .9	.199 ± .017	137.0 ± 3.2	.157 ± .013		
63.0 ± .9	.204 ± .018	140.3 ± 3.3	.153 ± .013		
64.0 ± .9	.194 ± .017	143.7 ± 3.4	.156 ± .013		
65.0 ± .9	.195 ± .017	147.2 ± 3.5	.156 ± .013		
66.0 ± 1.0	.184 ± .016	150.9 ± 3.7	.152 ± .013		
67.0 ± 1.0	.186 ± .016	154.7 ± 3.8	.152 ± .013		
68.0 ± 1.0	.182 ± .016	158.6 ± 4.0	.149 ± .012		
69.1 ± 1.0	.189 ± .017	162.8 ± 4.2	.150 ± .012		
70.2 ± 1.1	.187 ± .017	167.1 ± 4.4	.145 ± .012		
71.3 ± 1.1	.185 ± .016	171.6 ± 4.6	.143 ± .012		
72.5 ± 1.1	.194 ± .017	176.3 ± 4.8	.139 ± .012		
73.7 ± 1.2	.192 ± .017	181.2 ± 5.0	.136 ± .011		
74.9 ± 1.2	.198 ± .017	186.4 ± 5.2	.131 ± .011		
76.2 ± 1.2	.194 ± .017	191.7 ± 5.5	.128 ± .011		
77.4 ± 1.3	.194 ± .017	197.4 ± 5.7	.125 ± .010		
78.8 ± 1.3	.189 ± .017	203.3 ± 6.0	.118 ± .010		
80.1 ± 1.3	.171 ± .015	209.5 ± 6.3	.113 ± .009		
81.5 ± 1.4	.183 ± .016	216.1 ± 6.7	.110 ± .009		
82.9 ± 1.4	.166 ± .015	223.0 ± 7.0	.103 ± .009		
84.4 ± 1.4	.175 ± .015	230.2 ± 7.4	.098 ± .008		
85.9 ± 1.5	.175 ± .015	237.9 ± 7.8	.090 ± .008		
87.5 ± 1.5	.182 ± .016	246.0 ± 8.3	.084 ± .007		
89.1 ± 1.6	.177 ± .015	254.6 ± 8.8	.075 ± .006		
90.7 ± 1.6	.178 ± .016	263.7 ± 9.3	.066 ± .005		
92.4 ± 1.7	.179 ± .016	273.3 ± 9.9	.059 ± .005		

TABLE 10. - Concluded

(e) Angle of scatter of 60°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.4 ± .6	.000 ± .000	94.1 ± 1.7	.141 ± .012	283.6 ± 10.5	.012 ± .001
49.0 ± .6	.000 ± .000	95.9 ± 1.8	.141 ± .012	294.5 ± 11.2	.010 ± .000
49.6 ± .6	.000 ± .000	97.8 ± 1.8	.138 ± .012	306.2 ± 12.0	.008 ± .000
50.3 ± .6	.249 ± .020	99.7 ± 1.9	.133 ± .011	318.6 ± 12.9	.006 ± .000
51.0 ± .6	.217 ± .018	101.6 ± 1.9	.132 ± .011	332.0 ± 13.8	.004 ± .000
51.7 ± .6	.225 ± .018	103.6 ± 2.0	.132 ± .011	346.4 ± 14.9	.003 ± .000
52.4 ± .7	.218 ± .018	105.7 ± 2.1	.127 ± .011	361.9 ± 16.1	.002 ± .000
53.1 ± .7	.200 ± .017	107.9 ± 2.1	.128 ± .011	378.6 ± 17.4	.001 ± .000
53.8 ± .7	.195 ± .016	110.1 ± 2.2	.127 ± .011	396.8 ± 18.9	.000 ± .000
54.6 ± .7	.181 ± .015	112.4 ± 2.3	.124 ± .011	416.5 ± 20.6	.000 ± .000
55.3 ± .7	.189 ± .016	114.8 ± 2.4	.120 ± .010	438.1 ± 22.5	.000 ± .000
56.1 ± .7	.176 ± .015	117.2 ± 2.4	.121 ± .010	461.7 ± 24.7	.000 ± .000
56.9 ± .8	.163 ± .014	119.8 ± 2.5	.114 ± .010	487.7 ± 27.3	.000 ± .000
57.7 ± .8	.172 ± .015	122.4 ± 2.6	.114 ± .010	516.5 ± 30.3	.000 ± .000
58.6 ± .8	.180 ± .015	125.1 ± 2.7	.111 ± .009	548.6 ± 33.9	.000 ± .000
59.4 ± .8	.167 ± .014	127.9 ± 2.8	.108 ± .009	584.5 ± 38.1	.000 ± .000
60.3 ± .8	.166 ± .014	130.9 ± 2.9	.106 ± .008	625.1 ± 43.2	.000 ± .000
61.2 ± .9	.164 ± .014	133.9 ± 3.0	.104 ± .008	671.2 ± 49.4	.000 ± .000
62.1 ± .9	.172 ± .015	137.0 ± 3.2	.101 ± .008		
63.0 ± .9	.162 ± .014	140.3 ± 3.3	.098 ± .008		
64.0 ± .9	.162 ± .014	143.7 ± 3.4	.095 ± .008		
65.0 ± .9	.165 ± .014	147.2 ± 3.5	.092 ± .007		
66.0 ± 1.0	.169 ± .015	150.9 ± 3.7	.089 ± .007		
67.0 ± 1.0	.162 ± .014	154.7 ± 3.8	.083 ± .007		
68.0 ± 1.0	.162 ± .014	158.6 ± 4.0	.077 ± .006		
69.1 ± 1.0	.161 ± .014	162.8 ± 4.2	.074 ± .006		
70.2 ± 1.1	.157 ± .014	167.1 ± 4.4	.068 ± .005		
71.3 ± 1.1	.162 ± .014	171.6 ± 4.6	.066 ± .005		
72.5 ± 1.1	.172 ± .015	176.3 ± 4.8	.060 ± .005		
73.7 ± 1.2	.167 ± .015	181.2 ± 5.0	.056 ± .004		
74.9 ± 1.2	.159 ± .014	186.4 ± 5.2	.051 ± .004		
76.2 ± 1.2	.160 ± .014	191.7 ± 5.5	.047 ± .004		
77.4 ± 1.3	.155 ± .014	197.4 ± 5.7	.044 ± .003		
78.8 ± 1.3	.142 ± .012	203.3 ± 6.0	.039 ± .003		
80.1 ± 1.3	.136 ± .012	209.5 ± 6.3	.035 ± .003		
81.5 ± 1.4	.132 ± .012	216.1 ± 6.7	.032 ± .002		
82.9 ± 1.4	.138 ± .012	223.0 ± 7.0	.029 ± .002		
84.4 ± 1.4	.144 ± .013	230.2 ± 7.4	.026 ± .002		
85.9 ± 1.5	.144 ± .013	237.9 ± 7.8	.024 ± .002		
87.5 ± 1.5	.138 ± .012	246.0 ± 8.3	.021 ± .001		
89.1 ± 1.6	.147 ± .013	254.6 ± 8.8	.019 ± .001		
90.7 ± 1.6	.137 ± .012	263.7 ± 9.3	.015 ± .001		
92.4 ± 1.7	.138 ± .012	273.3 ± 9.9	.013 ± .001		

TABLE 11.- DOUBLE DIFFERENTIAL CROSS SECTIONS FOR PRODUCTION OF SECONDARY PROTONS FROM CARBON TARGET, 0.95 g/cm^2 THICK

[Incident proton energy, 558 MeV]

(a) Angle of scatter of 10°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
47.9 ± .6	.000 ± .000	93.1 ± 1.7	.331 ± .029	279.5 ± 10.3	.278 ± .025
48.5 ± .6	.592 ± .047	94.9 ± 1.7	.323 ± .028	290.2 ± 11.0	.268 ± .025
49.2 ± .6	.485 ± .039	96.7 ± 1.8	.316 ± .028	301.6 ± 11.8	.262 ± .024
49.8 ± .6	.278 ± .023	98.6 ± 1.9	.298 ± .026	313.8 ± 12.6	.251 ± .023
50.5 ± .6	.250 ± .020	100.5 ± 1.9	.312 ± .027	326.9 ± 13.5	.245 ± .023
51.2 ± .6	.308 ± .026	102.5 ± 2.0	.325 ± .028	340.9 ± 14.5	.228 ± .021
51.9 ± .7	.321 ± .027	104.6 ± 2.0	.329 ± .029	356.1 ± 15.7	.224 ± .021
52.6 ± .7	.414 ± .035	106.7 ± 2.1	.324 ± .028	372.4 ± 16.9	.208 ± .019
53.3 ± .7	.377 ± .032	108.9 ± 2.2	.339 ± .030	390.1 ± 18.4	.233 ± .022
54.0 ± .7	.364 ± .031	111.2 ± 2.3	.344 ± .030	409.3 ± 20.0	.289 ± .027
54.8 ± .7	.258 ± .022	113.5 ± 2.3	.315 ± .028	430.3 ± 21.9	.231 ± .022
55.6 ± .7	.262 ± .022	115.9 ± 2.4	.293 ± .025	453.3 ± 24.0	.221 ± .021
56.3 ± .7	.300 ± .026	118.4 ± 2.5	.349 ± .030	478.5 ± 26.5	.343 ± .033
57.2 ± .8	.309 ± .027	121.0 ± 2.6	.308 ± .027	506.5 ± 29.4	.853 ± .083
58.0 ± .8	.379 ± .033	123.7 ± 2.7	.318 ± .027	537.5 ± 32.7	2.822 ± .281
58.8 ± .8	.287 ± .025	126.5 ± 2.8	.296 ± .026	572.2 ± 36.8	3.996 ± .405
59.7 ± .8	.315 ± .028	129.4 ± 2.9	.331 ± .027	611.3 ± 41.6	.418 ± .043
60.6 ± .8	.361 ± .032	132.3 ± 3.0	.328 ± .027	655.7 ± 47.4	.065 ± .007
61.5 ± .9	.312 ± .027	135.4 ± 3.1	.332 ± .028		
62.4 ± .9	.309 ± .027	138.7 ± 3.2	.358 ± .030		
63.3 ± .9	.283 ± .025	142.0 ± 3.4	.317 ± .026		
64.3 ± .9	.303 ± .027	145.5 ± 3.5	.312 ± .026		
65.3 ± 1.0	.342 ± .030	149.1 ± 3.6	.351 ± .030		
66.3 ± 1.0	.367 ± .032	152.8 ± 3.8	.371 ± .031		
67.3 ± 1.0	.307 ± .027	156.7 ± 3.9	.365 ± .031		
68.4 ± 1.0	.321 ± .029	160.8 ± 4.1	.324 ± .027		
69.5 ± 1.1	.241 ± .021	165.1 ± 4.3	.324 ± .027		
70.6 ± 1.1	.395 ± .035	169.5 ± 4.5	.342 ± .029		
71.8 ± 1.1	.322 ± .028	174.1 ± 4.7	.350 ± .030		
72.9 ± 1.1	.309 ± .027	179.0 ± 4.9	.334 ± .028		
74.1 ± 1.2	.340 ± .030	184.0 ± 5.1	.302 ± .026		
75.4 ± 1.2	.384 ± .034	189.3 ± 5.4	.350 ± .032		
76.6 ± 1.2	.294 ± .026	194.9 ± 5.6	.380 ± .035		
77.9 ± 1.3	.302 ± .027	200.7 ± 5.9	.328 ± .030		
79.3 ± 1.3	.322 ± .029	206.8 ± 6.2	.323 ± .030		
80.7 ± 1.3	.307 ± .027	213.2 ± 6.5	.317 ± .029		
82.1 ± 1.4	.319 ± .028	220.0 ± 6.9	.349 ± .032		
83.5 ± 1.4	.330 ± .029	227.1 ± 7.3	.327 ± .030		
85.0 ± 1.5	.341 ± .030	234.7 ± 7.7	.347 ± .032		
86.5 ± 1.5	.348 ± .031	242.6 ± 8.1	.330 ± .030		
88.1 ± 1.5	.304 ± .027	251.0 ± 8.6	.341 ± .031		
89.7 ± 1.6	.286 ± .025	259.9 ± 9.1	.324 ± .030		
91.4 ± 1.6	.301 ± .027	269.4 ± 9.7	.289 ± .026		

TABLE 11.- Continued

(b) Angle of scatter of 20°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.0 ± .6	.000 ± .000	93.3 ± 1.7	.274 ± .024	278.9 ± 10.3	.164 ± .015
48.7 ± .6	.420 ± .033	95.0 ± 1.7	.250 ± .022	289.5 ± 10.9	.157 ± .014
49.3 ± .6	.448 ± .036	96.9 ± 1.8	.260 ± .023	300.9 ± 11.7	.157 ± .014
50.0 ± .6	.301 ± .024	98.7 ± 1.9	.303 ± .026	313.0 ± 12.5	.153 ± .014
50.6 ± .6	.336 ± .028	100.7 ± 1.9	.248 ± .022	326.0 ± 13.4	.151 ± .014
51.3 ± .6	.331 ± .027	102.7 ± 2.0	.277 ± .024	339.9 ± 14.4	.159 ± .014
52.0 ± .7	.279 ± .023	104.7 ± 2.0	.269 ± .023	354.9 ± 15.5	.181 ± .016
52.7 ± .7	.276 ± .023	106.8 ± 2.1	.243 ± .021	371.1 ± 16.8	.207 ± .019
53.4 ± .7	.302 ± .026	109.0 ± 2.2	.255 ± .022	388.6 ± 18.2	.249 ± .023
54.2 ± .7	.298 ± .025	111.3 ± 2.3	.270 ± .024	407.7 ± 19.8	.318 ± .030
54.9 ± .7	.282 ± .024	113.6 ± 2.3	.268 ± .023	428.4 ± 21.6	.469 ± .044
55.7 ± .7	.243 ± .021	116.1 ± 2.4	.260 ± .023	451.1 ± 23.7	.614 ± .058
56.5 ± .7	.277 ± .024	118.6 ± 2.5	.256 ± .022	476.1 ± 26.2	.683 ± .066
57.3 ± .8	.270 ± .023	121.1 ± 2.6	.262 ± .023	503.6 ± 29.0	.590 ± .057
58.1 ± .8	.271 ± .023	123.8 ± 2.7	.252 ± .022	534.2 ± 32.3	.363 ± .036
59.0 ± .8	.238 ± .021	126.6 ± 2.8	.236 ± .020	568.4 ± 36.2	.136 ± .013
59.8 ± .8	.289 ± .025	129.5 ± 2.9	.244 ± .020	606.9 ± 40.9	.023 ± .002
60.7 ± .8	.290 ± .026	132.4 ± 3.0	.249 ± .021	650.5 ± 46.6	.013 ± .001
61.6 ± .9	.288 ± .025	135.5 ± 3.1	.238 ± .020	700.4 ± 53.6	.009 ± .001
62.5 ± .9	.266 ± .023	138.7 ± 3.2	.246 ± .020		
63.5 ± .9	.305 ± .027	142.1 ± 3.3	.259 ± .022		
64.5 ± .9	.239 ± .021	145.5 ± 3.5	.260 ± .022		
65.4 ± 1.0	.251 ± .022	149.1 ± 3.6	.233 ± .019		
66.5 ± 1.0	.289 ± .026	152.9 ± 3.8	.247 ± .021		
67.5 ± 1.0	.304 ± .027	156.8 ± 3.9	.234 ± .020		
68.6 ± 1.0	.246 ± .022	160.8 ± 4.1	.226 ± .019		
69.7 ± 1.1	.291 ± .026	165.1 ± 4.3	.229 ± .019		
70.8 ± 1.1	.277 ± .025	169.5 ± 4.5	.209 ± .018		
71.9 ± 1.1	.328 ± .029	174.1 ± 4.7	.220 ± .018		
73.1 ± 1.1	.310 ± .027	178.9 ± 4.9	.224 ± .019		
74.3 ± 1.2	.304 ± .027	184.0 ± 5.1	.216 ± .018		
75.5 ± 1.2	.308 ± .027	189.2 ± 5.4	.219 ± .020		
76.8 ± 1.2	.274 ± .024	194.8 ± 5.6	.208 ± .019		
78.1 ± 1.3	.296 ± .026	200.6 ± 5.9	.213 ± .019		
79.4 ± 1.3	.272 ± .024	206.7 ± 6.2	.222 ± .020		
80.8 ± 1.3	.305 ± .027	213.1 ± 6.5	.208 ± .019		
82.2 ± 1.4	.274 ± .024	219.8 ± 6.9	.216 ± .019		
83.7 ± 1.4	.261 ± .023	226.9 ± 7.2	.199 ± .018		
85.2 ± 1.5	.265 ± .023	234.4 ± 7.6	.194 ± .017		
86.7 ± 1.5	.269 ± .024	242.3 ± 8.1	.190 ± .017		
88.3 ± 1.5	.284 ± .025	250.6 ± 8.6	.185 ± .016		
89.9 ± 1.6	.289 ± .025	259.5 ± 9.1	.174 ± .016		
91.6 ± 1.6	.268 ± .024	268.9 ± 9.6	.169 ± .015		

TABLE 11.- Continued

(c) Angle of scatter of 30°

Energy, MeV	Cross section mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
60.7 ± .8	.285 ± .025	132.4 ± 3.0	.204 ± .017	650.5 ± 46.6	.002 ± .000
61.6 ± .9	.252 ± .022	135.5 ± 3.1	.200 ± .016	700.4 ± 53.6	.002 ± .000
62.5 ± .9	.266 ± .023	138.7 ± 3.2	.209 ± .017		
63.5 ± .9	.258 ± .022	142.1 ± 3.3	.213 ± .018		
64.5 ± .9	.258 ± .022	145.5 ± 3.5	.215 ± .018		
65.4 ± 1.0	.223 ± .019	149.1 ± 3.6	.190 ± .016		
66.5 ± 1.0	.289 ± .025	152.9 ± 3.8	.204 ± .017		
67.5 ± 1.0	.276 ± .024	156.8 ± 3.9	.195 ± .016		
68.6 ± 1.0	.228 ± .020	160.8 ± 4.1	.196 ± .016		
69.7 ± 1.1	.303 ± .027	165.1 ± 4.3	.189 ± .016		
70.8 ± 1.1	.288 ± .026	169.5 ± 4.5	.187 ± .016		
71.9 ± 1.1	.289 ± .026	174.1 ± 4.7	.187 ± .016		
73.1 ± 1.1	.297 ± .026	178.9 ± 4.9	.185 ± .015		
74.3 ± 1.2	.266 ± .023	184.0 ± 5.1	.160 ± .013		
75.5 ± 1.2	.282 ± .025	189.2 ± 5.4	.166 ± .015		
76.8 ± 1.2	.270 ± .024	194.8 ± 5.6	.169 ± .015		
78.1 ± 1.3	.247 ± .022	200.6 ± 5.9	.162 ± .015		
79.4 ± 1.3	.264 ± .023	206.7 ± 6.2	.169 ± .015		
80.8 ± 1.3	.228 ± .020	213.1 ± 6.5	.169 ± .015		
82.2 ± 1.4	.218 ± .019	219.8 ± 6.9	.166 ± .015		
83.7 ± 1.4	.247 ± .022	226.9 ± 7.2	.158 ± .014		
85.2 ± 1.5	.271 ± .024	234.4 ± 7.6	.151 ± .014		
86.7 ± 1.5	.267 ± .024	242.3 ± 8.1	.148 ± .013		
88.3 ± 1.5	.236 ± .021	250.6 ± 8.6	.155 ± .014		
89.9 ± 1.6	.261 ± .023	259.5 ± 9.1	.158 ± .014		
91.6 ± 1.6	.240 ± .021	268.9 ± 9.6	.159 ± .014		
93.3 ± 1.7	.265 ± .023	278.9 ± 10.3	.166 ± .015		
95.0 ± 1.7	.259 ± .023	289.5 ± 10.9	.169 ± .015		
96.9 ± 1.8	.229 ± .020	300.9 ± 11.7	.195 ± .017		
98.7 ± 1.9	.259 ± .023	313.0 ± 12.5	.203 ± .018		
100.7 ± 1.9	.227 ± .020	326.0 ± 13.4	.226 ± .020		
102.7 ± 2.0	.237 ± .020	339.9 ± 14.4	.257 ± .023		
104.7 ± 2.0	.225 ± .019	354.9 ± 15.5	.270 ± .025		
106.8 ± 2.1	.256 ± .022	371.1 ± 16.8	.293 ± .027		
109.0 ± 2.2	.237 ± .021	388.6 ± 18.2	.298 ± .027		
111.3 ± 2.3	.238 ± .021	407.7 ± 19.8	.288 ± .027		
113.6 ± 2.3	.239 ± .021	428.4 ± 21.6	.257 ± .024		
116.1 ± 2.4	.255 ± .022	451.1 ± 23.7	.190 ± .018		
118.6 ± 2.5	.235 ± .020	476.1 ± 26.2	.117 ± .011		
121.1 ± 2.6	.217 ± .019	503.6 ± 29.0	.065 ± .006		
123.8 ± 2.7	.217 ± .019	534.2 ± 32.3	.031 ± .003		
126.6 ± 2.8	.218 ± .019	568.4 ± 36.2	.008 ± .000		
129.5 ± 2.9	.216 ± .018	606.9 ± 40.9	.004 ± .000		

TABLE 11.- Continued

(d) Angle of scatter of 40°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.0 ± .6	.000 ± .000	93.3 ± 1.7	.243 ± .021	278.9 ± 10.3	.181 ± .016
48.7 ± .6	.428 ± .034	95.0 ± 1.7	.241 ± .021	289.5 ± 10.9	.182 ± .016
49.3 ± .6	.327 ± .026	96.9 ± 1.8	.232 ± .020	300.9 ± 11.7	.174 ± .015
50.0 ± .6	.347 ± .028	98.7 ± 1.9	.231 ± .020	313.0 ± 12.5	.162 ± .014
50.6 ± .6	.318 ± .026	100.7 ± 1.9	.238 ± .021	326.0 ± 13.4	.146 ± .013
51.3 ± .6	.321 ± .027	102.7 ± 2.0	.213 ± .018	339.9 ± 14.4	.131 ± .012
52.0 ± .7	.321 ± .027	104.7 ± 2.0	.235 ± .020	354.9 ± 15.5	.111 ± .010
52.7 ± .7	.278 ± .023	106.8 ± 2.1	.230 ± .020	371.1 ± 16.8	.089 ± .008
53.4 ± .7	.275 ± .023	109.0 ± 2.2	.227 ± .020	388.6 ± 18.2	.069 ± .006
54.2 ± .7	.251 ± .021	111.3 ± 2.3	.223 ± .020	407.7 ± 19.8	.052 ± .004
54.9 ± .7	.307 ± .026	113.6 ± 2.3	.229 ± .020	428.4 ± 21.6	.038 ± .003
55.7 ± .7	.280 ± .024	116.1 ± 2.4	.219 ± .019	451.1 ± 23.7	.024 ± .002
56.5 ± .7	.264 ± .022	118.6 ± 2.5	.213 ± .018	476.1 ± 26.2	.012 ± .001
57.3 ± .8	.248 ± .021	121.1 ± 2.6	.214 ± .018	503.6 ± 29.0	.006 ± .000
58.1 ± .8	.258 ± .022	123.8 ± 2.7	.212 ± .018	534.2 ± 32.3	.002 ± .000
59.0 ± .8	.260 ± .023	126.6 ± 2.8	.209 ± .018	568.4 ± 36.2	.001 ± .000
59.8 ± .8	.256 ± .022	129.5 ± 2.9	.205 ± .017	606.9 ± 40.9	.001 ± .000
60.7 ± .8	.254 ± .022	132.4 ± 3.0	.207 ± .017	650.5 ± 46.6	.001 ± .000
61.6 ± .9	.283 ± .025	135.5 ± 3.1	.202 ± .017	700.4 ± 53.6	.002 ± .000
62.5 ± .9	.256 ± .022	138.7 ± 3.2	.204 ± .017		
63.5 ± .9	.259 ± .023	142.1 ± 3.3	.205 ± .017		
64.5 ± .9	.288 ± .025	145.5 ± 3.5	.197 ± .016		
65.4 ± 1.0	.253 ± .022	149.1 ± 3.6	.204 ± .017		
66.5 ± 1.0	.245 ± .022	152.9 ± 3.8	.205 ± .017		
67.5 ± 1.0	.262 ± .023	156.8 ± 3.9	.198 ± .016		
68.6 ± 1.0	.238 ± .021	160.8 ± 4.1	.190 ± .016		
69.7 ± 1.1	.234 ± .021	165.1 ± 4.3	.185 ± .015		
70.8 ± 1.1	.250 ± .022	169.5 ± 4.5	.195 ± .016		
71.9 ± 1.1	.232 ± .020	174.1 ± 4.7	.188 ± .016		
73.1 ± 1.1	.264 ± .023	178.9 ± 4.9	.181 ± .015		
74.3 ± 1.2	.256 ± .022	184.0 ± 5.1	.184 ± .015		
75.5 ± 1.2	.246 ± .022	189.2 ± 5.4	.188 ± .016		
76.8 ± 1.2	.248 ± .022	194.8 ± 5.6	.188 ± .016		
78.1 ± 1.3	.259 ± .023	200.6 ± 5.9	.184 ± .016		
79.4 ± 1.3	.244 ± .022	206.7 ± 6.2	.188 ± .016		
80.8 ± 1.3	.254 ± .023	213.1 ± 6.5	.182 ± .016		
82.2 ± 1.4	.239 ± .021	219.8 ± 6.9	.186 ± .016		
83.7 ± 1.4	.248 ± .022	226.9 ± 7.2	.186 ± .016		
85.2 ± 1.5	.244 ± .022	234.4 ± 7.6	.183 ± .016		
86.7 ± 1.5	.243 ± .021	242.3 ± 8.1	.186 ± .016		
88.3 ± 1.5	.233 ± .020	250.6 ± 8.6	.181 ± .016		
89.9 ± 1.6	.236 ± .021	259.5 ± 9.1	.185 ± .016		
91.6 ± 1.6	.242 ± .021	268.9 ± 9.6	.180 ± .016		

TABLE 11.- Continued

(e) Angle of scatter of 50°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.4 ± .6	.000 ± .000	94.1 ± 1.7	.225 ± .020	283.6 ± 10.5	.072 ± .006
49.0 ± .6	.456 ± .036	95.9 ± 1.8	.222 ± .019	294.5 ± 11.2	.063 ± .005
49.6 ± .6	.414 ± .033	97.8 ± 1.8	.227 ± .020	306.2 ± 12.0	.052 ± .004
50.3 ± .6	.366 ± .030	99.7 ± 1.9	.233 ± .020	318.6 ± 12.9	.046 ± .004
51.0 ± .6	.302 ± .025	101.6 ± 1.9	.215 ± .019	332.0 ± 13.8	.039 ± .003
51.7 ± .6	.319 ± .026	103.6 ± 2.0	.228 ± .020	346.4 ± 14.9	.032 ± .003
52.4 ± .7	.282 ± .023	105.7 ± 2.1	.221 ± .019	361.9 ± 16.1	.027 ± .002
53.1 ± .7	.275 ± .023	107.9 ± 2.1	.222 ± .019	378.6 ± 17.4	.020 ± .001
53.8 ± .7	.270 ± .023	110.1 ± 2.2	.226 ± .020	396.8 ± 18.9	.014 ± .001
54.6 ± .7	.251 ± .021	112.4 ± 2.3	.230 ± .020	416.5 ± 20.6	.010 ± .001
55.3 ± .7	.266 ± .023	114.8 ± 2.4	.211 ± .018	438.1 ± 22.5	.005 ± .000
56.1 ± .7	.249 ± .021	117.2 ± 2.4	.223 ± .019	461.7 ± 24.7	.003 ± .000
56.9 ± .8	.284 ± .024	119.8 ± 2.5	.211 ± .018	487.7 ± 27.3	.001 ± .000
57.7 ± .8	.253 ± .022	122.4 ± 2.6	.216 ± .018	516.5 ± 30.3	.001 ± .000
58.6 ± .8	.253 ± .022	125.1 ± 2.7	.210 ± .018	548.6 ± 33.9	.001 ± .000
59.4 ± .8	.242 ± .021	127.9 ± 2.8	.208 ± .018	584.5 ± 38.1	.001 ± .000
60.3 ± .8	.262 ± .023	130.9 ± 2.9	.209 ± .017	625.1 ± 43.2	.001 ± .000
61.2 ± .9	.291 ± .026	133.9 ± 3.0	.207 ± .017	671.2 ± 49.4	.001 ± .000
62.1 ± .9	.284 ± .025	137.0 ± 3.2	.214 ± .018		
63.0 ± .9	.264 ± .023	140.3 ± 3.3	.207 ± .017		
64.0 ± .9	.257 ± .022	143.7 ± 3.4	.198 ± .016		
65.0 ± .9	.274 ± .024	147.2 ± 3.5	.199 ± .016		
66.0 ± 1.0	.250 ± .022	150.9 ± 3.7	.195 ± .016		
67.0 ± 1.0	.250 ± .022	154.7 ± 3.8	.198 ± .016		
68.0 ± 1.0	.233 ± .020	158.6 ± 4.0	.193 ± .016		
69.1 ± 1.0	.250 ± .022	162.8 ± 4.2	.187 ± .016		
70.2 ± 1.1	.247 ± .022	167.1 ± 4.4	.178 ± .015		
71.3 ± 1.1	.249 ± .022	171.6 ± 4.6	.182 ± .015		
72.5 ± 1.1	.258 ± .023	176.3 ± 4.8	.175 ± .015		
73.7 ± 1.2	.268 ± .024	181.2 ± 5.0	.168 ± .014		
74.9 ± 1.2	.259 ± .023	186.4 ± 5.2	.162 ± .014		
76.2 ± 1.2	.256 ± .022	191.7 ± 5.5	.159 ± .014		
77.4 ± 1.3	.261 ± .023	197.4 ± 5.7	.158 ± .014		
78.8 ± 1.3	.257 ± .023	203.3 ± 6.0	.154 ± .013		
80.1 ± 1.3	.248 ± .022	209.5 ± 6.3	.147 ± .013		
81.5 ± 1.4	.246 ± .022	216.1 ± 6.7	.139 ± .012		
82.9 ± 1.4	.253 ± .022	223.0 ± 7.0	.131 ± .011		
84.4 ± 1.4	.239 ± .021	230.2 ± 7.4	.125 ± .011		
85.9 ± 1.5	.236 ± .021	237.9 ± 7.8	.115 ± .010		
87.5 ± 1.5	.258 ± .023	246.0 ± 8.3	.110 ± .009		
89.1 ± 1.6	.250 ± .022	254.6 ± 8.8	.097 ± .008		
90.7 ± 1.6	.243 ± .021	263.7 ± 9.3	.091 ± .008		
92.4 ± 1.7	.247 ± .022	273.3 ± 9.9	.077 ± .007		

TABLE 11.- Concluded

(f) Angle of scatter of 60°

Energy, MeV	Cross section mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.4 ± .6	.000 ± .000	94.1 ± 1.7	.214 ± .019	283.6 ± 10.5	.022 ± .002
49.0 ± .6	.428 ± .034	95.9 ± 1.8	.213 ± .019	294.5 ± 11.2	.018 ± .001
49.6 ± .6	.391 ± .031	97.8 ± 1.8	.198 ± .017	306.2 ± 12.0	.014 ± .001
50.3 ± .6	.332 ± .027	99.7 ± 1.9	.206 ± .018	318.6 ± 12.9	.012 ± .001
51.0 ± .6	.319 ± .026	101.6 ± 1.9	.202 ± .017	332.0 ± 13.8	.009 ± .000
51.7 ± .6	.287 ± .024	103.6 ± 2.0	.207 ± .018	346.4 ± 14.9	.006 ± .000
52.4 ± .7	.314 ± .026	105.7 ± 2.1	.204 ± .018	361.9 ± 16.1	.004 ± .000
53.1 ± .7	.293 ± .025	107.9 ± 2.1	.193 ± .017	378.6 ± 17.4	.003 ± .000
53.8 ± .7	.310 ± .026	110.1 ± 2.2	.208 ± .018	396.8 ± 18.9	.002 ± .000
54.6 ± .7	.254 ± .021	112.4 ± 2.3	.197 ± .017	416.5 ± 20.6	.001 ± .000
55.3 ± .7	.274 ± .023	114.8 ± 2.4	.191 ± .017	438.1 ± 22.5	.001 ± .000
56.1 ± .7	.292 ± .025	117.2 ± 2.4	.186 ± .016	461.7 ± 24.7	.001 ± .000
56.9 ± .8	.275 ± .023	119.8 ± 2.5	.174 ± .015	487.7 ± 27.3	.001 ± .000
57.7 ± .8	.240 ± .020	122.4 ± 2.6	.176 ± .015	516.5 ± 30.3	.001 ± .000
58.6 ± .8	.274 ± .024	125.1 ± 2.7	.171 ± .015	548.6 ± 33.9	.001 ± .000
59.4 ± .8	.247 ± .021	127.9 ± 2.8	.172 ± .015	584.5 ± 38.1	.001 ± .000
60.3 ± .8	.234 ± .020	130.9 ± 2.9	.171 ± .014	625.1 ± 43.2	.001 ± .000
61.2 ± .9	.232 ± .020	133.9 ± 3.0	.158 ± .013	671.2 ± 49.4	.001 ± .000
62.1 ± .9	.273 ± .024	137.0 ± 3.2	.159 ± .013		
63.0 ± .9	.251 ± .022	140.3 ± 3.3	.160 ± .013		
64.0 ± .9	.253 ± .022	143.7 ± 3.4	.152 ± .013		
65.0 ± .9	.235 ± .020	147.2 ± 3.5	.145 ± .012		
66.0 ± 1.0	.265 ± .023	150.9 ± 3.7	.140 ± .012		
67.0 ± 1.0	.251 ± .022	154.7 ± 3.8	.137 ± .011		
68.0 ± 1.0	.255 ± .022	158.6 ± 4.0	.128 ± .010		
69.1 ± 1.0	.246 ± .022	162.8 ± 4.2	.120 ± .010		
70.2 ± 1.1	.222 ± .020	167.1 ± 4.4	.117 ± .010		
71.3 ± 1.1	.229 ± .020	171.6 ± 4.6	.101 ± .008		
72.5 ± 1.1	.262 ± .023	176.3 ± 4.8	.101 ± .008		
73.7 ± 1.2	.250 ± .022	181.2 ± 5.0	.095 ± .008		
74.9 ± 1.2	.245 ± .021	186.4 ± 5.2	.088 ± .007		
76.2 ± 1.2	.238 ± .021	191.7 ± 5.5	.081 ± .007		
77.4 ± 1.3	.239 ± .021	197.4 ± 5.7	.075 ± .006		
78.8 ± 1.3	.220 ± .019	203.3 ± 6.0	.070 ± .006		
80.1 ± 1.3	.220 ± .019	209.5 ± 6.3	.062 ± .005		
81.5 ± 1.4	.216 ± .019	216.1 ± 6.7	.058 ± .005		
82.9 ± 1.4	.227 ± .020	223.0 ± 7.0	.054 ± .004		
84.4 ± 1.4	.235 ± .021	230.2 ± 7.4	.048 ± .004		
85.9 ± 1.5	.223 ± .020	237.9 ± 7.8	.041 ± .003		
87.5 ± 1.5	.214 ± .019	246.0 ± 8.3	.037 ± .003		
89.1 ± 1.6	.226 ± .020	254.6 ± 8.8	.031 ± .002		
90.7 ± 1.6	.207 ± .018	263.7 ± 9.3	.028 ± .002		
92.4 ± 1.7	.219 ± .019	273.3 ± 9.9	.024 ± .002		

TABLE 12.- DOUBLE DIFFERENTIAL CROSS SECTIONS FOR PRODUCTION OF SECONDARY PROTONS FROM ALUMINUM TARGET, 1.82 g/cm^2 THICK

[Incident proton energy, 558 MeV]

(a) Angle of scatter of 10^o

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
47.9 ± .6	.000 ± .000	93.1 ± 1.7	.648 + .057	279.5 ± 10.3	.450 ± .040
48.5 ± .6	1.205 ± .095	94.9 + 1.7	.595 ± .053	290.2 ± 11.0	.439 ± .040
49.2 ± .6	.982 + .079	96.7 + 1.8	.628 ± .055	301.6 ± 11.8	.427 ± .039
49.8 ± .6	.959 ± .079	98.6 ± 1.9	.622 ± .055	313.8 ± 12.6	.411 ± .037
50.5 ± .6	.746 ± .062	100.5 ± 1.9	.620 ± .054	326.9 ± 13.5	.389 ± .035
51.2 ± .6	.708 ± .059	102.5 ± 2.0	.621 ± .055	340.9 ± 14.5	.379 ± .035
51.9 ± .7	.770 ± .065	104.6 ± 2.0	.599 ± .053	356.1 ± 15.7	.359 ± .033
52.6 ± .7	.656 ± .056	106.7 ± 2.1	.602 ± .053	372.4 ± 16.9	.339 ± .031
53.3 ± .7	.667 ± .057	108.9 ± 2.2	.598 ± .053	390.1 ± 18.4	.375 ± .035
54.0 ± .7	.689 ± .059	111.2 ± 2.3	.599 ± .053	409.3 ± 20.0	.360 ± .034
54.8 ± .7	.569 ± .049	113.5 ± 2.3	.642 ± .057	430.3 ± 21.9	.320 ± .030
55.6 ± .7	.685 ± .059	115.9 ± 2.4	.635 ± .056	453.3 ± 24.0	.359 ± .034
56.3 ± .7	.606 ± .052	118.4 + 2.5	.610 ± .053	478.5 ± 26.5	.607 ± .058
57.2 ± .8	.662 ± .057	121.0 ± 2.6	.581 ± .050	506.5 ± 29.4	1.453 ± .142
58.0 ± .8	.590 ± .052	123.7 ± 2.7	.564 ± .049	537.5 ± 32.7	3.296 ± .328
58.8 ± .8	.677 ± .060	126.5 ± 2.8	.562 ± .049	572.2 ± 36.8	1.951 ± .198
59.7 ± .8	.672 ± .060	129.4 ± 2.9	.587 ± .049	611.3 ± 41.6	.171 ± .017
60.6 ± .8	.666 ± .059	132.3 ± 3.0	.599 ± .050	655.7 ± 47.4	.060 ± .006
61.5 ± .9	.670 ± .059	135.4 ± 3.1	.589 ± .049		
62.4 ± .9	.699 ± .062	138.7 ± 3.2	.574 ± .048		
63.3 ± .9	.651 ± .057	142.0 ± 3.4	.562 ± .047		
64.3 ± .9	.670 ± .059	145.5 ± 3.5	.598 ± .050		
65.3 ± 1.0	.659 ± .058	149.1 ± 3.6	.598 ± .051		
66.3 ± 1.0	.672 ± .060	152.8 ± 3.8	.592 ± .050		
67.3 ± 1.0	.596 ± .053	156.7 ± 3.9	.568 ± .048		
68.4 ± 1.0	.577 ± .052	160.8 ± 4.1	.574 ± .049		
69.5 ± 1.1	.718 ± .065	165.1 ± 4.3	.590 ± .050		
70.6 ± 1.1	.650 ± .058	169.5 ± 4.5	.562 ± .048		
71.8 ± 1.1	.646 ± .058	174.1 ± 4.7	.567 ± .048		
72.9 ± 1.1	.705 ± .063	179.0 ± 4.9	.548 ± .047		
74.1 ± 1.2	.588 ± .052	184.0 ± 5.1	.511 ± .044		
75.4 ± 1.2	.678 ± .060	189.3 ± 5.4	.624 + .055		
76.6 ± 1.2	.648 ± .058	194.9 ± 5.6	.619 + .055		
77.9 ± 1.3	.682 ± .061	200.7 ± 5.9	.575 ± .051		
79.3 ± 1.3	.612 ± .055	206.8 ± 6.2	.550 ± .049		
80.7 ± 1.3	.655 ± .059	213.2 ± 6.5	.548 ± .049		
82.1 ± 1.4	.644 + .058	220.0 ± 6.9	.532 + .047		
83.5 ± 1.4	.677 ± .060	227.1 ± 7.3	.540 ± .048		
85.0 ± 1.5	.581 ± .052	234.7 + 7.7	.536 ± .048		
86.5 ± 1.5	.621 ± .056	242.6 ± 8.1	.533 ± .047		
88.1 ± 1.5	.640 ± .057	251.0 ± 8.6	.524 ± .047		
89.7 + 1.6	.591 ± .053	259.9 ± 9.1	.491 ± .044		
91.4 + 1.6	.584 + .052	269.4 ± 9.7	.476 ± .043		

TABLE 12.- Continued

(b) Angle of scatter of 20°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.0 ± .6	.000 ± .000	93.3 ± 1.7	.515 ± .045	278.9 ± 10.3	.298 ± .027
48.7 ± .6	.804 ± .063	95.0 ± 1.7	.568 ± .050	289.5 ± 10.9	.268 ± .024
49.3 ± .6	.946 ± .076	96.9 ± 1.8	.527 ± .046	300.9 ± 11.7	.279 ± .025
50.0 ± .6	.869 ± .071	98.7 ± 1.9	.581 ± .051	313.0 ± 12.5	.273 ± .025
50.6 ± .6	.807 ± .067	100.7 ± 1.9	.508 ± .044	326.0 ± 13.4	.277 ± .025
51.3 ± .6	.623 ± .052	102.7 ± 2.0	.574 ± .050	339.9 ± 14.4	.284 ± .026
52.0 ± .7	.670 ± .056	104.7 ± 2.0	.527 ± .046	354.9 ± 15.5	.322 ± .029
52.7 ± .7	.906 ± .077	106.8 ± 2.1	.556 ± .049	371.1 ± 16.8	.354 ± .033
53.4 ± .7	.591 ± .050	109.0 ± 2.2	.516 ± .046	388.6 ± 18.2	.419 ± .039
54.2 ± .7	.726 ± .062	111.3 ± 2.3	.536 ± .047	407.7 ± 19.8	.517 ± .048
54.9 ± .7	.611 ± .053	113.6 ± 2.3	.553 ± .049	428.4 ± 21.6	.682 ± .064
55.7 ± .7	.608 ± .052	116.1 ± 2.4	.535 ± .047	451.1 ± 23.7	.836 ± .079
56.5 ± .7	.690 ± .060	118.6 ± 2.5	.525 ± .046	476.1 ± 26.2	.949 ± .091
57.3 ± .8	.652 ± .057	121.1 ± 2.6	.513 ± .044	503.6 ± 29.0	.863 ± .084
58.1 ± .8	.584 ± .051	123.8 ± 2.7	.497 ± .043	534.2 ± 32.3	.576 ± .057
59.0 ± .8	.565 ± .050	126.6 ± 2.8	.503 ± .044	568.4 ± 36.2	.192 ± .019
59.8 ± .8	.677 ± .060	129.5 ± 2.9	.476 ± .040	606.9 ± 40.9	.035 ± .003
60.7 ± .8	.708 ± .063	132.4 ± 3.0	.488 ± .041	650.5 ± 46.6	.020 ± .002
61.6 ± .9	.617 ± .055	135.5 ± 3.1	.462 ± .039	700.4 ± 53.6	.014 ± .001
62.5 ± .9	.642 ± .057	138.7 ± 3.2	.474 ± .040		
63.5 ± .9	.696 ± .061	142.1 ± 3.3	.484 ± .041		
64.5 ± .9	.593 ± .052	145.5 ± 3.5	.486 ± .041		
65.4 ± 1.0	.663 ± .059	149.1 ± 3.6	.484 ± .041		
66.5 ± 1.0	.610 ± .054	152.9 ± 3.8	.487 ± .041		
67.5 ± 1.0	.558 ± .050	156.8 ± 3.9	.462 ± .039		
68.6 ± 1.0	.689 ± .062	160.8 ± 4.1	.447 ± .038		
69.7 ± 1.1	.642 ± .058	165.1 ± 4.3	.417 ± .035		
70.8 ± 1.1	.604 ± .054	169.5 ± 4.5	.400 ± .034		
71.9 ± 1.1	.630 ± .056	174.1 ± 4.7	.406 ± .035		
73.1 ± 1.1	.613 ± .055	178.9 ± 4.9	.401 ± .034		
74.3 ± 1.2	.647 ± .057	184.0 ± 5.1	.417 ± .036		
75.5 ± 1.2	.629 ± .056	189.2 ± 5.4	.377 ± .034		
76.8 ± 1.2	.626 ± .056	194.8 ± 5.6	.425 ± .038		
78.1 ± 1.3	.616 ± .055	200.6 ± 5.9	.389 ± .035		
79.4 ± 1.3	.582 ± .052	206.7 ± 6.2	.397 ± .035		
80.8 ± 1.3	.588 ± .053	213.1 ± 6.5	.401 ± .036		
82.2 ± 1.4	.561 ± .050	219.8 ± 6.9	.385 ± .034		
83.7 ± 1.4	.561 ± .050	226.9 ± 7.2	.364 ± .033		
85.2 ± 1.5	.601 ± .054	234.4 ± 7.6	.360 ± .032		
86.7 ± 1.5	.578 ± .052	242.3 ± 8.1	.341 ± .031		
88.3 ± 1.5	.565 ± .050	250.6 ± 8.6	.330 ± .030		
89.9 ± 1.6	.511 ± .045	259.5 ± 9.1	.314 ± .028		
91.6 ± 1.6	.583 ± .052	268.9 ± 9.6	.295 ± .027		

TABLE 12.- Continued

(c) Angle of scatter of 30°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
60.7 ± .8	.403 ± .036	132.4 ± 3.0	.423 ± .035	650.5 ±46.6	.004 ± .000
61.6 ± .9	.591 ± .052	135.5 ± 3.1	.402 ± .034	700.4 ±53.6	.003 ± .000
62.5 ± .9	.556 ± .049	138.7 ± 3.2	.422 ± .035		
63.5 ± .9	.550 ± .049	142.1 ± 3.3	.399 ± .033		
64.5 ± .9	.588 ± .052	145.5 ± 3.5	.425 ± .036		
65.4 ± 1.0	.541 ± .048	149.1 ± 3.6	.378 ± .032		
66.5 ± 1.0	.613 ± .055	152.9 ± 3.8	.375 ± .032		
67.5 ± 1.0	.511 ± .045	156.8 ± 3.9	.373 ± .031		
68.6 ± 1.0	.517 ± .046	160.8 ± 4.1	.356 ± .030		
69.7 ± 1.1	.572 ± .051	165.1 ± 4.3	.358 ± .030		
70.8 ± 1.1	.582 ± .052	169.5 ± 4.5	.352 ± .030		
71.9 ± 1.1	.557 ± .050	174.1 ± 4.7	.322 ± .027		
73.1 ± 1.1	.615 ± .055	178.9 ± 4.9	.328 ± .028		
74.3 ± 1.2	.572 ± .051	184.0 ± 5.1	.347 ± .030		
75.5 ± 1.2	.577 ± .051	189.2 ± 5.4	.340 ± .030		
76.8 ± 1.2	.562 ± .050	194.8 ± 5.6	.312 ± .028		
78.1 ± 1.3	.560 ± .050	200.6 ± 5.9	.319 ± .028		
79.4 ± 1.3	.485 ± .043	206.7 ± 6.2	.305 ± .027		
80.8 ± 1.3	.552 ± .049	213.1 ± 6.5	.289 ± .026		
82.2 ± 1.4	.534 ± .048	219.8 ± 6.9	.283 ± .025		
83.7 ± 1.4	.501 ± .045	226.9 ± 7.2	.283 ± .025		
85.2 ± 1.5	.543 ± .048	234.4 ± 7.6	.285 ± .025		
86.7 ± 1.5	.523 ± .047	242.3 ± 8.1	.282 ± .025		
88.3 ± 1.5	.515 ± .046	250.6 ± 8.6	.281 ± .025		
89.9 ± 1.6	.507 ± .046	259.5 ± 9.1	.270 ± .024		
91.6 ± 1.6	.536 ± .047	268.9 ± 9.6	.281 ± .025		
93.3 ± 1.7	.492 ± .041	278.9 ±10.3	.300 ± .027		
95.0 ± 1.7	.525 ± .043	289.5 ±10.9	.305 ± .027		
96.9 ± 1.8	.506 ± .041	300.9 ±11.7	.316 ± .028		
98.7 ± 1.9	.501 ± .041	313.0 ±12.5	.329 ± .030		
100.7 ± 1.9	.479 ± .040	326.0 ±13.4	.344 ± .031		
102.7 ± 2.0	.468 ± .040	339.9 ±14.4	.375 ± .034		
104.7 ± 2.0	.478 ± .042	354.9 ±15.5	.401 ± .037		
106.8 ± 2.1	.486 ± .043	371.1 ±16.8	.419 ± .038		
109.0 ± 2.2	.468 ± .041	388.6 ±18.2	.431 ± .040		
111.3 ± 2.3	.443 ± .039	407.7 ±19.8	.425 ± .039		
113.6 ± 2.3	.484 ± .043	428.4 ±21.6	.382 ± .036		
116.1 ± 2.4	.464 ± .041	451.1 ±23.7	.299 ± .028		
118.6 ± 2.5	.495 ± .043	476.1 ±26.2	.194 ± .018		
121.1 ± 2.6	.440 ± .038	503.6 ±29.0	.108 ± .010		
123.8 ± 2.7	.456 ± .040	534.2 ±32.3	.049 ± .005		
126.6 ± 2.8	.435 ± .038	568.4 ±36.2	.015 ± .001		
129.5 ± 2.9	.425 ± .035	606.9 ±40.9	.006 ± .000		

TABLE 12.- Continued

(d) Angle of scatter of 40°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.0 ± .6	.000 ± .000	93.3 ± 1.7	.496 ± .044	278.9 ± 10.3	.283 ± .025
48.7 ± .6	.934 ± .074	95.0 ± 1.7	.483 ± .043	289.5 ± 10.9	.275 ± .024
49.3 ± .6	.730 ± .059	96.9 ± 1.8	.465 ± .041	300.9 ± 11.7	.265 ± .023
50.0 ± .6	.685 ± .056	98.7 ± 1.9	.462 ± .041	313.0 ± 12.5	.249 ± .022
50.6 ± .6	.683 ± .057	100.7 ± 1.9	.463 ± .041	326.0 ± 13.4	.234 ± .021
51.3 ± .6	.620 ± .052	102.7 ± 2.0	.479 ± .042	339.9 ± 14.4	.212 ± .019
52.0 ± .7	.603 ± .051	104.7 ± 2.0	.466 ± .041	354.9 ± 15.5	.185 ± .017
52.7 ± .7	.641 ± .054	106.8 ± 2.1	.443 ± .039	371.1 ± 16.8	.154 ± .014
53.4 ± .7	.639 ± .055	109.0 ± 2.2	.456 ± .040	388.6 ± 18.2	.119 ± .011
54.2 ± .7	.598 ± .051	111.3 ± 2.3	.445 ± .038	407.7 ± 19.8	.088 ± .008
54.9 ± .7	.631 ± .054	113.6 ± 2.3	.439 ± .036	428.4 ± 21.6	.063 ± .006
55.7 ± .7	.609 ± .052	116.1 ± 2.4	.427 ± .034	451.1 ± 23.7	.038 ± .003
56.5 ± .7	.598 ± .051	118.6 ± 2.5	.428 ± .035	476.1 ± 26.2	.020 ± .002
57.3 ± .8	.594 ± .051	121.1 ± 2.6	.421 ± .035	503.6 ± 29.0	.008 ± .000
58.1 ± .8	.585 ± .051	123.8 ± 2.7	.413 ± .035	534.2 ± 32.3	.003 ± .000
59.0 ± .8	.609 ± .054	126.6 ± 2.8	.405 ± .035	568.4 ± 36.2	.002 ± .000
59.8 ± .8	.586 ± .052	129.5 ± 2.9	.400 ± .033	606.9 ± 40.9	.003 ± .000
60.7 ± .8	.596 ± .053	132.4 ± 3.0	.403 ± .034	650.5 ± 46.6	.002 ± .000
61.6 ± .9	.615 ± .055	135.5 ± 3.1	.390 ± .033	700.4 ± 53.6	.003 ± .000
62.5 ± .9	.566 ± .050	138.7 ± 3.2	.399 ± .033		
63.5 ± .9	.526 ± .046	142.1 ± 3.3	.402 ± .034		
64.5 ± .9	.513 ± .045	145.5 ± 3.5	.401 ± .034		
65.4 ± 1.0	.542 ± .048	149.1 ± 3.6	.389 ± .033		
66.5 ± 1.0	.515 ± .046	152.9 ± 3.8	.374 ± .031		
67.5 ± 1.0	.534 ± .047	156.8 ± 3.9	.365 ± .031		
68.6 ± 1.0	.554 ± .050	160.8 ± 4.1	.360 ± .030		
69.7 ± 1.1	.561 ± .050	165.1 ± 4.3	.349 ± .029		
70.8 ± 1.1	.555 ± .050	169.5 ± 4.5	.344 ± .029		
71.9 ± 1.1	.547 ± .049	174.1 ± 4.7	.345 ± .029		
73.1 ± 1.1	.570 ± .051	178.9 ± 4.9	.333 ± .028		
74.3 ± 1.2	.553 ± .049	184.0 ± 5.1	.333 ± .028		
75.5 ± 1.2	.554 ± .049	189.2 ± 5.4	.335 ± .029		
76.8 ± 1.2	.519 ± .046	194.8 ± 5.6	.339 ± .029		
78.1 ± 1.3	.518 ± .046	200.6 ± 5.9	.329 ± .028		
79.4 ± 1.3	.496 ± .044	206.7 ± 6.2	.328 ± .028		
80.8 ± 1.3	.510 ± .046	213.1 ± 6.5	.326 ± .028		
82.2 ± 1.4	.494 ± .044	219.8 ± 6.9	.310 ± .027		
83.7 ± 1.4	.507 ± .045	226.9 ± 7.2	.310 ± .027		
85.2 ± 1.5	.477 ± .043	234.4 ± 7.6	.299 ± .026		
86.7 ± 1.5	.497 ± .044	242.3 ± 8.1	.296 ± .026		
88.3 ± 1.5	.482 ± .043	250.6 ± 8.6	.286 ± .025		
89.9 ± 1.6	.476 ± .042	259.5 ± 9.1	.291 ± .026		
91.6 ± 1.6	.490 ± .043	268.9 ± 9.6	.282 ± .025		

TABLE 12.- Continued

(e) Angle of scatter of 50°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.4 ± .6	.000 ± .000	94.1 ± 1.7	.451 ± .040	283.6 ± 10.5	.122 ± .011
49.0 ± .6	.000 ± .000	95.9 ± 1.8	.446 ± .039	294.5 ± 11.2	.109 ± .009
49.6 ± .6	.772 ± .062	97.8 ± 1.8	.448 ± .039	306.2 ± 12.0	.093 ± .008
50.3 ± .6	.699 ± .057	99.7 ± 1.9	.440 ± .039	318.6 ± 12.9	.081 ± .007
51.0 ± .6	.684 ± .057	101.6 ± 1.9	.409 ± .036	332.0 ± 13.8	.070 ± .006
51.7 ± .6	.668 ± .056	103.6 ± 2.0	.416 ± .036	346.4 ± 14.9	.060 ± .005
52.4 ± .7	.630 ± .053	105.7 ± 2.1	.428 ± .038	361.9 ± 16.1	.045 ± .004
53.1 ± .7	.640 ± .054	107.9 ± 2.1	.423 ± .037	378.6 ± 17.4	.035 ± .003
53.8 ± .7	.599 ± .051	110.1 ± 2.2	.429 ± .038	396.8 ± 18.9	.026 ± .002
54.6 ± .7	.531 ± .045	112.4 ± 2.3	.429 ± .038	416.5 ± 20.6	.017 ± .001
55.3 ± .7	.585 ± .050	114.8 ± 2.4	.431 ± .038	438.1 ± 22.5	.010 ± .001
56.1 ± .7	.521 ± .045	117.2 ± 2.4	.413 ± .036	461.7 ± 24.7	.006 ± .000
56.9 ± .8	.530 ± .046	119.8 ± 2.5	.408 ± .036	487.7 ± 27.3	.003 ± .000
57.7 ± .8	.519 ± .045	122.4 ± 2.6	.393 ± .034	516.5 ± 30.3	.002 ± .000
58.6 ± .8	.548 ± .048	125.1 ± 2.7	.392 ± .034	548.6 ± 33.9	.002 ± .000
59.4 ± .8	.541 ± .048	127.9 ± 2.8	.384 ± .033	584.5 ± 38.1	.001 ± .000
60.3 ± .8	.550 ± .049	130.9 ± 2.9	.383 ± .032	625.1 ± 43.2	.002 ± .000
61.2 ± .9	.547 ± .048	133.9 ± 3.0	.366 ± .031	671.2 ± 49.4	.002 ± .000
62.1 ± .9	.514 ± .046	137.0 ± 3.2	.356 ± .030		
63.0 ± .9	.543 ± .048	140.3 ± 3.3	.350 ± .029		
64.0 ± .9	.518 ± .046	143.7 ± 3.4	.343 ± .029		
65.0 ± .9	.485 ± .043	147.2 ± 3.5	.347 ± .029		
66.0 ± 1.0	.508 ± .045	150.9 ± 3.7	.344 ± .029		
67.0 ± 1.0	.526 ± .047	154.7 ± 3.8	.338 ± .028		
68.0 ± 1.0	.489 ± .043	158.6 ± 4.0	.332 ± .028		
69.1 ± 1.0	.487 ± .044	162.8 ± 4.2	.323 ± .027		
70.2 ± 1.1	.516 ± .046	167.1 ± 4.4	.312 ± .026		
71.3 ± 1.1	.536 ± .048	171.6 ± 4.6	.308 ± .026		
72.5 ± 1.1	.520 ± .046	176.3 ± 4.8	.291 ± .025		
73.7 ± 1.2	.496 ± .044	181.2 ± 5.0	.284 ± .024		
74.9 ± 1.2	.503 ± .045	186.4 ± 5.2	.283 ± .024		
76.2 ± 1.2	.521 ± .046	191.7 ± 5.5	.274 ± .024		
77.4 ± 1.3	.502 ± .045	197.4 ± 5.7	.258 ± .022		
78.8 ± 1.3	.472 ± .042	203.3 ± 6.0	.249 ± .021		
80.1 ± 1.3	.462 ± .041	209.5 ± 6.3	.238 ± .021		
81.5 ± 1.4	.491 ± .044	216.1 ± 6.7	.232 ± .020		
82.9 ± 1.4	.444 ± .040	223.0 ± 7.0	.213 ± .018		
84.4 ± 1.4	.461 ± .041	230.2 ± 7.4	.206 ± .018		
85.9 ± 1.5	.458 ± .041	237.9 ± 7.8	.192 ± .017		
87.5 ± 1.5	.472 ± .042	246.0 ± 8.3	.179 ± .016		
89.1 ± 1.6	.475 ± .042	254.6 ± 8.8	.164 ± .014		
90.7 ± 1.6	.448 ± .040	263.7 ± 9.3	.155 ± .013		
92.4 ± 1.7	.463 ± .041	273.3 ± 9.9	.136 ± .012		

TABLE 12.- Concluded

(f) Angle of scatter of 60°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.4 ± .6	.000 ± .000	94.1 ± 1.7	.388 ± .034	283.6 ± 10.5	.040 ± .003
49.0 ± .6	.000 ± .000	95.9 ± 1.8	.385 ± .034	294.5 ± 11.2	.035 ± .003
49.6 ± .6	.730 ± .059	97.8 ± 1.8	.382 ± .033	306.2 ± 12.0	.027 ± .002
50.3 ± .6	.687 ± .056	99.7 ± 1.9	.361 ± .032	318.6 ± 12.9	.024 ± .002
51.0 ± .6	.655 ± .054	101.6 ± 1.9	.363 ± .032	332.0 ± 13.8	.018 ± .001
51.7 ± .6	.572 ± .048	103.6 ± 2.0	.364 ± .032	346.4 ± 14.9	.014 ± .001
52.4 ± .7	.576 ± .048	105.7 ± 2.1	.354 ± .031	361.9 ± 16.1	.011 ± .001
53.1 ± .7	.581 ± .049	107.9 ± 2.1	.353 ± .031	378.6 ± 17.4	.007 ± .000
53.8 ± .7	.596 ± .051	110.1 ± 2.2	.343 ± .030	396.8 ± 18.9	.005 ± .000
54.6 ± .7	.578 ± .049	112.4 ± 2.3	.342 ± .030	416.5 ± 20.6	.002 ± .000
55.3 ± .7	.553 ± .048	114.8 ± 2.4	.327 ± .029	438.1 ± 22.5	.002 ± .000
56.1 ± .7	.514 ± .044	117.2 ± 2.4	.330 ± .029	461.7 ± 24.7	.001 ± .000
56.9 ± .8	.517 ± .044	119.8 ± 2.5	.319 ± .028	487.7 ± 27.3	.001 ± .000
57.7 ± .8	.531 ± .046	122.4 ± 2.6	.318 ± .027	516.5 ± 30.3	.001 ± .000
58.6 ± .8	.515 ± .045	125.1 ± 2.7	.299 ± .026	548.6 ± 33.9	.001 ± .000
59.4 ± .8	.481 ± .042	127.9 ± 2.8	.315 ± .027	584.5 ± 38.1	.001 ± .000
60.3 ± .8	.527 ± .047	130.9 ± 2.9	.290 ± .024	625.1 ± 43.2	.001 ± .000
61.2 ± .9	.469 ± .042	133.9 ± 3.0	.283 ± .024	671.2 ± 49.4	.002 ± .000
62.1 ± .9	.479 ± .042	137.0 ± 3.2	.280 ± .023		
63.0 ± .9	.491 ± .043	140.3 ± 3.3	.271 ± .023		
64.0 ± .9	.485 ± .043	143.7 ± 3.4	.268 ± .022		
65.0 ± .9	.463 ± .041	147.2 ± 3.5	.259 ± .022		
66.0 ± 1.0	.465 ± .041	150.9 ± 3.7	.255 ± .021		
67.0 ± 1.0	.455 ± .040	154.7 ± 3.8	.239 ± .020		
68.0 ± 1.0	.445 ± .039	158.6 ± 4.0	.223 ± .019		
69.1 ± 1.0	.451 ± .040	162.8 ± 4.2	.213 ± .018		
70.2 ± 1.1	.448 ± .040	167.1 ± 4.4	.202 ± .017		
71.3 ± 1.1	.460 ± .041	171.6 ± 4.6	.190 ± .016		
72.5 ± 1.1	.470 ± .042	176.3 ± 4.8	.178 ± .015		
73.7 ± 1.2	.458 ± .041	181.2 ± 5.0	.171 ± .014		
74.9 ± 1.2	.466 ± .041	186.4 ± 5.2	.160 ± .013		
76.2 ± 1.2	.456 ± .040	191.7 ± 5.5	.149 ± .013		
77.4 ± 1.3	.462 ± .041	197.4 ± 5.7	.140 ± .012		
78.8 ± 1.3	.441 ± .039	203.3 ± 6.0	.130 ± .011		
80.1 ± 1.3	.425 ± .038	209.5 ± 6.3	.119 ± .010		
81.5 ± 1.4	.424 ± .038	216.1 ± 6.7	.111 ± .009		
82.9 ± 1.4	.407 ± .036	223.0 ± 7.0	.097 ± .008		
84.4 ± 1.4	.413 ± .037	230.2 ± 7.4	.088 ± .007		
85.9 ± 1.5	.417 ± .037	237.9 ± 7.8	.082 ± .007		
87.5 ± 1.5	.396 ± .035	246.0 ± 8.3	.071 ± .006		
89.1 ± 1.6	.404 ± .036	254.6 ± 8.8	.062 ± .005		
90.7 ± 1.6	.392 ± .035	263.7 ± 9.3	.053 ± .004		
92.4 ± 1.7	.393 ± .035	273.3 ± 9.9	.045 ± .004		

TABLE 13.- DOUBLE DIFFERENTIAL CROSS SECTIONS FOR PRODUCTION OF SECONDARY PROTONS FROM IRON TARGET, 3.77 g/cm^2 THICK

[Incident proton energy, 558 MeV]

(a) Angle of scatter of 10°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
47.9 ± .6	.000 ± .000	93.1 ± 1.7	1.005 ± .089	279.5 ± 10.3	.652 ± .058
48.5 ± .6	1.470 ± .116	94.9 ± 1.7	.984 ± .087	290.2 ± 11.0	.618 ± .056
49.2 ± .6	1.285 ± .104	96.7 ± 1.8	.961 ± .085	301.6 ± 11.8	.606 ± .055
49.8 ± .6	1.237 ± .102	98.6 ± 1.9	.927 ± .082	313.8 ± 12.6	.584 ± .053
50.5 ± .6	1.231 ± .103	100.5 ± 1.9	.989 ± .087	326.9 ± 13.5	.559 ± .051
51.2 ± .6	1.153 ± .097	102.5 ± 2.0	.974 ± .086	340.9 ± 14.5	.534 ± .049
51.9 ± .7	1.219 ± .103	104.6 ± 2.0	.962 ± .085	356.1 ± 15.7	.511 ± .047
52.6 ± .7	1.302 ± .111	106.7 ± 2.1	.957 ± .084	372.4 ± 16.9	.491 ± .045
53.3 ± .7	1.185 ± .102	108.9 ± 2.2	.956 ± .085	390.1 ± 18.4	.531 ± .049
54.0 ± .7	1.077 ± .092	111.2 ± 2.3	1.038 ± .092	409.3 ± 20.0	.540 ± .050
54.8 ± .7	1.116 ± .096	113.5 ± 2.3	1.028 ± .091	430.3 ± 21.9	.492 ± .046
55.6 ± .7	1.072 ± .093	115.9 ± 2.4	.936 ± .082	453.3 ± 24.0	.556 ± .053
56.3 ± .7	1.049 ± .091	118.4 ± 2.5	.947 ± .083	478.5 ± 26.5	.921 ± .089
57.2 ± .8	1.156 ± .101	121.0 ± 2.6	.976 ± .085	506.5 ± 29.4	2.059 ± .201
58.0 ± .8	1.011 ± .089	123.7 ± 2.7	.910 ± .079	537.5 ± 32.7	5.050 ± .502
58.8 ± .8	.986 ± .087	126.5 ± 2.8	.915 ± .080	572.2 ± 36.8	3.554 ± .360
59.7 ± .8	1.073 ± .095	129.4 ± 2.9	.892 ± .075	611.3 ± 41.6	.311 ± .032
60.6 ± .8	1.121 ± .100	132.3 ± 3.0	.914 ± .077	655.7 ± 47.4	.095 ± .010
61.5 ± .9	1.103 ± .098	135.4 ± 3.1	.906 ± .076		
62.4 ± .9	1.061 ± .094	138.7 ± 3.2	.928 ± .078		
63.3 ± .9	1.012 ± .090	142.0 ± 3.4	.927 ± .078		
64.3 ± .9	1.119 ± .099	145.5 ± 3.5	.912 ± .077		
65.3 ± 1.0	1.132 ± .100	149.1 ± 3.6	.888 ± .075		
66.3 ± 1.0	1.004 ± .090	152.8 ± 3.8	.947 ± .080		
67.3 ± 1.0	1.146 ± .102	156.7 ± 3.9	.891 ± .076		
68.4 ± 1.0	.975 ± .088	160.8 ± 4.1	.905 ± .077		
69.5 ± 1.1	1.088 ± .098	165.1 ± 4.3	.894 ± .076		
70.6 ± 1.1	1.051 ± .095	169.5 ± 4.5	.877 ± .075		
71.8 ± 1.1	.979 ± .088	174.1 ± 4.7	.841 ± .072		
72.9 ± 1.1	1.148 ± .103	179.0 ± 4.9	.838 ± .072		
74.1 ± 1.2	1.088 ± .097	184.0 ± 5.1	.764 ± .066		
75.4 ± 1.2	1.131 ± .101	189.3 ± 5.4	.879 ± .077		
76.6 ± 1.2	1.139 ± .102	194.9 ± 5.6	.887 ± .078		
77.9 ± 1.3	1.005 ± .090	200.7 ± 5.9	.848 ± .075		
79.3 ± 1.3	1.044 ± .094	206.8 ± 6.2	.806 ± .071		
80.7 ± 1.3	1.025 ± .092	213.2 ± 6.5	.830 ± .073		
82.1 ± 1.4	1.020 ± .092	220.0 ± 6.9	.810 ± .072		
83.5 ± 1.4	1.002 ± .090	227.1 ± 7.3	.792 ± .070		
85.0 ± 1.5	1.004 ± .090	234.7 ± 7.7	.791 ± .070		
86.5 ± 1.5	1.073 ± .096	242.6 ± 8.1	.768 ± .068		
88.1 ± 1.5	1.032 ± .092	251.0 ± 8.6	.744 ± .066		
89.7 ± 1.6	1.019 ± .091	259.9 ± 9.1	.724 ± .065		
91.4 ± 1.6	.963 ± .086	269.4 ± 9.7	.672 ± .060		

TABLE 13.- Continued

(b) Angle of scatter of 20°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.0 ± .6	.000 ± .000	93.3 ± 1.7	.887 ± .079	278.9 ± 10.3	.431 ± .039
48.7 ± .6	1.736 ± .137	95.0 ± 1.7	.890 ± .079	289.5 ± 10.9	.431 ± .039
49.3 ± .6	1.438 ± .116	96.9 ± 1.8	.899 ± .079	300.9 ± 11.7	.408 ± .037
50.0 ± .6	1.273 ± .105	98.7 ± 1.9	.855 ± .076	313.0 ± 12.5	.392 ± .035
50.6 ± .6	1.168 ± .097	100.7 ± 1.9	.858 ± .075	326.0 ± 13.4	.401 ± .036
51.3 ± .6	1.229 ± .103	102.7 ± 2.0	.861 ± .076	339.9 ± 14.4	.412 ± .037
52.0 ± .7	1.189 ± .100	104.7 ± 2.0	.866 ± .076	354.9 ± 15.5	.446 ± .041
52.7 ± .7	1.172 ± .100	106.8 ± 2.1	.826 ± .073	371.1 ± 16.8	.491 ± .045
53.4 ± .7	1.133 ± .097	109.0 ± 2.2	.872 ± .077	388.6 ± 18.2	.580 ± .054
54.2 ± .7	1.035 ± .089	111.3 ± 2.3	.864 ± .077	407.7 ± 19.8	.712 ± .066
54.9 ± .7	1.110 ± .096	113.6 ± 2.3	.883 ± .078	428.4 ± 21.6	.889 ± .084
55.7 ± .7	1.214 ± .105	116.1 ± 2.4	.875 ± .077	451.1 ± 23.7	1.091 ± .104
56.5 ± .7	1.195 ± .103	118.6 ± 2.5	.829 ± .073	476.1 ± 26.2	1.236 ± .119
57.3 ± .8	.956 ± .083	121.1 ± 2.6	.793 ± .069	503.6 ± 29.0	1.108 ± .108
58.1 ± .8	1.067 ± .094	123.8 ± 2.7	.823 ± .072	534.2 ± 32.3	.766 ± .076
59.0 ± .8	1.019 ± .090	126.6 ± 2.8	.786 ± .069	568.4 ± 36.2	.280 ± .028
59.8 ± .8	1.053 ± .094	129.5 ± 2.9	.763 ± .064	606.9 ± 40.9	.047 ± .005
60.7 ± .8	1.139 ± .101	132.4 ± 3.0	.781 ± .066	650.5 ± 46.6	.027 ± .003
61.6 ± .9	.971 ± .086	135.5 ± 3.1	.772 ± .065	700.4 ± 53.6	.019 ± .002
62.5 ± .9	1.068 ± .095	138.7 ± 3.2	.750 ± .063		
63.5 ± .9	1.168 ± .103	142.1 ± 3.3	.773 ± .065		
64.5 ± .9	1.005 ± .089	145.5 ± 3.5	.778 ± .066		
65.4 ± 1.0	.968 ± .086	149.1 ± 3.6	.743 ± .063		
66.5 ± 1.0	.933 ± .083	152.9 ± 3.8	.740 ± .063		
67.5 ± 1.0	1.018 ± .091	156.8 ± 3.9	.701 ± .059		
68.6 ± 1.0	1.032 ± .093	160.8 ± 4.1	.712 ± .061		
69.7 ± 1.1	1.067 ± .096	165.1 ± 4.3	.680 ± .058		
70.8 ± 1.1	1.067 ± .096	169.5 ± 4.5	.648 ± .055		
71.9 ± 1.1	1.058 ± .095	174.1 ± 4.7	.607 ± .052		
73.1 ± 1.1	1.097 ± .098	178.9 ± 4.9	.629 ± .054		
74.3 ± 1.2	1.090 ± .097	184.0 ± 5.1	.599 ± .051		
75.5 ± 1.2	1.028 ± .092	189.2 ± 5.4	.592 ± .052		
76.8 ± 1.2	1.071 ± .096	194.8 ± 5.6	.635 ± .056		
78.1 ± 1.3	.941 ± .085	200.6 ± 5.9	.622 ± .055		
79.4 ± 1.3	.951 ± .086	206.7 ± 6.2	.582 ± .051		
80.8 ± 1.3	.955 ± .086	213.1 ± 6.5	.594 ± .053		
82.2 ± 1.4	.954 ± .086	219.8 ± 6.9	.549 ± .049		
83.7 ± 1.4	.954 ± .085	226.9 ± 7.2	.567 ± .050		
85.2 ± 1.5	.974 ± .087	234.4 ± 7.6	.531 ± .047		
86.7 ± 1.5	.920 ± .082	242.3 ± 8.1	.511 ± .045		
88.3 ± 1.5	.931 ± .083	250.6 ± 8.6	.499 ± .045		
89.9 ± 1.6	1.012 ± .090	259.5 ± 9.1	.453 ± .040		
91.6 ± 1.6	.869 ± .078	268.9 ± 9.6	.445 ± .040		

TABLE 13.- Continued

(c) Angle of scatter of 30°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
60.7 ± .8	.751 ± .067	132.4 ± 3.0	.617 ± .052	650.5 ± 46.6	.005 ± .000
61.6 ± .9	.840 ± .075	135.5 ± 3.1	.589 ± .049	700.4 ± 53.6	.004 ± .000
62.5 ± .9	.893 ± .079	138.7 ± 3.2	.589 ± .049		
63.5 ± .9	.789 ± .070	142.1 ± 3.3	.590 ± .050		
64.5 ± .9	.872 ± .077	145.5 ± 3.5	.556 ± .047		
65.4 ± 1.0	.842 ± .075	149.1 ± 3.6	.550 ± .046		
66.5 ± 1.0	.861 ± .077	152.9 ± 3.8	.560 ± .047		
67.5 ± 1.0	.901 ± .080	156.8 ± 3.9	.541 ± .046		
68.6 ± 1.0	.864 ± .078	160.8 ± 4.1	.548 ± .047		
69.7 ± 1.1	.938 ± .084	165.1 ± 4.3	.488 ± .041		
70.8 ± 1.1	.873 ± .079	169.5 ± 4.5	.478 ± .041		
71.9 ± 1.1	.829 ± .074	174.1 ± 4.7	.459 ± .039		
73.1 ± 1.1	.921 ± .083	178.9 ± 4.9	.485 ± .041		
74.3 ± 1.2	.908 ± .081	184.0 ± 5.1	.444 ± .038		
75.5 ± 1.2	.903 ± .080	189.2 ± 5.4	.469 ± .042		
76.8 ± 1.2	.855 ± .077	194.8 ± 5.6	.459 ± .041		
78.1 ± 1.3	.797 ± .072	200.6 ± 5.9	.422 ± .038		
79.4 ± 1.3	.876 ± .079	206.7 ± 6.2	.412 ± .037		
80.8 ± 1.3	.764 ± .069	213.1 ± 6.5	.411 ± .037		
82.2 ± 1.4	.833 ± .075	219.8 ± 6.9	.401 ± .036		
83.7 ± 1.4	.785 ± .070	226.9 ± 7.2	.382 ± .034		
85.2 ± 1.5	.770 ± .069	234.4 ± 7.6	.385 ± .034		
86.7 ± 1.5	.753 ± .067	242.3 ± 8.1	.383 ± .034		
88.3 ± 1.5	.771 ± .069	250.6 ± 8.6	.382 ± .034		
89.9 ± 1.6	.765 ± .068	259.5 ± 9.1	.376 ± .034		
91.6 ± 1.6	.753 ± .067	268.9 ± 9.6	.374 ± .034		
93.3 ± 1.7	.760 ± .067	278.9 ± 10.3	.386 ± .035		
95.0 ± 1.7	.720 ± .064	289.5 ± 10.9	.399 ± .036		
96.9 ± 1.8	.721 ± .064	300.9 ± 11.7	.409 ± .037		
98.7 ± 1.9	.705 ± .062	313.0 ± 12.5	.411 ± .037		
100.7 ± 1.9	.725 ± .064	326.0 ± 13.4	.457 ± .042		
102.7 ± 2.0	.716 ± .063	339.9 ± 14.4	.486 ± .044		
104.7 ± 2.0	.719 ± .063	354.9 ± 15.5	.510 ± .047		
106.8 ± 2.1	.729 ± .064	371.1 ± 16.8	.532 ± .049		
109.0 ± 2.2	.707 ± .063	388.6 ± 18.2	.546 ± .051		
111.3 ± 2.3	.675 ± .060	407.7 ± 19.8	.513 ± .048		
113.6 ± 2.3	.684 ± .060	428.4 ± 21.6	.463 ± .043		
116.1 ± 2.4	.659 ± .058	451.1 ± 23.7	.362 ± .034		
118.6 ± 2.5	.684 ± .060	476.1 ± 26.2	.255 ± .024		
121.1 ± 2.6	.629 ± .055	503.6 ± 29.0	.141 ± .014		
123.8 ± 2.7	.654 ± .057	534.2 ± 32.3	.059 ± .006		
126.6 ± 2.8	.565 ± .049	568.4 ± 36.2	.015 ± .001		
129.5 ± 2.9	.620 ± .052	606.9 ± 40.9	.007 ± .000		

TABLE 13.- Continued

(d) Angle of scatter of 40°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.4 ± .6	.000 ± .000	94.1 ± 1.7	.759 ± .067	283.6 ± 10.5	.395 ± .035
49.0 ± .6	1.372 ± .109	95.9 ± 1.8	.737 ± .065	294.5 ± 11.2	.388 ± .034
49.6 ± .6	1.183 ± .095	97.8 ± 1.8	.733 ± .065	306.2 ± 12.0	.365 ± .033
50.3 ± .6	1.070 ± .088	99.7 ± 1.9	.703 ± .062	318.6 ± 12.9	.343 ± .031
51.0 ± .6	1.118 ± .093	101.6 ± 1.9	.721 ± .063	332.0 ± 13.8	.318 ± .029
51.7 ± .6	1.066 ± .089	103.6 ± 2.0	.702 ± .062	346.4 ± 14.9	.287 ± .026
52.4 ± .7	1.036 ± .087	105.7 ± 2.1	.693 ± .061	361.9 ± 16.1	.253 ± .023
53.1 ± .7	1.015 ± .086	107.9 ± 2.1	.700 ± .062	378.6 ± 17.4	.208 ± .019
53.8 ± .7	.957 ± .082	110.1 ± 2.2	.691 ± .061	396.8 ± 18.9	.162 ± .015
54.6 ± .7	.900 ± .077	112.4 ± 2.3	.678 ± .060	416.5 ± 20.6	.119 ± .011
55.3 ± .7	.944 ± .081	114.8 ± 2.4	.667 ± .059	438.1 ± 22.5	.082 ± .007
56.1 ± .7	.896 ± .077	117.2 ± 2.4	.675 ± .059	461.7 ± 24.7	.048 ± .004
56.9 ± .8	.924 ± .080	119.8 ± 2.5	.659 ± .058	487.7 ± 27.3	.024 ± .002
57.7 ± .8	.897 ± .078	122.4 ± 2.6	.646 ± .056	516.5 ± 30.3	.009 ± .001
58.6 ± .8	.953 ± .083	125.1 ± 2.7	.621 ± .054	548.6 ± 33.9	.004 ± .000
59.4 ± .8	.894 ± .079	127.9 ± 2.8	.638 ± .056	584.5 ± 38.1	.003 ± .000
60.3 ± .8	.875 ± .078	130.9 ± 2.9	.618 ± .052	625.1 ± 43.2	.003 ± .000
61.2 ± .9	.879 ± .078	133.9 ± 3.0	.610 ± .051	671.2 ± 49.4	.003 ± .000
62.1 ± .9	.865 ± .077	137.0 ± 3.2	.594 ± .050		
63.0 ± .9	.892 ± .079	140.3 ± 3.3	.599 ± .050		
64.0 ± .9	.921 ± .081	143.7 ± 3.4	.617 ± .052		
65.0 ± .9	.843 ± .075	147.2 ± 3.5	.585 ± .049		
66.0 ± 1.0	.863 ± .076	150.9 ± 3.7	.576 ± .049		
67.0 ± 1.0	.815 ± .073	154.7 ± 3.8	.566 ± .048		
68.0 ± 1.0	.849 ± .076	158.6 ± 4.0	.542 ± .046		
69.1 ± 1.0	.837 ± .075	162.8 ± 4.2	.535 ± .045		
70.2 ± 1.1	.805 ± .072	167.1 ± 4.4	.530 ± .045		
71.3 ± 1.1	.827 ± .074	171.6 ± 4.6	.521 ± .044		
72.5 ± 1.1	.822 ± .074	176.3 ± 4.8	.501 ± .043		
73.7 ± 1.2	.868 ± .078	181.2 ± 5.0	.493 ± .042		
74.9 ± 1.2	.842 ± .075	186.4 ± 5.2	.485 ± .042		
76.2 ± 1.2	.849 ± .076	191.7 ± 5.5	.478 ± .041		
77.4 ± 1.3	.861 ± .077	197.4 ± 5.7	.482 ± .042		
78.8 ± 1.3	.810 ± .073	203.3 ± 6.0	.467 ± .041		
80.1 ± 1.3	.779 ± .070	209.5 ± 6.3	.452 ± .039		
81.5 ± 1.4	.821 ± .074	216.1 ± 6.7	.460 ± .040		
82.9 ± 1.4	.773 ± .070	223.0 ± 7.0	.440 ± .038		
84.4 ± 1.4	.801 ± .072	230.2 ± 7.4	.443 ± .039		
85.9 ± 1.5	.788 ± .071	237.9 ± 7.8	.430 ± .038		
87.5 ± 1.5	.770 ± .069	246.0 ± 8.3	.431 ± .038		
89.1 ± 1.6	.803 ± .071	254.6 ± 8.8	.413 ± .036		
90.7 ± 1.6	.769 ± .069	263.7 ± 9.3	.409 ± .036		
92.4 ± 1.7	.748 ± .067	273.3 ± 9.9	.389 ± .034		

TABLE 13.- Continued

(e) Angle of scatter of 50°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.4 ± .6	.000 ± .000	94.1 ± 1.7	.737 ± .065	283.6 ± 10.5	.182 ± .016
49.0 ± .6	1.526 ± .121	95.9 ± 1.8	.725 ± .064	294.5 ± 11.2	.168 ± .015
49.6 ± .6	1.243 ± .100	97.8 ± 1.8	.709 ± .063	306.2 ± 12.0	.145 ± .013
50.3 ± .6	1.135 ± .093	99.7 ± 1.9	.690 ± .061	318.6 ± 12.9	.122 ± .011
51.0 ± .6	1.109 ± .092	101.6 ± 1.9	.672 ± .059	332.0 ± 13.8	.105 ± .009
51.7 ± .6	.960 ± .080	103.6 ± 2.0	.665 ± .058	346.4 ± 14.9	.089 ± .008
52.4 ± .7	1.025 ± .086	105.7 ± 2.1	.686 ± .060	361.9 ± 16.1	.067 ± .006
53.1 ± .7	.989 ± .084	107.9 ± 2.1	.675 ± .059	378.6 ± 17.4	.053 ± .004
53.8 ± .7	.849 ± .073	110.1 ± 2.2	.668 ± .059	396.8 ± 18.9	.037 ± .003
54.6 ± .7	.871 ± .075	112.4 ± 2.3	.682 ± .061	416.5 ± 20.6	.025 ± .002
55.3 ± .7	.853 ± .074	114.8 ± 2.4	.661 ± .058	438.1 ± 22.5	.015 ± .001
56.1 ± .7	.852 ± .073	117.2 ± 2.4	.649 ± .057	461.7 ± 24.7	.008 ± .000
56.9 ± .8	.856 ± .074	119.8 ± 2.5	.640 ± .056	487.7 ± 27.3	.004 ± .000
57.7 ± .8	.839 ± .073	122.4 ± 2.6	.605 ± .053	516.5 ± 30.3	.003 ± .000
58.6 ± .8	.773 ± .068	125.1 ± 2.7	.608 ± .053	548.6 ± 33.9	.002 ± .000
59.4 ± .8	.871 ± .077	127.9 ± 2.8	.580 ± .051	584.5 ± 38.1	.002 ± .000
60.3 ± .8	.864 ± .077	130.9 ± 2.9	.587 ± .049	625.1 ± 43.2	.003 ± .000
61.2 ± .9	.855 ± .076	133.9 ± 3.0	.573 ± .048	671.2 ± 49.4	.003 ± .000
62.1 ± .9	.804 ± .072	137.0 ± 3.2	.558 ± .047		
63.0 ± .9	.831 ± .073	140.3 ± 3.3	.557 ± .047		
64.0 ± .9	.816 ± .072	143.7 ± 3.4	.559 ± .047		
65.0 ± .9	.826 ± .073	147.2 ± 3.5	.556 ± .047		
66.0 ± 1.0	.805 ± .071	150.9 ± 3.7	.537 ± .045		
67.0 ± 1.0	.805 ± .072	154.7 ± 3.8	.506 ± .043		
68.0 ± 1.0	.811 ± .072	158.6 ± 4.0	.506 ± .043		
69.1 ± 1.0	.781 ± .070	162.8 ± 4.2	.485 ± .041		
70.2 ± 1.1	.798 ± .072	167.1 ± 4.4	.475 ± .040		
71.3 ± 1.1	.788 ± .071	171.6 ± 4.6	.476 ± .041		
72.5 ± 1.1	.827 ± .074	176.3 ± 4.8	.445 ± .038		
73.7 ± 1.2	.835 ± .075	181.2 ± 5.0	.438 ± .037		
74.9 ± 1.2	.788 ± .070	186.4 ± 5.2	.416 ± .036		
76.2 ± 1.2	.779 ± .069	191.7 ± 5.5	.403 ± .035		
77.4 ± 1.3	.765 ± .069	197.4 ± 5.7	.390 ± .034		
78.8 ± 1.3	.758 ± .068	203.3 ± 6.0	.373 ± .032		
80.1 ± 1.3	.755 ± .068	209.5 ± 6.3	.356 ± .031		
81.5 ± 1.4	.774 ± .070	216.1 ± 6.7	.352 ± .031		
82.9 ± 1.4	.763 ± .069	223.0 ± 7.0	.322 ± .028		
84.4 ± 1.4	.722 ± .065	230.2 ± 7.4	.311 ± .027		
85.9 ± 1.5	.742 ± .066	237.9 ± 7.8	.287 ± .025		
87.5 ± 1.5	.756 ± .068	246.0 ± 8.3	.267 ± .023		
89.1 ± 1.6	.725 ± .065	254.6 ± 8.8	.253 ± .022		
90.7 ± 1.6	.751 ± .067	263.7 ± 9.3	.230 ± .020		
92.4 ± 1.7	.743 ± .066	273.3 ± 9.9	.200 ± .018		

TABLE 13.- Concluded

(f) Angle of scatter of 60°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.4 ± .6	.000 ± .000	94.1 ± 1.7	.599 ± .053	283.6 ± 10.5	.065 ± .005
49.0 ± .6	1.078 ± .085	95.9 ± 1.8	.596 ± .053	294.5 ± 11.2	.053 ± .004
49.6 ± .6	.978 ± .079	97.8 ± 1.8	.563 ± .050	306.2 ± 12.0	.046 ± .004
50.3 ± .6	.917 ± .075	99.7 ± 1.9	.583 ± .051	318.6 ± 12.9	.037 ± .003
51.0 ± .6	.926 ± .077	101.6 ± 1.9	.544 ± .048	332.0 ± 13.8	.030 ± .002
51.7 ± .6	.856 ± .072	103.6 ± 2.0	.542 ± .048	346.4 ± 14.9	.023 ± .002
52.4 ± .7	.831 ± .070	105.7 ± 2.1	.549 ± .048	361.9 ± 16.1	.017 ± .001
53.1 ± .7	.858 ± .073	107.9 ± 2.1	.531 ± .047	378.6 ± 17.4	.011 ± .001
53.8 ± .7	.823 ± .070	110.1 ± 2.2	.546 ± .048	396.8 ± 18.9	.008 ± .000
54.6 ± .7	.791 ± .068	112.4 ± 2.3	.532 ± .047	416.5 ± 20.6	.005 ± .000
55.3 ± .7	.761 ± .066	114.8 ± 2.4	.512 ± .045	438.1 ± 22.5	.003 ± .000
56.1 ± .7	.750 ± .065	117.2 ± 2.4	.493 ± .043	461.7 ± 24.7	.002 ± .000
56.9 ± .8	.814 ± .070	119.8 ± 2.5	.489 ± .043	487.7 ± 27.3	.002 ± .000
57.7 ± .8	.740 ± .064	122.4 ± 2.6	.470 ± .041	516.5 ± 30.3	.002 ± .000
58.6 ± .8	.765 ± .067	125.1 ± 2.7	.471 ± .041	548.6 ± 33.9	.002 ± .000
59.4 ± .8	.720 ± .063	127.9 ± 2.8	.467 ± .041	584.5 ± 38.1	.002 ± .000
60.3 ± .8	.763 ± .068	130.9 ± 2.9	.442 ± .037	625.1 ± 43.2	.002 ± .000
61.2 ± .9	.715 ± .064	133.9 ± 3.0	.437 ± .037	671.2 ± 49.4	.002 ± .000
62.1 ± .9	.732 ± .065	137.0 ± 3.2	.421 ± .035		
63.0 ± .9	.743 ± .066	140.3 ± 3.3	.416 ± .035		
64.0 ± .9	.743 ± .066	143.7 ± 3.4	.404 ± .034		
65.0 ± .9	.704 ± .062	147.2 ± 3.5	.386 ± .032		
66.0 ± 1.0	.696 ± .062	150.9 ± 3.7	.379 ± .032		
67.0 ± 1.0	.702 ± .063	154.7 ± 3.8	.361 ± .030		
68.0 ± 1.0	.696 ± .062	158.6 ± 4.0	.337 ± .028		
69.1 ± 1.0	.666 ± .060	162.8 ± 4.2	.318 ± .027		
70.2 ± 1.1	.715 ± .064	167.1 ± 4.4	.305 ± .026		
71.3 ± 1.1	.695 ± .062	171.6 ± 4.6	.292 ± .025		
72.5 ± 1.1	.712 ± .064	176.3 ± 4.8	.271 ± .023		
73.7 ± 1.2	.714 ± .064	181.2 ± 5.0	.258 ± .022		
74.9 ± 1.2	.686 ± .061	186.4 ± 5.2	.242 ± .020		
76.2 ± 1.2	.693 ± .062	191.7 ± 5.5	.229 ± .020		
77.4 ± 1.3	.681 ± .061	197.4 ± 5.7	.209 ± .018		
78.8 ± 1.3	.660 ± .059	203.3 ± 6.0	.202 ± .017		
80.1 ± 1.3	.638 ± .058	209.5 ± 6.3	.182 ± .016		
81.5 ± 1.4	.640 ± .058	216.1 ± 6.7	.168 ± .014		
82.9 ± 1.4	.649 ± .058	223.0 ± 7.0	.155 ± .013		
84.4 ± 1.4	.643 ± .054	230.2 ± 7.4	.142 ± .012		
85.9 ± 1.5	.623 ± .051	237.9 ± 7.8	.126 ± .011		
87.5 ± 1.5	.633 ± .051	246.0 ± 8.3	.111 ± .009		
89.1 ± 1.6	.628 ± .052	254.6 ± 8.8	.098 ± .008		
90.7 ± 1.6	.607 ± .052	263.7 ± 9.3	.086 ± .007		
92.4 ± 1.7	.629 ± .055	273.3 ± 9.9	.073 ± .006		

TABLE 14.- DOUBLE DIFFERENTIAL CROSS SECTIONS FOR PRODUCTION OF SECONDARY PROTONS FROM COPPER TARGET, 2.79 g/cm^2 THICK

[Incident proton energy, 558 MeV]

(a) Angle of scatter of 10^{o}

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
47.9 ± .6	1.482 ± .116	93.1 ± 1.7	1.203 ± .107	279.5 ± 10.3	.714 ± .065
48.5 ± .6	1.678 ± .133	94.9 ± 1.7	1.148 ± .102	290.2 ± 11.0	.689 ± .063
49.2 ± .6	1.526 ± .123	96.7 ± 1.8	1.110 ± .098	301.6 ± 11.8	.696 ± .063
49.8 ± .6	1.351 ± .111	98.6 ± 1.9	1.111 ± .098	313.8 ± 12.6	.636 ± .058
50.5 ± .6	1.624 ± .135	100.5 ± 1.9	1.169 ± .103	326.9 ± 13.5	.622 ± .057
51.2 ± .6	1.244 ± .104	102.5 ± 2.0	1.146 ± .101	340.9 ± 14.5	.589 ± .054
51.9 ± .7	1.254 ± .106	104.6 ± 2.0	1.161 ± .102	356.1 ± 15.7	.556 ± .051
52.6 ± .7	1.093 ± .093	106.7 ± 2.1	1.120 ± .099	372.4 ± 16.9	.527 ± .049
53.3 ± .7	1.153 ± .099	108.9 ± 2.2	1.116 ± .099	390.1 ± 18.4	.594 ± .055
54.0 ± .7	1.301 ± .112	111.2 ± 2.3	1.099 ± .098	409.3 ± 20.0	.625 ± .059
54.8 ± .7	1.276 ± .110	113.5 ± 2.3	1.071 ± .095	430.3 ± 21.9	.546 ± .052
55.6 ± .7	1.147 ± .099	115.9 ± 2.4	1.106 ± .097	453.3 ± 24.0	.605 ± .058
56.3 ± .7	1.090 ± .094	118.4 ± 2.5	1.092 ± .096	478.5 ± 26.5	1.008 ± .097
57.2 ± .8	1.103 ± .096	121.0 ± 2.6	1.034 ± .090	506.5 ± 29.4	2.307 ± .226
58.0 ± .8	1.150 ± .101	123.7 ± 2.7	1.067 ± .093	537.5 ± 32.7	6.315 ± .628
58.8 ± .8	1.060 ± .094	126.5 ± 2.8	.988 ± .086	572.2 ± 36.8	4.622 ± .469
59.7 ± .8	1.058 ± .094	129.4 ± 2.9	.994 ± .083	611.3 ± 41.6	.373 ± .039
60.6 ± .8	1.143 ± .102	132.3 ± 3.0	.980 ± .082	655.7 ± 47.4	.112 ± .012
61.5 ± .9	1.133 ± .101	135.4 ± 3.1	.992 ± .084		
62.4 ± .9	1.259 ± .112	138.7 ± 3.2	1.051 ± .089		
63.3 ± .9	1.297 ± .115	142.0 ± 3.4	.961 ± .081		
64.3 ± .9	1.212 ± .107	145.5 ± 3.5	1.020 ± .086		
65.3 ± 1.0	1.270 ± .113	149.1 ± 3.6	1.070 ± .091		
66.3 ± 1.0	1.375 ± .123	152.8 ± 3.8	1.004 ± .085		
67.3 ± 1.0	1.111 ± .099	156.7 ± 3.9	.992 ± .084		
68.4 ± 1.0	1.183 ± .107	160.8 ± 4.1	.958 ± .082		
69.5 ± 1.1	1.202 ± .108	165.1 ± 4.3	.975 ± .083		
70.6 ± 1.1	1.209 ± .109	169.5 ± 4.5	1.008 ± .086		
71.8 ± 1.1	1.132 ± .101	174.1 ± 4.7	.968 ± .083		
72.9 ± 1.1	1.175 ± .105	179.0 ± 4.9	.947 ± .081		
74.1 ± 1.2	1.222 ± .109	184.0 ± 5.1	.872 ± .075		
75.4 ± 1.2	1.177 ± .105	189.3 ± 5.4	1.031 ± .092		
76.6 ± 1.2	1.297 ± .117	194.9 ± 5.6	.990 ± .088		
77.9 ± 1.3	1.168 ± .105	200.7 ± 5.9	.942 ± .084		
79.3 ± 1.3	1.116 ± .100	206.8 ± 6.2	.913 ± .082		
80.7 ± 1.3	1.191 ± .107	213.2 ± 6.5	.866 ± .078		
82.1 ± 1.4	1.144 ± .103	220.0 ± 6.9	.878 ± .079		
83.5 ± 1.4	1.130 ± .101	227.1 ± 7.3	.888 ± .080		
85.0 ± 1.5	1.123 ± .101	234.7 ± 7.7	.868 ± .078		
86.5 ± 1.5	1.148 ± .103	242.6 ± 8.1	.874 ± .078		
88.1 ± 1.5	1.169 ± .104	251.0 ± 8.6	.831 ± .075		
89.7 ± 1.6	1.189 ± .106	259.9 ± 9.1	.817 ± .074		
91.4 ± 1.6	1.045 ± .093	269.4 ± 9.7	.709 ± .064		

TABLE 14.- Continued

(b) Angle of scatter of 20°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.0 ± .6	1.534 ± .120	93.3 ± 1.7	1.076 ± .089	278.9 ± 10.3	.467 ± .042
48.7 ± .6	2.081 ± .165	95.0 ± 1.7	1.015 ± .086	289.5 ± 10.9	.449 ± .041
49.3 ± .6	1.509 ± .122	96.9 ± 1.8	1.020 ± .090	300.9 ± 11.7	.442 ± .040
50.0 ± .6	1.475 ± .121	98.7 ± 1.9	1.047 ± .093	313.0 ± 12.5	.415 ± .038
50.6 ± .6	1.304 ± .109	100.7 ± 1.9	.966 ± .086	326.0 ± 13.4	.429 ± .039
51.3 ± .6	1.322 ± .111	102.7 ± 2.0	1.029 ± .091	339.9 ± 14.4	.446 ± .041
52.0 ± .7	1.331 ± .112	104.7 ± 2.0	.995 ± .088	354.9 ± 15.5	.478 ± .044
52.7 ± .7	1.196 ± .102	106.8 ± 2.1	.968 ± .085	371.1 ± 16.8	.531 ± .049
53.4 ± .7	1.381 ± .118	109.0 ± 2.2	1.013 ± .090	388.6 ± 18.2	.610 ± .057
54.2 ± .7	1.282 ± .110	111.3 ± 2.3	.921 ± .082	407.7 ± 19.8	.761 ± .071
54.9 ± .7	1.211 ± .105	113.6 ± 2.3	.961 ± .085	428.4 ± 21.6	.936 ± .088
55.7 ± .7	1.244 ± .107	116.1 ± 2.4	.934 ± .082	451.1 ± 23.7	1.196 ± .114
56.5 ± .7	1.148 ± .099	118.6 ± 2.5	.934 ± .082	476.1 ± 26.2	1.367 ± .132
57.3 ± .8	1.185 ± .103	121.1 ± 2.6	.956 ± .083	503.6 ± 29.0	1.231 ± .120
58.1 ± .8	1.157 ± .101	123.8 ± 2.7	.853 ± .074	534.2 ± 32.3	.808 ± .080
59.0 ± .8	1.117 ± .099	126.6 ± 2.8	.896 ± .078	568.4 ± 36.2	.270 ± .027
59.8 ± .8	1.186 ± .106	129.5 ± 2.9	.882 ± .074	606.9 ± 40.9	.049 ± .005
60.7 ± .8	1.182 ± .105	132.4 ± 3.0	.842 ± .071	650.5 ± 46.6	.029 ± .003
61.6 ± .9	1.103 ± .098	135.5 ± 3.1	.872 ± .073	700.4 ± 53.6	.020 ± .002
62.5 ± .9	1.182 ± .105	138.7 ± 3.2	.870 ± .073		
63.5 ± .9	1.286 ± .114	142.1 ± 3.3	.825 ± .070		
64.5 ± .9	1.196 ± .106	145.5 ± 3.5	.841 ± .071		
65.4 ± 1.0	1.169 ± .104	149.1 ± 3.6	.850 ± .072		
66.5 ± 1.0	1.039 ± .093	152.9 ± 3.8	.838 ± .071		
67.5 ± 1.0	1.164 ± .104	156.8 ± 3.9	.789 ± .067		
68.6 ± 1.0	1.092 ± .098	160.8 ± 4.1	.784 ± .067		
69.7 ± 1.1	1.146 ± .103	165.1 ± 4.3	.749 ± .064		
70.8 ± 1.1	1.132 ± .102	169.5 ± 4.5	.719 ± .061		
71.9 ± 1.1	1.214 ± .109	174.1 ± 4.7	.711 ± .061		
73.1 ± 1.1	1.164 ± .104	178.9 ± 4.9	.713 ± .061		
74.3 ± 1.2	1.143 ± .102	184.0 ± 5.1	.668 ± .057		
75.5 ± 1.2	1.202 ± .107	189.2 ± 5.4	.709 ± .063		
76.8 ± 1.2	1.079 ± .097	194.8 ± 5.6	.676 ± .061		
78.1 ± 1.3	1.088 ± .098	200.6 ± 5.9	.690 ± .062		
79.4 ± 1.3	.994 ± .089	206.7 ± 6.2	.670 ± .060		
80.8 ± 1.3	.937 ± .084	213.1 ± 6.5	.635 ± .057		
82.2 ± 1.4	1.048 ± .094	219.8 ± 6.9	.632 ± .057		
83.7 ± 1.4	1.154 ± .105	226.9 ± 7.2	.596 ± .054		
85.2 ± 1.5	1.124 ± .102	234.4 ± 7.6	.588 ± .053		
86.7 ± 1.5	1.065 ± .094	242.3 ± 8.1	.568 ± .051		
88.3 ± 1.5	1.102 ± .093	250.6 ± 8.6	.529 ± .048		
89.9 ± 1.6	1.096 ± .090	259.5 ± 9.1	.538 ± .049		
91.6 ± 1.6	1.069 ± .086	268.9 ± 9.6	.479 ± .043		

TABLE 14.- Continued

(c) Angle of scatter of 30°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
68.6 ± 1.0	.834 ± .075	160.8 ± 4.1	.579 ± .049		
69.7 ± 1.1	1.139 ± .103	165.1 ± 4.3	.577 ± .049		
70.8 ± 1.1	1.080 ± .097	169.5 ± 4.5	.566 ± .048		
71.9 ± 1.1	1.039 ± .093	174.1 ± 4.7	.548 ± .047		
73.1 ± 1.1	1.024 ± .092	178.9 ± 4.9	.506 ± .043		
74.3 ± 1.2	1.165 ± .104	184.0 ± 5.1	.513 ± .044		
75.5 ± 1.2	1.052 ± .094	189.2 ± 5.4	.516 ± .047		
76.8 ± 1.2	1.003 ± .090	194.8 ± 5.6	.523 ± .047		
78.1 ± 1.3	1.006 ± .090	200.6 ± 5.9	.497 ± .045		
79.4 ± 1.3	1.001 ± .090	206.7 ± 6.2	.498 ± .045		
80.8 ± 1.3	.899 ± .081	213.1 ± 6.5	.465 ± .042		
82.2 ± 1.4	.898 ± .081	219.8 ± 6.9	.450 ± .041		
83.7 ± 1.4	.876 ± .078	226.9 ± 7.2	.440 ± .040		
85.2 ± 1.5	1.062 ± .095	234.4 ± 7.6	.437 ± .040		
86.7 ± 1.5	.863 ± .077	242.3 ± 8.1	.424 ± .038		
88.3 ± 1.5	.881 ± .079	250.6 ± 8.6	.415 ± .038		
89.9 ± 1.6	.917 ± .082	259.5 ± 9.1	.420 ± .038		
91.6 ± 1.6	.961 ± .086	268.9 ± 9.6	.413 ± .037		
93.3 ± 1.7	.904 ± .080	278.9 ± 10.3	.425 ± .039		
95.0 ± 1.7	.901 ± .080	289.5 ± 10.9	.429 ± .039		
96.9 ± 1.8	.885 ± .078	300.9 ± 11.7	.448 ± .041		
98.7 ± 1.9	.882 ± .078	313.0 ± 12.5	.460 ± .042		
100.7 ± 1.9	.835 ± .073	326.0 ± 13.4	.487 ± .044		
102.7 ± 2.0	.824 ± .072	339.9 ± 14.4	.511 ± .047		
104.7 ± 2.0	.771 ± .068	354.9 ± 15.5	.577 ± .053		
106.8 ± 2.1	.815 ± .072	371.1 ± 16.8	.596 ± .055		
109.0 ± 2.2	.801 ± .071	388.6 ± 18.2	.616 ± .057		
111.3 ± 2.3	.826 ± .073	407.7 ± 19.8	.617 ± .058		
113.6 ± 2.3	.791 ± .070	428.4 ± 21.6	.531 ± .050		
116.1 ± 2.4	.762 ± .067	451.1 ± 23.7	.426 ± .041		
118.6 ± 2.5	.765 ± .067	476.1 ± 26.2	.296 ± .028		
121.1 ± 2.6	.763 ± .066	503.6 ± 29.0	.171 ± .017		
123.8 ± 2.7	.748 ± .065	534.2 ± 32.3	.072 ± .007		
126.6 ± 2.8	.751 ± .066	568.4 ± 36.2	.020 ± .002		
129.5 ± 2.9	.709 ± .059	606.9 ± 40.9	.007 ± .001		
132.4 ± 3.0	.686 ± .058	650.5 ± 46.6	.006 ± .000		
135.5 ± 3.1	.725 ± .061	700.4 ± 53.6	.005 + .000		
138.7 + 3.2	.657 ± .055	758.2 ± 62.4	.005 ± .000		
142.1 ± 3.3	.675 ± .057	826.0 ± 73.8	.004 ± .000		
145.5 ± 3.5	.678 ± .057	906.8 ± 88.8	.005 + .000		
149.1 ± 3.6	.666 ± .056	1005.0 ±109.2	.005 + .000		
152.9 ± 3.8	.631 ± .053	1127.4 ±138.2	.006 ± .000		
156.8 ± 3.9	.647 ± .055	1285.1 ±182.0	.141 ± -.024		

TABLE 14.- Continued

(d) Angle of scatter of 40^{o}

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.4 ± .6	1.748 ± .137	94.1 ± 1.7	.868 ± .071	283.6 ± 10.5	.437 ± .039
49.0 ± .6	1.496 ± .118	95.9 ± 1.8	.826 ± .070	294.5 ± 11.2	.429 ± .038
49.6 ± .6	1.393 ± .112	97.8 ± 1.8	.814 ± .071	306.2 ± 12.0	.414 ± .037
50.3 ± .6	1.343 ± .110	99.7 ± 1.9	.828 ± .073	318.6 ± 12.9	.386 ± .035
51.0 ± .6	1.267 ± .106	101.6 ± 1.9	.835 ± .074	332.0 ± 13.8	.360 ± .032
51.7 ± .6	1.200 ± .101	103.6 ± 2.0	.815 ± .072	346.4 ± 14.9	.323 ± .029
52.4 ± .7	1.149 ± .097	105.7 ± 2.1	.809 ± .071	361.9 ± 16.1	.282 ± .026
53.1 ± .7	1.150 ± .098	107.9 ± 2.1	.794 ± .070	378.6 ± 17.4	.232 ± .021
53.8 ± .7	1.128 ± .097	110.1 ± 2.2	.774 ± .069	396.8 ± 18.9	.181 ± .017
54.6 ± .7	1.070 ± .092	112.4 ± 2.3	.786 ± .070	416.5 ± 20.6	.134 ± .012
55.3 ± .7	1.014 ± .088	114.8 ± 2.4	.787 ± .070	438.1 ± 22.5	.093 ± .008
56.1 ± .7	1.063 ± .092	117.2 ± 2.4	.749 ± .066	461.7 ± 24.7	.052 ± .005
56.9 ± .8	1.034 ± .089	119.8 ± 2.5	.736 ± .064	487.7 ± 27.3	.027 ± .002
57.7 ± .8	1.043 ± .091	122.4 ± 2.6	.750 ± .065	516.5 ± 30.3	.010 ± .001
58.6 ± .8	1.034 ± .091	125.1 ± 2.7	.730 ± .064	548.6 ± 33.9	.004 ± .000
59.4 ± .8	1.042 ± .092	127.9 ± 2.8	.705 ± .062	584.5 ± 38.1	.004 ± .000
60.3 ± .8	1.083 ± .096	130.9 ± 2.5	.707 ± .059	625.1 ± 43.2	.004 ± .000
61.2 ± .9	1.041 ± .093	133.9 ± 3.0	.703 ± .059	671.2 ± 49.4	.004 ± .000
62.1 ± .9	1.114 ± .099	137.0 ± 3.2	.694 ± .058		
63.0 ± .9	.975 ± .086	140.3 ± 3.3	.692 ± .058		
64.0 ± .9	1.025 ± .091	143.7 ± 3.4	.666 ± .056		
65.0 ± .9	.947 ± .084	147.2 ± 3.5	.666 ± .056		
66.0 ± 1.0	.988 ± .088	150.9 ± 3.7	.655 ± .055		
67.0 ± 1.0	1.006 ± .090	154.7 ± 3.8	.631 ± .053		
68.0 ± 1.0	1.016 ± .091	158.6 ± 4.0	.616 ± .052		
69.1 ± 1.0	.926 ± .083	162.8 ± 4.2	.604 ± .051		
70.2 ± 1.1	.982 ± .088	167.1 ± 4.4	.584 ± .050		
71.3 ± 1.1	.987 ± .089	171.6 ± 4.6	.581 ± .050		
72.5 ± 1.1	.946 ± .085	176.3 ± 4.8	.563 ± .049		
73.7 ± 1.2	.968 ± .087	181.2 ± 5.0	.543 ± .046		
74.9 ± 1.2	1.039 ± .093	186.4 ± 5.2	.543 ± .047		
76.2 ± 1.2	.973 ± .087	191.7 ± 5.5	.544 ± .047		
77.4 ± 1.3	.957 ± .086	197.4 ± 5.7	.520 ± .045		
78.8 ± 1.3	.890 ± .080	203.3 ± 6.0	.528 ± .046		
80.1 ± 1.3	.901 ± .081	209.5 ± 6.3	.524 ± .046		
81.5 ± 1.4	.877 ± .079	216.1 ± 6.7	.510 ± .045		
82.9 ± 1.4	.921 ± .083	223.0 ± 7.0	.498 ± .044		
84.4 ± 1.4	.885 ± .080	230.2 ± 7.4	.482 ± .042		
85.9 ± 1.5	.908 ± .082	237.9 ± 7.8	.468 ± .041		
87.5 ± 1.5	.872 ± .077	246.0 ± 8.3	.472 ± .042		
89.1 ± 1.6	.865 ± .073	254.6 ± 8.8	.455 ± .040		
90.7 ± 1.6	.869 ± .071	263.7 ± 9.3	.454 ± .040		
92.4 ± 1.7	.889 ± .072	273.3 ± 9.9	.448 ± .040		

TABLE 14.- Continued

(e) Angle of scatter of 50°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.4 ± .6	.000 ± .000	94.1 ± 1.7	.772 ± .068	283.6 ± 10.5	.212 ± .019
49.0 ± .6	1.620 ± .128	95.9 ± 1.8	.770 ± .068	294.5 ± 11.2	.185 ± .016
49.6 ± .6	1.356 ± .109	97.8 ± 1.8	.779 ± .069	306.2 ± 12.0	.163 ± .015
50.3 ± .6	1.345 ± .111	99.7 ± 1.9	.755 ± .067	318.6 ± 12.9	.142 ± .013
51.0 ± .6	1.222 ± .102	101.6 ± 1.9	.757 ± .066	332.0 ± 13.8	.121 ± .011
51.7 ± .6	1.155 ± .097	103.6 ± 2.0	.768 ± .068	346.4 ± 14.9	.101 ± .009
52.4 ± .7	1.151 ± .097	105.7 ± 2.1	.788 ± .069	361.9 ± 16.1	.083 ± .007
53.1 ± .7	1.066 ± .091	107.9 ± 2.1	.740 ± .065	378.6 ± 17.4	.061 ± .005
53.8 ± .7	1.090 ± .093	110.1 ± 2.2	.777 ± .069	396.8 ± 18.9	.044 ± .004
54.6 ± .7	1.098 ± .094	112.4 ± 2.3	.757 ± .067	416.5 ± 20.6	.027 ± .002
55.3 ± .7	.992 ± .086	114.8 ± 2.4	.741 ± .066	438.1 ± 22.5	.017 ± .001
56.1 ± .7	.980 ± .085	117.2 ± 2.4	.731 ± .064	461.7 ± 24.7	.009 ± .001
56.9 ± .8	.979 ± .085	119.8 ± 2.5	.705 ± .062	487.7 ± 27.3	.004 ± .000
57.7 ± .8	.907 ± .079	122.4 ± 2.6	.725 ± .063	516.5 ± 30.3	.003 ± .000
58.6 ± .8	.903 ± .079	125.1 ± 2.7	.690 ± .060	548.6 ± 33.9	.003 ± .000
59.4 ± .8	.993 ± .088	127.9 ± 2.8	.686 ± .060	584.5 ± 38.1	.002 ± .000
60.3 ± .8	.934 ± .083	130.9 ± 2.9	.654 ± .055	625.1 ± 43.2	.003 ± .000
61.2 ± .9	.967 ± .086	133.9 ± 3.0	.633 ± .053	671.2 ± 49.4	.003 ± .000
62.1 ± .9	.954 ± .085	137.0 ± 3.2	.646 ± .054		
63.0 ± .9	.919 ± .081	140.3 ± 3.3	.628 ± .053		
64.0 ± .9	.921 ± .081	143.7 ± 3.4	.621 ± .052		
65.0 ± .9	.949 ± .084	147.2 ± 3.5	.611 ± .052		
66.0 ± 1.0	.951 ± .084	150.9 ± 3.7	.607 ± .051		
67.0 ± 1.0	.940 ± .084	154.7 ± 3.8	.586 ± .050		
68.0 ± 1.0	.889 ± .079	158.6 ± 4.0	.576 ± .049		
69.1 ± 1.0	.873 ± .079	162.8 ± 4.2	.560 ± .048		
70.2 ± 1.1	.956 ± .086	167.1 ± 4.4	.521 ± .044		
71.3 ± 1.1	.894 ± .081	171.6 ± 4.6	.532 ± .045		
72.5 ± 1.1	.885 ± .079	176.3 ± 4.8	.507 ± .043		
73.7 ± 1.2	.975 ± .087	181.2 ± 5.0	.486 ± .042		
74.9 ± 1.2	.934 ± .083	186.4 ± 5.2	.470 ± .040		
76.2 ± 1.2	.937 ± .084	191.7 ± 5.5	.459 ± .040		
77.4 ± 1.3	.912 ± .082	197.4 ± 5.7	.438 ± .038		
78.8 ± 1.3	.859 ± .077	203.3 ± 6.0	.416 ± .036		
80.1 ± 1.3	.866 ± .078	209.5 ± 6.3	.400 ± .035		
81.5 ± 1.4	.864 ± .078	216.1 ± 6.7	.382 ± .033		
82.9 ± 1.4	.817 ± .073	223.0 ± 7.0	.369 ± .032		
84.4 ± 1.4	.858 ± .077	230.2 ± 7.4	.349 ± .031		
85.9 ± 1.5	.832 ± .074	237.9 ± 7.8	.329 ± .029		
87.5 ± 1.5	.833 ± .075	246.0 ± 8.3	.307 ± .027		
89.1 ± 1.6	.837 ± .075	254.6 ± 8.8	.281 ± .025		
90.7 ± 1.6	.839 ± .075	263.7 ± 9.3	.260 ± .023		
92.4 ± 1.7	.801 ± .071	273.3 ± 9.9	.227 ± .020		

TABLE 14.- Concluded

(f) Angle of scatter of 60^{o}

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.4 ± .6	.000 ± .000	94.1 ± 1.7	.692 ± .061	283.6 ± 10.5	.074 ± .006
49.0 ± .6	1.361 ± .108	95.9 ± 1.8	.703 + .062	294.5 ± 11.2	.061 ± .005
49.6 ± .6	1.210 ± .097	97.8 ± 1.8	.648 ± .057	306.2 ± 12.0	.050 ± .004
50.3 ± .6	1.044 ± .086	99.7 ± 1.9	.641 ± .057	318.6 ± 12.9	.044 ± .004
51.0 ± .6	.997 ± .083	101.6 ± 1.9	.664 ± .058	332.0 ± 13.8	.033 ± .003
51.7 ± .6	.978 ± .082	103.6 ± 2.0	.642 ± .056	346.4 ± 14.9	.027 ± .002
52.4 ± .7	.955 ± .081	105.7 ± 2.1	.637 ± .056	361.9 ± 16.1	.019 ± .001
53.1 ± .7	.929 ± .079	107.9 ± 2.1	.651 ± .057	378.6 ± 17.4	.012 ± .001
53.8 ± .7	.953 ± .082	110.1 ± 2.2	.644 ± .057	396.8 ± 18.9	.008 ± .000
54.6 ± .7	.907 ± .078	112.4 ± 2.3	.609 ± .054	416.5 ± 20.6	.004 ± .000
55.3 ± .7	.853 ± .074	114.8 ± 2.4	.611 ± .054	438.1 ± 22.5	.003 ± .000
56.1 ± .7	.860 ± .074	117.2 ± 2.4	.592 ± .052	461.7 ± 24.7	.002 ± .000
56.9 ± .8	.835 ± .072	119.8 ± 2.5	.564 ± .049	487.7 ± 27.3	.002 ± .000
57.7 ± .8	.906 ± .079	122.4 ± 2.6	.565 ± .049	516.5 ± 30.3	.002 ± .000
58.6 ± .8	.790 ± .069	125.1 ± 2.7	.544 ± .047	548.6 ± 33.9	.002 ± .000
59.4 ± .8	.849 ± .075	127.9 ± 2.8	.518 ± .045	584.5 ± 38.1	.002 ± .000
60.3 ± .8	.842 ± .075	130.9 ± 2.9	.527 ± .044	625.1 ± 43.2	.003 ± .000
61.2 ± .9	.827 ± .074	133.9 ± 3.0	.489 ± .041	671.2 ± 49.4	.003 ± .000
62.1 ± .9	.860 ± .077	137.0 ± 3.2	.485 ± .041		
63.0 ± .9	.852 ± .075	140.3 ± 3.3	.491 ± .041		
64.0 ± .9	.839 ± .074	143.7 ± 3.4	.486 ± .041		
65.0 ± .9	.829 ± .073	147.2 ± 3.5	.445 ± .037		
66.0 ± 1.0	.814 ± .072	150.9 ± 3.7	.438 ± .037		
67.0 ± 1.0	.809 ± .072	154.7 ± 3.8	.415 ± .035		
68.0 ± 1.0	.800 ± .071	158.6 ± 4.0	.402 ± .034		
69.1 ± 1.0	.820 ± .074	162.8 ± 4.2	.386 ± .033		
70.2 ± 1.1	.820 ± .074	167.1 ± 4.4	.352 ± .030		
71.3 ± 1.1	.835 ± .075	171.6 ± 4.6	.324 ± .027		
72.5 ± 1.1	.813 ± .073	176.3 ± 4.8	.315 ± .027		
73.7 ± 1.2	.822 ± .074	181.2 ± 5.0	.300 ± .026		
74.9 ± 1.2	.806 ± .072	186.4 ± 5.2	.286 ± .024		
76.2 ± 1.2	.786 ± .070	191.7 ± 5.5	.260 ± .022		
77.4 ± 1.3	.802 ± .072	197.4 + 5.7	.238 ± .021		
78.8 ± 1.3	.771 ± .069	203.3 ± 6.0	.230 ± .020		
80.1 ± 1.3	.754 ± .068	209.5 ± 6.3	.217 ± .019		
81.5 ± 1.4	.754 ± .068	216.1 ± 6.7	.196 ± .017		
82.9 ± 1.4	.758 ± .068	223.0 ± 7.0	.177 ± .015		
84.4 ± 1.4	.702 ± .063	230.2 ± 7.4	.162 + .014		
85.9 ± 1.5	.732 ± .065	237.9 ± 7.8	.141 ± .012		
87.5 ± 1.5	.769 ± .069	246.0 ± 8.3	.125 ± .011		
89.1 ± 1.6	.708 ± .063	254.6 ± 8.8	.111 ± .010		
90.7 ± 1.6	.723 ± .064	263.7 + 9.3	.095 ± .008		
92.4 ± 1.7	.720 ± .064	273.3 ± 9.9	.080 ± .007		

TABLE 15.- DOUBLE DIFFERENTIAL CROSS SECTIONS FOR PRODUCTION OF SECONDARY PROTONS FROM GERMANIUM TARGET, 5.26 g/cm^2 THICK

[Incident proton energy, 558 MeV]

(a) Angle of scatter of 10°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
47.9 ± .6	.000 ± .000	93.1 ± 1.7	1.056 ± .094	279.5 ± 10.3	.646 ± .058
48.5 ± .6	1.603 ± .127	94.9 ± 1.7	1.004 ± .089	290.2 ± 11.0	.617 ± .056
49.2 ± .6	1.494 ± .120	96.7 ± 1.8	1.006 ± .089	301.6 ± 11.8	.581 ± .053
49.8 ± .6	1.444 ± .119	98.6 ± 1.9	1.006 ± .089	313.8 ± 12.6	.595 ± .054
50.5 ± .6	1.543 ± .129	100.5 ± 1.9	.956 ± .084	326.9 ± 13.5	.557 ± .051
51.2 ± .6	1.402 ± .118	102.5 ± 2.0	1.010 ± .089	340.9 ± 14.5	.521 ± .048
51.9 ± .7	1.247 ± .105	104.6 ± 2.0	.972 ± .086	356.1 ± 15.7	.504 ± .046
52.6 ± .7	1.373 ± .117	106.7 ± 2.1	1.005 ± .089	372.4 ± 16.9	.488 ± .045
53.3 ± .7	1.366 ± .117	108.9 ± 2.2	1.033 ± .092	390.1 ± 18.4	.545 ± .051
54.0 ± .7	1.214 ± .104	111.2 ± 2.3	.956 ± .085	409.3 ± 20.0	.584 ± .055
54.8 ± .7	1.160 ± .100	113.5 ± 2.3	1.041 ± .092	430.3 ± 21.9	.519 ± .049
55.6 ± .7	1.288 ± .111	115.9 ± 2.4	.968 ± .085	453.3 ± 24.0	.564 ± .054
56.3 ± .7	1.190 ± .103	118.4 ± 2.5	.973 ± .085	478.5 ± 26.5	.929 ± .090
57.2 ± .8	1.280 ± .111	121.0 ± 2.6	.929 ± .081	506.5 ± 29.4	2.074 ± .203
58.0 ± .8	1.214 ± .107	123.7 ± 2.7	.942 ± .082	537.5 ± 32.7	6.026 ± .599
58.8 ± .8	1.271 ± .112	126.5 ± 2.8	.872 ± .076	572.2 ± 36.8	4.720 ± .479
59.7 ± .8	1.167 ± .104	129.4 ± 2.9	.953 ± .080	611.3 ± 41.6	.396 ± .041
60.6 ± .8	1.137 ± .101	132.3 ± 3.0	.911 ± .077	655.7 ± 47.4	.105 ± .011
61.5 ± .9	1.066 ± .095	135.4 ± 3.1	.897 ± .076		
62.4 ± .9	1.222 ± .108	138.7 ± 3.2	.926 ± .078		
63.3 ± .9	1.154 ± .102	142.0 ± 3.4	.918 ± .078		
64.3 ± .9	1.026 ± .091	145.5 ± 3.5	.947 ± .080		
65.3 ± 1.0	1.114 ± .099	149.1 ± 3.6	.950 ± .081		
66.3 ± 1.0	1.054 ± .094	152.8 ± 3.8	.939 ± .080		
67.3 ± 1.0	1.262 ± .113	156.7 ± 3.9	.870 ± .074		
68.4 ± 1.0	1.099 ± .099	160.8 ± 4.1	.899 ± .077		
69.5 ± 1.1	1.142 ± .103	165.1 ± 4.3	.890 ± .076		
70.6 ± 1.1	1.128 ± .102	169.5 ± 4.5	.879 ± .075		
71.8 ± 1.1	1.137 ± .102	174.1 ± 4.7	.875 ± .075		
72.9 ± 1.1	1.115 ± .100	179.0 ± 4.9	.822 ± .071		
74.1 ± 1.2	1.072 ± .095	184.0 ± 5.1	.770 ± .066		
75.4 ± 1.2	1.098 ± .098	189.3 ± 5.4	.870 ± .077		
76.6 ± 1.2	1.140 ± .102	194.9 ± 5.6	.915 ± .081		
77.9 ± 1.3	1.068 ± .096	200.7 ± 5.9	.842 ± .075		
79.3 ± 1.3	1.089 ± .098	206.8 ± 6.2	.772 ± .069		
80.7 ± 1.3	1.013 ± .091	213.2 ± 6.5	.786 ± .070		
82.1 ± 1.4	1.015 ± .091	220.0 ± 6.9	.801 ± .071		
83.5 ± 1.4	.967 ± .087	227.1 ± 7.3	.792 ± .070		
85.0 ± 1.5	.989 ± .089	234.7 ± 7.7	.766 ± .068		
86.5 ± 1.5	1.085 ± .097	242.6 ± 8.1	.766 ± .068		
88.1 ± 1.5	1.118 ± .100	251.0 ± 8.6	.734 ± .066		
89.7 ± 1.6	1.034 ± .092	259.9 ± 9.1	.700 ± .063		
91.4 ± 1.6	1.017 ± .091	269.4 ± 9.7	.658 ± .059		

TABLE 15.- Continued

(b) Angle of scatter of 20°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.0 ± .6	.000 ± .000	93.3 ± 1.7	1.011 ± .090	278.9 ± 10.3	.442 ± .040
48.7 ± .6	1.796 ± .142	95.0 ± 1.7	.987 ± .088	289.5 ± 10.9	.418 ± .038
49.3 ± .6	1.537 ± .124	96.9 ± 1.8	.946 ± .084	300.9 ± 11.7	.410 ± .037
50.0 ± .6	1.548 ± .127	98.7 ± 1.9	.933 ± .083	313.0 ± 12.5	.395 ± .036
50.6 ± .6	1.325 ± .110	100.7 ± 1.9	.922 ± .081	326.0 ± 13.4	.403 ± .037
51.3 ± .6	1.284 ± .108	102.7 ± 2.0	.935 ± .082	339.9 ± 14.4	.416 ± .038
52.0 ± .7	1.285 ± .109	104.7 ± 2.0	.928 ± .082	354.9 ± 15.5	.436 ± .040
52.7 ± .7	1.305 ± .111	106.8 ± 2.1	.898 ± .079	371.1 ± 16.8	.488 ± .045
53.4 ± .7	1.230 ± .105	109.0 ± 2.2	.877 ± .078	388.6 ± 18.2	.569 ± .053
54.2 ± .7	1.322 ± .113	111.3 ± 2.3	.933 ± .083	407.7 ± 19.8	.703 ± .066
54.9 ± .7	1.130 ± .098	113.6 ± 2.3	.867 ± .077	428.4 ± 21.6	.897 ± .084
55.7 ± .7	1.086 ± .094	116.1 ± 2.4	.890 ± .078	451.1 ± 23.7	1.090 ± .104
56.5 ± .7	1.163 ± .100	118.6 ± 2.5	.862 ± .075	476.1 ± 26.2	1.257 ± .121
57.3 ± .8	1.153 ± .100	121.1 ± 2.6	.859 ± .075	503.6 ± 29.0	1.113 ± .108
58.1 ± .8	1.084 ± .095	123.8 ± 2.7	.808 ± .070	534.2 ± 32.3	.738 ± .073
59.0 ± .8	1.220 ± .108	126.6 ± 2.8	.826 ± .072	568.4 ± 36.2	.246 ± .025
59.8 ± .8	1.154 ± .103	129.5 ± 2.9	.797 ± .067	606.9 ± 40.9	.046 ± .005
60.7 ± .8	1.054 ± .094	132.4 ± 3.0	.784 ± .066	650.5 ± 46.6	.027 ± .003
61.6 ± .9	1.173 ± .104	135.5 ± 3.1	.763 ± .064	700.4 ± 53.6	.018 ± .002
62.5 ± .9	1.151 ± .102	138.7 ± 3.2	.799 ± .067		
63.5 ± .9	1.168 ± .103	142.1 ± 3.3	.786 ± .066		
64.5 ± .9	1.105 ± .098	145.5 ± 3.5	.758 ± .064		
65.4 ± 1.0	1.033 ± .092	149.1 ± 3.6	.749 ± .063		
66.5 ± 1.0	1.128 ± .101	152.9 ± 3.8	.745 ± .063		
67.5 ± 1.0	1.097 ± .098	156.8 ± 3.9	.716 ± .061		
68.6 ± 1.0	1.045 ± .094	160.8 ± 4.1	.718 ± .061		
69.7 ± 1.1	1.078 ± .097	165.1 ± 4.3	.692 ± .059		
70.8 ± 1.1	1.082 ± .098	169.5 ± 4.5	.703 ± .060		
71.9 ± 1.1	1.114 ± .100	174.1 ± 4.7	.652 ± .056		
73.1 ± 1.1	1.091 ± .098	178.9 ± 4.9	.637 ± .055		
74.3 ± 1.2	1.091 ± .097	184.0 ± 5.1	.632 ± .054		
75.5 ± 1.2	1.200 ± .107	189.2 ± 5.4	.609 ± .054		
76.8 ± 1.2	1.116 ± .100	194.8 ± 5.6	.641 ± .057		
78.1 ± 1.3	1.009 ± .091	200.6 ± 5.9	.632 ± .056		
79.4 ± 1.3	1.096 ± .099	206.7 ± 6.2	.610 ± .054		
80.8 ± 1.3	1.099 ± .099	213.1 ± 6.5	.588 ± .052		
82.2 ± 1.4	.967 ± .087	219.8 ± 6.9	.576 ± .051		
83.7 ± 1.4	1.007 ± .090	226.9 ± 7.2	.561 ± .050		
85.2 ± 1.5	1.034 ± .093	234.4 ± 7.6	.538 ± .048		
86.7 ± 1.5	1.015 ± .091	242.3 ± 8.1	.513 ± .046		
88.3 ± 1.5	1.025 ± .091	250.6 ± 8.6	.487 ± .043		
89.9 ± 1.6	.972 ± .087	259.5 ± 9.1	.480 ± .043		
91.6 ± 1.6	.988 ± .088	268.9 ± 9.6	.446 ± .040		

TABLE 15.- Continued

(c) Angle of scatter of 30°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.0 ± .6	.000 ± .000	93.3 ± 1.7	.867 ± .077	278.9 ± 10.3	.435 ± .039
48.7 ± .6	1.521 ± .120	95.0 ± 1.7	.847 ± .075	289.5 ± 10.9	.449 ± .040
49.3 ± .6	1.515 ± .122	96.9 ± 1.8	.862 ± .076	300.9 ± 11.7	.468 ± .042
50.0 ± .6	1.266 ± .104	98.7 ± 1.9	.859 ± .076	313.0 ± 12.5	.491 ± .044
50.6 ± .6	1.216 ± .101	100.7 ± 1.9	.833 ± .073	326.0 ± 13.4	.532 ± .048
51.3 ± .6	1.082 ± .091	102.7 ± 2.0	.793 ± .070	339.9 ± 14.4	.575 ± .052
52.0 ± .7	1.064 ± .090	104.7 ± 2.0	.835 ± .074	354.9 ± 15.5	.622 ± .057
52.7 ± .7	1.012 ± .086	106.8 ± 2.1	.795 ± .070	371.1 ± 16.8	.628 ± .058
53.4 ± .7	1.119 ± .096	109.0 ± 2.2	.807 ± .072	388.6 ± 18.2	.635 ± .059
54.2 ± .7	1.138 ± .098	111.3 ± 2.3	.767 ± .068	407.7 ± 19.8	.572 ± .053
54.9 ± .7	1.192 ± .103	113.6 ± 2.3	.805 ± .071	428.4 ± 21.6	.484 ± .045
55.7 ± .7	.917 ± .079	116.1 ± 2.4	.770 ± .068	451.1 ± 23.7	.354 ± .033
56.5 ± .7	1.095 ± .095	118.6 ± 2.5	.734 ± .064	476.1 ± 26.2	.209 ± .020
57.3 ± .8	1.076 ± .094	121.1 ± 2.6	.757 ± .066	503.6 ± 29.0	.104 ± .010
58.1 ± .8	1.096 ± .096	123.8 ± 2.7	.736 ± .064	534.2 ± 32.3	.032 ± .003
59.0 ± .8	1.103 ± .097	126.6 ± 2.8	.701 ± .061	568.4 ± 36.2	.011 ± .001
59.8 ± .8	1.035 ± .092	129.5 ± 2.9	.691 ± .058	606.9 ± 40.9	.007 ± .000
60.7 ± .8	1.010 ± .090	132.4 ± 3.0	.722 ± .061	650.5 ± 46.6	.006 ± .000
61.6 ± .9	1.077 ± .096	135.5 ± 3.1	.654 ± .055	700.4 ± 53.6	.005 ± .000
62.5 ± .9	1.015 ± .090	138.7 ± 3.2	.687 ± .058		
63.5 ± .9	1.057 ± .094	142.1 ± 3.3	.681 ± .057		
64.5 ± .9	.974 ± .086	145.5 ± 3.5	.646 ± .055		
65.4 ± 1.0	.934 ± .083	149.1 ± 3.6	.656 ± .055		
66.5 ± 1.0	.990 ± .088	152.9 ± 3.8	.645 ± .055		
67.5 ± 1.0	.952 ± .085	156.8 ± 3.9	.617 ± .052		
68.6 ± 1.0	1.007 ± .091	160.8 ± 4.1	.612 ± .052		
69.7 ± 1.1	.904 ± .081	165.1 ± 4.3	.585 ± .050		
70.8 ± 1.1	1.036 ± .093	169.5 ± 4.5	.561 ± .048		
71.9 ± 1.1	.939 ± .084	174.1 ± 4.7	.553 ± .047		
73.1 ± 1.1	.976 ± .087	178.9 ± 4.9	.549 ± .047		
74.3 ± 1.2	.933 ± .083	184.0 ± 5.1	.537 ± .046		
75.5 ± 1.2	1.029 ± .092	189.2 ± 5.4	.525 ± .046		
76.8 ± 1.2	.969 ± .087	194.8 ± 5.6	.527 ± .046		
78.1 ± 1.3	.941 ± .084	200.6 ± 5.9	.479 ± .042		
79.4 ± 1.3	.850 ± .076	206.7 ± 6.2	.481 ± .042		
80.8 ± 1.3	.913 ± .082	213.1 ± 6.5	.481 ± .042		
82.2 ± 1.4	.870 ± .078	219.8 ± 6.9	.460 ± .041		
83.7 ± 1.4	.908 ± .081	226.9 ± 7.2	.447 ± .040		
85.2 ± 1.5	.922 ± .083	234.4 ± 7.6	.425 ± .038		
86.7 ± 1.5	.873 ± .078	242.3 ± 8.1	.430 ± .038		
88.3 ± 1.5	.925 ± .082	250.6 ± 8.6	.420 ± .037		
89.9 ± 1.6	.871 ± .078	259.5 ± 9.1	.431 ± .038		
91.6 ± 1.6	.847 ± .076	268.9 ± 9.6	.425 ± .038		

TABLE 15.- Concluded

(d) Angle of scatter of 40°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.4 ± .6	.000 ± .000	94.1 ± 1.7	.782 ± .069	283.6 ± 10.5	.394 ± .035
49.0 ± .6	.000 ± .000	95.9 ± 1.8	.802 ± .071	294.5 ± 11.2	.384 ± .034
49.6 ± .6	1.558 ± .126	97.8 ± 1.8	.753 ± .066	306.2 ± 12.0	.372 ± .033
50.3 ± .6	1.290 ± .106	99.7 ± 1.9	.755 ± .067	318.6 ± 12.9	.349 ± .031
51.0 ± .6	1.257 ± .105	101.6 ± 1.9	.750 ± .066	332.0 ± 13.8	.326 ± .029
51.7 ± .6	1.118 ± .094	103.6 ± 2.0	.734 ± .065	346.4 ± 14.9	.294 ± .027
52.4 ± .7	1.176 ± .099	105.7 ± 2.1	.744 ± .065	361.9 ± 16.1	.259 ± .023
53.1 ± .7	1.096 ± .093	107.9 ± 2.1	.735 ± .065	378.6 ± 17.4	.214 ± .019
53.8 ± .7	1.085 ± .093	110.1 ± 2.2	.740 ± .066	396.8 ± 18.9	.169 ± .015
54.6 ± .7	1.060 ± .091	112.4 ± 2.3	.721 ± .064	416.5 ± 20.6	.127 ± .012
55.3 ± .7	1.059 ± .091	114.8 ± 2.4	.697 ± .062	438.1 ± 22.5	.086 ± .008
56.1 ± .7	1.050 ± .091	117.2 ± 2.4	.682 ± .060	461.7 ± 24.7	.054 ± .005
56.9 ± .8	.967 ± .083	119.8 ± 2.5	.686 ± .060	487.7 ± 27.3	.027 ± .002
57.7 ± .8	1.072 ± .093	122.4 ± 2.6	.651 ± .057	516.5 ± 30.3	.011 ± .001
58.6 ± .8	.948 ± .083	125.1 ± 2.7	.652 ± .057	548.6 ± 33.9	.004 ± .000
59.4 ± .8	.944 ± .083	127.9 ± 2.8	.635 ± .055	584.5 ± 38.1	.003 ± .000
60.3 ± .8	.990 ± .088	130.9 ± 2.9	.624 ± .052	625.1 ± 43.2	.003 ± .000
61.2 ± .9	1.005 ± .089	133.9 ± 3.0	.621 ± .052	671.2 ± 49.4	.003 ± .000
62.1 ± .9	.955 ± .085	137.0 ± 3.2	.625 ± .053		
63.0 ± .9	1.003 ± .089	140.3 ± 3.3	.619 ± .052		
64.0 ± .9	.961 ± .085	143.7 ± 3.4	.625 ± .053		
65.0 ± .9	.885 ± .078	147.2 ± 3.5	.604 ± .051		
66.0 ± 1.0	.887 ± .079	150.9 ± 3.7	.612 ± .052		
67.0 ± 1.0	.920 ± .082	154.7 ± 3.8	.572 ± .048		
68.0 ± 1.0	.818 ± .073	158.6 ± 4.0	.550 ± .047		
69.1 ± 1.0	.902 ± .081	162.8 ± 4.2	.553 ± .047		
70.2 ± 1.1	.900 ± .081	167.1 ± 4.4	.536 ± .046		
71.3 ± 1.1	.934 ± .084	171.6 ± 4.6	.517 ± .044		
72.5 ± 1.1	.911 ± .082	176.3 ± 4.8	.495 ± .042		
73.7 ± 1.2	.906 ± .081	181.2 ± 5.0	.499 ± .043		
74.9 ± 1.2	.915 ± .081	186.4 ± 5.2	.482 ± .041		
76.2 ± 1.2	.887 ± .079	191.7 ± 5.5	.491 ± .042		
77.4 ± 1.3	.897 ± .081	197.4 ± 5.7	.480 ± .042		
78.8 ± 1.3	.879 ± .079	203.3 ± 6.0	.487 ± .042		
80.1 ± 1.3	.839 ± .075	209.5 ± 6.3	.465 ± .040		
81.5 ± 1.4	.807 ± .073	216.1 ± 6.7	.453 ± .039		
82.9 ± 1.4	.843 ± .076	223.0 ± 7.0	.447 ± .039		
84.4 ± 1.4	.860 ± .077	230.2 ± 7.4	.436 ± .038		
85.9 ± 1.5	.814 ± .073	237.9 ± 7.8	.437 ± .038		
87.5 ± 1.5	.827 ± .074	246.0 ± 8.3	.423 ± .037		
89.1 ± 1.6	.812 ± .072	254.6 ± 8.8	.410 ± .036		
90.7 ± 1.6	.787 ± .070	263.7 ± 9.3	.412 ± .036		
92.4 ± 1.7	.812 ± .072	273.3 ± 9.9	.393 ± .035		

TABLE 16.- DOUBLE DIFFERENTIAL CROSS SECTIONS FOR PRODUCTION OF SECONDARY PROTONS FROM TUNGSTEN TARGET, 3.05 g/cm^2 THICK

[Incident proton energy, 558 MeV]

(a) Angle of scatter of 10°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
47.9 ± .6	3.476 ± .272	92.2 ± 1.6	1.827 ± .162	268.0 ± 9.5	1.016 ± .093
48.6 ± .6	3.552 ± .282	93.9 ± 1.7	1.861 ± .166	277.9 ± 10.1	.981 ± .090
49.2 ± .6	2.782 ± .225	95.7 ± 1.7	1.770 ± .157	288.3 ± 10.7	.946 ± .087
49.8 ± .6	2.369 ± .195	97.5 ± 1.8	2.051 ± .182	299.5 ± 11.5	.915 ± .084
50.5 ± .6	2.743 ± .229	99.4 ± 1.9	1.809 ± .159	311.3 ± 12.2	.880 ± .081
51.2 ± .6	3.015 ± .253	101.3 ± 1.9	1.720 ± .152	324.1 ± 13.1	.864 ± .080
51.8 ± .6	2.363 ± .200	103.3 ± 2.0	1.655 ± .146	337.7 ± 14.1	.850 ± .079
52.5 ± .7	2.672 ± .228	105.3 ± 2.0	1.722 ± .152	352.4 ± 15.2	.793 ± .074
53.3 ± .7	1.949 ± .167	107.5 ± 2.1	1.780 ± .158	368.2 ± 16.4	.709 ± .066
54.0 ± .7	2.537 ± .218	109.6 ± 2.2	1.976 ± .176	385.3 ± 17.7	.618 ± .058
54.7 ± .7	2.319 ± .201	111.9 ± 2.2	1.718 ± .152	403.8 ± 19.3	.589 ± .056
55.5 ± .7	2.400 ± .208	114.2 ± 2.3	1.749 ± .154	424.0 ± 21.0	.584 ± .056
56.3 ± .7	2.469 ± .214	116.7 ± 2.4	1.632 ± .143	446.0 ± 23.0	.636 ± .061
57.1 ± .8	2.099 ± .183	119.1 ± 2.5	1.599 ± .140	470.2 ± 25.3	.944 ± .091
57.9 ± .8	1.981 ± .174	121.7 ± 2.6	1.649 ± .144	496.8 ± 28.0	1.674 ± .163
58.7 ± .8	2.310 ± .204	124.4 ± 2.7	1.748 ± .153	526.3 ± 31.1	3.462 ± .341
59.5 ± .8	2.369 ± .211	127.2 ± 2.8	1.604 ± .135	559.1 ± 34.7	7.268 ± .728
60.4 ± .8	2.258 ± .201	130.0 ± 2.9	1.532 ± .129	596.0 ± 39.1	3.768 ± .386
61.3 ± .8	2.351 ± .210	133.0 ± 3.0	1.599 ± .135	637.6 ± 44.4	.485 ± .051
62.2 ± .9	2.125 ± .188	136.1 ± 3.1	1.599 ± .135	685.1 ± 50.8	.201 ± .022
63.1 ± .9	2.363 ± .210	139.3 ± 3.2	1.598 ± .135		
64.1 ± .9	2.217 ± .197	142.6 ± 3.3	1.656 ± .140		
65.0 ± .9	2.006 ± .178	146.0 ± 3.5	1.520 ± .129		
66.0 ± 1.0	2.068 ± .185	149.6 ± 3.6	1.522 ± .129		
67.1 ± 1.0	2.076 ± .186	153.3 ± 3.7	1.463 ± .124		
68.1 ± 1.0	2.173 ± .196	157.2 ± 3.9	1.434 ± .122		
69.2 ± 1.0	1.959 ± .177	161.2 ± 4.1	1.491 ± .127		
70.3 ± 1.1	1.978 ± .179	165.4 ± 4.2	1.365 ± .117		
71.4 ± 1.1	2.213 ± .199	169.8 ± 4.4	1.399 ± .120		
72.5 ± 1.1	2.093 ± .188	174.4 ± 4.6	1.336 ± .115		
73.7 ± 1.1	2.422 ± .216	179.2 ± 4.8	1.451 ± .125		
74.9 ± 1.2	2.309 ± .206	184.2 ± 5.1	1.423 ± .129		
76.2 ± 1.2	2.042 ± .184	189.4 ± 5.3	1.658 ± .149		
77.4 ± 1.2	1.991 ± .179	194.9 ± 5.6	1.429 ± .129		
78.7 ± 1.3	2.068 ± .186	200.6 ± 5.8	1.377 ± .124		
80.1 ± 1.3	2.031 ± .183	206.6 ± 6.1	1.401 ± .127		
81.4 ± 1.3	2.078 ± .187	213.0 ± 6.4	1.323 ± .120		
82.9 ± 1.4	2.013 ± .180	219.6 ± 6.8	1.308 ± .118		
84.3 ± 1.4	1.913 ± .172	226.6 ± 7.1	1.229 ± .111		
85.8 ± 1.5	2.183 ± .196	234.0 ± 7.5	1.214 ± .110		
87.3 ± 1.5	1.857 ± .166	241.8 ± 8.0	1.170 ± .106		
88.9 ± 1.5	1.992 ± .178	250.1 ± 8.4	1.159 ± .105		
90.5 ± 1.6	1.975 ± .177	258.8 ± 8.9	1.068 ± .097		

TABLE 16.- Continued

(b) Angle of scatter of 20°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
47.9 ± .6	3.820 ± .299	92.2 ± 1.6	1.671 ± .148	268.0 ± 9.5	.694 ± .063
48.6 ± .6	3.155 ± .250	93.9 ± 1.7	1.681 ± .149	277.9 ± 10.1	.633 ± .057
49.2 ± .6	2.593 ± .209	95.7 ± 1.7	1.602 ± .142	288.3 ± 10.7	.626 ± .057
49.8 ± .6	2.608 ± .215	97.5 ± 1.8	1.551 ± .137	299.5 ± 11.5	.596 ± .054
50.5 ± .6	2.578 ± .215	99.4 ± 1.9	1.569 ± .138	311.3 ± 12.2	.577 ± .053
51.2 ± .6	2.524 ± .212	101.3 ± 1.9	1.638 ± .144	324.1 ± 13.1	.567 ± .052
51.8 ± .6	2.296 ± .194	103.3 ± 2.0	1.527 ± .135	337.7 ± 14.1	.588 ± .054
52.5 ± .7	2.353 ± .201	105.3 ± 2.0	1.608 ± .142	352.4 ± 15.2	.562 ± .052
53.3 ± .7	2.799 ± .240	107.5 ± 2.1	1.655 ± .147	368.2 ± 16.4	.592 ± .055
54.0 ± .7	2.506 ± .215	109.6 ± 2.2	1.528 ± .136	385.3 ± 17.7	.643 ± .060
54.7 ± .7	1.851 ± .160	111.9 ± 2.2	1.520 ± .135	403.8 ± 19.3	.768 ± .072
55.5 ± .7	1.974 ± .171	114.2 ± 2.3	1.429 ± .126	424.0 ± 21.0	.940 ± .088
56.3 ± .7	2.103 ± .182	116.7 ± 2.4	1.491 ± .131	446.0 ± 23.0	1.183 ± .112
57.1 ± .8	2.014 ± .176	119.1 ± 2.5	1.418 ± .125	470.2 ± 25.3	1.472 ± .141
57.9 ± .8	2.112 ± .186	121.7 ± 2.6	1.412 ± .124	496.8 ± 28.0	1.593 ± .154
58.7 ± .8	2.269 ± .201	124.4 ± 2.7	1.365 ± .118	526.3 ± 31.1	1.444 ± .142
59.5 ± .8	2.109 ± .188	127.2 ± 2.8	1.406 ± .118	559.1 ± 34.7	.965 ± .097
60.4 ± .8	2.008 ± .179	130.0 ± 2.9	1.295 ± .109	596.0 ± 39.1	.353 ± .036
61.3 ± .8	1.915 ± .171	133.0 ± 3.0	1.340 ± .113	637.6 ± 44.4	.084 ± .009
62.2 ± .9	1.993 ± .177	136.1 ± 3.1	1.470 ± .124	685.1 ± 50.8	.046 ± .005
63.1 ± .9	2.099 ± .186	139.3 ± 3.2	1.332 ± .113		
64.1 ± .9	1.977 ± .175	142.6 ± 3.3	1.337 ± .113		
65.0 ± .9	1.950 ± .173	146.0 ± 3.5	1.269 ± .108		
66.0 ± 1.0	1.914 ± .171	149.6 ± 3.6	1.248 ± .106		
67.1 ± 1.0	1.999 ± .179	153.3 ± 3.7	1.209 ± .103		
68.1 ± 1.0	1.843 ± .166	157.2 ± 3.9	1.156 ± .098		
69.2 ± 1.0	1.868 ± .168	161.2 ± 4.1	1.108 ± .094		
70.3 ± 1.1	1.939 ± .175	165.4 ± 4.2	1.134 ± .097		
71.4 ± 1.1	1.884 ± .169	169.8 ± 4.4	1.026 ± .088		
72.5 ± 1.1	2.206 ± .198	174.4 ± 4.6	1.051 ± .090		
73.7 ± 1.1	1.998 ± .178	179.2 ± 4.8	.968 ± .083		
74.9 ± 1.2	2.129 ± .190	184.2 ± 5.1	.968 ± .087		
76.2 ± 1.2	2.037 ± .183	189.4 ± 5.3	1.030 ± .092		
77.4 ± 1.2	1.940 ± .175	194.9 ± 5.6	.988 ± .088		
78.7 ± 1.3	1.818 ± .164	200.6 ± 5.8	.961 ± .086		
80.1 ± 1.3	1.881 ± .169	206.6 ± 6.1	.926 ± .083		
81.4 ± 1.3	1.779 ± .160	213.0 ± 6.4	.914 ± .082		
82.9 ± 1.4	1.772 ± .159	219.6 ± 6.8	.924 ± .083		
84.3 ± 1.4	1.808 ± .162	226.6 ± 7.1	.812 ± .073		
85.8 ± 1.5	1.713 ± .154	234.0 ± 7.5	.800 ± .072		
87.3 ± 1.5	1.783 ± .159	241.8 ± 8.0	.784 ± .071		
88.9 ± 1.5	1.776 ± .159	250.1 ± 8.4	.734 ± .066		
90.5 ± 1.6	1.731 ± .155	258.8 ± 8.9	.705 ± .064		

TABLE 16.- Continued

(c) Angle of scatter of 30°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
47.9 ± .6	3.951 ± .309	92.2 ± 1.6	1.752 ± .156	268.0 ± 9.5	.628 ± .057
48.6 ± .6	2.938 ± .233	93.9 ± 1.7	1.734 ± .154	277.9 ± 10.1	.637 ± .057
49.2 ± .6	2.533 ± .205	95.7 ± 1.7	1.640 ± .145	288.3 ± 10.7	.625 ± .056
49.8 ± .6	2.610 ± .215	97.5 ± 1.8	1.574 ± .139	299.5 ± 11.5	.629 ± .057
50.5 ± .6	2.842 ± .237	99.4 ± 1.9	1.554 ± .137	311.3 ± 12.2	.654 ± .059
51.2 ± .6	2.173 ± .183	101.3 ± 1.9	1.632 ± .144	324.1 ± 13.1	.688 ± .063
51.8 ± .6	2.232 ± .189	103.3 ± 2.0	1.518 ± .134	337.7 ± 14.1	.738 ± .067
52.5 ± .7	2.300 ± .196	105.3 ± 2.0	1.479 ± .131	352.4 ± 15.2	.763 ± .070
53.3 ± .7	2.313 ± .199	107.5 ± 2.1	1.449 ± .129	368.2 ± 16.4	.819 ± .075
54.0 ± .7	2.063 ± .177	109.6 ± 2.2	1.582 ± .141	385.3 ± 17.7	.855 ± .079
54.7 ± .7	2.123 ± .184	111.9 ± 2.2	1.488 ± .132	403.8 ± 19.3	.866 ± .081
55.5 ± .7	2.200 ± .190	114.2 ± 2.3	1.445 ± .127	424.0 ± 21.0	.816 ± .077
56.3 ± .7	2.160 ± .187	116.7 ± 2.4	1.404 ± .123	446.0 ± 23.0	.722 ± .068
57.1 ± .8	2.094 ± .183	119.1 ± 2.5	1.360 ± .119	470.2 ± 25.3	.580 ± .056
57.9 ± .8	1.912 ± .168	121.7 ± 2.6	1.323 ± .115	496.8 ± 28.0	.395 ± .038
58.7 ± .8	2.013 ± .178	124.4 ± 2.7	1.246 ± .109	526.3 ± 31.1	.232 ± .023
59.5 ± .8	2.232 ± .199	127.2 ± 2.8	1.287 ± .108	559.1 ± 34.7	.106 ± .010
60.4 ± .8	2.075 ± .185	130.0 ± 2.9	1.193 ± .100	596.0 ± 39.1	.033 ± .003
61.3 ± .8	2.028 ± .181	133.0 ± 3.0	1.306 ± .110	637.6 ± 44.4	.016 ± .001
62.2 ± .9	1.910 ± .169	136.1 ± 3.1	1.280 ± .108	685.1 ± 50.8	.011 ± .001
63.1 ± .9	1.899 ± .168	139.3 ± 3.2	1.225 ± .103		
64.1 ± .9	2.100 ± .186	142.6 ± 3.3	1.254 ± .106		
65.0 ± .9	2.040 ± .181	146.0 ± 3.5	1.193 ± .101		
66.0 ± 1.0	1.728 ± .154	149.6 ± 3.6	1.109 ± .094		
67.1 ± 1.0	1.929 ± .173	153.3 ± 3.7	1.075 ± .091		
68.1 ± 1.0	1.774 ± .160	157.2 ± 3.9	1.048 ± .089		
69.2 ± 1.0	1.846 ± .167	161.2 ± 4.1	1.048 ± .089		
70.3 ± 1.1	1.963 ± .177	165.4 ± 4.2	.979 ± .084		
71.4 ± 1.1	1.914 ± .172	169.8 ± 4.4	.988 ± .084		
72.5 ± 1.1	2.004 ± .180	174.4 ± 4.6	.934 ± .080		
73.7 ± 1.1	1.973 ± .176	179.2 ± 4.8	.876 ± .075		
74.9 ± 1.2	1.996 ± .178	184.2 ± 5.1	.864 ± .077		
76.2 ± 1.2	1.814 ± .163	189.4 ± 5.3	.881 ± .078		
77.4 ± 1.2	1.870 ± .168	194.9 ± 5.6	.848 ± .075		
78.7 ± 1.3	1.711 ± .154	200.6 ± 5.8	.867 ± .077		
80.1 ± 1.3	1.680 ± .151	206.6 ± 6.1	.834 ± .074		
81.4 ± 1.3	1.630 ± .147	213.0 ± 6.4	.793 ± .071		
82.9 ± 1.4	1.731 ± .155	219.6 ± 6.8	.763 ± .068		
84.3 ± 1.4	1.621 ± .145	226.6 ± 7.1	.713 ± .064		
85.8 ± 1.5	1.644 ± .148	234.0 ± 7.5	.673 ± .060		
87.3 ± 1.5	1.568 ± .140	241.8 ± 8.0	.668 ± .060		
88.9 ± 1.5	1.752 ± .156	250.1 ± 8.4	.651 ± .058		
90.5 ± 1.6	1.591 ± .142	258.8 ± 8.9	.620 ± .056		

TABLE 16.- Continued

(d) Angle of scatter of 40°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
47.9 ± .6	3.038 ± .238	92.2 ± 1.6	1.648 ± .146	268.0 ± 9.5	.644 ± .058
48.6 ± .6	3.346 ± .265	93.9 ± 1.7	1.589 ± .141	277.9 ± 10.1	.627 ± .057
49.2 ± .6	2.765 ± .223	95.7 ± 1.7	1.596 ± .141	288.3 ± 10.7	.607 ± .055
49.8 ± .6	2.535 ± .209	97.5 ± 1.8	1.441 ± .127	299.5 ± 11.5	.593 ± .054
50.5 ± .6	2.483 ± .207	99.4 ± 1.9	1.442 ± .127	311.3 ± 12.2	.564 ± .051
51.2 ± .6	2.276 ± .191	101.3 ± 1.9	1.468 ± .129	324.1 ± 13.1	.555 ± .051
51.8 ± .6	1.985 ± .168	103.3 ± 2.0	1.369 ± .121	337.7 ± 14.1	.525 ± .048
52.5 ± .7	2.425 ± .207	105.3 ± 2.0	1.497 ± .132	352.4 ± 15.2	.461 ± .042
53.3 ± .7	2.189 ± .188	107.5 ± 2.1	1.387 ± .123	368.2 ± 16.4	.411 ± .038
54.0 ± .7	2.112 ± .181	109.6 ± 2.2	1.419 ± .126	385.3 ± 17.7	.366 ± .034
54.7 ± .7	1.917 ± .166	111.9 ± 2.2	1.303 ± .115	403.8 ± 19.3	.293 ± .027
55.5 ± .7	1.858 ± .161	114.2 ± 2.3	1.334 ± .117	424.0 ± 21.0	.229 ± .022
56.3 ± .7	1.887 ± .163	116.7 ± 2.4	1.399 ± .123	446.0 ± 23.0	.168 ± .016
57.1 ± .8	1.746 ± .152	119.1 ± 2.5	1.254 ± .109	470.2 ± 25.3	.105 ± .010
57.9 ± .8	1.858 ± .163	121.7 ± 2.6	1.259 ± .110	496.8 ± 28.0	.066 ± .006
58.7 ± .8	1.798 ± .159	124.4 ± 2.7	1.225 ± .107	526.3 ± 31.1	.028 ± .003
59.5 ± .8	2.025 ± .180	127.2 ± 2.8	1.246 ± .105	559.1 ± 34.7	.011 ± .001
60.4 ± .8	2.112 ± .188	130.0 ± 2.9	1.232 ± .104	596.0 ± 39.1	.006 ± .000
61.3 ± .8	2.026 ± .181	133.0 ± 3.0	1.171 ± .099	637.6 ± 44.4	.004 ± .000
62.2 ± .9	1.983 ± .176	136.1 ± 3.1	1.120 ± .094	685.1 ± 50.8	.005 ± .000
63.1 ± .9	1.678 ± .149	139.3 ± 3.2	1.193 ± .101		
64.1 ± .9	1.935 ± .172	142.6 ± 3.3	1.131 ± .096		
65.0 ± .9	1.899 ± .169	146.0 ± 3.5	1.078 ± .091		
66.0 ± 1.0	1.902 ± .170	149.6 ± 3.6	1.119 ± .095		
67.1 ± 1.0	1.889 ± .169	153.3 ± 3.7	1.070 ± .091		
68.1 ± 1.0	1.705 ± .154	157.2 ± 3.9	1.009 ± .086		
69.2 ± 1.0	1.826 ± .165	161.2 ± 4.1	.979 ± .083		
70.3 ± 1.1	1.831 ± .165	165.4 ± 4.2	.916 ± .078		
71.4 ± 1.1	1.768 ± .160	169.8 ± 4.4	.919 ± .078		
72.5 ± 1.1	1.855 ± .169	174.4 ± 4.6	.892 ± .076		
73.7 ± 1.1	1.868 ± .169	179.2 ± 4.8	.870 ± .075		
74.9 ± 1.2	1.800 ± .160	184.2 ± 5.1	.863 ± .077		
76.2 ± 1.2	1.852 ± .157	189.4 ± 5.3	.830 ± .074		
77.4 ± 1.2	1.833 ± .150	194.9 ± 5.6	.815 ± .073		
78.7 ± 1.3	1.829 ± .149	200.6 ± 5.8	.786 ± .070		
80.1 ± 1.3	1.696 ± .141	206.6 ± 6.1	.752 ± .067		
81.4 ± 1.3	1.665 ± .143	213.0 ± 6.4	.769 ± .069		
82.9 ± 1.4	1.538 ± .137	219.6 ± 6.8	.745 ± .067		
84.3 ± 1.4	1.535 ± .139	226.6 ± 7.1	.677 ± .061		
85.8 ± 1.5	1.619 ± .146	234.0 ± 7.5	.683 ± .061		
87.3 ± 1.5	1.511 ± .136	241.8 ± 8.0	.685 ± .061		
88.9 ± 1.5	1.665 ± .149	250.1 ± 8.4	.646 ± .058		
90.5 ± 1.6	1.628 ± .146	258.8 ± 8.9	.634 ± .057		

TABLE 16.- Continued

(e) Angle of scatter of 50°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
47.9 ± .6	3.017 ± .236	92.2 ± 1.6	1.352 ± .120	268.0 ± 9.5	.371 ± .033
48.6 ± .6	2.589 ± .205	93.9 ± 1.7	1.379 ± .123	277.9 ± 10.1	.338 ± .030
49.2 ± .6	2.536 ± .205	95.7 ± 1.7	1.296 ± .115	288.3 ± 10.7	.299 ± .027
49.8 ± .6	2.283 ± .188	97.5 ± 1.8	1.304 ± .115	299.5 ± 11.5	.278 ± .025
50.5 ± .6	2.104 ± .175	99.4 ± 1.9	1.296 ± .114	311.3 ± 12.2	.239 ± .022
51.2 ± .6	1.848 ± .155	101.3 ± 1.9	1.275 ± .112	324.1 ± 13.1	.214 ± .019
51.8 ± .6	1.914 ± .162	103.3 ± 2.0	1.251 ± .110	337.7 ± 14.1	.186 ± .017
52.5 ± .7	1.964 ± .167	105.3 ± 2.0	1.233 ± .109	352.4 ± 15.2	.156 ± .014
53.3 ± .7	1.947 ± .167	107.5 ± 2.1	1.230 ± .109	368.2 ± 16.4	.118 ± .011
54.0 ± .7	1.864 ± .160	109.6 ± 2.2	1.224 ± .109	385.3 ± 17.7	.094 ± .009
54.7 ± .7	1.627 ± .141	111.9 ± 2.2	1.168 ± .103	403.8 ± 19.3	.064 ± .006
55.5 ± .7	1.755 ± .152	114.2 ± 2.3	1.152 ± .101	424.0 ± 21.0	.046 ± .004
56.3 ± .7	1.616 ± .140	116.7 ± 2.4	1.123 ± .098	446.0 ± 23.0	.026 ± .002
57.1 ± .8	1.924 ± .168	119.1 ± 2.5	1.121 ± .098	470.2 ± 25.3	.016 ± .001
57.9 ± .8	1.711 ± .150	121.7 ± 2.6	1.075 ± .094	496.8 ± 28.0	.008 ± .001
58.7 ± .8	1.721 ± .152	124.4 ± 2.7	1.097 ± .096	526.3 ± 31.1	.005 ± .000
59.5 ± .8	1.591 ± .142	127.2 ± 2.8	1.071 ± .090	559.1 ± 34.7	.004 ± .000
60.4 ± .8	1.682 ± .150	130.0 ± 2.9	1.078 ± .091	596.0 ± 39.1	.003 ± .000
61.3 ± .8	1.707 ± .152	133.0 ± 3.0	1.058 ± .089	637.6 ± 44.4	.003 ± .000
62.2 ± .9	1.703 ± .151	136.1 ± 3.1	1.017 ± .086	685.1 ± 50.8	.003 ± .000
63.1 ± .9	1.717 ± .152	139.3 ± 3.2	.968 ± .082		
64.1 ± .9	1.524 ± .135	142.6 ± 3.3	.960 ± .081		
65.0 ± .9	1.690 ± .150	146.0 ± 3.5	.938 ± .079		
66.0 ± 1.0	1.566 ± .140	149.6 ± 3.6	.910 ± .077		
67.1 ± 1.0	1.592 ± .142	153.3 ± 3.7	.889 ± .075		
68.1 ± 1.0	1.525 ± .137	157.2 ± 3.9	.865 ± .073		
69.2 ± 1.0	1.605 ± .145	161.2 ± 4.1	.814 ± .069		
70.3 ± 1.1	1.566 ± .141	165.4 ± 4.2	.808 ± .069		
71.4 ± 1.1	1.754 ± .157	169.8 ± 4.4	.785 ± .067		
72.5 ± 1.1	1.594 ± .143	174.4 ± 4.6	.769 ± .066		
73.7 ± 1.1	1.510 ± .135	179.2 ± 4.8	.736 ± .063		
74.9 ± 1.2	1.596 ± .142	184.2 ± 5.1	.705 ± .062		
76.2 ± 1.2	1.554 ± .140	189.4 ± 5.3	.692 ± .061		
77.4 ± 1.2	1.576 ± .142	194.9 ± 5.6	.667 ± .059		
78.7 ± 1.3	1.492 ± .134	200.6 ± 5.8	.638 ± .056		
80.1 ± 1.3	1.383 ± .124	206.6 ± 6.1	.613 ± .054		
81.4 ± 1.3	1.447 ± .130	213.0 ± 6.4	.601 ± .053		
82.9 ± 1.4	1.434 ± .128	219.6 ± 6.8	.561 ± .050		
84.3 ± 1.4	1.368 ± .123	226.6 ± 7.1	.531 ± .047		
85.8 ± 1.5	1.452 ± .130	234.0 ± 7.5	.495 ± .044		
87.3 ± 1.5	1.458 ± .130	241.8 ± 8.0	.460 ± .041		
88.9 ± 1.5	1.319 ± .118	250.1 ± 8.4	.428 ± .038		
90.5 ± 1.6	1.354 ± .121	258.8 ± 8.9	.403 ± .036		

TABLE 16.- Concluded

(f) Angle of scatter of 60°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.4 ± .6	3.394 ± .266	94.1 ± 1.7	1.364 ± .121	283.6 ± 10.5	.139 ± .012
49.0 ± .6	2.466 ± .195	95.9 ± 1.8	1.220 ± .109	294.5 ± 11.2	.120 ± .011
49.6 ± .6	2.275 ± .184	97.8 ± 1.8	1.198 ± .106	306.2 ± 12.0	.106 ± .009
50.3 ± .6	2.117 ± .174	99.7 ± 1.9	1.220 ± .108	318.6 ± 12.9	.083 ± .007
51.0 ± .6	2.042 ± .170	101.6 ± 1.9	1.192 ± .105	332.0 ± 13.8	.069 ± .006
51.7 ± .6	1.986 ± .167	103.6 ± 2.0	1.189 ± .105	346.4 ± 14.9	.051 ± .005
52.4 ± .7	1.977 ± .167	105.7 ± 2.1	1.161 ± .102	361.9 ± 16.1	.037 ± .003
53.1 ± .7	1.920 ± .164	107.9 ± 2.1	1.157 ± .102	378.6 ± 17.4	.027 ± .002
53.8 ± .7	1.787 ± .153	110.1 ± 2.2	1.141 ± .102	396.8 ± 18.9	.018 ± .001
54.6 ± .7	1.540 ± .132	112.4 ± 2.3	1.152 ± .103	416.5 ± 20.6	.010 ± .001
55.3 ± .7	1.690 ± .146	114.8 ± 2.4	1.106 ± .098	438.1 ± 22.5	.006 ± .000
56.1 ± .7	1.598 ± .138	117.2 ± 2.4	1.056 ± .093	461.7 ± 24.7	.004 ± .000
56.9 ± .8	1.695 ± .147	119.8 ± 2.5	1.039 ± .091	487.7 ± 27.3	.003 ± .000
57.7 ± .8	1.583 ± .138	122.4 ± 2.6	.990 ± .086	516.5 ± 30.3	.003 ± .000
58.6 ± .8	1.696 ± .149	125.1 ± 2.7	.961 ± .084	548.6 ± 33.9	.003 ± .000
59.4 ± .8	1.642 ± .145	127.9 ± 2.8	.962 ± .084	584.5 ± 38.1	.003 ± .000
60.3 ± .8	1.642 ± .146	130.9 ± 2.9	.887 ± .075	625.1 ± 43.2	.004 ± .000
61.2 ± .9	1.642 ± .146	133.9 ± 3.0	.924 ± .078	671.2 ± 49.4	.003 ± .000
62.1 ± .9	1.741 ± .155	137.0 ± 3.2	.877 ± .074		
63.0 ± .9	1.705 ± .151	140.3 ± 3.3	.861 ± .073		
64.0 ± .9	1.601 ± .142	143.7 ± 3.4	.862 ± .073		
65.0 ± .9	1.610 ± .143	147.2 ± 3.5	.801 ± .068		
66.0 ± 1.0	1.572 ± .140	150.9 ± 3.7	.751 ± .064		
67.0 ± 1.0	1.593 ± .143	154.7 ± 3.8	.712 ± .060		
68.0 ± 1.0	1.539 ± .138	158.6 ± 4.0	.713 ± .061		
69.1 ± 1.0	1.520 ± .137	162.8 ± 4.2	.658 ± .056		
70.2 ± 1.1	1.538 ± .139	167.1 ± 4.4	.621 ± .053		
71.3 ± 1.1	1.418 ± .128	171.6 ± 4.6	.603 ± .051		
72.5 ± 1.1	1.506 ± .135	176.3 ± 4.8	.571 ± .049		
73.7 ± 1.2	1.511 ± .136	181.2 ± 5.0	.538 ± .046		
74.9 ± 1.2	1.438 ± .128	186.4 ± 5.2	.509 ± .044		
76.2 ± 1.2	1.560 ± .139	191.7 ± 5.5	.477 ± .042		
77.4 ± 1.3	1.514 ± .136	197.4 ± 5.7	.444 ± .039		
78.8 ± 1.3	1.462 ± .132	203.3 ± 6.0	.408 ± .036		
80.1 ± 1.3	1.376 ± .124	209.5 ± 6.3	.378 ± .033		
81.5 ± 1.4	1.441 ± .130	216.1 ± 6.7	.372 ± .033		
82.9 ± 1.4	1.311 ± .118	223.0 ± 7.0	.316 ± .028		
84.4 ± 1.4	1.340 ± .120	230.2 ± 7.4	.301 ± .027		
85.9 ± 1.5	1.321 ± .118	237.9 ± 7.8	.272 ± .024		
87.5 ± 1.5	1.363 ± .122	246.0 ± 8.3	.236 ± .021		
89.1 ± 1.6	1.378 ± .123	254.6 ± 8.8	.210 ± .019		
90.7 ± 1.6	1.329 ± .119	263.7 ± 9.3	.183 ± .016		
92.4 ± 1.7	1.331 ± .119	273.3 ± 9.9	.160 ± .014		

TABLE 17.- DOUBLE DIFFERENTIAL CROSS SECTIONS FOR PRODUCTION OF SECONDARY PROTONS FROM LEAD TARGET, 3.91 g/cm^2 THICK

[Incident proton energy, 558 MeV]

(a) Angle of scatter of 10°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
47.9 ± .6	4.938 ± .387	93.1 ± 1.7	1.936 ± .172	279.5 ± 10.3	1.056 ± .098
48.5 ± .6	3.396 ± .317	94.9 ± 1.7	1.813 ± .161	290.2 ± 11.0	1.046 ± .097
49.2 ± .6	4.344 ± .351	96.7 ± 1.8	1.912 ± .169	301.6 ± 11.8	.958 ± .089
49.8 ± .6	2.981 ± .246	98.6 ± 1.9	2.024 ± .179	313.8 ± 12.6	.941 ± .088
50.5 ± .6	2.585 ± .216	100.5 ± 1.9	2.072 ± .183	326.9 ± 13.5	.898 ± .084
51.2 ± .6	2.838 ± .239	102.5 ± 2.0	2.183 ± .193	340.9 ± 14.5	.885 ± .083
51.9 ± .7	2.272 ± .192	104.6 ± 2.0	1.894 ± .167	356.1 ± 15.7	.778 ± .073
52.6 ± .7	1.914 ± .163	106.7 ± 2.1	2.026 ± .179	372.4 ± 16.9	.780 ± .074
53.3 ± .7	2.444 ± .210	108.9 ± 2.2	1.876 ± .167	390.1 ± 18.4	.775 ± .074
54.0 ± .7	2.771 ± .238	111.2 ± 2.3	1.875 ± .167	409.3 ± 20.0	.856 ± .082
54.8 ± .7	2.651 ± .229	113.5 ± 2.3	1.929 ± .171	430.3 ± 21.9	.810 ± .078
55.6 ± .7	2.255 ± .195	115.9 ± 2.4	1.834 ± .162	453.3 ± 24.0	.819 ± .079
56.3 ± .7	2.356 ± .204	118.4 ± 2.5	1.842 ± .162	478.5 ± 26.5	1.089 ± .106
57.2 ± .8	2.648 ± .231	121.0 ± 2.6	1.986 ± .174	506.5 ± 29.4	2.173 ± .214
58.0 ± .8	2.438 ± .214	123.7 ± 2.7	1.679 ± .147	537.5 ± 32.7	5.139 ± .512
58.8 ± .8	2.138 ± .189	126.5 ± 2.8	1.932 ± .169	572.2 ± 36.8	8.258 ± .838
59.7 ± .8	2.239 ± .200	129.4 ± 2.9	1.739 ± .146	611.3 ± 41.6	1.173 ± .122
60.6 ± .8	2.905 ± .259	132.3 ± 3.0	1.767 ± .149	655.7 ± 47.4	.146 ± .016
61.5 ± .9	2.406 ± .215	135.4 ± 3.1	1.658 ± .140		
62.4 ± .9	2.210 ± .196	138.7 ± 3.2	1.733 ± .147		
63.3 ± .9	2.613 ± .232	142.0 ± 3.4	1.777 ± .151		
64.3 ± .9	2.499 ± .222	145.5 ± 3.5	1.577 ± .134		
65.3 ± 1.0	2.121 ± .188	149.1 ± 3.6	1.626 ± .138		
66.3 ± 1.0	2.305 ± .206	152.8 ± 3.8	1.537 ± .131		
67.3 ± 1.0	2.328 ± .209	156.7 ± 3.9	1.572 ± .134		
68.4 ± 1.0	2.448 ± .221	160.8 ± 4.1	1.569 ± .134		
69.5 ± 1.1	2.314 ± .209	165.1 ± 4.3	1.528 ± .131		
70.6 ± 1.1	2.327 ± .210	169.5 ± 4.5	1.536 ± .132		
71.8 ± 1.1	2.261 ± .203	174.1 ± 4.7	1.498 ± .129		
72.9 ± 1.1	2.241 ± .201	179.0 ± 4.9	1.434 ± .123		
74.1 ± 1.2	2.137 ± .191	184.0 ± 5.1	1.269 ± .109		
75.4 ± 1.2	1.946 ± .174	189.3 ± 5.4	1.453 ± .134		
76.6 ± 1.2	2.140 ± .193	194.9 ± 5.6	1.666 ± .153		
77.9 ± 1.3	2.183 ± .197	200.7 ± 5.9	1.516 ± .139		
79.3 ± 1.3	2.089 ± .188	206.8 ± 6.2	1.339 ± .124		
80.7 ± 1.3	2.083 ± .188	213.2 ± 6.5	1.273 ± .118		
82.1 ± 1.4	2.380 ± .215	220.0 ± 6.9	1.283 ± .118		
83.5 ± 1.4	2.154 ± .193	227.1 ± 7.3	1.236 ± .114		
85.0 ± 1.5	2.105 ± .189	234.7 ± 7.7	1.254 ± .116		
86.5 ± 1.5	1.930 ± .173	242.6 ± 8.1	1.266 ± .117		
88.1 ± 1.5	2.211 ± .198	251.0 ± 8.6	1.250 ± .115		
89.7 ± 1.6	2.113 ± .189	259.9 ± 9.1	1.159 ± .107		
91.4 ± 1.6	1.995 ± .179	269.4 ± 9.7	1.145 ± .106		

TABLE 17.- Continued

(b) Angle of scatter of 20°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, Mev	Cross section, mb/sr-MeV
48.0 ± .6	4.770 ± .374	93.3 ± 1.7	1.895 ± .157	278.9 ± 10.3	.737 ± .067
48.7 ± .6	2.958 ± .234	95.0 ± 1.7	1.790 ± .153	289.5 ± 10.9	.675 ± .062
49.3 ± .6	3.079 ± .249	96.9 ± 1.8	1.696 ± .149	300.9 ± 11.7	.665 ± .061
50.0 ± .6	2.810 ± .231	98.7 ± 1.9	1.878 ± .166	313.0 ± 12.5	.637 ± .059
50.6 ± .6	2.800 ± .234	100.7 ± 1.9	1.766 ± .157	326.0 ± 13.4	.637 ± .059
51.3 ± .6	2.196 ± .185	102.7 ± 2.0	1.715 ± .151	339.9 ± 14.4	.640 ± .059
52.0 ± .7	2.683 ± .227	104.7 ± 2.0	1.705 ± .151	354.9 ± 15.5	.709 ± .066
52.7 ± .7	2.564 ± .219	106.8 ± 2.1	1.903 ± .168	371.1 ± 16.8	.750 ± .070
53.4 ± .7	2.817 ± .242	109.0 ± 2.2	1.745 ± .155	388.6 ± 18.2	.816 ± .076
54.2 ± .7	2.451 ± .211	111.3 ± 2.3	1.802 ± .161	407.7 ± 19.8	.945 ± .089
54.9 ± .7	2.335 ± .202	113.6 ± 2.3	1.617 ± .143	428.4 ± 21.6	1.235 ± .117
55.7 ± .7	2.612 ± .226	116.1 ± 2.4	1.785 ± .158	451.1 ± 23.7	1.617 ± .154
56.5 ± .7	2.323 ± .201	118.6 ± 2.5	1.813 ± .159	476.1 ± 26.2	1.915 ± .185
57.3 ± .8	2.225 ± .194	121.1 ± 2.6	1.645 ± .144	503.6 ± 29.0	1.887 ± .184
58.1 ± .8	2.349 ± .206	123.8 ± 2.7	1.535 ± .134	534.2 ± 32.3	1.338 ± .133
59.0 ± .8	2.566 ± .227	126.6 ± 2.8	1.541 ± .135	568.4 ± 36.2	.546 ± .055
59.8 ± .8	2.615 ± .233	129.5 ± 2.9	1.506 ± .127	606.9 ± 40.9	.095 ± .010
60.7 ± .8	2.148 ± .192	132.4 ± 3.0	1.455 ± .123	650.5 ± 46.6	.045 ± .005
61.6 ± .9	2.264 ± .202	135.5 ± 3.1	1.422 ± .120	700.4 ± 53.6	.035 ± .004
62.5 ± .9	2.298 ± .204	138.7 ± 3.2	1.415 ± .120		
63.5 ± .9	2.283 ± .203	142.1 ± 3.3	1.384 ± .117		
64.5 ± .9	2.430 ± .216	145.5 ± 3.5	1.443 ± .122		
65.4 ± 1.0	2.195 ± .195	149.1 ± 3.6	1.514 ± .129		
66.5 ± 1.0	2.241 ± .201	152.9 ± 3.8	1.383 ± .118		
67.5 ± 1.0	2.063 ± .185	156.8 ± 3.9	1.349 ± .115		
68.6 ± 1.0	2.114 ± .191	160.8 ± 4.1	1.306 ± .111		
69.7 ± 1.1	2.267 ± .205	165.1 ± 4.3	1.293 ± .111		
70.8 ± 1.1	2.443 ± .221	169.5 ± 4.5	1.222 ± .105		
71.9 ± 1.1	2.365 ± .212	174.1 ± 4.7	1.191 ± .102		
73.1 ± 1.1	2.217 ± .199	178.9 ± 4.9	1.036 ± .089		
74.3 ± 1.2	2.309 ± .206	184.0 ± 5.1	1.076 ± .093		
75.5 ± 1.2	2.156 ± .193	189.2 ± 5.4	1.119 ± .101		
76.8 ± 1.2	2.262 ± .204	194.8 ± 5.6	1.101 ± .099		
78.1 ± 1.3	2.051 ± .187	200.6 ± 5.9	1.083 ± .098		
79.4 ± 1.3	2.196 ± .201	206.7 ± 6.2	1.048 ± .095		
80.8 ± 1.3	2.162 ± .192	213.1 ± 6.5	.986 ± .089		
82.2 ± 1.4	2.024 ± .173	219.8 ± 6.9	.950 ± .086		
83.7 ± 1.4	1.901 ± .157	226.9 ± 7.2	.938 ± .085		
85.2 ± 1.5	1.742 ± .143	234.4 ± 7.6	.909 ± .082		
86.7 ± 1.5	1.931 ± .159	242.3 ± 8.1	.908 ± .082		
88.3 ± 1.5	2.116 ± .173	250.6 ± 8.6	.812 ± .074		
89.9 ± 1.6	1.755 ± .142	259.5 ± 9.1	.796 ± .073		
91.6 ± 1.6	1.982 ± .162	268.9 ± 9.6	.766 ± .070		

TABLE 17.- Continued

(e) Angle of scatter of 50°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.4 ± .6	3.503 ± .274	94.1 ± 1.7	1.539 ± .137	283.6 ± 10.5	.370 ± .033
49.0 ± .6	2.821 ± .224	95.9 ± 1.8	1.475 ± .131	294.5 ± 11.2	.325 ± .029
49.6 ± .6	2.633 ± .213	97.8 ± 1.8	1.434 ± .127	306.2 ± 12.0	.285 ± .026
50.3 ± .6	2.594 ± .214	99.7 ± 1.9	1.368 ± .121	318.6 ± 12.9	.250 ± .023
51.0 ± .6	2.267 ± .189	101.6 ± 1.9	1.387 ± .122	332.0 ± 13.8	.213 ± .019
51.7 ± .6	2.208 ± .186	103.6 ± 2.0	1.385 ± .122	346.4 ± 14.9	.178 ± .016
52.4 ± .7	2.214 ± .187	105.7 ± 2.1	1.349 ± .119	361.9 ± 16.1	.143 ± .013
53.1 ± .7	2.200 ± .188	107.9 ± 2.1	1.379 ± .122	378.6 ± 17.4	.110 ± .010
53.8 ± .7	1.985 ± .170	110.1 ± 2.2	1.286 ± .114	396.8 ± 18.9	.078 ± .007
54.6 ± .7	2.093 ± .180	112.4 ± 2.3	1.294 ± .115	416.5 ± 20.6	.052 ± .005
55.3 ± .7	1.958 ± .169	114.8 ± 2.4	1.285 ± .114	438.1 ± 22.5	.034 ± .003
56.1 ± .7	1.966 ± .170	117.2 ± 2.4	1.258 ± .111	461.7 ± 24.7	.019 ± .002
56.9 ± .8	1.794 ± .155	119.8 ± 2.5	1.221 ± .107	487.7 ± 27.3	.009 ± .001
57.7 ± .8	1.918 ± .167	122.4 ± 2.6	1.219 ± .106	516.5 ± 30.3	.005 ± .000
58.6 ± .8	1.911 ± .168	125.1 ± 2.7	1.163 ± .102	548.6 ± 33.9	.004 ± .000
59.4 ± .8	1.852 ± .164	127.9 ± 2.8	1.126 ± .099	584.5 ± 38.1	.004 ± .000
60.3 ± .8	2.043 ± .182	130.9 ± 2.9	1.083 ± .091	625.1 ± 43.2	.005 ± .000
61.2 ± .9	1.941 ± .173	133.9 ± 3.0	1.083 ± .091	671.2 ± 49.4	.005 ± .000
62.1 ± .9	2.132 ± .190	137.0 ± 3.2	1.057 ± .089		
63.0 ± .9	1.756 ± .156	140.3 ± 3.3	1.052 ± .089		
64.0 ± .9	1.962 ± .174	143.7 ± 3.4	1.020 ± .086		
65.0 ± .9	1.836 ± .163	147.2 ± 3.5	1.009 ± .086		
66.0 ± 1.0	1.951 ± .173	150.9 ± 3.7	.985 ± .084		
67.0 ± 1.0	1.855 ± .166	154.7 ± 3.8	.939 ± .080		
68.0 ± 1.0	1.842 ± .165	158.6 ± 4.0	.902 ± .077		
69.1 ± 1.0	1.716 ± .155	162.8 ± 4.2	.899 ± .077		
70.2 ± 1.1	1.743 ± .157	167.1 ± 4.4	.827 ± .071		
71.3 ± 1.1	1.716 ± .155	171.6 ± 4.6	.814 ± .070		
72.5 ± 1.1	1.856 ± .167	176.3 ± 4.8	.739 ± .063		
73.7 ± 1.2	1.956 ± .176	181.2 ± 5.0	.771 ± .066		
74.9 ± 1.2	1.873 ± .167	186.4 ± 5.2	.713 ± .061		
76.2 ± 1.2	1.741 ± .156	191.7 ± 5.5	.720 ± .063		
77.4 ± 1.3	1.759 ± .158	197.4 ± 5.7	.735 ± .064		
78.8 ± 1.3	1.643 ± .148	203.3 ± 6.0	.689 ± .061		
80.1 ± 1.3	1.585 ± .143	209.5 ± 6.3	.671 ± .059		
81.5 ± 1.4	1.638 ± .148	216.1 ± 6.7	.656 ± .058		
82.9 ± 1.4	1.570 ± .142	223.0 ± 7.0	.616 ± .054		
84.4 ± 1.4	1.649 ± .148	230.2 ± 7.4	.581 ± .051		
85.9 ± 1.5	1.593 ± .143	237.9 ± 7.8	.551 ± .049		
87.5 ± 1.5	1.611 ± .145	246.0 ± 8.3	.517 ± .046		
89.1 ± 1.6	1.609 ± .144	254.6 ± 8.8	.470 ± .042		
90.7 ± 1.6	1.566 ± .140	263.7 ± 9.3	.446 ± .040		
92.4 ± 1.7	1.541 ± .138	273.3 ± 9.9	.392 ± .035		

TABLE 17.- Concluded

(f) Angle of scatter of 60°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
48.4 ± .6	.000 ± .000	94.1 ± 1.7	1.343 ± .119	283.6 ± 10.5	.143 ± .013
49.0 ± .6	2.852 ± .226	95.9 ± 1.8	1.222 ± .109	294.5 ± 11.2	.120 ± .011
49.6 ± .6	2.504 ± .202	97.8 ± 1.8	1.226 ± .108	306.2 ± 12.0	.103 ± .009
50.3 ± .6	2.241 ± .185	99.7 ± 1.9	1.328 ± .118	318.6 ± 12.9	.087 ± .008
51.0 ± .6	2.301 ± .192	101.6 ± 1.9	1.236 ± .109	332.0 ± 13.8	.070 ± .006
51.7 ± .6	2.061 ± .173	103.6 ± 2.0	1.171 ± .103	346.4 ± 14.9	.050 ± .004
52.4 ± .7	2.021 ± .171	105.7 ± 2.1	1.182 ± .104	361.9 ± 16.1	.039 ± .003
53.1 ± .7	2.038 ± .174	107.9 ± 2.1	1.151 ± .102	378.6 ± 17.4	.025 ± .002
53.8 ± .7	1.821 ± .156	110.1 ± 2.2	1.157 ± .103	396.8 ± 18.9	.017 ± .001
54.6 ± .7	1.823 ± .157	112.4 ± 2.3	1.140 ± .102	416.5 ± 20.6	.010 ± .001
55.3 ± .7	1.726 ± .149	114.8 ± 2.4	1.108 ± .098	438.1 ± 22.5	.006 ± .000
56.1 ± .7	1.644 ± .142	117.2 ± 2.4	1.098 ± .097	461.7 ± 24.7	.004 ± .000
56.9 ± .8	1.730 ± .150	119.8 ± 2.5	1.072 ± .094	487.7 ± 27.3	.003 ± .000
57.7 ± .8	1.628 ± .142	122.4 ± 2.6	1.040 ± .091	516.5 ± 30.3	.003 ± .000
58.6 ± .8	1.510 ± .133	125.1 ± 2.7	1.001 ± .087	548.6 ± 33.9	.004 ± .000
59.4 ± .8	1.765 ± .156	127.9 ± 2.8	.974 ± .085	584.5 ± 38.1	.004 ± .000
60.3 ± .8	1.840 ± .164	130.9 ± 2.9	.946 ± .080	625.1 ± 43.2	.004 ± .000
61.2 ± .9	1.742 ± .155	133.9 ± 3.0	.949 ± .080	671.2 ± 49.4	.004 ± .000
62.1 ± .9	1.730 ± .154	137.0 ± 3.2	.889 ± .075		
63.0 ± .9	1.648 ± .146	140.3 ± 3.3	.861 ± .073		
64.0 ± .9	1.746 ± .155	143.7 ± 3.4	.846 ± .071		
65.0 ± .9	1.687 ± .150	147.2 ± 3.5	.832 ± .070		
66.0 ± 1.0	1.590 ± .141	150.9 ± 3.7	.795 ± .067		
67.0 ± 1.0	1.621 ± .145	154.7 ± 3.8	.769 ± .065		
68.0 ± 1.0	1.570 ± .141	158.6 ± 4.0	.693 ± .059		
69.1 ± 1.0	1.471 ± .133	162.8 ± 4.2	.688 ± .059		
70.2 ± 1.1	1.543 ± .139	167.1 ± 4.4	.639 ± .054		
71.3 ± 1.1	1.567 ± .141	171.6 ± 4.6	.634 ± .054		
72.5 ± 1.1	1.481 ± .133	176.3 ± 4.8	.569 ± .049		
73.7 ± 1.2	1.608 ± .144	181.2 ± 5.0	.537 ± .046		
74.9 ± 1.2	1.477 ± .132	186.4 ± 5.2	.508 ± .044		
76.2 ± 1.2	1.550 ± .138	191.7 ± 5.5	.490 ± .043		
77.4 ± 1.3	1.504 ± .135	197.4 ± 5.7	.448 ± .039		
78.8 ± 1.3	1.499 ± .135	203.3 ± 6.0	.425 ± .037		
80.1 ± 1.3	1.459 ± .131	209.5 ± 6.3	.397 ± .035		
81.5 ± 1.4	1.426 ± .129	216.1 ± 6.7	.349 ± .031		
82.9 ± 1.4	1.445 ± .130	223.0 ± 7.0	.333 ± .029		
84.4 ± 1.4	1.385 ± .124	230.2 ± 7.4	.294 ± .026		
85.9 ± 1.5	1.369 ± .123	237.9 ± 7.8	.269 ± .024		
87.5 ± 1.5	1.396 ± .125	246.0 ± 8.3	.246 ± .022		
89.1 ± 1.6	1.367 ± .122	254.6 ± 8.8	.208 ± .018		
90.7 ± 1.6	1.342 ± .120	263.7 ± 9.3	.188 ± .017		
92.4 ± 1.7	1.359 ± .122	273.3 ± 9.9	.161 ± .014		

TABLE 18.- DOUBLE DIFFERENTIAL CROSS SECTIONS FOR PRODUCTION OF SECONDARY DEUTERONS FROM BERYLLIUM TARGET, 2.35 g/cm^2 THICK

[Incident proton energy, 558 MeV]

(a) Angle of scatter of 10°

Energy, MeV	Cross section, μb/sr-MeV	Energy, MeV	Cross section, μb/sr-MeV
88.8 ± 1.1	.0 ± .0	167.0 ± 2.9	68.0 ± 7.6
89.9 ± 1.1	.0 ± .0	170.0 ± 3.0	75.4 ± 8.1
91.0 ± 1.1	95.1 ± 17.0	173.1 ± 3.1	66.2 ± 7.3
92.2 ± 1.1	85.1 ± 14.9	176.2 ± 3.1	65.3 ± 7.1
93.4 ± 1.1	63.8 ± 11.9	179.5 ± 3.2	68.1 ± 7.3
94.6 ± 1.2	72.0 ± 12.3	182.8 ± 3.3	68.4 ± 7.3
95.8 ± 1.2	67.3 ± 11.4	186.2 ± 3.4	66.3 ± 7.1
97.1 ± 1.2	53.9 ± 9.7	189.8 ± 3.5	68.2 ± 7.2
98.3 ± 1.2	67.1 ± 10.8	193.4 ± 3.6	61.3 ± 6.5
99.7 ± 1.3	67.9 ± 10.7	197.2 ± 3.8	67.8 ± 7.0
101.0 ± 1.3	59.7 ± 9.7	201.0 ± 3.9	59.6 ± 6.3
102.3 ± 1.3	72.1 ± 10.8	205.0 ± 4.0	59.3 ± 6.2
103.7 ± 1.4	56.3 ± 9.0	209.2 ± 4.1	50.7 ± 5.4
105.2 ± 1.4	57.9 ± 9.0	213.4 ± 4.3	56.7 ± 5.8
106.6 ± 1.4	42.2 ± 7.3	217.8 ± 4.4	56.2 ± 5.7
108.1 ± 1.4	50.7 ± 8.1	222.3 ± 4.6	52.0 ± 5.3
109.6 ± 1.5	48.8 ± 7.8	227.0 ± 4.7	61.5 ± 6.1
111.1 ± 1.5	65.0 ± 9.3	231.8 ± 4.9	58.9 ± 5.8
112.7 ± 1.5	52.0 ± 7.9	236.9 ± 5.0	48.6 ± 4.9
114.3 ± 1.6	66.1 ± 9.2	242.0 ± 5.2	52.7 ± 5.2
116.0 ± 1.6	67.6 ± 9.2	247.4 ± 5.4	51.8 ± 5.1
117.7 ± 1.7	54.1 ± 7.8	253.0 ± 5.6	53.7 ± 5.3
119.4 ± 1.7	62.2 ± 8.6	258.7 ± 5.8	51.9 ± 5.1
121.1 ± 1.7	53.8 ± 7.6	264.7 ± 6.0	58.1 ± 5.6
123.0 ± 1.8	55.9 ± 7.8	270.9 ± 6.3	61.3 ± 5.8
124.8 ± 1.8	56.4 ± 7.7	277.3 ± 6.5	55.4 ± 5.3
126.7 ± 1.9	54.4 ± 7.5	284.0 ± 6.8	57.7 ± 5.5
128.6 ± 1.9	64.3 ± 8.3	290.9 ± 7.0	55.2 ± 5.2
130.6 ± 2.0	60.2 ± 7.8	298.1 ± 7.3	61.7 ± 5.8
132.6 ± 2.0	65.8 ± 8.3	305.6 ± 7.6	60.3 ± 5.6
134.7 ± 2.1	59.6 ± 7.6	313.5 ± 7.9	65.4 ± 6.0
136.8 ± 2.1	59.5 ± 7.5	321.6 ± 8.3	69.3 ± 6.3
139.0 ± 2.2	60.9 ± 7.6	330.1 ± 8.6	74.9 ± 6.8
141.2 ± 2.2	55.8 ± 7.1	339.0 ± 9.0	69.8 ± 6.3
143.5 ± 2.3	55.7 ± 7.0	348.2 ± 9.4	69.7 ± 6.3
145.9 ± 2.3	55.2 ± 6.9	357.9 ± 9.8	67.2 ± 6.1
148.3 ± 2.4	66.3 ± 7.8	368.0 ± 10.3	60.8 ± 5.5
150.8 ± 2.5	65.9 ± 7.7	378.6 ± 10.8	.0 ± .0
153.3 ± 2.5	64.3 ± 7.5	389.7 ± 11.3	.0 ± .0
155.9 ± 2.6	68.0 ± 7.8	401.4 ± 11.9	.0 ± .0
158.6 ± 2.7	66.2 ± 7.6	413.6 ± 12.5	.0 ± .0
161.3 ± 2.7	72.5 ± 8.1	426.4 ± 13.1	.0 ± .0
164.1 ± 2.8	66.8 ± 7.6	440.0 ± 13.8	.0 ± .0

TABLE 18.- Continued

(b) Angle of scatter of 20°

Energy, MeV	Cross section, μb/sr-MeV	Energy, MeV	Cross section, μb/sr-MeV
108.4 ± 1.4	31.8 ± 5.2	222.6 ± 4.6	24.0 ± 2.6
109.9 ± 1.5	38.4 ± 5.8	227.3 ± 4.7	22.0 ± 2.4
111.4 ± 1.5	31.8 ± 5.1	232.1 ± 4.9	22.3 ± 2.4
113.0 ± 1.5	36.3 ± 5.4	237.1 ± 5.0	21.0 ± 2.3
114.6 ± 1.6	36.1 ± 5.4	242.3 ± 5.2	21.0 ± 2.3
116.3 ± 1.6	38.4 ± 5.5	247.6 ± 5.4	17.8 ± 2.0
118.0 ± 1.7	33.0 ± 4.9	253.2 ± 5.6	20.3 ± 2.2
119.7 ± 1.7	34.3 ± 5.0	258.9 ± 5.8	18.5 ± 2.0
121.5 ± 1.7	30.7 ± 4.6	264.9 ± 6.0	18.0 ± 1.9
123.3 ± 1.8	35.9 ± 5.0	271.1 ± 6.2	17.4 ± 1.9
125.1 ± 1.8	29.0 ± 4.3	277.5 ± 6.5	14.4 ± 1.6
127.0 ± 1.9	43.0 ± 5.6	284.1 ± 6.7	16.3 ± 1.7
128.9 ± 1.9	33.0 ± 4.6	291.0 ± 7.0	16.2 ± 1.7
130.9 ± 2.0	29.4 ± 4.2	298.2 ± 7.3	12.6 ± 1.4
132.9 ± 2.0	35.1 ± 4.7	305.7 ± 7.6	9.8 ± 1.1
135.0 ± 2.1	40.6 ± 5.2	313.5 ± 7.9	10.0 ± 1.1
137.1 ± 2.1	34.0 ± 4.5	321.6 ± 8.2	9.6 ± 1.1
139.3 ± 2.2	28.7 ± 3.9	330.1 ± 8.6	10.2 ± 1.1
141.6 ± 2.2	33.2 ± 4.3	338.9 ± 9.0	9.1 ± 1.0
143.9 ± 2.3	35.8 ± 4.5	348.2 ± 9.4	6.5 ± .8
146.2 ± 2.3	29.2 ± 3.9	357.8 ± 9.8	5.3 ± .6
148.6 ± 2.4	31.7 ± 4.1	367.9 ± 10.3	6.2 ± .7
151.1 ± 2.5	29.8 ± 3.8	378.4 ± 10.8	.0 ± .0
153.6 ± 2.5	28.9 ± 3.7	389.5 ± 11.3	.0 ± .0
156.2 ± 2.6	29.1 ± 3.7	401.1 ± 11.8	.0 ± .0
158.9 ± 2.7	30.7 ± 3.8	413.3 ± 12.4	.0 ± .0
161.6 ± 2.7	29.6 ± 3.7	426.1 ± 13.1	.0 ± .0
164.5 ± 2.8	37.2 ± 4.4	439.5 ± 13.8	.0 ± .0
167.4 ± 2.9	32.5 ± 3.9	453.7 ± 14.5	.0 ± .0
170.3 ± 3.0	30.5 ± 3.7	468.7 ± 15.3	.0 ± .0
173.4 ± 3.1	30.0 ± 3.6	484.5 ± 16.2	.0 ± .0
176.5 ± 3.1	34.2 ± 3.9	501.2 ± 17.2	.0 ± .0
179.8 ± 3.2	25.0 ± 3.1	518.9 ± 18.2	.0 ± .0
183.1 ± 3.3	25.4 ± 3.1	537.7 ± 19.3	.0 ± .0
186.5 ± 3.4	27.7 ± 3.2	557.7 ± 20.5	.0 ± .0
190.1 ± 3.5	27.4 ± 3.2	579.0 ± 21.9	.0 ± .0
193.7 ± 3.6	27.8 ± 3.2	601.6 ± 23.4	.0 ± .0
197.5 ± 3.8	26.1 ± 3.0	625.9 ± 25.0	.0 ± .0
201.3 ± 3.9	23.7 ± 2.7	651.8 ± 26.8	.0 ± .0
205.3 ± 4.0	24.0 ± 2.7	679.7 ± 28.9	.0 ± .0
209.4 ± 4.1	23.6 ± 2.7	709.7 ± 31.1	.0 ± .0
213.7 ± 4.3	24.3 ± 2.7	742.1 ± 33.6	.0 ± .0
218.1 ± 4.4	22.4 ± 2.5	777.1 ± 36.5	.0 ± .0

TABLE 18.- Continued

(c) Angle of scatter of 30°

Energy, MeV	Cross section, μb/sr-MeV	Energy, MeV	Cross section, μb/sr-MeV
111.4 ± 1.5	18.2 ± 2.8	232.1 ± 4.9	10.9 ± 1.2
113.0 ± 1.5	26.5 ± 3.6	237.1 ± 5.0	7.9 ± .9
114.6 ± 1.6	22.4 ± 3.1	242.3 ± 5.2	7.7 ± .9
116.3 ± 1.6	23.2 ± 3.2	247.6 ± 5.4	8.7 ± 1.0
118.0 ± 1.7	21.0 ± 3.0	253.2 ± 5.6	7.8 ± .9
119.7 ± 1.7	25.2 ± 3.3	258.9 ± 5.8	8.3 ± .9
121.5 ± 1.7	24.0 ± 3.2	264.9 ± 6.0	5.9 ± .7
123.3 ± 1.8	20.0 ± 2.8	271.1 ± 6.2	6.9 ± .8
125.1 ± 1.8	21.6 ± 2.9	277.5 ± 6.5	6.9 ± .8
127.0 ± 1.9	17.3 ± 2.4	284.1 ± 6.7	5.9 ± .7
128.9 ± 1.9	20.0 ± 2.7	291.0 ± 7.0	6.0 ± .7
130.9 ± 2.0	18.9 ± 2.5	298.2 ± 7.3	6.2 ± .7
132.9 ± 2.0	18.8 ± 2.4	305.7 ± 7.6	4.6 ± .5
135.0 ± 2.1	15.6 ± 2.1	313.5 ± 7.9	5.4 ± .6
137.1 ± 2.1	16.0 ± 2.1	321.6 ± 8.2	5.1 ± .6
139.3 ± 2.2	19.0 ± 2.4	330.1 ± 8.6	4.8 ± .5
141.6 ± 2.2	18.3 ± 2.3	338.9 ± 9.0	4.4 ± .5
143.9 ± 2.3	22.7 ± 2.7	348.2 ± 9.4	5.2 ± .5
146.2 ± 2.3	17.8 ± 2.3	357.8 ± 9.8	4.4 ± .5
148.6 ± 2.4	20.9 ± 2.5	367.9 ± 10.3	3.9 ± .4
151.1 ± 2.5	18.6 ± 2.3	378.4 ± 10.8	.0 ± .0
153.6 ± 2.5	16.1 ± 2.0	389.5 ± 11.3	.0 ± .0
156.2 ± 2.6	15.3 ± 1.9	401.1 ± 11.8	.0 ± .0
158.9 ± 2.7	15.8 ± 2.0	413.3 ± 12.4	.0 ± .0
161.6 ± 2.7	15.5 ± 1.9	426.1 ± 13.1	.0 ± .0
164.5 ± 2.8	17.1 ± 2.1	439.5 ± 13.8	.0 ± .0
167.4 ± 2.9	13.8 ± 1.7	453.7 ± 14.5	.0 ± .0
170.3 ± 3.0	15.8 ± 1.9	468.7 ± 15.3	.0 ± .0
173.4 ± 3.1	15.1 ± 1.8	484.5 ± 16.2	.0 ± .0
176.5 ± 3.1	13.4 ± 1.6	501.2 ± 17.2	.0 ± .0
179.8 ± 3.2	12.9 ± 1.6	518.9 ± 18.2	.0 ± .0
183.1 ± 3.3	12.4 ± 1.5	537.7 ± 19.3	.0 ± .0
186.5 ± 3.4	13.6 ± 1.6	557.7 ± 20.5	.0 ± .0
190.1 ± 3.5	14.0 ± 1.6	579.0 ± 21.9	.0 ± .0
193.7 ± 3.6	12.0 ± 1.4	601.6 ± 23.4	.0 ± .0
197.5 ± 3.8	12.6 ± 1.5	625.9 ± 25.0	.0 ± .0
201.3 ± 3.9	10.9 ± 1.3	651.8 ± 26.8	.0 ± .0
205.3 ± 4.0	11.8 ± 1.4	679.7 ± 28.9	.0 ± .0
209.4 ± 4.1	12.7 ± 1.4	709.7 ± 31.1	.0 ± .0
213.7 ± 4.3	10.6 ± 1.2	742.1 ± 33.6	.0 ± .0
218.1 ± 4.4	11.3 ± 1.2	777.1 ± 36.5	.0 ± .0
222.6 ± 4.6	10.7 ± 1.2	815.2 ± 39.7	.0 ± .0
227.3 ± 4.7	9.1 ± 1.0	856.7 ± 43.3	.0 ± .0

TABLE 18.- Continued

(d) Angle of scatter of 50°

Energy, MeV	Cross section, $\mu b/sr\text{-}MeV$	Energy, MeV	Cross section, $\mu b/sr\text{-}MeV$
89.7 ± 1.1	.0 ± .0	168.8 ± 2.9	8.4 ± .9
90.8 ± 1.1	.0 ± .0	171.8 ± 3.0	9.3 ± 1.0
91.9 ± 1.1	27.6 ± 3.6	174.9 ± 3.1	8.6 ± .9
93.1 ± 1.1	26.7 ± 3.3	178.1 ± 3.2	8.2 ± .8
94.3 ± 1.2	23.4 ± 2.9	181.4 ± 3.3	7.3 ± .8
95.5 ± 1.2	21.6 ± 2.7	184.8 ± 3.4	7.1 ± .7
96.8 ± 1.2	21.1 ± 2.6	188.3 ± 3.5	6.4 ± .7
98.0 ± 1.2	24.8 ± 2.9	191.8 ± 3.6	7.0 ± .7
99.3 ± 1.3	18.7 ± 2.3	195.5 ± 3.7	6.8 ± .7
100.6 ± 1.3	17.7 ± 2.2	199.3 ± 3.8	5.0 ± .5
102.0 ± 1.3	19.3 ± 2.3	203.2 ± 3.9	6.0 ± .6
103.4 ± 1.3	18.2 ± 2.2	207.3 ± 4.1	5.2 ± .5
104.8 ± 1.4	17.2 ± 2.1	211.5 ± 4.2	5.0 ± .5
106.2 ± 1.4	14.3 ± 1.8	215.8 ± 4.3	5.0 ± .5
107.7 ± 1.4	18.0 ± 2.1	220.2 ± 4.5	4.8 ± .5
109.2 ± 1.5	16.7 ± 1.9	224.8 ± 4.6	3.8 ± .4
110.7 ± 1.5	16.5 ± 1.9	229.6 ± 4.8	4.3 ± .4
112.2 ± 1.5	17.0 ± 1.9	234.5 ± 4.9	4.1 ± .4
113.8 ± 1.6	14.1 ± 1.7	239.5 ± 5.1	3.6 ± .4
115.5 ± 1.6	15.9 ± 1.8	244.8 ± 5.3	3.1 ± .3
117.1 ± 1.6	13.1 ± 1.5	250.2 ± 5.5	3.0 ± .3
118.8 ± 1.7	13.4 ± 1.5	255.9 ± 5.7	3.1 ± .3
120.6 ± 1.7	14.0 ± 1.6	261.7 ± 5.9	2.6 ± .3
122.4 ± 1.8	12.1 ± 1.4	267.8 ± 6.1	3.8 ± .4
124.2 ± 1.8	12.3 ± 1.4	274.0 ± 6.4	2.0 ± .2
126.1 ± 1.8	11.4 ± 1.3	280.6 ± 6.6	3.0 ± .3
128.0 ± 1.9	12.9 ± 1.4	287.3 ± 6.9	1.4 ± .1
129.9 ± 1.9	10.6 ± 1.2	294.4 ± 7.1	2.5 ± .2
131.9 ± 2.0	12.0 ± 1.3	301.7 ± 7.4	2.1 ± .2
134.0 ± 2.0	10.8 ± 1.2	309.3 ± 7.7	1.9 ± .2
136.1 ± 2.1	11.8 ± 1.3	317.3 ± 8.1	1.8 ± .2
138.2 ± 2.1	11.5 ± 1.3	325.5 ± 8.4	1.7 ± .1
140.4 ± 2.2	10.7 ± 1.2	334.1 ± 8.8	1.6 ± .1
142.7 ± 2.2	10.6 ± 1.2	343.1 ± 9.1	1.6 ± .1
145.0 ± 2.3	10.4 ± 1.1	352.6 ± 9.6	1.4 ± .1
147.4 ± 2.4	10.4 ± 1.1	362.4 ± 10.0	1.3 ± .1
149.8 ± 2.4	12.1 ± 1.3	372.7 ± 10.5	1.3 ± .1
152.3 ± 2.5	9.6 ± 1.0	383.4 ± 11.0	.0 ± .0
154.9 ± 2.6	9.7 ± 1.0	394.7 ± 11.5	.0 ± .0
157.5 ± 2.6	9.6 ± 1.0	406.6 ± 12.1	.0 ± .0
160.2 ± 2.7	10.0 ± 1.0	419.0 ± 12.7	.0 ± .0
163.0 ± 2.8	8.4 ± .9	432.1 ± 13.4	.0 ± .0
165.9 ± 2.8	10.2 ± 1.1	445.9 ± 14.1	.0 ± .0

TABLE 18.- Concluded

(e) Angle of scatter of 60°

Energy, MeV	Cross section, μb/sr-MeV	Energy, MeV	Cross section, μb/sr-MeV
89.7 ± 1.1	.0 ± .0	168.8 ± 2.9	3.4 ± .3
90.8 ± 1.1	.0 ± .0	171.8 ± 3.0	2.7 ± .3
91.9 ± 1.1	16.3 ± 2.0	174.9 ± 3.1	2.6 ± .3
93.1 ± 1.1	15.1 ± 1.8	178.1 ± 3.2	3.0 ± .3
94.3 ± 1.2	16.6 ± 1.9	181.4 ± 3.3	2.6 ± .3
95.5 ± 1.2	13.3 ± 1.6	184.8 ± 3.4	2.5 ± .3
96.8 ± 1.2	12.1 ± 1.4	188.3 ± 3.5	2.2 ± .2
98.0 ± 1.2	12.9 ± 1.5	191.8 ± 3.6	2.5 ± .2
99.3 ± 1.3	14.0 ± 1.5	195.5 ± 3.7	1.8 ± .2
100.6 ± 1.3	11.9 ± 1.3	199.3 ± 3.8	1.7 ± .2
102.0 ± 1.3	10.4 ± 1.2	203.2 ± 3.9	1.8 ± .2
103.4 ± 1.3	9.7 ± 1.1	207.3 ± 4.1	1.6 ± .2
104.8 ± 1.4	9.0 ± 1.1	211.5 ± 4.2	1.4 ± .1
106.2 ± 1.4	10.4 ± 1.2	215.8 ± 4.3	1.1 ± .1
107.7 ± 1.4	8.6 ± 1.0	220.2 ± 4.5	1.3 ± .1
109.2 ± 1.5	8.8 ± 1.0	224.8 ± 4.6	1.1 ± .1
110.7 ± 1.5	9.6 ± 1.1	229.6 ± 4.8	1.0 ± .1
112.2 ± 1.5	9.2 ± 1.0	234.5 ± 4.9	.9 ± .1
113.8 ± 1.6	8.9 ± 1.0	239.5 ± 5.1	.8 ± .1
115.5 ± 1.6	8.6 ± .9	244.8 ± 5.3	.6 ± .0
117.1 ± 1.6	7.8 ± .9	250.2 ± 5.5	.5 ± .0
118.8 ± 1.7	7.6 ± .8	255.9 ± 5.7	.3 ± .0
120.6 ± 1.7	7.8 ± .8	261.7 ± 5.9	.3 ± .0
122.4 ± 1.8	7.3 ± .8	267.8 ± 6.1	.3 ± .0
124.2 ± 1.8	6.9 ± .8	274.0 ± 6.4	.2 ± .0
126.1 ± 1.8	5.8 ± .6	280.6 ± 6.6	.2 ± .0
128.0 ± 1.9	6.7 ± .7	287.3 ± 6.9	.2 ± .0
129.9 ± 1.9	6.1 ± .7	294.4 ± 7.1	.2 ± .0
131.9 ± 2.0	6.2 ± .7	301.7 ± 7.4	.1 ± .0
134.0 ± 2.0	5.1 ± .6	309.3 ± 7.7	.1 ± .0
136.1 ± 2.1	6.0 ± .6	317.3 ± 8.1	.0 ± .0
138.2 ± 2.1	5.5 ± .6	325.5 ± 8.4	.0 ± .0
140.4 ± 2.2	5.4 ± .6	334.1 ± 8.8	.0 ± .0
142.7 ± 2.2	5.2 ± .6	343.1 ± 9.1	.0 ± .0
145.0 ± 2.3	5.0 ± .5	352.6 ± 9.6	.0 + .0
147.4 ± 2.4	4.9 ± .5	362.4 ± 10.0	.0 + .0
149.8 ± 2.4	4.6 ± .5	372.7 ± 10.5	.0 ± .0
152.3 ± 2.5	4.1 ± .4	383.4 ± 11.0	.0 ± .0
154.9 ± 2.6	4.3 ± .4	394.7 ± 11.5	.0 ± .0
157.5 ± 2.6	4.1 ± .4	406.6 ± 12.1	.0 ± .0
160.2 ± 2.7	3.7 ± .4	419.0 ± 12.7	.0 ± .0
163.0 ± 2.8	3.6 ± .4	432.1 ± 13.4	.0 ± .0
165.9 ± 2.8	3.9 ± .4	445.9 ± 14.1	.0 ± .0

TABLE 19.- DOUBLE DIFFERENTIAL CROSS SECTIONS FOR PRODUCTION OF SECONDARY DEUTERONS FROM CARBON TARGET, 0.95 g/cm^2 THICK

[Incident proton energy, 558 MeV]

(a) Angle of scatter of 10^{o}

Energy, MeV	Cross section, μb/sr-MeV	Energy, MeV	Cross section, μb/sr-MeV
88.8 ± 1.1	.0 ± .0	167.0 ± 2.9	70.0 ± 9.9
89.9 ± 1.1	83.3 ± 24.0	170.0 ± 3.0	71.0 ± 9.8
91.0 ± 1.1	96.9 ± 24.1	173.1 ± 3.1	90.5 ± 11.6
92.2 ± 1.1	70.3 ± 19.0	176.2 ± 3.1	58.1 ± 8.4
93.4 ± 1.1	58.5 ± 16.3	179.5 ± 3.2	79.6 ± 10.3
94.6 ± 1.2	72.2 ± 17.6	182.8 ± 3.3	73.1 ± 9.6
95.8 ± 1.2	87.5 ± 18.9	186.2 ± 3.4	49.3 ± 7.2
97.1 ± 1.2	52.1 ± 13.7	189.8 ± 3.5	69.2 ± 9.0
98.3 ± 1.2	70.3 ± 15.8	193.4 ± 3.6	58.8 ± 7.9
99.7 ± 1.3	75.2 ± 16.0	197.2 ± 3.8	60.9 ± 8.0
101.0 ± 1.3	49.4 ± 12.3	201.0 ± 3.9	61.7 ± 8.0
102.3 ± 1.3	63.0 ± 13.9	205.0 ± 4.0	66.3 ± 8.4
103.7 ± 1.4	65.4 ± 14.0	209.2 ± 4.1	66.0 ± 8.2
105.2 ± 1.4	62.8 ± 13.4	213.4 ± 4.3	64.0 ± 7.9
106.6 ± 1.4	53.5 ± 12.0	217.8 ± 4.4	54.7 ± 7.0
108.1 ± 1.4	65.1 ± 13.3	222.3 ± 4.6	50.1 ± 6.5
109.6 ± 1.5	67.2 ± 13.4	227.0 ± 4.7	59.5 ± 7.2
111.1 ± 1.5	73.3 ± 13.9	231.8 ± 4.9	55.3 ± 6.8
112.7 ± 1.5	83.1 ± 14.8	236.9 ± 5.0	57.3 ± 6.9
114.3 ± 1.6	88.3 ± 15.2	242.0 ± 5.2	53.3 ± 6.5
116.0 ± 1.6	60.8 ± 11.9	247.4 ± 5.4	55.1 ± 6.6
117.7 ± 1.7	71.7 ± 13.0	253.0 ± 5.6	60.5 ± 7.0
119.4 ± 1.7	80.1 ± 13.8	258.7 ± 5.8	51.3 ± 6.1
121.1 ± 1.7	60.3 ± 11.4	264.7 ± 6.0	55.8 ± 6.4
123.0 ± 1.8	71.7 ± 12.6	270.9 ± 6.3	58.7 ± 6.6
124.8 ± 1.8	64.5 ± 11.6	277.3 ± 6.5	51.3 ± 5.9
126.7 ± 1.9	85.8 ± 13.8	284.0 ± 6.8	53.1 ± 6.0
128.6 ± 1.9	70.8 ± 12.0	290.9 ± 7.0	61.2 ± 6.6
130.6 ± 2.0	68.4 ± 11.6	298.1 ± 7.3	50.3 ± 5.6
132.6 ± 2.0	76.0 ± 12.2	305.6 ± 7.6	55.8 ± 6.1
134.7 ± 2.1	95.1 ± 14.0	313.5 ± 7.9	67.8 ± 7.0
136.8 ± 2.1	70.8 ± 11.4	321.6 ± 8.3	73.1 ± 7.4
139.0 ± 2.2	54.4 ± 9.5	330.1 ± 8.6	78.7 ± 7.9
141.2 ± 2.2	74.6 ± 11.5	339.0 ± 9.0	69.8 ± 7.1
143.5 ± 2.3	56.7 ± 9.5	348.2 ± 9.4	66.2 ± 6.7
145.9 ± 2.3	54.8 ± 9.2	357.9 ± 9.8	63.3 ± 6.4
148.3 ± 2.4	80.5 ± 11.7	368.0 ± 10.3	74.8 ± 7.4
150.8 ± 2.5	88.6 ± 12.3	378.6 ± 10.8	.0 ± .0
153.3 ± 2.5	74.4 ± 10.9	389.7 ± 11.3	.0 ± .0
155.9 ± 2.6	68.1 ± 10.1	401.4 ± 11.9	.0 ± .0
158.6 ± 2.7	58.3 ± 9.0	413.6 ± 12.5	.0 ± .0
161.3 ± 2.7	64.3 ± 9.5	426.4 ± 13.1	.0 ± .0
164.1 ± 2.8	77.6 ± 10.7	440.0 ± 13.8	.0 ± .0

TABLE 19.- Continued

(b) Angle of scatter of 20°

Energy, MeV	Cross section, μb/sr-MeV	Energy, MeV	Cross section, μb/sr-MeV
89.1 ± 1.1	.0 ± .0	167.4 ± 2.9	38.7 ± 5.1
90.2 ± 1.1	67.5 ± 15.0	170.3 ± 3.0	32.1 ± 4.4
91.3 ± 1.1	64.0 ± 13.5	173.4 ± 3.1	29.9 ± 4.1
92.5 ± 1.1	55.5 ± 11.7	176.5 ± 3.1	33.1 ± 4.4
93.7 ± 1.1	49.4 ± 10.5	179.8 ± 3.2	33.9 ± 4.4
94.9 ± 1.2	46.5 ± 9.7	183.1 ± 3.3	37.3 ± 4.7
96.1 ± 1.2	55.3 ± 10.4	186.5 ± 3.4	35.0 ± 4.4
97.4 ± 1.2	38.2 ± 8.1	190.1 ± 3.5	33.4 ± 4.2
98.6 ± 1.2	37.1 ± 7.8	193.7 ± 3.6	37.4 ± 4.6
099.9 ± 1.3	57.1 ± 9.8	197.5 ± 3.8	28.1 ± 3.7
101.3 ± 1.3	54.2 ± 9.3	201.3 ± 3.9	26.5 ± 3.5
102.6 ± 1.3	38.7 ± 7.5	205.3 ± 4.0	26.3 ± 3.4
104.0 ± 1.4	37.1 ± 7.2	209.4 ± 4.1	29.5 ± 3.7
105.5 ± 1.4	36.6 ± 7.0	213.7 ± 4.3	31.0 ± 3.7
106.9 ± 1.4	40.5 ± 7.3	218.1 ± 4.4	27.5 ± 3.4
108.4 ± 1.4	45.0 ± 7.7	222.6 ± 4.6	30.0 ± 3.6
109.9 ± 1.5	47.4 ± 7.9	227.3 ± 4.7	26.0 ± 3.2
111.4 ± 1.5	56.1 ± 8.7	232.1 ± 4.9	27.2 ± 3.2
113.0 ± 1.5	38.9 ± 6.8	237.1 ± 5.0	27.8 ± 3.3
114.6 ± 1.6	37.7 ± 6.6	242.3 ± 5.2	25.4 ± 3.0
116.3 ± 1.6	39.0 ± 6.6	247.6 ± 5.4	27.5 ± 3.2
118.0 ± 1.7	51.0 ± 7.8	253.2 ± 5.6	23.3 ± 2.8
119.7 ± 1.7	54.2 ± 8.0	258.9 ± 5.8	20.1 ± 2.4
121.5 ± 1.7	47.8 ± 7.3	264.9 ± 6.0	20.7 ± 2.5
123.3 ± 1.8	45.5 ± 7.0	271.1 ± 6.2	19.3 ± 2.3
125.1 ± 1.8	39.7 ± 6.3	277.5 ± 6.5	21.4 ± 2.5
127.0 ± 1.9	37.0 ± 6.0	284.1 ± 6.7	20.3 ± 2.3
128.9 ± 1.9	32.4 ± 5.4	291.0 ± 7.0	21.3 ± 2.4
130.9 ± 2.0	46.3 ± 6.8	298.2 ± 7.3	13.7 ± 1.7
132.9 ± 2.0	52.3 ± 7.3	305.7 ± 7.6	13.3 ± 1.6
135.0 ± 2.1	42.6 ± 6.3	313.5 ± 7.9	17.5 ± 2.0
137.1 ± 2.1	40.5 ± 6.0	321.6 ± 8.2	13.1 ± 1.6
139.3 ± 2.2	43.0 ± 6.2	330.1 ± 8.6	14.3 ± 1.7
141.6 ± 2.2	40.4 ± 5.8	338.9 ± 9.0	10.2 ± 1.3
143.9 ± 2.3	38.0 ± 5.5	348.2 ± 9.4	10.0 ± 1.2
146.2 ± 2.3	35.6 ± 5.2	357.8 ± 9.8	7.2 ± 1.0
148.6 ± 2.4	38.9 ± 5.5	367.9 ± 10.3	8.3 ± 1.1
151.1 ± 2.5	33.3 ± 4.9	378.4 ± 10.8	.0 ± .0
153.6 ± 2.5	40.1 ± 5.5	389.5 ± 11.3	.0 ± .0
156.2 ± 2.6	36.7 ± 5.1	401.1 ± 11.8	.0 ± .0
158.9 ± 2.7	36.5 ± 5.0	413.3 ± 12.4	.0 ± .0
161.6 ± 2.7	47.4 ± 6.0	426.1 ± 13.1	.0 ± .0
164.5 ± 2.8	31.9 ± 4.5	439.5 ± 13.8	.0 ± .0

TABLE 19.- Continued

(c) Angle of scatter of 30°

Energy, MeV	Cross section, $\mu b/sr$-MeV	Energy, MeV	Cross section, $\mu b/sr$-MeV
109.9 ± 1.5	36.8 ± 6.7	227.3 ± 4.7	15.1 ± 2.1
111.4 ± 1.5	25.5 ± 5.3	232.1 ± 4.9	9.9 ± 1.6
113.0 ± 1.5	30.0 ± 5.7	237.1 ± 5.0	13.9 ± 2.0
114.6 ± 1.6	38.5 ± 6.6	242.3 ± 5.2	11.8 ± 1.7
116.3 ± 1.6	30.6 ± 5.7	247.6 ± 5.4	11.3 ± 1.7
118.0 ± 1.7	34.5 ± 6.0	253.2 ± 5.6	12.0 ± 1.7
119.7 ± 1.7	32.6 ± 5.7	258.9 ± 5.8	9.0 ± 1.4
121.5 ± 1.7	42.1 ± 6.7	264.9 ± 6.0	10.4 ± 1.5
123.3 ± 1.8	35.0 ± 5.9	271.1 ± 6.2	9.1 ± 1.3
125.1 ± 1.8	19.7 ± 4.1	277.5 ± 6.5	8.4 ± 1.3
127.0 ± 1.9	27.9 ± 5.0	284.1 ± 6.7	11.2 ± 1.5
128.9 ± 1.9	21.7 ± 4.2	291.0 ± 7.0	7.4 ± 1.1
130.9 ± 2.0	23.5 ± 4.3	298.2 ± 7.3	6.4 ± 1.0
132.9 ± 2.0	26.4 ± 4.6	305.7 ± 7.6	5.3 ± .9
135.0 ± 2.1	29.0 ± 4.8	313.5 ± 7.9	6.3 ± .9
137.1 ± 2.1	25.7 ± 4.4	321.6 ± 8.2	5.9 ± .9
139.3 ± 2.2	24.8 ± 4.2	330.1 ± 8.6	6.0 ± .9
141.6 ± 2.2	30.3 ± 4.8	338.9 ± 9.0	5.5 ± .8
143.9 ± 2.3	23.6 ± 4.0	348.2 ± 9.4	3.9 ± .6
146.2 ± 2.3	21.8 ± 3.8	357.8 ± 9.8	6.2 ± .9
148.6 ± 2.4	21.5 ± 3.7	367.9 ± 10.3	4.4 ± .7
151.1 ± 2.5	24.5 ± 3.9	378.4 ± 10.8	.0 ± .0
153.6 ± 2.5	22.4 ± 3.7	389.5 ± 11.3	.0 ± .0
156.2 ± 2.6	29.6 ± 4.4	401.1 ± 11.8	.0 ± .0
158.9 ± 2.7	22.0 ± 3.6	413.3 ± 12.4	.0 ± .0
161.6 ± 2.7	26.5 ± 4.0	426.1 ± 13.1	.0 ± .0
164.5 ± 2.8	20.4 ± 3.3	439.5 ± 13.8	.0 ± .0
167.4 ± 2.9	22.5 ± 3.5	453.7 ± 14.5	.0 ± .0
170.3 ± 3.0	19.1 ± 3.1	468.7 ± 15.3	.0 ± .0
173.4 ± 3.1	23.8 ± 3.5	484.5 ± 16.2	.0 ± .0
176.5 ± 3.1	24.0 ± 3.5	501.2 ± 17.2	.0 ± .0
179.8 ± 3.2	21.1 ± 3.2	518.9 ± 18.2	.0 ± .0
183.1 ± 3.3	16.5 ± 2.7	537.7 ± 19.3	.0 ± .0
186.5 ± 3.4	21.8 ± 3.1	557.7 ± 20.5	.0 ± .0
190.1 ± 3.5	15.3 ± 2.5	579.0 ± 21.9	.0 ± .0
193.7 ± 3.6	15.3 ± 2.4	601.6 ± 23.4	.0 ± .0
197.5 ± 3.8	15.9 ± 2.4	625.9 ± 25.0	.0 ± .0
201.3 ± 3.9	19.2 ± 2.7	651.8 ± 26.8	.0 ± .0
205.3 ± 4.0	17.2 ± 2.5	679.7 ± 28.9	.0 ± .0
209.4 ± 4.1	17.5 ± 2.5	709.7 ± 31.1	.0 ± .0
213.7 ± 4.3	16.6 ± 2.4	742.1 ± 33.6	.0 ± .0
218.1 ± 4.4	16.4 ± 2.3	777.1 ± 36.5	.0 ± .0
222.6 ± 4.6	13.8 ± 2.0	815.2 ± 39.7	.0 ± .0

TABLE 19.- Continued

(d) Angle of scatter of 40°

Energy, MeV	Cross section, μb/sr-MeV	Energy, MeV	Cross section, μb/sr-MeV
89.1 ± 1.1	.0 ± .0	167.4 ± 2.9	15.4 ± 1.8
90.2 ± 1.1	59.5 ± 8.2	170.3 ± 3.0	16.6 ± 1.9
91.3 ± 1.1	55.0 ± 7.4	173.4 ± 3.1	13.7 ± 1.6
92.5 ± 1.1	42.0 ± 5.9	176.5 ± 3.1	14.2 ± 1.6
93.7 ± 1.1	35.8 ± 5.1	179.8 ± 3.2	12.3 ± 1.4
94.9 ± 1.2	36.0 ± 5.0	183.1 ± 3.3	12.9 ± 1.5
96.1 ± 1.2	38.0 ± 5.0	186.5 ± 3.4	13.1 ± 1.5
97.4 ± 1.2	30.6 ± 4.2	190.1 ± 3.5	11.9 ± 1.4
98.6 ± 1.2	28.0 ± 3.9	193.7 ± 3.6	12.5 ± 1.4
099.9 ± 1.3	28.1 ± 3.9	197.5 ± 3.8	12.7 ± 1.4
101.3 ± 1.3	34.7 ± 4.4	201.3 ± 3.9	12.0 ± 1.3
102.6 ± 1.3	29.1 ± 3.9	205.3 ± 4.0	10.6 ± 1.2
104.0 ± 1.4	29.6 ± 3.9	209.4 ± 4.1	12.5 ± 1.3
105.5 ± 1.4	31.5 ± 4.0	213.7 ± 4.3	9.3 ± 1.0
106.9 ± 1.4	28.1 ± 3.6	218.1 ± 4.4	11.7 ± 1.2
108.4 ± 1.4	26.1 ± 3.4	222.6 ± 4.6	9.4 ± 1.0
109.9 ± 1.5	27.5 ± 3.5	227.3 ± 4.7	8.8 ± 1.0
111.4 ± 1.5	24.8 ± 3.2	232.1 ± 4.9	9.9 ± 1.1
113.0 ± 1.5	29.0 ± 3.6	237.1 ± 5.0	8.2 ± .9
114.6 ± 1.6	25.6 ± 3.2	242.3 ± 5.2	8.3 ± .9
116.3 ± 1.6	30.4 ± 3.7	247.6 ± 5.4	7.7 ± .8
118.0 ± 1.7	22.9 ± 2.9	253.2 ± 5.6	7.7 ± .8
119.7 ± 1.7	25.5 ± 3.2	258.9 ± 5.8	7.2 ± .8
121.5 ± 1.7	26.1 ± 3.2	264.9 ± 6.0	7.0 ± .8
123.3 ± 1.8	25.9 ± 3.1	271.1 ± 6.2	7.0 ± .7
125.1 ± 1.8	24.8 ± 3.0	277.5 ± 6.5	5.7 ± .6
127.0 ± 1.9	21.2 ± 2.7	284.1 ± 6.7	5.7 ± .6
128.9 ± 1.9	19.3 ± 2.5	291.0 ± 7.0	6.3 ± .7
130.9 ± 2.0	23.6 ± 2.8	298.2 ± 7.3	4.5 ± .5
132.9 ± 2.0	23.1 ± 2.8	305.7 ± 7.6	3.6 ± .4
135.0 ± 2.1	24.2 ± 2.8	313.5 ± 7.9	4.0 ± .4
137.1 ± 2.1	23.1 ± 2.7	321.6 ± 8.2	3.0 ± .3
139.3 ± 2.2	24.5 ± 2.8	330.1 ± 8.6	3.1 ± .3
141.6 ± 2.2	17.7 ± 2.2	338.9 ± 9.0	2.7 ± .3
143.9 ± 2.3	19.7 ± 2.3	348.2 ± 9.4	2.5 ± .3
146.2 ± 2.3	19.1 ± 2.3	357.8 ± 9.8	2.1 ± .2
148.6 ± 2.4	18.6 ± 2.2	367.9 ± 10.3	1.7 ± .2
151.1 ± 2.5	19.6 ± 2.3	378.4 ± 10.8	.0 ± .0
153.6 ± 2.5	18.2 ± 2.1	389.5 ± 11.3	.0 ± .0
156.2 ± 2.6	16.7 ± 2.0	401.1 ± 11.8	.0 ± .0
158.9 ± 2.7	16.1 ± 1.9	413.3 ± 12.4	.0 ± .0
161.6 ± 2.7	18.9 ± 2.1	426.1 ± 13.1	.0 ± .0
164.5 ± 2.8	20.9 ± 2.3	439.5 ± 13.8	.0 ± .0

TABLE 19.- Continued

(e) Angle of scatter of 50°

Energy, MeV	Cross section, μb/sr-MeV	Energy, MeV	Cross section, μb/sr-MeV
89.7 ± 1.1	.0 ± .0	168.8 ± 2.9	13.1 ± 1.7
90.8 ± 1.1	69.0 ± 9.8	171.8 ± 3.0	9.5 ± 1.3
91.9 ± 1.1	37.9 ± 6.3	174.9 ± 3.1	9.5 ± 1.3
93.1 ± 1.1	48.0 ± 6.9	178.1 ± 3.2	11.0 ± 1.4
94.3 ± 1.2	36.3 ± 5.5	181.4 ± 3.3	9.5 ± 1.2
95.5 ± 1.2	36.7 ± 5.4	184.8 ± 3.4	10.6 ± 1.3
96.8 ± 1.2	33.6 ± 4.9	188.3 ± 3.5	9.1 ± 1.2
98.0 ± 1.2	32.6 ± 4.7	191.8 ± 3.6	7.9 ± 1.1
99.3 ± 1.3	24.7 ± 3.9	195.5 ± 3.7	6.0 ± .9
100.6 ± 1.3	23.3 ± 3.6	199.3 ± 3.8	8.3 ± 1.1
102.0 ± 1.3	18.9 ± 3.1	203.2 ± 3.9	8.0 ± 1.0
103.4 ± 1.3	24.8 ± 3.7	207.3 ± 4.1	6.3 ± .8
104.8 ± 1.4	19.4 ± 3.1	211.5 ± 4.2	8.5 ± 1.0
106.2 ± 1.4	23.1 ± 3.4	215.8 ± 4.3	6.4 ± .8
107.7 ± 1.4	18.9 ± 2.9	220.2 ± 4.5	7.1 ± .9
109.2 ± 1.5	25.8 ± 3.6	224.8 ± 4.6	6.1 ± .8
110.7 ± 1.5	22.8 ± 3.3	229.6 ± 4.8	5.8 ± .7
112.2 ± 1.5	22.9 ± 3.2	234.5 ± 4.9	4.8 ± .6
113.8 ± 1.6	21.8 ± 3.1	239.5 ± 5.1	4.7 ± .6
115.5 ± 1.6	26.1 ± 3.5	244.8 ± 5.3	4.1 ± .6
117.1 ± 1.6	19.4 ± 2.8	250.2 ± 5.5	4.5 ± .6
118.8 ± 1.7	20.0 ± 2.8	255.9 ± 5.7	4.5 ± .6
120.6 ± 1.7	20.1 ± 2.8	261.7 ± 5.9	3.0 ± .4
122.4 ± 1.8	20.2 ± 2.8	267.8 ± 6.1	2.8 ± .4
124.2 ± 1.8	21.0 ± 2.8	274.0 ± 6.4	2.7 ± .4
126.1 ± 1.8	16.6 ± 2.4	280.6 ± 6.6	2.6 ± .4
128.0 ± 1.9	16.5 ± 2.3	287.3 ± 6.9	1.8 ± .3
129.9 ± 1.9	18.3 ± 2.5	294.4 ± 7.1	1.1 ± .2
131.9 ± 2.0	16.2 ± 2.3	301.7 ± 7.4	2.0 ± .3
134.0 ± 2.0	14.4 ± 2.1	309.3 ± 7.7	1.7 ± .2
136.1 ± 2.1	15.6 ± 2.2	317.3 ± 8.1	1.1 ± .2
138.2 ± 2.1	15.6 ± 2.1	325.5 ± 8.4	1.1 ± .2
140.4 ± 2.2	11.9 ± 1.7	334.1 ± 8.8	1.1 ± .2
142.7 ± 2.2	13.0 ± 1.8	343.1 ± 9.1	.9 ± .1
145.0 ± 2.3	14.4 ± 1.9	352.6 ± 9.6	.7 ± .1
147.4 ± 2.4	12.8 ± 1.8	362.4 ± 10.0	.7 ± .1
149.8 ± 2.4	16.0 ± 2.1	372.7 ± 10.5	1.1 ± .1
152.3 ± 2.5	10.3 ± 1.5	383.4 ± 11.0	.0 ± .0
154.9 ± 2.6	10.5 ± 1.5	394.7 ± 11.5	.0 ± .0
157.5 ± 2.6	13.4 ± 1.8	406.6 ± 12.1	.0 ± .0
160.2 ± 2.7	11.1 ± 1.5	419.0 ± 12.7	.0 ± .0
163.0 ± 2.8	11.5 ± 1.5	432.1 ± 13.4	.0 ± .0
165.9 ± 2.8	12.4 ± 1.6	445.9 ± 14.1	.0 ± .0

TABLE 19.- Concluded

(f) Angle of scatter of 60°

Energy, MeV	Cross section, μb/sr-MeV	Energy, MeV	Cross section, μb/sr-MeV
89.7 ± 1.1	.0 ± .0	168.8 ± 2.9	6.3 ± .8
90.8 ± 1.1	43.2 ± 5.5	171.8 ± 3.0	7.0 ± .8
91.9 ± 1.1	38.4 ± 4.8	174.9 ± 3.1	5.1 ± .6
93.1 ± 1.1	22.7 ± 3.2	178.1 ± 3.2	5.2 ± .6
94.3 ± 1.2	33.6 ± 4.1	181.4 ± 3.3	5.1 ± .6
95.5 ± 1.2	26.0 ± 3.3	184.8 ± 3.4	4.1 ± .5
96.8 ± 1.2	21.9 ± 2.9	188.3 ± 3.5	4.4 ± .5
98.0 ± 1.2	19.2 ± 2.5	191.8 ± 3.6	4.5 ± .5
99.3 ± 1.3	22.9 ± 2.8	195.5 ± 3.7	4.3 ± .5
100.6 ± 1.3	18.9 ± 2.4	199.3 ± 3.8	3.8 ± .5
102.0 ± 1.3	16.8 ± 2.2	203.2 ± 3.9	3.3 ± .4
103.4 ± 1.3	15.5 ± 2.1	207.3 ± 4.1	3.1 ± .4
104.8 ± 1.4	17.3 ± 2.2	211.5 ± 4.2	2.7 ± .3
106.2 ± 1.4	15.3 ± 2.0	215.8 ± 4.3	2.9 ± .3
107.7 ± 1.4	17.9 ± 2.2	220.2 ± 4.5	2.7 ± .3
109.2 ± 1.5	15.5 ± 2.0	224.8 ± 4.6	2.5 ± .3
110.7 ± 1.5	15.2 ± 1.9	229.6 ± 4.8	2.0 ± .3
112.2 ± 1.5	17.4 ± 2.1	234.5 ± 4.9	1.9 ± .2
113.8 ± 1.6	13.9 ± 1.8	239.5 ± 5.1	1.6 ± .2
115.5 ± 1.6	16.3 ± 2.0	244.8 ± 5.3	1.2 ± .2
117.1 ± 1.6	15.1 ± 1.8	250.2 ± 5.5	.9 ± .1
118.8 ± 1.7	14.1 ± 1.7	255.9 ± 5.7	1.1 ± .1
120.6 ± 1.7	11.8 ± 1.5	261.7 ± 5.9	.8 ± .1
122.4 ± 1.8	12.5 ± 1.6	267.8 ± 6.1	.7 ± .1
124.2 ± 1.8	12.3 ± 1.5	274.0 ± 6.4	.6 ± .1
126.1 ± 1.8	12.4 ± 1.5	280.6 ± 6.6	.5 ± .1
128.0 ± 1.9	11.7 ± 1.4	287.3 ± 6.9	.4 ± .1
129.9 ± 1.9	10.9 ± 1.4	294.4 ± 7.1	.3 ± .0
131.9 ± 2.0	9.7 ± 1.2	301.7 ± 7.4	.3 ± .0
134.0 ± 2.0	12.2 ± 1.4	309.3 ± 7.7	.2 ± .0
136.1 ± 2.1	10.4 ± 1.3	317.3 ± 8.1	.2 ± .0
138.2 ± 2.1	9.3 ± 1.1	325.5 ± 8.4	.1 ± .0
140.4 ± 2.2	11.3 ± 1.3	334.1 ± 8.8	.1 ± .0
142.7 ± 2.2	10.6 ± 1.3	343.1 ± 9.1	.1 ± .0
145.0 ± 2.3	9.1 ± 1.1	352.6 ± 9.6	.0 ± .0
147.4 ± 2.4	8.7 ± 1.1	362.4 ± 10.0	.1 ± .0
149.8 ± 2.4	7.8 ± 1.0	372.7 ± 10.5	.1 ± .0
152.3 ± 2.5	8.1 ± 1.0	383.4 ± 11.0	.0 ± .0
154.9 ± 2.6	7.7 ± .9	394.7 ± 11.5	.0 ± .0
157.5 ± 2.6	8.1 ± 1.0	406.6 ± 12.1	.0 ± .0
160.2 ± 2.7	6.7 ± .8	419.0 ± 12.7	.0 ± .0
163.0 ± 2.8	6.0 ± .8	432.1 ± 13.4	.0 ± .0
165.9 ± 2.8	7.2 ± .9	445.9 ± 14.1	.0 ± .0

TABLE 20.- DOUBLE DIFFERENTIAL CROSS SECTIONS FOR PRODUCTION OF SECONDARY DEUTERONS FROM ALUMINUM TARGET, 1.82 g/cm^2 THICK

[Incident proton energy, 558 MeV]

(a) Angle of scatter of 10^o

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
88.8 ± 1.1	.000 ± .000	167.0 ± 2.9	.104 ± .010
89.9 ± 1.1	.241 ± .035	170.0 ± 3.0	.109 ± .011
91.0 ± 1.1	.206 ± .030	173.1 ± 3.1	.104 ± .011
92.2 ± 1.1	.160 ± .024	176.2 ± 3.1	.100 ± .010
93.4 ± 1.1	.113 ± .018	179.5 ± 3.2	.097 ± .010
94.6 ± 1.2	.169 ± .023	182.8 ± 3.3	.114 ± .011
95.8 ± 1.2	.134 ± .019	186.2 ± 3.4	.100 ± .010
97.1 ± 1.2	.128 ± .018	189.8 ± 3.5	.097 ± .009
98.3 ± 1.2	.137 ± .019	193.4 ± 3.6	.096 ± .009
99.7 ± 1.3	.141 ± .019	197.2 ± 3.8	.093 ± .009
101.0 ± 1.3	.141 ± .019	201.0 ± 3.9	.094 ± .009
102.3 ± 1.3	.120 ± .016	205.0 ± 4.0	.097 ± .010
103.7 ± 1.4	.122 ± .016	209.2 ± 4.1	.085 ± .008
105.2 ± 1.4	.115 ± .015	213.4 ± 4.3	.093 ± .009
106.6 ± 1.4	.093 ± .013	217.8 ± 4.4	.093 ± .009
108.1 ± 1.4	.107 ± .014	222.3 ± 4.6	.088 ± .008
109.6 ± 1.5	.126 ± .016	227.0 ± 4.7	.089 ± .008
111.1 ± 1.5	.116 ± .015	231.8 ± 4.9	.079 ± .008
112.7 ± 1.5	.109 ± .014	236.9 ± 5.0	.087 ± .008
114.3 ± 1.6	.116 ± .015	242.0 ± 5.2	.077 ± .007
116.0 ± 1.6	.109 ± .014	247.4 ± 5.4	.079 ± .007
117.7 ± 1.7	.119 ± .015	253.0 ± 5.6	.074 ± .007
119.4 ± 1.7	.137 ± .016	258.7 ± 5.8	.072 ± .007
121.1 ± 1.7	.097 ± .012	264.7 ± 6.0	.079 ± .007
123.0 ± 1.8	.110 ± .014	270.9 ± 6.3	.080 ± .007
124.8 ± 1.8	.125 ± .015	277.3 ± 6.5	.078 ± .007
126.7 ± 1.9	.102 ± .013	284.0 ± 6.8	.083 ± .007
128.6 ± 1.9	.109 ± .013	290.9 ± 7.0	.084 ± .008
130.6 ± 2.0	.111 ± .013	298.1 ± 7.3	.088 ± .008
132.6 ± 2.0	.111 ± .013	305.6 ± 7.6	.087 ± .008
134.7 ± 2.1	.119 ± .014	313.5 ± 7.9	.096 ± .008
136.8 ± 2.1	.118 ± .013	321.6 ± 8.3	.097 ± .009
139.0 ± 2.2	.115 ± .013	330.1 ± 8.6	.097 ± .008
141.2 ± 2.2	.115 ± .013	339.0 ± 9.0	.090 ± .008
143.5 ± 2.3	.098 ± .011	348.2 ± 9.4	.101 ± .009
145.9 ± 2.3	.111 ± .012	357.9 ± 9.8	.099 ± .009
148.3 ± 2.4	.113 ± .012	368.0 ± 10.3	.101 ± .009
150.8 ± 2.5	.109 ± .012	378.6 ± 10.8	.000 ± .000
153.3 ± 2.5	.092 ± .010	389.7 ± 11.3	.000 ± .000
155.9 ± 2.6	.104 ± .011	401.4 ± 11.9	.000 ± .000
158.6 ± 2.7	.094 ± .010	413.6 ± 12.5	.000 ± .000
161.3 ± 2.7	.105 ± .011	426.4 ± 13.1	.000 ± .000
164.1 ± 2.8	.120 ± .012	440.0 ± 13.8	.000 ± .000

TABLE 20.- Continued

(b) Angle of scatter of 20°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.1 ± 1.1	.000 ± .000	167.4 ± 2.9	.058 ± .007
90.2 ± 1.1	.162 ± .029	170.3 ± 3.0	.059 ± .007
91.3 ± 1.1	.142 ± .025	173.4 ± 3.1	.071 ± .008
92.5 ± 1.1	.138 ± .023	176.5 ± 3.1	.066 ± .008
93.7 ± 1.1	.166 ± .025	179.8 ± 3.2	.057 ± .007
94.9 ± 1.2	.123 ± .020	183.1 ± 3.3	.062 ± .007
96.1 ± 1.2	.115 ± .018	186.5 ± 3.4	.063 ± .007
97.4 ± 1.2	.103 ± .017	190.1 ± 3.5	.051 ± .006
98.6 ± 1.2	.090 ± .015	193.7 ± 3.6	.063 ± .007
099.9 ± 1.3	.109 ± .017	197.5 ± 3.8	.056 ± .006
101.3 ± 1.3	.084 ± .014	201.3 ± 3.9	.051 ± .006
102.6 ± 1.3	.099 ± .015	205.3 ± 4.0	.047 ± .005
104.0 ± 1.4	.078 ± .013	209.4 ± 4.1	.057 ± .006
105.5 ± 1.4	.089 ± .014	213.7 ± 4.3	.049 ± .005
106.9 ± 1.4	.099 ± .014	218.1 ± 4.4	.059 ± .006
108.4 ± 1.4	.094 ± .014	222.6 ± 4.6	.056 ± .006
109.9 ± 1.5	.088 ± .013	227.3 ± 4.7	.045 ± .005
111.4 ± 1.5	.090 ± .013	232.1 ± 4.9	.048 ± .005
113.0 ± 1.5	.095 ± .013	237.1 ± 5.0	.040 ± .004
114.6 ± 1.6	.097 ± .013	242.3 ± 5.2	.045 ± .005
116.3 ± 1.6	.071 ± .011	247.6 ± 5.4	.040 ± .004
118.0 ± 1.7	.082 ± .012	253.2 ± 5.6	.040 ± .004
119.7 ± 1.7	.097 ± .013	258.9 ± 5.8	.044 ± .004
121.5 ± 1.7	.088 ± .012	264.9 ± 6.0	.038 ± .004
123.3 ± 1.8	.085 ± .012	271.1 ± 6.2	.036 ± .004
125.1 ± 1.8	.064 ± .009	277.5 ± 6.5	.034 ± .003
127.0 ± 1.9	.079 ± .011	284.1 ± 6.7	.033 ± .003
128.9 ± 1.9	.077 ± .010	291.0 ± 7.0	.027 ± .003
130.9 ± 2.0	.068 ± .009	298.2 ± 7.3	.027 ± .003
132.9 ± 2.0	.084 ± .011	305.7 ± 7.6	.028 ± .003
135.0 ± 2.1	.078 ± .010	313.5 ± 7.9	.025 ± .002
137.1 ± 2.1	.092 ± .011	321.6 ± 8.2	.023 ± .002
139.3 ± 2.2	.077 ± .010	330.1 ± 8.6	.019 ± .002
141.6 ± 2.2	.076 ± .010	338.9 ± 9.0	.018 ± .002
143.9 ± 2.3	.085 ± .010	348.2 ± 9.4	.016 ± .002
146.2 ± 2.3	.081 ± .010	357.8 ± 9.8	.016 ± .001
148.6 ± 2.4	.069 ± .009	367.9 ± 10.3	.013 ± .001
151.1 ± 2.5	.077 ± .009	378.4 ± 10.8	.000 ± .000
153.6 ± 2.5	.088 ± .010	389.5 ± 11.3	.000 ± .000
156.2 ± 2.6	.073 ± .009	401.1 ± 11.8	.000 ± .000
158.9 ± 2.7	.075 ± .009	413.3 ± 12.4	.000 ± .000
161.6 ± 2.7	.081 ± .009	426.1 ± 13.1	.000 ± .000
164.5 ± 2.8	.067 ± .008	439.5 ± 13.8	.000 ± .000

TABLE 20.- Continued

(c) Angle of scatter of 30°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
109.9 ± 1.5	.052 ± .008	227.3 ± 4.7	.023 ± .003
111.4 ± 1.5	.072 ± .010	232.1 ± 4.9	.031 ± .003
113.0 ± 1.5	.074 ± .010	237.1 ± 5.0	.026 ± .003
114.6 ± 1.6	.067 ± .010	242.3 ± 5.2	.023 ± .003
116.3 ± 1.6	.071 ± .010	247.6 ± 5.4	.020 ± .002
118.0 ± 1.7	.056 ± .008	253.2 ± 5.6	.019 ± .002
119.7 ± 1.7	.059 ± .009	258.9 ± 5.8	.020 ± .002
121.5 ± 1.7	.071 ± .010	264.9 ± 6.0	.019 ± .002
123.3 ± 1.8	.057 ± .008	271.1 ± 6.2	.018 ± .002
125.1 ± 1.8	.068 ± .009	277.5 ± 6.5	.018 ± .002
127.0 ± 1.9	.051 ± .007	284.1 ± 6.7	.011 ± .001
128.9 ± 1.9	.053 ± .007	291.0 ± 7.0	.016 ± .002
130.9 ± 2.0	.052 ± .007	298.2 ± 7.3	.014 ± .001
132.9 ± 2.0	.069 ± .009	305.7 ± 7.6	.012 ± .001
135.0 ± 2.1	.058 ± .008	313.5 ± 7.9	.010 ± .001
137.1 ± 2.1	.064 ± .008	321.6 ± 8.2	.012 ± .001
139.3 ± 2.2	.054 ± .007	330.1 ± 8.6	.008 ± .001
141.6 ± 2.2	.043 ± .006	338.9 ± 9.0	.009 ± .001
143.9 ± 2.3	.061 ± .008	348.2 ± 9.4	.008 ± .001
146.2 ± 2.3	.047 ± .006	357.8 ± 9.8	.007 ± .001
148.6 ± 2.4	.041 ± .006	367.9 ± 10.3	.007 ± .001
151.1 ± 2.5	.042 ± .006	378.4 ± 10.8	.000 ± .000
153.6 ± 2.5	.046 ± .006	389.5 ± 11.3	.000 ± .000
156.2 ± 2.6	.044 ± .006	401.1 ± 11.8	.000 ± .000
158.9 ± 2.7	.051 ± .006	413.3 ± 12.4	.000 ± .000
161.6 ± 2.7	.043 ± .005	426.1 ± 13.1	.000 ± .000
164.5 ± 2.8	.044 ± .005	439.5 ± 13.8	.000 ± .000
167.4 ± 2.9	.036 ± .005	453.7 ± 14.5	.000 ± .000
170.3 ± 3.0	.040 ± .005	468.7 ± 15.3	.000 ± .000
173.4 ± 3.1	.036 ± .005	484.5 ± 16.2	.000 ± .000
176.5 ± 3.1	.040 ± .005	501.2 ± 17.2	.000 ± .000
179.8 ± 3.2	.040 ± .005	518.9 ± 18.2	.000 ± .000
183.1 ± 3.3	.036 ± .004	537.7 ± 19.3	.000 ± .000
186.5 ± 3.4	.039 ± .005	557.7 ± 20.5	.000 ± .000
190.1 ± 3.5	.034 ± .004	579.0 ± 21.9	.000 ± .000
193.7 ± 3.6	.025 ± .003	601.6 ± 23.4	.000 ± .000
197.5 ± 3.8	.035 ± .004	625.9 ± 25.0	.000 ± .000
201.3 ± 3.9	.030 ± .004	651.8 ± 26.8	.000 ± .000
205.3 ± 4.0	.036 ± .004	679.7 ± 28.9	.000 ± .000
209.4 ± 4.1	.028 ± .003	709.7 ± 31.1	.000 ± .000
213.7 ± 4.3	.029 ± .003	742.1 ± 33.6	.000 ± .000
218.1 ± 4.4	.027 ± .003	777.1 ± 36.5	.000 ± .000
222.6 ± 4.6	.032 ± .003	815.2 ± 39.7	.000 ± .000

TABLE 20.- Continued

(d) Angle of scatter of 40^{o}

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.1 ± 1.1	.000 ± .000	167.4 ± 2.9	.033 ± .003
90.2 ± 1.1	.136 ± .015	170.3 ± 3.0	.031 ± .003
91.3 ± 1.1	.094 ± .011	173.4 ± 3.1	.030 ± .003
92.5 ± 1.1	.088 ± .010	176.5 ± 3.1	.030 ± .003
93.7 ± 1.1	.086 ± .010	179.8 ± 3.2	.025 ± .002
94.9 ± 1.2	.084 ± .009	183.1 ± 3.3	.030 ± .003
96.1 ± 1.2	.078 ± .008	186.5 ± 3.4	.027 ± .002
97.4 ± 1.2	.076 ± .008	190.1 ± 3.5	.024 ± .002
98.6 ± 1.2	.089 ± .009	193.7 ± 3.6	.024 ± .002
099.9 ± 1.3	.072 ± .008	197.5 ± 3.8	.024 ± .002
101.3 ± 1.3	.063 ± .007	201.3 ± 3.9	.020 ± .002
102.6 ± 1.3	.065 ± .007	205.3 ± 4.0	.020 ± .002
104.0 ± 1.4	.065 ± .007	209.4 ± 4.1	.019 ± .002
105.5 ± 1.4	.064 ± .007	213.7 ± 4.3	.018 ± .001
106.9 ± 1.4	.061 ± .006	218.1 ± 4.4	.020 ± .002
108.4 ± 1.4	.066 ± .007	222.6 ± 4.6	.018 ± .001
109.9 ± 1.5	.058 ± .006	227.3 ± 4.7	.018 ± .001
111.4 ± 1.5	.063 ± .006	232.1 ± 4.9	.016 ± .001
113.0 ± 1.5	.050 ± .005	237.1 ± 5.0	.016 ± .001
114.6 ± 1.6	.052 ± .005	242.3 ± 5.2	.014 ± .001
116.3 ± 1.6	.056 ± .006	247.6 ± 5.4	.014 ± .001
118.0 ± 1.7	.060 ± .006	253.2 ± 5.6	.013 ± .001
119.7 ± 1.7	.053 ± .005	258.9 ± 5.8	.011 ± .001
121.5 ± 1.7	.054 ± .005	264.9 ± 6.0	.010 ± .001
123.3 ± 1.8	.048 ± .005	271.1 ± 6.2	.011 ± .001
125.1 ± 1.8	.047 ± .005	277.5 ± 6.5	.009 ± .001
127.0 ± 1.9	.046 ± .005	284.1 ± 6.7	.009 ± .001
128.9 ± 1.9	.040 ± .004	291.0 ± 7.0	.008 ± .000
130.9 ± 2.0	.047 ± .005	298.2 ± 7.3	.008 ± .000
132.9 ± 2.0	.045 ± .004	305.7 ± 7.6	.007 ± .000
135.0 ± 2.1	.046 ± .004	313.5 ± 7.9	.007 ± .000
137.1 ± 2.1	.046 ± .004	321.6 ± 8.2	.005 ± .000
139.3 ± 2.2	.046 ± .004	330.1 ± 8.6	.005 ± .000
141.6 ± 2.2	.046 ± .004	338.9 ± 9.0	.004 ± .000
143.9 ± 2.3	.039 ± .004	348.2 ± 9.4	.003 ± .000
146.2 ± 2.3	.039 ± .004	357.8 ± 9.8	.002 ± .000
148.6 ± 2.4	.037 ± .004	367.9 ± 10.3	.002 ± .000
151.1 ± 2.5	.035 ± .003	378.4 ± 10.8	.000 ± .000
153.6 ± 2.5	.035 ± .003	389.5 ± 11.3	.000 ± .000
156.2 ± 2.6	.035 ± .003	401.1 ± 11.8	.000 ± .000
158.9 ± 2.7	.034 ± .003	413.3 ± 12.4	.000 ± .000
161.6 ± 2.7	.035 ± .003	426.1 ± 13.1	.000 ± .000
164.5 ± 2.8	.036 ± .003	439.5 ± 13.8	.000 ± .000

TABLE 20.- Continued

(e) Angle of scatter of 50°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.7 ± 1.1	.000 ± .000	168.8 ± 2.9	.024 ± .002
90.8 ± 1.1	.116 ± .014	171.8 ± 3.0	.021 ± .002
91.9 ± 1.1	.084 ± .010	174.9 ± 3.1	.023 ± .002
93.1 ± 1.1	.072 ± .009	178.1 ± 3.2	.017 ± .002
94.3 ± 1.2	.057 ± .007	181.4 ± 3.3	.018 ± .002
95.5 ± 1.2	.074 ± .008	184.8 ± 3.4	.017 ± .001
96.8 ± 1.2	.065 ± .007	188.3 ± 3.5	.018 ± .002
98.0 ± 1.2	.065 ± .007	191.8 ± 3.6	.017 ± .002
99.3 ± 1.3	.057 ± .007	195.5 ± 3.7	.016 ± .001
100.6 ± 1.3	.065 ± .007	199.3 ± 3.8	.015 ± .001
102.0 ± 1.3	.047 ± .005	203.2 ± 3.9	.015 ± .001
103.4 ± 1.3	.047 ± .005	207.3 ± 4.1	.013 ± .001
104.8 ± 1.4	.045 ± .005	211.5 ± 4.2	.011 ± .001
106.2 ± 1.4	.042 ± .005	215.8 ± 4.3	.012 ± .001
107.7 ± 1.4	.058 ± .006	220.2 ± 4.5	.013 ± .001
109.2 ± 1.5	.049 ± .005	224.8 ± 4.6	.010 ± .001
110.7 ± 1.5	.038 ± .004	229.6 ± 4.8	.011 ± .001
112.2 ± 1.5	.051 ± .005	234.5 ± 4.9	.009 ± .001
113.8 ± 1.6	.046 ± .005	239.5 ± 5.1	.008 ± .001
115.5 ± 1.6	.046 ± .005	244.8 ± 5.3	.008 ± .000
117.1 ± 1.6	.038 ± .004	250.2 ± 5.5	.006 ± .000
118.8 ± 1.7	.043 ± .005	255.9 ± 5.7	.006 ± .000
120.6 ± 1.7	.045 ± .005	261.7 ± 5.9	.005 ± .000
122.4 ± 1.8	.036 ± .004	267.8 ± 6.1	.006 ± .000
124.2 ± 1.8	.038 ± .004	274.0 ± 6.4	.004 ± .000
126.1 ± 1.8	.039 ± .004	280.6 ± 6.6	.005 ± .000
128.0 ± 1.9	.037 ± .004	287.3 ± 6.9	.004 ± .000
129.9 ± 1.9	.034 ± .004	294.4 ± 7.1	.003 ± .000
131.9 ± 2.0	.032 ± .003	301.7 ± 7.4	.003 ± .000
134.0 ± 2.0	.032 ± .003	309.3 ± 7.7	.002 ± .000
136.1 ± 2.1	.036 ± .004	317.3 ± 8.1	.002 ± .000
138.2 ± 2.1	.031 ± .003	325.5 ± 8.4	.002 ± .000
140.4 ± 2.2	.029 ± .003	334.1 ± 8.8	.001 ± .000
142.7 ± 2.2	.027 ± .003	343.1 ± 9.1	.001 ± .000
145.0 ± 2.3	.034 ± .003	352.6 ± 9.6	.001 ± .000
147.4 ± 2.4	.032 ± .003	362.4 ± 10.0	.001 ± .000
149.8 ± 2.4	.026 ± .003	372.7 ± 10.5	.000 ± .000
152.3 ± 2.5	.027 ± .003	383.4 ± 11.0	.000 ± .000
154.9 ± 2.6	.025 ± .002	394.7 ± 11.5	.000 ± .000
157.5 ± 2.6	.025 ± .002	406.6 ± 12.1	.000 ± .000
160.2 ± 2.7	.026 ± .002	419.0 ± 12.7	.000 ± .000
163.0 ± 2.8	.024 ± .002	432.1 ± 13.4	.000 ± .000
165.9 ± 2.8	.022 ± .002	445.9 ± 14.1	.000 ± .000

TABLE 20.- Concluded

(f) Angle of scatter of 60°

Energy, MeV	Cross section, μb/sr-MeV	Energy, MeV	Cross section, μb/sr-MeV
89.7 ± 1.1	.0 ± .0	168.8 ± 2.9	13.8 ± 1.5
90.8 ± 1.1	.0 ± .0	171.8 ± 3.0	11.5 ± 1.2
91.9 ± 1.1	66.3 ± 7.5	174.9 ± 3.1	8.8 ± 1.0
93.1 ± 1.1	58.8 ± 6.6	178.1 ± 3.2	11.3 ± 1.2
94.3 ± 1.2	54.6 ± 6.1	181.4 ± 3.3	9.4 ± 1.0
95.5 ± 1.2	52.1 ± 5.8	184.8 ± 3.4	9.0 ± 1.0
96.8 ± 1.2	44.8 ± 5.1	188.3 ± 3.5	8.5 ± .9
98.0 ± 1.2	46.3 ± 5.1	191.8 ± 3.6	9.1 ± 1.0
99.3 ± 1.3	42.3 ± 4.7	195.5 ± 3.7	8.1 ± .9
100.6 ± 1.3	45.1 ± 4.9	199.3 ± 3.8	6.8 ± .8
102.0 ± 1.3	40.6 ± 4.5	203.2 ± 3.9	6.1 ± .7
103.4 ± 1.3	33.8 ± 3.8	207.3 ± 4.1	5.9 ± .7
104.8 ± 1.4	36.5 ± 4.0	211.5 ± 4.2	5.1 ± .6
106.2 ± 1.4	34.9 ± 3.9	215.8 ± 4.3	5.1 ± .6
107.7 ± 1.4	38.2 ± 4.2	220.2 ± 4.5	5.0 ± .6
109.2 ± 1.5	29.2 ± 3.3	224.8 ± 4.6	4.8 ± .5
110.7 ± 1.5	26.5 ± 3.0	229.6 ± 4.8	3.9 ± .5
112.2 ± 1.5	27.1 ± 3.1	234.5 ± 4.9	3.0 ± .4
113.8 ± 1.6	28.1 ± 3.1	239.5 ± 5.1	3.1 ± .4
115.5 ± 1.6	30.8 ± 3.4	244.8 ± 5.3	2.4 ± .3
117.1 ± 1.6	23.8 ± 2.7	250.2 ± 5.5	2.7 ± .3
118.8 ± 1.7	29.5 ± 3.2	255.9 ± 5.7	2.3 ± .3
120.6 ± 1.7	25.4 ± 2.8	261.7 ± 5.9	2.1 ± .3
122.4 ± 1.8	24.5 ± 2.7	267.8 ± 6.1	1.4 ± .2
124.2 ± 1.8	21.3 ± 2.4	274.0 ± 6.4	1.4 ± .2
126.1 ± 1.8	21.9 ± 2.4	280.6 ± 6.6	1.1 ± .1
128.0 ± 1.9	22.1 ± 2.5	287.3 ± 6.9	1.2 ± .1
129.9 ± 1.9	21.5 ± 2.4	294.4 ± 7.1	1.0 ± .1
131.9 ± 2.0	19.3 ± 2.2	301.7 ± 7.4	.5 ± .1
134.0 ± 2.0	24.1 ± 2.6	309.3 ± 7.7	.4 ± .0
136.1 ± 2.1	19.5 ± 2.1	317.3 ± 8.1	.4 ± .1
138.2 ± 2.1	19.6 ± 2.1	325.5 ± 8.4	.2 ± .0
140.4 ± 2.2	20.5 ± 2.2	334.1 ± 8.8	.3 ± .0
142.7 ± 2.2	20.1 ± 2.1	343.1 ± 9.1	.2 ± .0
145.0 ± 2.3	17.9 ± 1.9	352.6 ± 9.6	.1 ± .0
147.4 ± 2.4	18.3 ± 2.0	362.4 ± 10.0	.1 ± .0
149.8 ± 2.4	16.7 ± 1.8	372.7 ± 10.5	.1 ± .0
152.3 ± 2.5	16.7 ± 1.8	383.4 ± 11.0	.0 ± .0
154.9 ± 2.6	15.8 ± 1.7	394.7 ± 11.5	.0 ± .0
157.5 ± 2.6	15.5 ± 1.7	406.6 ± 12.1	.0 ± .0
160.2 ± 2.7	13.8 ± 1.5	419.0 ± 12.7	.0 ± .0
163.0 ± 2.8	13.0 ± 1.4	432.1 ± 13.4	.0 ± .0
165.9 ± 2.8	13.1 ± 1.4	445.9 ± 14.1	.0 ± .0

TABLE 21.- DOUBLE DIFFERENTIAL CROSS SECTIONS FOR PRODUCTION OF SECONDARY DEUTERONS FROM IRON TARGET, 3.77 g/cm^2 THICK

[Incident proton energy, 558 MeV]

(a) Angle of scatter of 10^o

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
88.8 ± 1.1	.000 ± .000	167.0 ± 2.9	.146 ± .015
89.9 ± 1.1	.384 ± .047	170.0 ± 3.0	.142 ± .014
91.0 ± 1.1	.274 ± .035	173.1 ± 3.1	.149 ± .015
92.2 ± 1.1	.262 ± .033	176.2 ± 3.1	.138 ± .014
93.4 ± 1.1	.223 ± .029	179.5 ± 3.2	.164 ± .015
94.6 ± 1.2	.226 ± .028	182.8 ± 3.3	.142 ± .013
95.8 ± 1.2	.221 ± .027	186.2 ± 3.4	.127 ± .012
97.1 ± 1.2	.254 ± .030	189.8 ± 3.5	.138 ± .013
98.3 ± 1.2	.215 ± .026	193.4 ± 3.6	.137 ± .013
99.7 ± 1.3	.197 ± .024	197.2 ± 3.8	.131 ± .013
101.0 ± 1.3	.206 ± .024	201.0 ± 3.9	.132 ± .013
102.3 ± 1.3	.165 ± .020	205.0 ± 4.0	.123 ± .012
103.7 ± 1.4	.192 ± .023	209.2 ± 4.1	.123 ± .012
105.2 ± 1.4	.175 ± .021	213.4 ± 4.3	.133 ± .012
106.6 ± 1.4	.201 ± .023	217.8 ± 4.4	.120 ± .011
108.1 ± 1.4	.181 ± .021	222.3 ± 4.6	.112 ± .010
109.6 ± 1.5	.176 ± .021	227.0 ± 4.7	.119 ± .011
111.1 ± 1.5	.143 ± .017	231.8 ± 4.9	.111 ± .010
112.7 ± 1.5	.211 ± .023	236.9 ± 5.0	.117 ± .011
114.3 ± 1.6	.173 ± .020	242.0 ± 5.2	.110 ± .010
116.0 ± 1.6	.177 ± .020	247.4 ± 5.4	.108 ± .010
117.7 ± 1.7	.169 ± .019	253.0 ± 5.6	.103 ± .009
119.4 ± 1.7	.163 ± .019	258.7 ± 5.8	.096 ± .009
121.1 ± 1.7	.177 ± .020	264.7 ± 6.0	.098 ± .009
123.0 ± 1.8	.169 ± .019	270.9 ± 6.3	.109 ± .010
124.8 ± 1.8	.155 ± .017	277.3 ± 6.5	.105 ± .009
126.7 ± 1.9	.168 ± .019	284.0 ± 6.8	.117 ± .010
128.6 ± 1.9	.158 ± .018	290.9 ± 7.0	.114 ± .010
130.6 ± 2.0	.158 ± .017	298.1 ± 7.3	.112 ± .010
132.6 ± 2.0	.150 ± .016	305.6 ± 7.6	.112 ± .010
134.7 ± 2.1	.160 ± .017	313.5 ± 7.9	.120 ± .010
136.8 ± 2.1	.153 ± .017	321.6 ± 8.3	.129 ± .011
139.0 ± 2.2	.164 ± .017	330.1 ± 8.6	.130 ± .011
141.2 ± 2.2	.138 ± .015	339.0 ± 9.0	.127 ± .011
143.5 ± 2.3	.181 ± .019	348.2 ± 9.4	.127 ± .011
145.9 ± 2.3	.177 ± .018	357.9 ± 9.8	.121 ± .010
148.3 ± 2.4	.148 ± .015	368.0 ± 10.3	.118 ± .010
150.8 ± 2.5	.155 ± .016	378.6 ± 10.8	.000 ± .000
153.3 ± 2.5	.148 ± .015	389.7 ± 11.3	.000 ± .000
155.9 ± 2.6	.158 ± .016	401.4 ± 11.9	.000 ± .000
158.6 ± 2.7	.148 ± .015	413.6 ± 12.5	.000 ± .000
161.3 ± 2.7	.148 ± .015	426.4 ± 13.1	.000 ± .000
164.1 ± 2.8	.136 ± .014	440.0 ± 13.8	.000 ± .000

TABLE 21.- Continued

(b) Angle of scatter of 20°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.1 ± 1.1	.000 ± .000	167.4 ± 2.9	.104 ± .011
90.2 ± 1.1	.269 ± .037	170.3 ± 3.0	.101 ± .011
91.3 ± 1.1	.260 ± .035	173.4 ± 3.1	.096 ± .010
92.5 ± 1.1	.168 ± .025	176.5 ± 3.1	.107 ± .011
93.7 ± 1.1	.198 ± .027	179.8 ± 3.2	.088 ± .009
94.9 ± 1.2	.213 ± .027	183.1 ± 3.3	.093 ± .010
96.1 ± 1.2	.189 ± .025	186.5 ± 3.4	.082 ± .009
97.4 ± 1.2	.144 ± .020	190.1 ± 3.5	.080 ± .008
98.6 ± 1.2	.156 ± .021	193.7 ± 3.6	.088 ± .009
099.9 ± 1.3	.202 ± .025	197.5 ± 3.8	.083 ± .009
101.3 ± 1.3	.147 ± .019	201.3 ± 3.9	.081 ± .008
102.6 ± 1.3	.141 ± .019	205.3 ± 4.0	.078 ± .008
104.0 ± 1.4	.141 ± .018	209.4 ± 4.1	.067 ± .007
105.5 ± 1.4	.151 ± .019	213.7 ± 4.3	.071 ± .007
106.9 ± 1.4	.148 ± .019	218.1 ± 4.4	.078 ± .008
108.4 ± 1.4	.162 ± .020	222.6 ± 4.6	.065 ± .006
109.9 ± 1.5	.135 ± .017	227.3 ± 4.7	.062 ± .006
111.4 ± 1.5	.134 ± .017	232.1 ± 4.9	.066 ± .006
113.0 ± 1.5	.144 ± .018	237.1 ± 5.0	.061 ± .006
114.6 ± 1.6	.107 ± .014	242.3 ± 5.2	.059 ± .006
116.3 ± 1.6	.142 ± .017	247.6 ± 5.4	.062 ± .006
118.0 ± 1.7	.133 ± .016	253.2 ± 5.6	.054 ± .005
119.7 ± 1.7	.141 ± .017	258.9 ± 5.8	.057 ± .005
121.5 ± 1.7	.125 ± .015	264.9 ± 6.0	.052 ± .005
123.3 ± 1.8	.128 ± .015	271.1 ± 6.2	.045 ± .004
125.1 ± 1.8	.124 ± .015	277.5 ± 6.5	.052 ± .005
127.0 ± 1.9	.138 ± .016	284.1 ± 6.7	.048 ± .005
128.9 ± 1.9	.110 ± .013	291.0 ± 7.0	.044 ± .004
130.9 ± 2.0	.136 ± .016	298.2 ± 7.3	.041 ± .004
132.9 ± 2.0	.128 ± .015	305.7 ± 7.6	.034 ± .003
135.0 ± 2.1	.120 ± .014	313.5 ± 7.9	.029 ± .003
137.1 ± 2.1	.137 ± .015	321.6 ± 8.2	.034 ± .003
139.3 ± 2.2	.100 ± .012	330.1 ± 8.6	.031 ± .003
141.6 ± 2.2	.118 ± .013	338.9 ± 9.0	.025 ± .002
143.9 ± 2.3	.135 ± .015	348.2 ± 9.4	.027 ± .003
146.2 ± 2.3	.129 ± .014	357.8 ± 9.8	.019 ± .002
148.6 ± 2.4	.127 ± .014	367.9 ± 10.3	.020 ± .002
151.1 ± 2.5	.118 ± .013	378.4 ± 10.8	.000 ± .000
153.6 ± 2.5	.098 ± .011	389.5 ± 11.3	.000 ± .000
156.2 ± 2.6	.104 ± .011	401.1 ± 11.8	.000 ± .000
158.9 ± 2.7	.111 ± .012	413.3 ± 12.4	.000 ± .000
161.6 ± 2.7	.092 ± .010	426.1 ± 13.1	.000 ± .000
164.5 ± 2.8	.105 ± .011	439.5 ± 13.8	.000 ± .000

TABLE 21.- Continued

(c) Angle of scatter of 30°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
108.4 ± 1.4	.079 ± .012	222.6 ± 4.6	.035 ± .004
109.9 ± 1.5	.091 ± .013	227.3 ± 4.7	.034 ± .004
111.4 ± 1.5	.099 ± .014	232.1 ± 4.9	.035 ± .004
113.0 ± 1.5	.081 ± .012	237.1 ± 5.0	.031 ± .003
114.6 ± 1.6	.121 ± .016	242.3 ± 5.2	.031 ± .003
116.3 ± 1.6	.101 ± .014	247.6 ± 5.4	.026 ± .003
118.0 ± 1.7	.088 ± .012	253.2 ± 5.6	.030 ± .003
119.7 ± 1.7	.097 ± .013	258.9 ± 5.8	.023 ± .003
121.5 ± 1.7	.084 ± .012	264.9 ± 6.0	.020 ± .002
123.3 ± 1.8	.090 ± .012	271.1 ± 6.2	.024 ± .003
125.1 ± 1.8	.084 ± .011	277.5 ± 6.5	.020 ± .002
127.0 ± 1.9	.086 ± .011	284.1 ± 6.7	.026 ± .003
128.9 ± 1.9	.068 ± .010	291.0 ± 7.0	.018 ± .002
130.9 ± 2.0	.073 ± .010	298.2 ± 7.3	.020 ± .002
132.9 ± 2.0	.105 ± .013	305.7 ± 7.6	.015 ± .002
135.0 ± 2.1	.080 ± .010	313.5 ± 7.9	.013 ± .001
137.1 ± 2.1	.087 ± .011	321.6 ± 8.2	.015 ± .002
139.3 ± 2.2	.083 ± .010	330.1 ± 8.6	.010 ± .001
141.6 ± 2.2	.079 ± .010	338.9 ± 9.0	.012 ± .001
143.9 ± 2.3	.073 ± .009	348.2 ± 9.4	.010 ± .001
146.2 ± 2.3	.069 ± .009	357.8 ± 9.8	.011 ± .001
148.6 ± 2.4	.064 ± .008	367.9 ± 10.3	.008 ± .001
151.1 ± 2.5	.054 ± .007	378.4 ± 10.8	.000 ± .000
153.6 ± 2.5	.060 ± .008	389.5 ± 11.3	.000 ± .000
156.2 ± 2.6	.059 ± .007	401.1 ± 11.8	.000 ± .000
158.9 ± 2.7	.061 ± .008	413.3 ± 12.4	.000 ± .000
161.6 ± 2.7	.073 ± .009	426.1 ± 13.1	.000 ± .000
164.5 ± 2.8	.059 ± .007	439.5 ± 13.8	.000 ± .000
167.4 ± 2.9	.056 ± .007	453.7 ± 14.5	.000 ± .000
170.3 ± 3.0	.060 ± .007	468.7 ± 15.3	.000 ± .000
173.4 ± 3.1	.051 ± .006	484.5 ± 16.2	.000 ± .000
176.5 ± 3.1	.058 ± .007	501.2 ± 17.2	.000 ± .000
179.8 ± 3.2	.054 ± .006	518.9 ± 18.2	.000 ± .000
183.1 ± 3.3	.051 ± .006	537.7 ± 19.3	.000 ± .000
186.5 ± 3.4	.050 ± .006	557.7 ± 20.5	.000 ± .000
190.1 ± 3.5	.043 ± .005	579.0 ± 21.9	.000 ± .000
193.7 ± 3.6	.046 ± .005	601.6 ± 23.4	.000 ± .000
197.5 ± 3.8	.043 ± .005	625.9 ± 25.0	.000 ± .000
201.3 ± 3.9	.047 ± .005	651.8 ± 26.8	.000 ± .000
205.3 ± 4.0	.043 ± .005	679.7 ± 28.9	.000 ± .000
209.4 ± 4.1	.051 ± .006	709.7 ± 31.1	.000 ± .000
213.7 ± 4.3	.037 ± .004	742.1 ± 33.6	.000 ± .000
218.1 ± 4.4	.037 ± .004	777.1 ± 36.5	.000 ± .000

TABLE 21.- Continued

(d) Angle of scatter of 40°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.7 ± 1.1	.000 ± .000	168.8 ± 2.9	.050 ± .005
90.8 ± 1.1	.193 ± .020	171.8 ± 3.0	.043 ± .004
91.9 ± 1.1	.166 ± .017	174.9 ± 3.1	.041 ± .004
93.1 ± 1.1	.138 ± .014	178.1 ± 3.2	.041 ± .004
94.3 ± 1.2	.138 ± .014	181.4 ± 3.3	.042 ± .004
95.5 ± 1.2	.145 ± .014	184.8 ± 3.4	.039 ± .003
96.8 ± 1.2	.115 ± .012	188.3 ± 3.5	.038 ± .003
98.0 ± 1.2	.117 ± .012	191.8 ± 3.6	.038 ± .003
99.3 ± 1.3	.111 ± .011	195.5 ± 3.7	.035 ± .003
100.6 ± 1.3	.095 ± .010	199.3 ± 3.8	.032 ± .003
102.0 ± 1.3	.105 ± .010	203.2 ± 3.9	.033 ± .003
103.4 ± 1.3	.098 ± .010	207.3 ± 4.1	.031 ± .003
104.8 ± 1.4	.101 ± .010	211.5 ± 4.2	.027 ± .002
106.2 ± 1.4	.100 ± .010	215.8 ± 4.3	.028 ± .002
107.7 ± 1.4	.098 ± .010	220.2 ± 4.5	.025 ± .002
109.2 ± 1.5	.090 ± .009	224.8 ± 4.6	.027 ± .002
110.7 ± 1.5	.078 ± .008	229.6 ± 4.8	.025 ± .002
112.2 ± 1.5	.081 ± .008	234.5 ± 4.9	.022 ± .002
113.8 ± 1.6	.086 ± .008	239.5 ± 5.1	.021 ± .002
115.5 ± 1.6	.084 ± .008	244.8 ± 5.3	.020 ± .002
117.1 ± 1.6	.084 ± .008	250.2 ± 5.5	.017 ± .001
118.8 ± 1.7	.078 ± .008	255.9 ± 5.7	.017 ± .001
120.6 ± 1.7	.073 ± .007	261.7 ± 5.9	.015 ± .001
122.4 ± 1.8	.077 ± .008	267.8 ± 6.1	.015 ± .001
124.2 ± 1.8	.073 ± .007	274.0 ± 6.4	.016 ± .001
126.1 ± 1.8	.069 ± .007	280.6 ± 6.6	.014 ± .001
128.0 ± 1.9	.077 ± .007	287.3 ± 6.9	.013 ± .001
129.9 ± 1.9	.067 ± .006	294.4 ± 7.1	.011 ± .001
131.9 ± 2.0	.066 ± .006	301.7 ± 7.4	.010 ± .001
134.0 ± 2.0	.060 ± .006	309.3 ± 7.7	.009 ± .001
136.1 ± 2.1	.065 ± .006	317.3 ± 8.1	.008 ± .000
138.2 ± 2.1	.065 ± .006	325.5 ± 8.4	.008 ± .000
140.4 ± 2.2	.066 ± .006	334.1 ± 8.8	.006 ± .000
142.7 ± 2.2	.057 ± .005	343.1 ± 9.1	.005 ± .000
145.0 ± 2.3	.064 ± .006	352.6 ± 9.6	.004 ± .000
147.4 ± 2.4	.058 ± .005	362.4 ± 10.0	.004 ± .000
149.8 ± 2.4	.057 ± .005	372.7 ± 10.5	.004 ± .000
152.3 ± 2.5	.058 ± .005	383.4 ± 11.0	.000 ± .000
154.9 ± 2.6	.054 ± .005	394.7 ± 11.5	.000 ± .000
157.5 ± 2.6	.052 ± .005	406.6 ± 12.1	.000 ± .000
160.2 ± 2.7	.050 ± .005	419.0 ± 12.7	.000 ± .000
163.0 ± 2.8	.052 ± .005	432.1 ± 13.4	.000 ± .000
165.9 ± 2.8	.046 ± .004	445.9 ± 14.1	.000 ± .000

TABLE 21.- Continued

(e) Angle of scatter of 50°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.7 ± 1.1	.000 ± .000	168.8 ± 2.9	.033 ± .003
90.8 ± 1.1	.151 ± .016	171.8 ± 3.0	.030 ± .003
91.9 ± 1.1	.151 ± .016	174.9 ± 3.1	.033 ± .003
93.1 ± 1.1	.103 ± .011	178.1 ± 3.2	.027 ± .002
94.3 ± 1.2	.104 ± .011	181.4 ± 3.3	.030 ± .003
95.5 ± 1.2	.096 ± .010	184.8 ± 3.4	.025 ± .002
96.8 ± 1.2	.109 ± .011	188.3 ± 3.5	.030 ± .002
98.0 ± 1.2	.098 ± .010	191.8 ± 3.6	.024 ± .002
99.3 ± 1.3	.096 ± .010	195.5 ± 3.7	.024 ± .002
100.6 ± 1.3	.089 ± .009	199.3 ± 3.8	.020 ± .002
102.0 ± 1.3	.082 ± .009	203.2 ± 3.9	.021 ± .002
103.4 ± 1.3	.076 ± .008	207.3 ± 4.1	.020 ± .002
104.8 ± 1.4	.075 ± .008	211.5 ± 4.2	.018 ± .002
106.2 ± 1.4	.076 ± .008	215.8 ± 4.3	.018 ± .001
107.7 ± 1.4	.077 ± .008	220.2 ± 4.5	.018 ± .001
109.2 ± 1.5	.071 ± .007	224.8 ± 4.6	.014 ± .001
110.7 ± 1.5	.064 ± .007	229.6 ± 4.8	.014 ± .001
112.2 ± 1.5	.066 ± .007	234.5 ± 4.9	.012 ± .001
113.8 ± 1.6	.069 ± .007	239.5 ± 5.1	.012 ± .001
115.5 ± 1.6	.059 ± .006	244.8 ± 5.3	.012 ± .001
117.1 ± 1.6	.075 ± .007	250.2 ± 5.5	.011 ± .001
118.8 ± 1.7	.065 ± .007	255.9 ± 5.7	.010 ± .001
120.6 ± 1.7	.065 ± .006	261.7 ± 5.9	.008 ± .000
122.4 ± 1.8	.062 ± .006	267.8 ± 6.1	.007 ± .000
124.2 ± 1.8	.056 ± .006	274.0 ± 6.4	.007 ± .000
126.1 ± 1.8	.050 ± .005	280.6 ± 6.6	.006 ± .000
128.0 ± 1.9	.054 ± .005	287.3 ± 6.9	.006 ± .000
129.9 ± 1.9	.057 ± .006	294.4 ± 7.1	.005 ± .000
131.9 ± 2.0	.056 ± .005	301.7 ± 7.4	.004 ± .000
134.0 ± 2.0	.051 ± .005	309.3 ± 7.7	.003 ± .000
136.1 ± 2.1	.049 ± .005	317.3 ± 8.1	.003 ± .000
138.2 ± 2.1	.046 ± .005	325.5 ± 8.4	.002 ± .000
140.4 ± 2.2	.047 ± .005	334.1 ± 8.8	.002 ± .000
142.7 ± 2.2	.044 ± .004	343.1 ± 9.1	.002 ± .000
145.0 ± 2.3	.053 ± .005	352.6 ± 9.6	.001 ± .000
147.4 ± 2.4	.047 ± .004	362.4 ± 10.0	.001 ± .000
149.8 ± 2.4	.042 ± .004	372.7 ± 10.5	.000 ± .000
152.3 ± 2.5	.039 ± .004	383.4 ± 11.0	.000 ± .000
154.9 ± 2.6	.038 ± .004	394.7 ± 11.5	.000 ± .000
157.5 ± 2.6	.036 ± .003	406.6 ± 12.1	.000 ± .000
160.2 ± 2.7	.032 ± .003	419.0 ± 12.7	.000 ± .000
163.0 ± 2.8	.034 ± .003	432.1 ± 13.4	.000 ± .000
165.9 ± 2.8	.037 ± .003	445.9 ± 14.1	.000 ± .000

TABLE 21.- Concluded

(f) Angle of scatter of 60°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.7 ± 1.1	.000 ± .000	168.8 ± 2.9	.017 ± .001
90.8 ± 1.1	.116 ± .012	171.8 ± 3.0	.017 ± .001
91.9 ± 1.1	.091 ± .009	174.9 ± 3.1	.013 ± .001
93.1 ± 1.1	.087 ± .009	178.1 ± 3.2	.014 ± .001
94.3 ± 1.2	.074 ± .007	181.4 ± 3.3	.013 ± .001
95.5 ± 1.2	.059 ± .006	184.8 ± 3.4	.012 ± .001
96.8 ± 1.2	.068 ± .007	188.3 ± 3.5	.011 ± .001
98.0 ± 1.2	.065 ± .006	191.8 ± 3.6	.012 ± .001
99.3 ± 1.3	.058 ± .006	195.5 ± 3.7	.010 ± .001
100.6 ± 1.3	.053 ± .005	199.3 ± 3.8	.011 ± .001
102.0 ± 1.3	.059 ± .006	203.2 ± 3.9	.009 ± .001
103.4 ± 1.3	.044 ± .004	207.3 ± 4.1	.008 ± .000
104.8 ± 1.4	.046 ± .005	211.5 ± 4.2	.008 ± .000
106.2 ± 1.4	.040 ± .004	215.8 ± 4.3	.007 ± .000
107.7 ± 1.4	.039 ± .004	220.2 ± 4.5	.006 ± .000
109.2 ± 1.5	.047 ± .005	224.8 ± 4.6	.006 ± .000
110.7 ± 1.5	.044 ± .004	229.6 ± 4.8	.005 ± .000
112.2 ± 1.5	.040 ± .004	234.5 ± 4.9	.005 ± .000
113.8 ± 1.6	.041 ± .004	239.5 ± 5.1	.004 ± .000
115.5 ± 1.6	.036 ± .003	244.8 ± 5.3	.003 ± .000
117.1 ± 1.6	.036 ± .003	250.2 ± 5.5	.003 ± .000
118.8 ± 1.7	.037 ± .004	255.9 ± 5.7	.003 ± .000
120.6 ± 1.7	.033 ± .003	261.7 ± 5.9	.002 ± .000
122.4 ± 1.8	.039 ± .004	267.8 ± 6.1	.002 ± .000
124.2 ± 1.8	.034 ± .003	274.0 ± 6.4	.002 ± .000
126.1 ± 1.8	.035 ± .003	280.6 ± 6.6	.001 ± .000
128.0 ± 1.9	.036 ± .003	287.3 ± 6.9	.001 ± .000
129.9 ± 1.9	.029 ± .003	294.4 ± 7.1	.001 ± .000
131.9 ± 2.0	.031 ± .003	301.7 ± 7.4	.000 ± .000
134.0 ± 2.0	.028 ± .003	309.3 ± 7.7	.000 ± .000
136.1 ± 2.1	.027 ± .002	317.3 ± 8.1	.000 ± .000
138.2 ± 2.1	.028 ± .002	325.5 ± 8.4	.000 ± .000
140.4 ± 2.2	.029 ± .003	334.1 ± 8.8	.000 ± .000
142.7 ± 2.2	.027 ± .002	343.1 ± 9.1	.000 ± .000
145.0 ± 2.3	.026 ± .002	352.6 ± 9.6	.000 ± .000
147.4 ± 2.4	.025 ± .002	362.4 ± 10.0	.000 ± .000
149.8 ± 2.4	.024 ± .002	372.7 ± 10.5	.000 ± .000
152.3 ± 2.5	.023 ± .002	383.4 ± 11.0	.000 ± .000
154.9 ± 2.6	.019 ± .002	394.7 ± 11.5	.000 ± .000
157.5 ± 2.6	.020 ± .002	406.6 ± 12.1	.000 ± .000
160.2 ± 2.7	.019 ± .002	419.0 ± 12.7	.000 ± .000
163.0 ± 2.8	.016 ± .001	432.1 ± 13.4	.000 ± .000
165.9 ± 2.8	.019 ± .002	445.9 ± 14.1	.000 ± .000

TABLE 22.- DOUBLE DIFFERENTIAL CROSS SECTIONS FOR PRODUCTION OF SECONDARY DEUTERONS FROM COPPER TARGET, 2.79 g/cm^2 THICK

[Incident proton energy, 558 MeV]

(a) Angle of scatter of 10°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
88.8 ± 1.1	.375 ± .064	167.0 ± 2.9	.157 ± .018
89.9 ± 1.1	.386 ± .060	170.0 ± 3.0	.170 ± .019
91.0 ± 1.1	.272 ± .046	173.1 ± 3.1	.147 ± .017
92.2 ± 1.1	.233 ± .040	176.2 ± 3.1	.161 ± .018
93.4 ± 1.1	.219 ± .037	179.5 ± 3.2	.159 ± .018
94.6 ± 1.2	.205 ± .034	182.8 ± 3.3	.147 ± .017
95.8 ± 1.2	.227 ± .035	186.2 ± 3.4	.160 ± .018
97.1 ± 1.2	.247 ± .036	189.8 ± 3.5	.155 ± .017
98.3 ± 1.2	.236 ± .035	193.4 ± 3.6	.153 ± .017
99.7 ± 1.3	.208 ± .031	197.2 ± 3.8	.156 ± .017
101.0 ± 1.3	.244 ± .034	201.0 ± 3.9	.148 ± .016
102.3 ± 1.3	.249 ± .035	205.0 ± 4.0	.142 ± .015
103.7 ± 1.4	.152 ± .025	209.2 ± 4.1	.139 ± .015
105.2 ± 1.4	.199 ± .029	213.4 ± 4.3	.135 ± .014
106.6 ± 1.4	.175 ± .026	217.8 ± 4.4	.146 ± .015
108.1 ± 1.4	.196 ± .028	222.3 ± 4.6	.145 ± .015
109.6 ± 1.5	.187 ± .027	227.0 ± 4.7	.149 ± .015
111.1 ± 1.5	.181 ± .026	231.8 ± 4.9	.138 ± .014
112.7 ± 1.5	.214 ± .029	236.9 ± 5.0	.125 ± .013
114.3 ± 1.6	.171 ± .025	242.0 ± 5.2	.130 ± .013
116.0 ± 1.6	.214 ± .028	247.4 ± 5.4	.122 ± .012
117.7 ± 1.7	.189 ± .026	253.0 ± 5.6	.117 ± .012
119.4 ± 1.7	.219 ± .028	258.7 ± 5.8	.125 ± .012
121.1 ± 1.7	.199 ± .026	264.7 ± 6.0	.119 ± .012
123.0 ± 1.8	.161 ± .022	270.9 ± 6.3	.126 ± .012
124.8 ± 1.8	.171 ± .023	277.3 ± 6.5	.113 ± .011
126.7 ± 1.9	.199 ± .026	284.0 ± 6.8	.119 ± .012
128.6 ± 1.9	.180 ± .023	290.9 ± 7.0	.130 ± .012
130.6 ± 2.0	.208 ± .026	298.1 ± 7.3	.131 ± .012
132.6 ± 2.0	.159 ± .021	305.6 ± 7.6	.124 ± .012
134.7 ± 2.1	.161 ± .021	313.5 ± 7.9	.130 ± .012
136.8 ± 2.1	.201 ± .025	321.6 ± 8.3	.136 ± .013
139.0 ± 2.2	.208 ± .025	330.1 ± 8.6	.147 ± .014
141.2 ± 2.2	.188 ± .023	339.0 ± 9.0	.136 ± .013
143.5 ± 2.3	.167 ± .021	348.2 ± 9.4	.127 ± .012
145.9 ± 2.3	.178 ± .022	357.9 ± 9.8	.124 ± .011
148.3 ± 2.4	.194 ± .023	368.0 ± 10.3	.121 ± .011
150.8 ± 2.5	.157 ± .019	378.6 ± 10.8	.000 ± .000
153.3 ± 2.5	.173 ± .021	389.7 ± 11.3	.000 ± .000
155.9 ± 2.6	.203 ± .023	401.4 ± 11.9	.000 ± .000
158.6 ± 2.7	.171 ± .020	413.6 ± 12.5	.000 ± .000
161.3 ± 2.7	.201 ± .023	426.4 ± 13.1	.000 ± .000
164.1 ± 2.8	.177 ± .020	440.0 ± 13.8	.000 ± .000

TABLE 22.- Continued

(b) Angle of scatter of 20°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.1 ± 1.1	.390 ± .061	167.4 ± 2.9	.119 ± .014
90.2 ± 1.1	.371 ± .055	170.3 ± 3.0	.114 ± .013
91.3 ± 1.1	.269 ± .042	173.4 ± 3.1	.106 ± .013
92.5 ± 1.1	.219 ± .035	176.5 ± 3.1	.100 ± .012
93.7 ± 1.1	.201 ± .032	179.8 ± 3.2	.094 ± .011
94.9 ± 1.2	.241 ± .035	183.1 ± 3.3	.097 ± .011
96.1 ± 1.2	.197 ± .030	186.5 ± 3.4	.093 ± .011
97.4 ± 1.2	.160 ± .026	190.1 ± 3.5	.084 ± .010
98.6 ± 1.2	.228 ± .032	193.7 ± 3.6	.088 ± .010
099.9 ± 1.3	.200 ± .029	197.5 ± 3.8	.087 ± .010
101.3 ± 1.3	.169 ± .025	201.3 ± 3.9	.099 ± .011
102.6 ± 1.3	.149 ± .023	205.3 ± 4.0	.081 ± .009
104.0 ± 1.4	.200 ± .028	209.4 ± 4.1	.092 ± .010
105.5 ± 1.4	.186 ± .026	213.7 ± 4.3	.082 ± .009
106.9 ± 1.4	.170 ± .024	218.1 ± 4.4	.082 ± .009
108.4 ± 1.4	.153 ± .022	222.6 ± 4.6	.079 ± .009
109.9 ± 1.5	.144 ± .021	227.3 ± 4.7	.071 ± .008
111.4 ± 1.5	.135 ± .020	232.1 ± 4.9	.077 ± .008
113.0 ± 1.5	.154 ± .022	237.1 ± 5.0	.082 ± .009
114.6 ± 1.6	.145 ± .021	242.3 ± 5.2	.072 ± .008
116.3 ± 1.6	.150 ± .021	247.6 ± 5.4	.068 ± .007
118.0 ± 1.7	.174 ± .023	253.2 ± 5.6	.057 ± .006
119.7 ± 1.7	.146 ± .020	258.9 ± 5.8	.054 ± .006
121.5 ± 1.7	.156 ± .021	264.9 ± 6.0	.059 ± .006
123.3 ± 1.8	.138 ± .019	271.1 ± 6.2	.062 ± .006
125.1 ± 1.8	.141 ± .019	277.5 ± 6.5	.053 ± .006
127.0 ± 1.9	.133 ± .018	284.1 ± 6.7	.058 ± .006
128.9 ± 1.9	.144 ± .019	291.0 ± 7.0	.046 ± .005
130.9 ± 2.0	.136 ± .018	298.2 ± 7.3	.041 ± .004
132.9 ± 2.0	.115 ± .016	305.7 ± 7.6	.033 ± .004
135.0 ± 2.1	.154 ± .019	313.5 ± 7.9	.040 ± .004
137.1 ± 2.1	.140 ± .018	321.6 ± 8.2	.030 ± .003
139.3 ± 2.2	.147 ± .018	330.1 ± 8.6	.033 ± .003
141.6 ± 2.2	.130 ± .016	338.9 ± 9.0	.033 ± .003
143.9 ± 2.3	.123 ± .016	348.2 ± 9.4	.029 ± .003
146.2 ± 2.3	.134 ± .017	357.8 ± 9.8	.028 ± .003
148.6 ± 2.4	.140 ± .017	367.9 ± 10.3	.023 ± .002
151.1 ± 2.5	.138 ± .017	378.4 ± 10.8	.000 ± .000
153.6 ± 2.5	.143 ± .017	389.5 ± 11.3	.000 ± .000
156.2 ± 2.6	.117 ± .014	401.1 ± 11.8	.000 ± .000
158.9 ± 2.7	.096 ± .012	413.3 ± 12.4	.000 ± .000
161.6 ± 2.7	.116 ± .014	426.1 ± 13.1	.000 ± .000
164.5 ± 2.8	.114 ± .014	439.5 ± 13.8	.000 ± .000

TABLE 22.- Continued

(c) Angle of scatter of 30°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
106.9 ± 1.4	.095 ± .017	218.1 ± 4.4	.050 ± .006
108.4 ± 1.4	.137 ± .021	222.6 ± 4.6	.043 ± .005
109.9 ± 1.5	.102 ± .017	227.3 ± 4.7	.038 ± .005
111.4 ± 1.5	.120 ± .019	232.1 ± 4.9	.042 ± .005
113.0 ± 1.5	.092 ± .015	237.1 ± 5.0	.034 ± .004
114.6 ± 1.6	.100 ± .016	242.3 ± 5.2	.038 ± .005
116.3 ± 1.6	.112 ± .017	247.6 ± 5.4	.032 ± .004
118.0 ± 1.7	.099 ± .016	253.2 ± 5.6	.026 ± .003
119.7 ± 1.7	.121 ± .018	258.9 ± 5.8	.027 ± .004
121.5 ± 1.7	.136 ± .019	264.9 ± 6.0	.028 ± .004
123.3 ± 1.8	.095 ± .015	271.1 ± 6.2	.024 ± .003
125.1 ± 1.8	.100 ± .015	277.5 ± 6.5	.026 ± .003
127.0 ± 1.9	.103 ± .015	284.1 ± 6.7	.025 ± .003
128.9 ± 1.9	.101 ± .015	291.0 ± 7.0	.023 ± .003
130.9 ± 2.0	.094 ± .014	298.2 ± 7.3	.026 ± .003
132.9 ± 2.0	.070 ± .011	305.7 ± 7.6	.021 ± .003
135.0 ± 2.1	.107 ± .015	313.5 ± 7.9	.018 ± .002
137.1 ± 2.1	.102 ± .014	321.6 ± 8.2	.021 ± .002
139.3 ± 2.2	.086 ± .012	330.1 ± 8.6	.017 ± .002
141.6 ± 2.2	.084 ± .012	338.9 ± 9.0	.012 ± .002
143.9 ± 2.3	.094 ± .013	348.2 ± 9.4	.020 ± .002
146.2 ± 2.3	.095 ± .013	357.8 ± 9.8	.013 ± .002
148.6 ± 2.4	.103 ± .014	367.9 ± 10.3	.016 ± .002
151.1 ± 2.5	.076 ± .011	378.4 ± 10.8	.000 ± .000
153.6 ± 2.5	.096 ± .013	389.5 ± 11.3	.000 ± .000
156.2 ± 2.6	.054 ± .008	401.1 ± 11.8	.000 ± .000
158.9 ± 2.7	.067 ± .010	413.3 ± 12.4	.000 ± .000
161.6 ± 2.7	.066 ± .009	426.1 ± 13.1	.000 ± .000
164.5 ± 2.8	.068 ± .009	439.5 ± 13.8	.000 ± .000
167.4 ± 2.9	.072 ± .010	453.7 ± 14.5	.000 ± .000
170.3 ± 3.0	.085 ± .011	468.7 ± 15.3	.000 ± .000
173.4 ± 3.1	.059 ± .008	484.5 ± 16.2	.000 ± .000
176.5 ± 3.1	.054 ± .008	501.2 ± 17.2	.000 ± .000
179.8 ± 3.2	.076 ± .009	518.9 ± 18.2	.000 ± .000
183.1 ± 3.3	.054 ± .007	537.7 ± 19.3	.000 ± .000
186.5 ± 3.4	.055 ± .007	557.7 + 20.5	.000 ± .000
190.1 ± 3.5	.055 ± .007	579.0 ± 21.9	.000 ± .000
193.7 ± 3.6	.069 ± .008	601.6 + 23.4	.000 ± .000
197.5 ± 3.8	.063 ± .008	625.9 ± 25.0	.000 ± .000
201.3 ± 3.9	.056 ± .007	651.8 ± 26.8	.000 ± .000
205.3 ± 4.0	.050 ± .006	679.7 ± 28.9	.000 ± .000
209.4 ± 4.1	.048 ± .006	709.7 ± 31.1	.000 ± .000
213.7 ± 4.3	.041 ± .005	742.1 ± 33.6	.000 ± .000

TABLE 22.- Continued

(d) Angle of scatter of 40°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.7 ± 1.1	.262 ± .028	168.8 ± 2.9	.055 ± .005
90.8 ± 1.1	.252 ± .026	171.8 ± 3.0	.052 ± .005
91.9 ± 1.1	.185 ± .020	174.9 ± 3.1	.049 ± .005
93.1 ± 1.1	.177 ± .019	178.1 ± 3.2	.048 ± .004
94.3 ± 1.2	.164 ± .017	181.4 ± 3.3	.051 ± .005
95.5 ± 1.2	.147 ± .015	184.8 ± 3.4	.044 ± .004
96.8 ± 1.2	.150 ± .015	188.3 ± 3.5	.046 ± .004
98.0 ± 1.2	.141 ± .015	191.8 ± 3.6	.039 ± .004
99.3 ± 1.3	.120 ± .013	195.5 ± 3.7	.041 ± .004
100.6 ± 1.3	.137 ± .014	199.3 ± 3.8	.038 ± .003
102.0 ± 1.3	.108 ± .011	203.2 ± 3.9	.038 ± .003
103.4 ± 1.3	.119 ± .012	207.3 ± 4.1	.034 ± .003
104.8 ± 1.4	.110 ± .012	211.5 ± 4.2	.036 ± .003
106.2 ± 1.4	.122 ± .012	215.8 ± 4.3	.034 ± .003
107.7 ± 1.4	.099 ± .010	220.2 ± 4.5	.031 ± .003
109.2 ± 1.5	.101 ± .010	224.8 ± 4.6	.032 ± .003
110.7 ± 1.5	.091 ± .010	229.6 ± 4.8	.028 ± .002
112.2 ± 1.5	.105 ± .011	234.5 ± 4.9	.025 ± .002
113.8 ± 1.6	.101 ± .010	239.5 ± 5.1	.024 ± .002
115.5 ± 1.6	.103 ± .010	244.8 ± 5.3	.023 ± .002
117.1 ± 1.6	.107 ± .011	250.2 ± 5.5	.024 ± .002
118.8 ± 1.7	.102 ± .010	255.9 ± 5.7	.021 ± .002
120.6 ± 1.7	.103 ± .010	261.7 ± 5.9	.019 ± .001
122.4 ± 1.8	.089 ± .009	267.8 ± 6.1	.018 ± .001
124.2 ± 1.8	.089 ± .009	274.0 ± 6.4	.017 ± .001
126.1 ± 1.8	.084 ± .008	280.6 ± 6.6	.015 ± .001
128.0 ± 1.9	.076 ± .008	287.3 ± 6.9	.012 ± .001
129.9 ± 1.9	.084 ± .008	294.4 ± 7.1	.013 ± .001
131.9 ± 2.0	.083 ± .008	301.7 ± 7.4	.012 ± .001
134.0 ± 2.0	.078 ± .008	309.3 ± 7.7	.010 ± .001
136.1 ± 2.1	.082 ± .008	317.3 ± 8.1	.009 ± .001
138.2 ± 2.1	.079 ± .008	325.5 ± 8.4	.007 ± .000
140.4 ± 2.2	.071 ± .007	334.1 ± 8.8	.007 ± .000
142.7 ± 2.2	.068 ± .007	343.1 ± 9.1	.006 ± .000
145.0 ± 2.3	.076 ± .007	352.6 ± 9.6	.005 ± .000
147.4 ± 2.4	.065 ± .006	362.4 ± 10.0	.004 ± .000
149.8 ± 2.4	.065 ± .006	372.7 ± 10.5	.005 ± .000
152.3 ± 2.5	.062 ± .006	383.4 ± 11.0	.000 ± .000
154.9 ± 2.6	.066 ± .006	394.7 ± 11.5	.000 ± .000
157.5 ± 2.6	.055 ± .005	406.6 ± 12.1	.000 ± .000
160.2 ± 2.7	.058 ± .005	419.0 ± 12.7	.000 ± .000
163.0 ± 2.8	.061 ± .006	432.1 ± 13.4	.000 ± .000
165.9 ± 2.8	.053 ± .005	445.9 ± 14.1	.000 ± .000

TABLE 22.- Continued

(e) Angle of scatter of 50°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.7 ± 1.1	.000 ± .000	168.8 ± 2.9	.036 ± .004
90.8 ± 1.1	.187 ± .023	171.8 ± 3.0	.034 ± .004
91.9 ± 1.1	.140 ± .018	174.9 ± 3.1	.031 ± .003
93.1 ± 1.1	.127 ± .016	178.1 ± 3.2	.031 ± .003
94.3 ± 1.2	.138 ± .016	181.4 ± 3.3	.029 ± .003
95.5 ± 1.2	.129 ± .015	184.8 ± 3.4	.032 ± .003
96.8 ± 1.2	.127 ± .015	188.3 ± 3.5	.032 ± .003
98.0 ± 1.2	.105 ± .013	191.8 ± 3.6	.025 ± .003
99.3 ± 1.3	.102 ± .012	195.5 ± 3.7	.027 ± .003
100.6 ± 1.3	.124 ± .014	199.3 ± 3.8	.026 ± .003
102.0 ± 1.3	.085 ± .010	203.2 ± 3.9	.021 ± .002
103.4 ± 1.3	.088 ± .010	207.3 ± 4.1	.020 ± .002
104.8 ± 1.4	.085 ± .010	211.5 ± 4.2	.020 ± .002
106.2 ± 1.4	.097 ± .011	215.8 ± 4.3	.019 ± .002
107.7 ± 1.4	.070 ± .009	220.2 ± 4.5	.019 ± .002
109.2 ± 1.5	.076 ± .009	224.8 ± 4.6	.019 ± .002
110.7 ± 1.5	.094 ± .010	229.6 ± 4.8	.016 ± .001
112.2 ± 1.5	.080 ± .009	234.5 ± 4.9	.016 ± .001
113.8 ± 1.6	.073 ± .008	239.5 ± 5.1	.013 ± .001
115.5 ± 1.6	.080 ± .009	244.8 ± 5.3	.014 ± .001
117.1 ± 1.6	.076 ± .009	250.2 ± 5.5	.012 ± .001
118.8 ± 1.7	.074 ± .008	255.9 ± 5.7	.010 ± .001
120.6 ± 1.7	.076 ± .008	261.7 ± 5.9	.010 ± .001
122.4 ± 1.8	.067 ± .008	267.8 ± 6.1	.009 ± .001
124.2 ± 1.8	.061 ± .007	274.0 ± 6.4	.008 ± .001
126.1 ± 1.8	.064 ± .007	280.6 ± 6.6	.006 ± .000
128.0 ± 1.9	.069 ± .008	287.3 ± 6.9	.005 ± .000
129.9 ± 1.9	.060 ± .007	294.4 ± 7.1	.005 ± .000
131.9 ± 2.0	.056 ± .006	301.7 ± 7.4	.004 ± .000
134.0 ± 2.0	.047 ± .005	309.3 ± 7.7	.003 ± .000
136.1 ± 2.1	.055 ± .006	317.3 ± 8.1	.003 ± .000
138.2 ± 2.1	.060 ± .007	325.5 ± 8.4	.003 ± .000
140.4 ± 2.2	.049 ± .005	334.1 ± 8.8	.003 ± .000
142.7 ± 2.2	.055 ± .006	343.1 ± 9.1	.002 ± .000
145.0 ± 2.3	.046 ± .005	352.6 ± 9.6	.002 ± .000
147.4 ± 2.4	.051 ± .005	362.4 ± 10.0	.001 ± .000
149.8 ± 2.4	.045 ± .005	372.7 ± 10.5	.001 ± .000
152.3 ± 2.5	.047 ± .005	383.4 ± 11.0	.000 ± .000
154.9 ± 2.6	.042 ± .005	394.7 ± 11.5	.000 ± .000
157.5 ± 2.6	.045 ± .005	406.6 ± 12.1	.000 ± .000
160.2 ± 2.7	.042 ± .004	419.0 ± 12.7	.000 ± .000
163.0 ± 2.8	.043 ± .005	432.1 ± 13.4	.000 ± .000
165.9 ± 2.8	.044 ± .005	445.9 ± 14.1	.000 ± .000

TABLE 22.- Concluded

(f) Angle of scatter of 60°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.7 ± 1.1	.000 ± .000	168.8 ± 2.9	.021 ± .002
90.8 ± 1.1	.142 ± .016	171.8 ± 3.0	.018 ± .002
91.9 ± 1.1	.094 ± .011	174.9 ± 3.1	.017 ± .002
93.1 ± 1.1	.089 ± .010	178.1 ± 3.2	.019 ± .002
94.3 ± 1.2	.097 ± .011	181.4 ± 3.3	.014 ± .001
95.5 ± 1.2	.084 ± .009	184.8 ± 3.4	.015 ± .001
96.8 ± 1.2	.075 ± .008	188.3 ± 3.5	.015 ± .001
98.0 ± 1.2	.071 ± .008	191.8 ± 3.6	.014 ± .001
99.3 ± 1.3	.055 ± .006	195.5 ± 3.7	.014 ± .001
100.6 ± 1.3	.067 ± .007	199.3 ± 3.8	.010 ± .001
102.0 ± 1.3	.067 ± .007	203.2 ± 3.9	.011 ± .001
103.4 ± 1.3	.064 ± .007	207.3 ± 4.1	.010 ± .001
104.8 ± 1.4	.062 ± .007	211.5 ± 4.2	.009 ± .001
106.2 ± 1.4	.055 ± .006	215.8 ± 4.3	.008 ± .001
107.7 ± 1.4	.052 ± .006	220.2 ± 4.5	.008 ± .001
109.2 ± 1.5	.050 ± .005	224.8 ± 4.6	.007 ± .000
110.7 ± 1.5	.042 ± .005	229.6 ± 4.8	.005 ± .000
112.2 ± 1.5	.056 ± .006	234.5 ± 4.9	.006 ± .000
113.8 ± 1.6	.051 ± .005	239.5 ± 5.1	.005 ± .000
115.5 ± 1.6	.052 ± .005	244.8 ± 5.3	.005 ± .000
117.1 ± 1.6	.045 ± .005	250.2 ± 5.5	.004 ± .000
118.8 ± 1.7	.049 ± .005	255.9 ± 5.7	.004 ± .000
120.6 ± 1.7	.040 ± .004	261.7 ± 5.9	.002 ± .000
122.4 ± 1.8	.044 ± .005	267.8 ± 6.1	.003 ± .000
124.2 ± 1.8	.038 ± .004	274.0 ± 6.4	.002 ± .000
126.1 ± 1.8	.046 ± .005	280.6 ± 6.6	.003 ± .000
128.0 ± 1.9	.045 ± .005	287.3 ± 6.9	.001 ± .000
129.9 ± 1.9	.035 ± .004	294.4 ± 7.1	.001 ± .000
131.9 ± 2.0	.031 ± .003	301.7 ± 7.4	.001 ± .000
134.0 ± 2.0	.037 ± .004	309.3 ± 7.7	.000 ± .000
136.1 ± 2.1	.036 ± .004	317.3 ± 8.1	.001 ± .000
138.2 ± 2.1	.037 ± .004	325.5 ± 8.4	.000 ± .000
140.4 ± 2.2	.033 ± .003	334.1 ± 8.8	.000 ± .000
142.7 ± 2.2	.034 ± .003	343.1 ± 9.1	.000 ± .000
145.0 ± 2.3	.038 ± .004	352.6 ± 9.6	.000 ± .000
147.4 ± 2.4	.029 ± .003	362.4 ± 10.0	.000 ± .000
149.8 ± 2.4	.031 ± .003	372.7 ± 10.5	.000 ± .000
152.3 ± 2.5	.026 ± .003	383.4 ± 11.0	.000 ± .000
154.9 ± 2.6	.026 ± .003	394.7 ± 11.5	.000 ± .000
157.5 ± 2.6	.026 ± .003	406.6 ± 12.1	.000 ± .000
160.2 ± 2.7	.024 ± .002	419.0 ± 12.7	.000 ± .000
163.0 ± 2.8	.025 ± .002	432.1 ± 13.4	.000 ± .000
165.9 ± 2.8	.024 ± .002	445.9 ± 14.1	.000 ± .000

TABLE 23.- DOUBLE DIFFERENTIAL CROSS SECTIONS FOR PRODUCTION OF SECONDARY DEUTERONS FROM GERMANIUM TARGET, 5.26 g/cm^2 THICK

[Incident proton energy, 558 MeV]

(a) Angle of scatter of 10°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
88.8 ± 1.1	.000 ± .000	167.0 ± 2.9	.146 ± .016
89.9 ± 1.1	.409 ± .057	170.0 ± 3.0	.137 ± .015
91.0 ± 1.1	.288 ± .043	173.1 ± 3.1	.136 ± .015
92.2 ± 1.1	.312 ± .043	176.2 ± 3.1	.168 ± .017
93.4 ± 1.1	.252 ± .036	179.5 ± 3.2	.146 ± .015
94.6 ± 1.2	.228 ± .032	182.8 ± 3.3	.135 ± .014
95.8 ± 1.2	.253 ± .034	186.2 ± 3.4	.133 ± .014
97.1 ± 1.2	.197 ± .028	189.8 ± 3.5	.144 ± .015
98.3 ± 1.2	.222 ± .030	193.4 ± 3.6	.154 ± .016
99.7 ± 1.3	.198 ± .027	197.2 ± 3.8	.137 ± .014
101.0 ± 1.3	.195 ± .026	201.0 ± 3.9	.119 ± .012
102.3 ± 1.3	.205 ± .027	205.0 ± 4.0	.131 ± .013
103.7 ± 1.4	.192 ± .026	209.2 ± 4.1	.140 ± .014
105.2 ± 1.4	.190 ± .025	213.4 ± 4.3	.121 ± .012
106.6 ± 1.4	.173 ± .023	217.8 ± 4.4	.124 ± .012
108.1 ± 1.4	.204 ± .026	222.3 ± 4.6	.116 ± .011
109.6 ± 1.5	.167 ± .022	227.0 ± 4.7	.127 ± .012
111.1 ± 1.5	.210 ± .026	231.8 ± 4.9	.123 ± .012
112.7 ± 1.5	.171 ± .022	236.9 ± 5.0	.114 ± .011
114.3 ± 1.6	.193 ± .024	242.0 ± 5.2	.093 ± .009
116.0 ± 1.6	.145 ± .019	247.4 ± 5.4	.092 ± .009
117.7 ± 1.7	.170 ± .021	253.0 ± 5.6	.105 ± .010
119.4 ± 1.7	.180 ± .022	258.7 ± 5.8	.105 ± .010
121.1 ± 1.7	.187 ± .023	264.7 ± 6.0	.108 ± .010
123.0 ± 1.8	.180 ± .022	270.9 ± 6.3	.107 ± .010
124.8 ± 1.8	.153 ± .019	277.3 ± 6.5	.109 ± .010
126.7 ± 1.9	.159 ± .019	284.0 ± 6.8	.114 ± .010
128.6 ± 1.9	.164 ± .020	290.9 ± 7.0	.121 ± .011
130.6 ± 2.0	.151 ± .018	298.1 ± 7.3	.112 ± .010
132.6 ± 2.0	.175 ± .020	305.6 ± 7.6	.096 ± .009
134.7 ± 2.1	.166 ± .019	313.5 ± 7.9	.111 ± .010
136.8 ± 2.1	.158 ± .018	321.6 ± 8.3	.124 ± .011
139.0 ± 2.2	.174 ± .020	330.1 ± 8.6	.119 ± .011
141.2 ± 2.2	.178 ± .020	339.0 ± 9.0	.128 ± .011
143.5 ± 2.3	.164 ± .019	348.2 ± 9.4	.116 ± .010
145.9 ± 2.3	.146 ± .017	357.9 ± 9.8	.111 ± .010
148.3 ± 2.4	.157 ± .018	368.0 ± 10.3	.107 ± .010
150.8 ± 2.5	.159 ± .018	378.6 ± 10.8	.000 ± .000
153.3 ± 2.5	.157 ± .017	389.7 ± 11.3	.000 ± .000
155.9 ± 2.6	.174 ± .019	401.4 ± 11.9	.000 ± .000
158.6 ± 2.7	.151 ± .017	413.6 ± 12.5	.000 ± .000
161.3 ± 2.7	.161 ± .017	426.4 ± 13.1	.000 ± .000
164.1 ± 2.8	.126 ± .014	440.0 ± 13.8	.000 ± .000

TABLE 23.- Continued

(b) Angle of scatter of 20°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.1 ± 1.1	.000 ± .000	167.4 ± 2.9	.103 ± .011
90.2 ± 1.1	.312 ± .043	170.3 ± 3.0	.094 ± .010
91.3 ± 1.1	.301 ± .039	173.4 ± 3.1	.088 ± .010
92.5 ± 1.1	.251 ± .033	176.5 ± 3.1	.090 ± .010
93.7 ± 1.1	.226 ± .030	179.8 ± 3.2	.098 ± .010
94.9 ± 1.2	.216 ± .028	183.1 ± 3.3	.095 ± .010
96.1 ± 1.2	.175 ± .024	186.5 ± 3.4	.098 ± .010
97.4 ± 1.2	.195 ± .025	190.1 ± 3.5	.093 ± .010
98.6 ± 1.2	.196 ± .025	193.7 ± 3.6	.083 ± .009
099.9 ± 1.3	.185 ± .023	197.5 ± 3.8	.084 ± .009
101.3 ± 1.3	.169 ± .022	201.3 ± 3.9	.084 ± .009
102.6 ± 1.3	.186 ± .023	205.3 ± 4.0	.083 ± .008
104.0 ± 1.4	.146 ± .019	209.4 ± 4.1	.077 ± .008
105.5 ± 1.4	.140 ± .018	213.7 ± 4.3	.082 ± .008
106.9 ± 1.4	.153 ± .019	218.1 ± 4.4	.067 ± .007
108.4 ± 1.4	.166 ± .020	222.6 ± 4.6	.071 ± .007
109.9 ± 1.5	.144 ± .018	227.3 ± 4.7	.067 ± .007
111.4 ± 1.5	.135 ± .017	232.1 ± 4.9	.062 ± .006
113.0 ± 1.5	.141 ± .017	237.1 ± 5.0	.056 ± .006
114.6 ± 1.6	.155 ± .019	242.3 ± 5.2	.066 ± .006
116.3 ± 1.6	.126 ± .016	247.6 ± 5.4	.057 ± .006
118.0 ± 1.7	.136 ± .017	253.2 ± 5.6	.058 ± .006
119.7 ± 1.7	.181 ± .021	258.9 ± 5.8	.050 ± .005
121.5 ± 1.7	.133 ± .016	264.9 ± 6.0	.052 ± .005
123.3 ± 1.8	.150 ± .017	271.1 ± 6.2	.056 ± .005
125.1 ± 1.8	.123 ± .015	277.5 ± 6.5	.049 ± .005
127.0 ± 1.9	.144 ± .017	284.1 ± 6.7	.047 ± .004
128.9 ± 1.9	.125 ± .015	291.0 ± 7.0	.041 ± .004
130.9 ± 2.0	.115 ± .014	298.2 ± 7.3	.040 ± .004
132.9 ± 2.0	.117 ± .014	305.7 ± 7.6	.034 ± .003
135.0 ± 2.1	.118 ± .014	313.5 ± 7.9	.035 ± .003
137.1 ± 2.1	.109 ± .013	321.6 ± 8.2	.029 ± .003
139.3 ± 2.2	.118 ± .014	330.1 ± 8.6	.030 ± .003
141.6 ± 2.2	.128 ± .014	338.9 ± 9.0	.028 ± .003
143.9 ± 2.3	.113 ± .013	348.2 ± 9.4	.025 ± .002
146.2 ± 2.3	.120 ± .013	357.8 ± 9.8	.021 ± .002
148.6 ± 2.4	.105 ± .012	367.9 ± 10.3	.021 ± .002
151.1 ± 2.5	.092 ± .011	378.4 ± 10.8	.000 ± .000
153.6 ± 2.5	.116 ± .013	389.5 ± 11.3	.000 ± .000
156.2 ± 2.6	.103 ± .011	401.1 ± 11.8	.000 ± .000
158.9 ± 2.7	.098 ± .011	413.3 ± 12.4	.000 ± .000
161.6 ± 2.7	.112 ± .012	426.1 ± 13.1	.000 ± .000
164.5 ± 2.8	.109 ± .012	439.5 ± 13.8	.000 ± .000

TABLE 23.- Continued

(c) Angle of scatter of 30°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.1 ± 1.1	.000 ± .000	167.4 ± 2.9	.075 ± .008
90.2 ± 1.1	.253 ± .035	170.3 ± 3.0	.072 ± .008
91.3 ± 1.1	.264 ± .034	173.4 ± 3.1	.073 ± .008
92.5 ± 1.1	.187 ± .025	176.5 ± 3.1	.060 ± .007
93.7 ± 1.1	.180 ± .024	179.8 ± 3.2	.067 ± .007
94.9 ± 1.2	.133 ± .019	183.1 ± 3.3	.052 ± .006
96.1 ± 1.2	.209 ± .025	186.5 ± 3.4	.056 ± .006
97.4 ± 1.2	.157 ± .020	190.1 ± 3.5	.058 ± .006
98.6 ± 1.2	.157 ± .020	193.7 ± 3.6	.048 ± .005
099.9 ± 1.3	.154 ± .019	197.5 ± 3.8	.046 ± .005
101.3 ± 1.3	.147 ± .018	201.3 ± 3.9	.053 ± .006
102.6 ± 1.3	.129 ± .017	205.3 ± 4.0	.049 ± .005
104.0 ± 1.4	.136 ± .017	209.4 ± 4.1	.047 ± .005
105.5 ± 1.4	.128 ± .016	213.7 ± 4.3	.049 ± .005
106.9 ± 1.4	.118 ± .015	218.1 ± 4.4	.045 ± .005
108.4 ± 1.4	.105 ± .014	222.6 ± 4.6	.045 ± .004
109.9 ± 1.5	.116 ± .015	227.3 ± 4.7	.042 ± .004
111.4 ± 1.5	.126 ± .015	232.1 ± 4.9	.037 ± .004
113.0 ± 1.5	.107 ± .013	237.1 ± 5.0	.036 ± .004
114.6 ± 1.6	.112 ± .014	242.3 ± 5.2	.037 ± .004
116.3 ± 1.6	.125 ± .015	247.6 ± 5.4	.031 ± .003
118.0 ± 1.7	.117 ± .014	253.2 ± 5.6	.030 ± .003
119.7 ± 1.7	.108 ± .013	258.9 ± 5.8	.029 ± .003
121.5 ± 1.7	.111 ± .013	264.9 ± 6.0	.027 ± .003
123.3 ± 1.8	.111 ± .013	271.1 ± 6.2	.025 ± .002
125.1 ± 1.8	.104 ± .012	277.5 ± 6.5	.026 ± .003
127.0 ± 1.9	.092 ± .011	284.1 ± 6.7	.022 ± .002
128.9 ± 1.9	.091 ± .011	291.0 ± 7.0	.019 ± .002
130.9 ± 2.0	.099 ± .012	298.2 ± 7.3	.019 ± .002
132.9 ± 2.0	.091 ± .011	305.7 ± 7.6	.018 ± .002
135.0 ± 2.1	.093 ± .011	313.5 ± 7.9	.019 ± .002
137.1 ± 2.1	.088 ± .010	321.6 ± 8.2	.015 ± .001
139.3 ± 2.2	.101 ± .011	330.1 ± 8.6	.013 ± .001
141.6 ± 2.2	.084 ± .010	338.9 ± 9.0	.013 ± .001
143.9 ± 2.3	.086 ± .010	348.2 ± 9.4	.012 ± .001
146.2 ± 2.3	.076 ± .009	357.8 ± 9.8	.010 ± .001
148.6 ± 2.4	.095 ± .010	367.9 ± 10.3	.008 ± .001
151.1 ± 2.5	.088 ± .010	378.4 ± 10.8	.000 ± .000
153.6 ± 2.5	.080 ± .009	389.5 ± 11.3	.000 ± .000
156.2 ± 2.6	.076 ± .008	401.1 ± 11.8	.000 ± .000
158.9 ± 2.7	.073 ± .008	413.3 ± 12.4	.000 ± .000
161.6 ± 2.7	.072 ± .008	426.1 ± 13.1	.000 ± .000
164.5 ± 2.8	.071 ± .008	439.5 ± 13.8	.000 ± .000

TABLE 23.- Concluded

(d) Angle of scatter of 40°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.7 ± 1.1	.000 ± .000	168.8 ± 2.9	.050 ± .005
90.8 ± 1.1	.241 ± .025	171.8 ± 3.0	.050 ± .005
91.9 ± 1.1	.166 ± .018	174.9 ± 3.1	.044 ± .004
93.1 ± 1.1	.167 ± .017	178.1 ± 3.2	.039 ± .004
94.3 ± 1.2	.150 ± .015	181.4 ± 3.3	.044 ± .004
95.5 ± 1.2	.133 ± .014	184.8 ± 3.4	.040 ± .004
96.8 ± 1.2	.149 ± .015	188.3 ± 3.5	.040 ± .004
98.0 ± 1.2	.125 ± .013	191.8 ± 3.6	.040 ± .003
99.3 ± 1.3	.110 ± .011	195.5 ± 3.7	.037 ± .003
100.6 ± 1.3	.120 ± .012	199.3 ± 3.8	.036 ± .003
102.0 ± 1.3	.102 ± .010	203.2 ± 3.9	.035 ± .003
103.4 ± 1.3	.114 ± .011	207.3 ± 4.1	.030 ± .003
104.8 ± 1.4	.096 ± .010	211.5 ± 4.2	.029 ± .002
106.2 ± 1.4	.097 ± .010	215.8 ± 4.3	.029 ± .002
107.7 ± 1.4	.094 ± .010	220.2 ± 4.5	.026 ± .002
109.2 ± 1.5	.089 ± .009	224.8 ± 4.6	.026 ± .002
110.7 ± 1.5	.086 ± .009	229.6 ± 4.8	.026 ± .002
112.2 ± 1.5	.105 ± .010	234.5 ± 4.9	.021 ± .002
113.8 ± 1.6	.085 ± .009	239.5 ± 5.1	.023 ± .002
115.5 ± 1.6	.100 ± .010	244.8 ± 5.3	.022 ± .002
117.1 ± 1.6	.089 ± .009	250.2 ± 5.5	.020 ± .002
118.8 ± 1.7	.086 ± .009	255.9 ± 5.7	.017 ± .001
120.6 ± 1.7	.086 ± .008	261.7 ± 5.9	.018 ± .001
122.4 ± 1.8	.086 ± .008	267.8 ± 6.1	.017 ± .001
124.2 ± 1.8	.073 ± .007	274.0 ± 6.4	.016 ± .001
126.1 ± 1.8	.084 ± .008	280.6 ± 6.6	.014 ± .001
128.0 ± 1.9	.083 ± .008	287.3 ± 6.9	.013 ± .001
129.9 ± 1.9	.079 ± .008	294.4 ± 7.1	.013 ± .001
131.9 ± 2.0	.067 ± .007	301.7 ± 7.4	.009 ± .001
134.0 ± 2.0	.072 ± .007	309.3 ± 7.7	.009 ± .001
136.1 ± 2.1	.070 ± .007	317.3 ± 8.1	.008 ± .000
138.2 ± 2.1	.067 ± .006	325.5 ± 8.4	.008 ± .000
140.4 ± 2.2	.070 ± .007	334.1 ± 8.8	.007 ± .000
142.7 ± 2.2	.065 ± .006	343.1 ± 9.1	.009 ± .000
145.0 ± 2.3	.069 ± .007	352.6 ± 9.6	.005 ± .000
147.4 ± 2.4	.062 ± .006	362.4 ± 10.0	.007 ± .000
149.8 ± 2.4	.055 ± .005	372.7 ± 10.5	.005 ± .000
152.3 ± 2.5	.064 ± .006	383.4 ± 11.0	.000 ± .000
154.9 ± 2.6	.062 ± .006	394.7 ± 11.5	.000 ± .000
157.5 ± 2.6	.053 ± .005	406.6 ± 12.1	.000 ± .000
160.2 ± 2.7	.054 ± .005	419.0 ± 12.7	.000 ± .000
163.0 ± 2.8	.054 ± .005	432.1 ± 13.4	.000 ± .000
165.9 ± 2.8	.051 ± .005	445.9 ± 14.1	.000 ± .000

TABLE 24.- DOUBLE DIFFERENTIAL CROSS SECTIONS FOR PRODUCTION OF SECONDARY DEUTERONS FROM TUNGSTEN TARGET, 3.05 g/cm^2 THICK

[Incident proton energy, 558 MeV]

(a) Angle of scatter of 10^{o}

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
88.9 ± 1.0	.858 ± .140	165.7 ± 2.8	.260 ± .032
90.0 ± 1.1	.591 ± .103	168.6 ± 2.9	.198 ± .026
91.2 ± 1.1	.563 ± .094	171.6 ± 3.0	.238 ± .030
92.3 ± 1.1	.397 ± .072	174.7 ± 3.1	.238 ± .029
93.5 ± 1.1	.473 ± .078	177.8 ± 3.1	.253 ± .031
94.7 ± 1.2	.353 ± .063	181.0 ± 3.2	.212 ± .026
95.9 ± 1.2	.475 ± .073	184.4 ± 3.3	.183 ± .024
97.1 ± 1.2	.392 ± .063	187.8 ± 3.4	.249 ± .029
98.4 ± 1.2	.413 ± .064	191.3 ± 3.5	.191 ± .024
99.7 ± 1.3	.406 ± .063	195.0 ± 3.6	.204 ± .025
101.0 ± 1.3	.447 ± .066	198.7 ± 3.8	.194 ± .023
102.3 ± 1.3	.365 ± .057	202.6 ± 3.9	.213 ± .025
103.7 ± 1.3	.393 ± .059	206.6 ± 4.0	.201 ± .024
105.1 ± 1.4	.402 ± .059	210.7 ± 4.1	.187 ± .022
106.5 ± 1.4	.394 ± .058	214.9 ± 4.3	.186 ± .022
108.0 ± 1.4	.343 ± .052	219.3 ± 4.4	.164 ± .019
109.5 ± 1.5	.310 ± .048	223.8 ± 4.5	.228 ± .025
111.0 ± 1.5	.341 ± .051	228.5 ± 4.7	.165 ± .019
112.5 ± 1.5	.370 ± .053	233.3 ± 4.9	.175 ± .020
114.1 ± 1.6	.311 ± .047	238.3 ± 5.0	.167 ± .019
115.8 ± 1.6	.375 ± .052	243.4 ± 5.2	.156 ± .018
117.4 ± 1.6	.305 ± .045	248.8 ± 5.4	.157 ± .018
119.1 ± 1.7	.356 ± .050	254.3 ± 5.6	.169 ± .019
120.8 ± 1.7	.392 ± .053	260.0 ± 5.8	.166 ± .018
122.6 ± 1.7	.363 ± .049	266.0 ± 6.0	.164 ± .018
124.4 ± 1.8	.268 ± .040	272.1 ± 6.2	.195 ± .020
126.3 ± 1.8	.325 ± .045	278.5 ± 6.5	.167 ± .018
128.2 ± 1.9	.359 ± .048	285.1 ± 6.7	.140 ± .015
130.1 ± 1.9	.294 ± .041	292.0 ± 7.0	.172 ± .018
132.1 ± 2.0	.298 ± .041	299.2 ± 7.2	.150 ± .016
134.1 ± 2.0	.285 ± .039	306.6 ± 7.5	.174 ± .018
136.2 ± 2.1	.260 ± .036	314.4 ± 7.9	.172 ± .017
138.3 ± 2.1	.305 ± .040	322.4 ± 8.2	.156 ± .016
140.5 ± 2.2	.308 ± .040	330.8 ± 8.5	.169 ± .017
142.8 ± 2.2	.292 ± .038	339.6 ± 8.9	.172 ± .017
145.1 ± 2.3	.317 ± .040	348.7 ± 9.3	.185 ± .018
147.4 ± 2.3	.271 ± .036	358.3 ± 9.7	.168 ± .017
149.8 ± 2.4	.303 ± .038	368.3 ± 10.2	.000 ± .000
152.3 ± 2.5	.257 ± .034	378.8 ± 10.7	.000 ± .000
154.9 ± 2.5	.247 ± .032	389.7 ± 11.2	.000 ± .000
157.5 ± 2.6	.307 ± .038	401.2 ± 11.7	.000 ± .000
160.1 ± 2.7	.250 ± .032	413.2 ± 12.3	.000 ± .000
162.9 ± 2.7	.278 ± .034	425.9 ± 12.9	.000 ± .000

TABLE 24.- Continued

(b) Angle of scatter of 20°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
88.9 ± 1.0	.668 ± .094	165.7 ± 2.8	.166 ± .019
90.0 ± 1.1	.476 ± .070	168.6 ± 2.9	.195 ± .022
91.2 ± 1.1	.500 ± .069	171.6 ± 3.0	.140 ± .017
92.3 ± 1.1	.444 ± .061	174.7 ± 3.1	.158 ± .018
93.5 ± 1.1	.415 ± .057	177.8 ± 3.1	.151 ± .017
94.7 ± 1.2	.393 ± .053	181.0 ± 3.2	.153 ± .017
95.9 ± 1.2	.373 ± .050	184.4 ± 3.3	.126 ± .015
97.1 ± 1.2	.333 ± .045	187.8 ± 3.4	.125 ± .015
98.4 ± 1.2	.314 ± .043	191.3 ± 3.5	.146 ± .016
99.7 ± 1.3	.335 ± .044	195.0 ± 3.6	.138 ± .015
101.0 ± 1.3	.323 ± .043	198.7 ± 3.8	.119 ± .014
102.3 ± 1.3	.316 ± .042	202.6 ± 3.9	.134 ± .015
103.7 ± 1.3	.313 ± .041	206.6 ± 4.0	.130 ± .014
105.1 ± 1.4	.344 ± .043	210.7 ± 4.1	.117 ± .013
106.5 ± 1.4	.306 ± .040	214.9 ± 4.3	.102 ± .012
108.0 ± 1.4	.333 ± .042	219.3 ± 4.4	.118 ± .013
109.5 ± 1.5	.245 ± .033	223.8 ± 4.5	.106 ± .012
111.0 ± 1.5	.250 ± .033	228.5 ± 4.7	.120 ± .013
112.5 ± 1.5	.255 ± .033	233.3 ± 4.9	.082 ± .009
114.1 ± 1.6	.307 ± .038	238.3 ± 5.0	.091 ± .010
115.8 ± 1.6	.266 ± .034	243.4 ± 5.2	.097 ± .010
117.4 ± 1.6	.218 ± .029	248.8 ± 5.4	.087 ± .009
119.1 ± 1.7	.275 ± .034	254.3 ± 5.6	.086 ± .009
120.8 ± 1.7	.240 ± .031	260.0 ± 5.8	.076 ± .008
122.6 ± 1.7	.230 ± .029	266.0 ± 6.0	.093 ± .010
124.4 ± 1.8	.248 ± .031	272.1 ± 6.2	.078 ± .008
126.3 ± 1.8	.290 ± .035	278.5 ± 6.5	.071 ± .008
128.2 ± 1.9	.193 ± .025	285.1 ± 6.7	.073 ± .008
130.1 ± 1.9	.223 ± .028	292.0 ± 7.0	.066 ± .007
132.1 ± 2.0	.195 ± .025	299.2 ± 7.2	.061 ± .007
134.1 ± 2.0	.254 ± .030	306.6 ± 7.5	.057 ± .006
136.2 ± 2.1	.231 ± .028	314.4 ± 7.9	.050 ± .005
138.3 ± 2.1	.199 ± .025	322.4 ± 8.2	.054 ± .006
140.5 ± 2.2	.197 ± .024	330.8 ± 8.5	.044 ± .005
142.8 ± 2.2	.196 ± .024	339.6 ± 8.9	.039 ± .004
145.1 ± 2.3	.201 ± .024	348.7 ± 9.3	.033 ± .004
147.4 ± 2.3	.230 ± .027	358.3 ± 9.7	.026 ± .003
149.8 ± 2.4	.203 ± .024	368.3 ± 10.2	.000 ± .000
152.3 ± 2.5	.198 ± .023	378.8 ± 10.7	.000 ± .000
154.9 ± 2.5	.181 ± .022	389.7 ± 11.2	.000 ± .000
157.5 ± 2.6	.190 ± .022	401.2 ± 11.7	.000 ± .000
160.1 ± 2.7	.153 ± .019	413.2 ± 12.3	.000 ± .000
162.9 ± 2.7	.149 ± .018	425.9 ± 12.9	.000 ± .000

TABLE 24.- Continued

(c) Angle of scatter of 30°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
88.9 ± 1.0	.568 ± .077	165.7 ± 2.8	.133 ± .015
90.0 ± 1.1	.422 ± .059	168.6 ± 2.9	.117 ± .014
91.2 ± 1.1	.438 ± .058	171.6 ± 3.0	.104 ± .012
92.3 ± 1.1	.354 ± .048	174.7 ± 3.1	.113 ± .013
93.5 ± 1.1	.362 ± .047	177.8 ± 3.1	.120 ± .014
94.7 ± 1.2	.421 ± .052	181.0 ± 3.2	.106 ± .012
95.9 ± 1.2	.293 ± .039	184.4 ± 3.3	.111 ± .013
97.1 ± 1.2	.290 ± .038	187.8 ± 3.4	.094 ± .011
98.4 ± 1.2	.333 ± .042	191.3 ± 3.5	.093 ± .011
99.7 ± 1.3	.300 ± .038	195.0 ± 3.6	.099 ± .011
101.0 ± 1.3	.291 ± .037	198.7 ± 3.8	.087 ± .010
102.3 ± 1.3	.318 ± .039	202.6 ± 3.9	.097 ± .011
103.7 ± 1.3	.263 ± .034	206.6 ± 4.0	.085 ± .010
105.1 ± 1.4	.227 ± .030	210.7 ± 4.1	.069 ± .008
106.5 ± 1.4	.226 ± .030	214.9 ± 4.3	.080 ± .009
108.0 ± 1.4	.208 ± .028	219.3 ± 4.4	.076 ± .009
109.5 ± 1.5	.237 ± .030	223.8 ± 4.5	.077 ± .008
111.0 ± 1.5	.238 ± .030	228.5 ± 4.7	.062 ± .007
112.5 ± 1.5	.222 ± .028	233.3 ± 4.9	.056 ± .006
114.1 ± 1.6	.213 ± .027	238.3 ± 5.0	.066 ± .007
115.8 ± 1.6	.239 ± .029	243.4 ± 5.2	.050 ± .006
117.4 ± 1.6	.228 ± .028	248.8 ± 5.4	.054 ± .006
119.1 ± 1.7	.229 ± .028	254.3 ± 5.6	.054 ± .006
120.8 ± 1.7	.210 ± .026	260.0 ± 5.8	.047 ± .005
122.6 ± 1.7	.228 ± .027	266.0 ± 6.0	.045 ± .005
124.4 ± 1.8	.184 ± .023	272.1 ± 6.2	.041 ± .005
126.3 ± 1.8	.214 ± .026	278.5 ± 6.5	.041 ± .005
128.2 ± 1.9	.207 ± .025	285.1 ± 6.7	.042 ± .005
130.1 ± 1.9	.193 ± .023	292.0 ± 7.0	.031 ± .004
132.1 ± 2.0	.182 ± .022	299.2 ± 7.2	.028 ± .003
134.1 ± 2.0	.198 ± .023	306.6 ± 7.5	.029 ± .003
136.2 ± 2.1	.161 ± .020	314.4 ± 7.9	.026 ± .003
138.3 ± 2.1	.193 ± .023	322.4 ± 8.2	.023 ± .003
140.5 ± 2.2	.158 ± .019	330.8 ± 8.5	.022 ± .002
142.8 ± 2.2	.158 ± .019	339.6 ± 8.9	.019 ± .002
145.1 ± 2.3	.165 ± .020	348.7 ± 9.3	.019 ± .002
147.4 ± 2.3	.141 ± .017	358.3 ± 9.7	.015 ± .002
149.8 ± 2.4	.141 ± .017	368.3 ± 10.2	.000 ± .000
152.3 ± 2.5	.137 ± .016	378.8 ± 10.7	.000 ± .000
154.9 ± 2.5	.117 ± .014	389.7 ± 11.2	.000 ± .000
157.5 ± 2.6	.136 ± .016	401.2 ± 11.7	.000 ± .000
160.1 ± 2.7	.135 ± .016	413.2 ± 12.3	.000 ± .000
162.9 ± 2.7	.116 ± .014	425.9 ± 12.9	.000 ± .000

TABLE 24.- Continued

(d) Angle of scatter of 40°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
88.9 ± 1.0	.579 ± .079	165.7 ± 2.8	.102 ± .013
90.0 ± 1.1	.461 ± .064	168.6 ± 2.9	.090 ± .011
91.2 ± 1.1	.423 ± .057	171.6 ± 3.0	.092 ± .012
92.3 ± 1.1	.326 ± .046	174.7 ± 3.1	.094 ± .012
93.5 ± 1.1	.293 ± .042	177.8 ± 3.1	.090 ± .011
94.7 ± 1.2	.253 ± .037	181.0 ± 3.2	.086 ± .011
95.9 ± 1.2	.269 ± .037	184.4 ± 3.3	.081 ± .010
97.1 ± 1.2	.252 ± .035	187.8 ± 3.4	.081 ± .010
98.4 ± 1.2	.257 ± .035	191.3 ± 3.5	.081 ± .010
99.7 ± 1.3	.279 ± .036	195.0 ± 3.6	.068 ± .008
101.0 ± 1.3	.235 ± .032	198.7 ± 3.8	.075 ± .009
102.3 ± 1.3	.225 ± .031	202.6 ± 3.9	.076 ± .009
103.7 ± 1.3	.209 ± .029	206.6 ± 4.0	.052 ± .007
105.1 ± 1.4	.189 ± .027	210.7 ± 4.1	.052 ± .007
106.5 ± 1.4	.178 ± .025	214.9 ± 4.3	.056 ± .007
108.0 ± 1.4	.197 ± .027	219.3 ± 4.4	.046 ± .006
109.5 ± 1.5	.215 ± .028	223.8 ± 4.5	.048 ± .006
111.0 ± 1.5	.215 ± .028	228.5 ± 4.7	.043 ± .005
112.5 ± 1.5	.189 ± .025	233.3 ± 4.9	.050 ± .006
114.1 ± 1.6	.153 ± .022	238.3 ± 5.0	.032 ± .004
115.8 ± 1.6	.182 ± .024	243.4 ± 5.2	.037 ± .005
117.4 ± 1.6	.178 ± .024	248.8 ± 5.4	.039 ± .005
119.1 ± 1.7	.163 ± .022	254.3 ± 5.6	.029 ± .004
120.8 ± 1.7	.190 ± .024	260.0 ± 5.8	.026 ± .003
122.6 ± 1.7	.182 ± .023	266.0 ± 6.0	.031 ± .004
124.4 ± 1.8	.186 ± .023	272.1 ± 6.2	.023 ± .003
126.3 ± 1.8	.146 ± .019	278.5 ± 6.5	.029 ± .004
128.2 ± 1.9	.149 ± .019	285.1 ± 6.7	.030 ± .004
130.1 ± 1.9	.143 ± .019	292.0 ± 7.0	.018 ± .002
132.1 ± 2.0	.139 ± .018	299.2 ± 7.2	.021 ± .003
134.1 ± 2.0	.124 ± .017	306.6 ± 7.5	.015 ± .002
136.2 ± 2.1	.145 ± .019	314.4 ± 7.9	.014 ± .002
138.3 ± 2.1	.140 ± .018	322.4 ± 8.2	.013 ± .002
140.5 ± 2.2	.152 ± .019	330.8 ± 8.5	.010 ± .001
142.8 ± 2.2	.114 ± .015	339.6 ± 8.9	.008 ± .001
145.1 ± 2.3	.131 ± .016	348.7 ± 9.3	.008 ± .001
147.4 ± 2.3	.114 ± .014	358.3 ± 9.7	.007 ± .001
149.8 ± 2.4	.134 ± .016	368.3 ± 10.2	.000 ± .000
152.3 ± 2.5	.121 ± .015	378.8 ± 10.7	.000 ± .000
154.9 ± 2.5	.105 ± .013	389.7 ± 11.2	.000 ± .000
157.5 ± 2.6	.097 ± .012	401.2 ± 11.7	.000 ± .000
160.1 ± 2.7	.100 ± .013	413.2 ± 12.3	.000 ± .000
162.9 ± 2.7	.107 ± .013	425.9 ± 12.9	.000 ± .000

TABLE 24.- Continued

(e) Angle of scatter of 50°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
88.9 ± 1.0	.418 ± .052	165.7 ± 2.8	.075 ± .008
90.0 ± 1.1	.311 ± .040	168.6 ± 2.9	.064 ± .007
91.2 ± 1.1	.277 ± .035	171.6 ± 3.0	.059 ± .007
92.3 ± 1.1	.275 ± .033	174.7 ± 3.1	.066 ± .007
93.5 ± 1.1	.206 ± .027	177.8 ± 3.1	.056 ± .006
94.7 ± 1.2	.214 ± .027	181.0 ± 3.2	.051 ± .006
95.9 ± 1.2	.195 ± .024	184.4 ± 3.3	.060 ± .007
97.1 ± 1.2	.183 ± .023	187.8 ± 3.4	.041 ± .005
98.4 ± 1.2	.152 ± .020	191.3 ± 3.5	.046 ± .005
99.7 ± 1.3	.161 ± .020	195.0 ± 3.6	.044 ± .005
101.0 ± 1.3	.157 ± .020	198.7 ± 3.8	.038 ± .004
102.3 ± 1.3	.191 ± .023	202.6 ± 3.9	.039 ± .004
103.7 ± 1.3	.141 ± .018	206.6 ± 4.0	.034 ± .004
105.1 ± 1.4	.143 ± .018	210.7 ± 4.1	.032 ± .004
106.5 ± 1.4	.148 ± .018	214.9 ± 4.3	.040 ± .004
108.0 ± 1.4	.148 ± .018	219.3 ± 4.4	.024 ± .003
109.5 ± 1.5	.126 ± .016	223.8 ± 4.5	.025 ± .003
111.0 ± 1.5	.154 ± .018	228.5 ± 4.7	.029 ± .003
112.5 ± 1.5	.128 ± .016	233.3 ± 4.9	.021 ± .002
114.1 ± 1.6	.118 ± .015	238.3 ± 5.0	.024 ± .003
115.8 ± 1.6	.123 ± .015	243.4 ± 5.2	.017 ± .002
117.4 ± 1.6	.156 ± .018	248.8 ± 5.4	.018 ± .002
119.1 ± 1.7	.109 ± .014	254.3 ± 5.6	.013 ± .002
120.8 ± 1.7	.124 ± .015	260.0 ± 5.8	.018 ± .002
122.6 ± 1.7	.128 ± .015	266.0 ± 6.0	.016 ± .002
124.4 ± 1.8	.108 ± .013	272.1 ± 6.2	.012 ± .001
126.3 ± 1.8	.107 ± .013	278.5 ± 6.5	.010 ± .001
128.2 ± 1.9	.097 ± .012	285.1 ± 6.7	.009 ± .001
130.1 ± 1.9	.106 ± .013	292.0 ± 7.0	.011 ± .001
132.1 ± 2.0	.097 ± .012	299.2 ± 7.2	.006 ± .001
134.1 ± 2.0	.108 ± .013	306.6 ± 7.5	.005 ± .001
136.2 ± 2.1	.102 ± .012	314.4 ± 7.9	.004 ± .000
138.3 ± 2.1	.095 ± .011	322.4 ± 8.2	.005 ± .000
140.5 ± 2.2	.097 ± .011	330.8 ± 8.5	.003 ± .000
142.8 ± 2.2	.082 ± .010	339.6 ± 8.9	.003 ± .000
145.1 ± 2.3	.087 ± .010	348.7 ± 9.3	.002 ± .000
147.4 ± 2.3	.079 ± .009	358.3 ± 9.7	.001 ± .000
149.8 ± 2.4	.081 ± .009	368.3 ± 10.2	.000 ± .000
152.3 ± 2.5	.080 ± .009	378.8 ± 10.7	.000 ± .000
154.9 ± 2.5	.063 ± .008	389.7 ± 11.2	.000 ± .000
157.5 ± 2.6	.064 ± .008	401.2 ± 11.7	.000 ± .000
160.1 ± 2.7	.066 ± .008	413.2 ± 12.3	.000 ± .000
162.9 ± 2.7	.061 ± .007	425.9 ± 12.9	.000 ± .000

TABLE 24.- Concluded

(f) Angle of scatter of 60^{o}

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.7 ± 1.1	.321 ± .039	168.8 ± 2.9	.038 ± .005
90.8 ± 1.1	.277 ± .034	171.8 ± 3.0	.044 ± .005
91.9 ± 1.1	.229 ± .028	174.9 ± 3.1	.035 ± .004
93.1 ± 1.1	.210 ± .025	178.1 ± 3.2	.035 ± .004
94.3 ± 1.2	.177 ± .022	181.4 ± 3.3	.037 ± .004
95.5 ± 1.2	.177 ± .021	184.8 ± 3.4	.035 ± .004
96.8 ± 1.2	.141 ± .018	188.3 ± 3.5	.031 ± .004
98.0 ± 1.2	.141 ± .018	191.8 ± 3.6	.029 ± .003
99.3 ± 1.3	.146 ± .018	195.5 ± 3.7	.028 ± .003
100.6 ± 1.3	.117 ± .015	199.3 ± 3.8	.021 ± .003
102.0 ± 1.3	.168 ± .019	203.2 ± 3.9	.024 ± .003
103.4 ± 1.3	.122 ± .015	207.3 ± 4.1	.019 ± .002
104.8 ± 1.4	.134 ± .016	211.5 ± 4.2	.018 ± .002
106.2 ± 1.4	.150 ± .017	215.8 ± 4.3	.018 ± .002
107.7 ± 1.4	.119 ± .014	220.2 ± 4.5	.018 ± .002
109.2 ± 1.5	.107 ± .013	224.8 ± 4.6	.016 ± .002
110.7 ± 1.5	.123 ± .014	229.6 ± 4.8	.013 ± .002
112.2 ± 1.5	.103 ± .013	234.5 ± 4.9	.009 ± .001
113.8 ± 1.6	.110 ± .013	239.5 ± 5.1	.011 ± .001
115.5 ± 1.6	.106 ± .013	244.8 ± 5.3	.009 ± .001
117.1 ± 1.6	.086 ± .011	250.2 ± 5.5	.010 ± .001
118.8 ± 1.7	.088 ± .011	255.9 ± 5.7	.008 ± .001
120.6 ± 1.7	.091 ± .011	261.7 ± 5.9	.005 ± .001
122.4 ± 1.8	.104 ± .012	267.8 ± 6.1	.005 ± .000
124.2 ± 1.8	.075 ± .009	274.0 ± 6.4	.007 ± .001
126.1 ± 1.8	.091 ± .011	280.6 ± 6.6	.007 ± .001
128.0 ± 1.9	.093 ± .011	287.3 ± 6.9	.005 ± .000
129.9 ± 1.9	.079 ± .009	294.4 ± 7.1	.003 ± .000
131.9 ± 2.0	.078 ± .009	301.7 ± 7.4	.003 ± .000
134.0 ± 2.0	.069 ± .008	309.3 ± 7.7	.003 ± .000
136.1 ± 2.1	.069 ± .008	317.3 ± 8.1	.002 ± .000
138.2 ± 2.1	.069 ± .008	325.5 ± 8.4	.002 ± .000
140.4 ± 2.2	.059 ± .007	334.1 ± 8.8	.003 ± .000
142.7 ± 2.2	.065 ± .008	343.1 ± 9.1	.001 ± .000
145.0 ± 2.3	.062 ± .007	352.6 ± 9.6	.001 ± .000
147.4 ± 2.4	.061 ± .007	362.4 ± 10.0	.002 ± .000
149.8 ± 2.4	.052 ± .006	372.7 ± 10.5	.001 ± .000
152.3 ± 2.5	.054 ± .006	383.4 ± 11.0	.000 ± .000
154.9 ± 2.6	.058 ± .006	394.7 ± 11.5	.000 ± .000
157.5 ± 2.6	.052 ± .006	406.6 ± 12.1	.000 ± .000
160.2 ± 2.7	.049 ± .006	419.0 ± 12.7	.000 ± .000
163.0 ± 2.8	.053 ± .006	432.1 ± 13.4	.000 ± .000
165.9 ± 2.8	.036 ± .004	445.9 ± 14.1	.000 ± .000

TABLE 25.- DOUBLE DIFFERENTIAL CROSS SECTIONS FOR PRODUCTION OF SECONDARY DEUTERONS FROM LEAD TARGET, 3.91 g/cm^2 THICK

[Incident proton energy, 558 MeV]

(a) Angle of scatter of 10°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
88.8 ± 1.1	.788 ± .158	167.0 ± 2.9	.256 ± .036
89.9 ± 1.1	.873 ± .154	170.0 ± 3.0	.241 ± .034
91.0 ± 1.1	.573 ± .112	173.1 ± 3.1	.251 ± .035
92.2 ± 1.1	.487 ± .097	176.2 ± 3.1	.274 ± .036
93.4 ± 1.1	.554 ± .100	179.5 ± 3.2	.219 ± .031
94.6 ± 1.2	.454 ± .086	182.8 ± 3.3	.220 ± .030
95.8 ± 1.2	.582 ± .097	186.2 ± 3.4	.267 ± .035
97.1 ± 1.2	.289 ± .062	189.8 ± 3.5	.259 ± .033
98.3 ± 1.2	.459 ± .080	193.4 ± 3.6	.216 ± .029
99.7 ± 1.3	.311 ± .062	197.2 ± 3.8	.238 ± .031
101.0 ± 1.3	.396 ± .071	201.0 ± 3.9	.202 ± .027
102.3 ± 1.3	.427 ± .073	205.0 ± 4.0	.223 ± .029
103.7 ± 1.4	.383 ± .067	209.2 ± 4.1	.204 ± .026
105.2 ± 1.4	.378 ± .066	213.4 ± 4.3	.236 ± .029
106.6 ± 1.4	.331 ± .060	217.8 ± 4.4	.207 ± .026
108.1 ± 1.4	.360 ± .062	222.3 ± 4.6	.188 ± .024
109.6 ± 1.5	.348 ± .060	227.0 ± 4.7	.197 ± .024
111.1 ± 1.5	.398 ± .065	231.8 ± 4.9	.163 ± .021
112.7 ± 1.5	.415 ± .066	236.9 ± 5.0	.181 ± .022
114.3 ± 1.6	.416 ± .065	242.0 ± 5.2	.184 ± .023
116.0 ± 1.6	.319 ± .054	247.4 ± 5.4	.150 ± .019
117.7 ± 1.7	.262 ± .047	253.0 ± 5.6	.161 ± .020
119.4 ± 1.7	.312 ± .052	258.7 ± 5.8	.187 ± .022
121.1 ± 1.7	.365 ± .057	264.7 ± 6.0	.168 ± .020
123.0 ± 1.8	.359 ± .056	270.9 ± 6.3	.156 ± .019
124.8 ± 1.8	.253 ± .044	277.3 ± 6.5	.165 ± .019
126.7 ± 1.9	.290 ± .048	284.0 ± 6.8	.167 ± .019
128.6 ± 1.9	.248 ± .042	290.9 ± 7.0	.176 ± .020
130.6 ± 2.0	.282 ± .046	298.1 ± 7.3	.149 ± .017
132.6 ± 2.0	.361 ± .053	305.6 ± 7.6	.151 ± .017
134.7 ± 2.1	.289 ± .045	313.5 ± 7.9	.182 ± .020
136.8 ± 2.1	.313 ± .047	321.6 ± 8.3	.190 ± .020
139.0 ± 2.2	.252 ± .040	330.1 ± 8.6	.184 ± .020
141.2 ± 2.2	.244 ± .039	339.0 ± 9.0	.170 ± .018
143.5 ± 2.3	.275 ± .042	348.2 ± 9.4	.186 ± .019
145.9 ± 2.3	.245 ± .038	357.9 ± 9.8	.169 ± .018
148.3 ± 2.4	.315 ± .045	368.0 ± 10.3	.212 ± .021
150.8 ± 2.5	.290 ± .042	378.6 ± 10.8	.000 ± .000
153.3 ± 2.5	.308 ± .043	389.7 ± 11.3	.000 ± .000
155.9 ± 2.6	.223 ± .034	401.4 ± 11.9	.000 ± .000
158.6 ± 2.7	.263 ± .038	413.6 ± 12.5	.000 ± .000
161.3 ± 2.7	.269 ± .038	426.4 ± 13.1	.000 ± .000
164.1 ± 2.8	.286 ± .039	440.0 ± 13.8	.000 ± .000

TABLE 25.- Continued

(b) Angle of scatter of 20^{o}

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.1 ± 1.1	.737 ± .116	167.4 ± 2.9	.166 ± .022
90.2 ± 1.1	.525 ± .087	170.3 ± 3.0	.203 ± .025
91.3 ± 1.1	.569 ± .086	173.4 ± 3.1	.153 ± .020
92.5 ± 1.1	.541 ± .080	176.5 ± 3.1	.151 ± .019
93.7 ± 1.1	.359 ± .059	179.8 ± 3.2	.138 ± .018
94.9 ± 1.2	.480 ± .069	183.1 ± 3.3	.168 ± .021
96.1 ± 1.2	.293 ± .049	186.5 ± 3.4	.140 ± .018
97.4 ± 1.2	.537 ± .072	190.1 ± 3.5	.154 ± .019
98.6 ± 1.2	.355 ± .053	193.7 ± 3.6	.152 ± .018
099.9 ± 1.3	.343 ± .051	197.5 ± 3.8	.128 ± .016
101.3 ± 1.3	.317 ± .048	201.3 ± 3.9	.151 ± .018
102.6 ± 1.3	.333 ± .049	205.3 ± 4.0	.145 ± .017
104.0 ± 1.4	.302 ± .045	209.4 ± 4.1	.126 ± .015
105.5 ± 1.4	.313 ± .046	213.7 ± 4.3	.140 ± .016
106.9 ± 1.4	.276 ± .042	218.1 ± 4.4	.113 ± .014
108.4 ± 1.4	.314 ± .045	222.6 ± 4.6	.120 ± .014
109.9 ± 1.5	.315 ± .045	227.3 ± 4.7	.123 ± .014
111.4 ± 1.5	.301 ± .043	232.1 ± 4.9	.119 ± .014
113.0 ± 1.5	.284 ± .041	237.1 ± 5.0	.110 ± .013
114.6 ± 1.6	.256 ± .038	242.3 ± 5.2	.104 ± .012
116.3 ± 1.6	.259 ± .037	247.6 ± 5.4	.093 ± .011
118.0 ± 1.7	.264 ± .038	253.2 ± 5.6	.067 ± .009
119.7 ± 1.7	.336 ± .044	258.9 ± 5.8	.098 ± .011
121.5 ± 1.7	.247 ± .035	264.9 ± 6.0	.085 ± .010
123.3 ± 1.8	.258 ± .036	271.1 ± 6.2	.098 ± .011
125.1 ± 1.8	.277 ± .037	277.5 ± 6.5	.078 ± .009
127.0 ± 1.9	.274 ± .037	284.1 ± 6.7	.077 ± .009
128.9 ± 1.9	.222 ± .031	291.0 ± 7.0	.080 ± .009
130.9 ± 2.0	.248 ± .033	298.2 ± 7.3	.065 ± .008
132.9 ± 2.0	.199 ± .028	305.7 ± 7.6	.061 ± .007
135.0 ± 2.1	.226 ± .031	313.5 ± 7.9	.058 ± .007
137.1 ± 2.1	.217 ± .029	321.6 ± 8.2	.052 ± .006
139.3 ± 2.2	.231 ± .031	330.1 ± 8.6	.049 ± .006
141.6 ± 2.2	.184 ± .026	338.9 ± 9.0	.039 ± .005
143.9 ± 2.3	.235 ± .030	348.2 ± 9.4	.036 ± .004
146.2 ± 2.3	.148 ± .022	357.8 ± 9.8	.032 ± .004
148.6 ± 2.4	.239 ± .030	367.9 ± 10.3	.037 ± .004
151.1 ± 2.5	.252 ± .031	378.4 ± 10.8	.000 ± .000
153.6 ± 2.5	.208 ± .027	389.5 ± 11.3	.000 ± .000
156.2 ± 2.6	.186 ± .024	401.1 ± 11.8	.000 ± .000
158.9 ± 2.7	.179 ± .023	413.3 ± 12.4	.000 ± .000
161.6 ± 2.7	.180 ± .023	426.1 ± 13.1	.000 ± .000
164.5 ± 2.8	.196 ± .025	439.5 ± 13.8	.000 ± .000

TABLE 25.- Continued

(c) Angle of scatter of 30°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.1 ± 1.1	.701 ± .109	167.4 ± 2.9	.123 ± .017
90.2 ± 1.1	.440 ± .075	170.3 ± 3.0	.160 ± .020
91.3 ± 1.1	.468 ± .073	173.4 ± 3.1	.120 ± .016
92.5 ± 1.1	.350 ± .058	176.5 ± 3.1	.110 ± .015
93.7 ± 1.1	.363 ± .058	179.8 ± 3.2	.109 ± .015
94.9 ± 1.2	.320 ± .052	183.1 ± 3.3	.114 ± .015
96.1 ± 1.2	.279 ± .046	186.5 ± 3.4	.105 ± .014
97.4 ± 1.2	.300 ± .047	190.1 ± 3.5	.079 ± .011
98.6 ± 1.2	.304 ± .047	193.7 ± 3.6	.115 ± .015
099.9 ± 1.3	.289 ± .044	197.5 ± 3.8	.092 ± .012
101.3 ± 1.3	.366 ± .051	201.3 ± 3.9	.073 ± .010
102.6 ± 1.3	.265 ± .041	205.3 ± 4.0	.093 ± .012
104.0 ± 1.4	.311 ± .045	209.4 ± 4.1	.084 ± .011
105.5 ± 1.4	.233 ± .037	213.7 ± 4.3	.080 ± .011
106.9 ± 1.4	.189 ± .032	218.1 ± 4.4	.079 ± .010
108.4 ± 1.4	.233 ± .036	222.6 ± 4.6	.062 ± .009
109.9 ± 1.5	.301 ± .042	227.3 ± 4.7	.063 ± .009
111.4 ± 1.5	.266 ± .038	232.1 ± 4.9	.056 ± .008
113.0 ± 1.5	.264 ± .038	237.1 ± 5.0	.057 ± .008
114.6 ± 1.6	.286 ± .039	242.3 ± 5.2	.059 ± .008
116.3 ± 1.6	.201 ± .031	247.6 ± 5.4	.060 ± .008
118.0 ± 1.7	.198 ± .030	253.2 ± 5.6	.060 ± .008
119.7 ± 1.7	.225 ± .032	258.9 ± 5.8	.049 ± .007
121.5 ± 1.7	.227 ± .032	264.9 ± 6.0	.055 ± .007
123.3 ± 1.8	.239 ± .033	271.1 ± 6.2	.047 ± .006
125.1 ± 1.8	.198 ± .029	277.5 ± 6.5	.033 ± .005
127.0 ± 1.9	.191 ± .028	284.1 ± 6.7	.030 ± .004
128.9 ± 1.9	.193 ± .028	291.0 ± 7.0	.042 ± .005
130.9 ± 2.0	.169 ± .025	298.2 ± 7.3	.040 ± .005
132.9 ± 2.0	.190 ± .027	305.7 ± 7.6	.033 ± .004
135.0 ± 2.1	.186 ± .026	313.5 ± 7.9	.020 ± .003
137.1 ± 2.1	.194 ± .027	321.6 ± 8.2	.022 ± .003
139.3 ± 2.2	.176 ± .025	330.1 ± 8.6	.025 ± .003
141.6 ± 2.2	.194 ± .026	338.9 ± 9.0	.020 ± .003
143.9 ± 2.3	.182 ± .025	348.2 ± 9.4	.015 ± .002
146.2 ± 2.3	.196 ± .026	357.8 ± 9.8	.015 ± .002
148.6 ± 2.4	.140 ± .020	367.9 ± 10.3	.017 ± .002
151.1 ± 2.5	.169 ± .023	378.4 ± 10.8	.000 ± .000
153.6 ± 2.5	.127 ± .018	389.5 ± 11.3	.000 ± .000
156.2 ± 2.6	.132 ± .019	401.1 ± 11.8	.000 ± .000
158.9 ± 2.7	.131 ± .018	413.3 ± 12.4	.000 ± .000
161.6 ± 2.7	.130 ± .018	426.1 ± 13.1	.000 ± .000
164.5 ± 2.8	.139 ± .019	439.5 ± 13.8	.000 ± .000

TABLE 25.- Continued

(d) Angle of scatter of 40°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.7 ± 1.1	.534 ± .058	168.8 ± 2.9	.100 ± .010
90.8 ± 1.1	.496 ± .053	171.8 ± 3.0	.101 ± .010
91.9 ± 1.1	.355 ± .040	174.9 ± 3.1	.086 ± .009
93.1 ± 1.1	.349 ± .038	178.1 ± 3.2	.096 ± .010
94.3 ± 1.2	.329 ± .036	181.4 ± 3.3	.082 ± .008
95.5 ± 1.2	.275 ± .030	184.8 ± 3.4	.079 ± .008
96.8 ± 1.2	.257 ± .028	188.3 ± 3.5	.081 ± .008
98.0 ± 1.2	.299 ± .032	191.8 ± 3.6	.065 ± .007
99.3 ± 1.3	.273 ± .029	195.5 ± 3.7	.072 ± .007
100.6 ± 1.3	.239 ± .026	199.3 ± 3.8	.064 ± .006
102.0 ± 1.3	.217 ± .024	203.2 ± 3.9	.067 ± .007
103.4 ± 1.3	.249 ± .027	207.3 ± 4.1	.062 ± .006
104.8 ± 1.4	.233 ± .025	211.5 ± 4.2	.061 ± .006
106.2 ± 1.4	.206 ± .023	215.8 ± 4.3	.054 ± .005
107.7 ± 1.4	.217 ± .023	220.2 ± 4.5	.055 ± .005
109.2 ± 1.5	.237 ± .025	224.8 ± 4.6	.052 ± .005
110.7 ± 1.5	.199 ± .022	229.6 ± 4.8	.049 ± .005
112.2 ± 1.5	.197 ± .021	234.5 ± 4.9	.053 ± .005
113.8 ± 1.6	.241 ± .025	239.5 ± 5.1	.040 ± .004
115.5 ± 1.6	.202 ± .021	244.8 ± 5.3	.042 ± .004
117.1 ± 1.6	.201 ± .021	250.2 ± 5.5	.030 ± .003
118.8 ± 1.7	.187 ± .020	255.9 ± 5.7	.028 ± .003
120.6 ± 1.7	.181 ± .019	261.7 ± 5.9	.032 ± .003
122.4 ± 1.8	.176 ± .019	267.8 ± 6.1	.030 ± .003
124.2 ± 1.8	.175 ± .018	274.0 ± 6.4	.025 ± .002
126.1 ± 1.8	.160 ± .017	280.6 ± 6.6	.025 ± .002
128.0 ± 1.9	.163 ± .017	287.3 ± 6.9	.024 ± .002
129.9 ± 1.9	.162 ± .017	294.4 ± 7.1	.017 ± .002
131.9 ± 2.0	.156 ± .016	301.7 ± 7.4	.017 ± .002
134.0 ± 2.0	.139 ± .015	309.3 ± 7.7	.016 ± .002
136.1 ± 2.1	.141 ± .015	317.3 ± 8.1	.016 ± .001
138.2 ± 2.1	.140 ± .015	325.5 ± 8.4	.010 ± .001
140.4 ± 2.2	.145 ± .015	334.1 ± 8.8	.013 ± .001
142.7 ± 2.2	.145 ± .015	343.1 ± 9.1	.010 ± .001
145.0 ± 2.3	.128 ± .013	352.6 ± 9.6	.008 ± .001
147.4 ± 2.4	.128 ± .013	362.4 ± 10.0	.007 ± .001
149.8 ± 2.4	.120 ± .012	372.7 ± 10.5	.004 ± .000
152.3 ± 2.5	.106 ± .011	383.4 ± 11.0	.000 ± .000
154.9 ± 2.6	.125 ± .013	394.7 ± 11.5	.000 ± .000
157.5 ± 2.6	.122 ± .012	406.6 ± 12.1	.000 ± .000
160.2 ± 2.7	.115 ± .012	419.0 ± 12.7	.000 ± .000
163.0 ± 2.8	.105 ± .011	432.1 ± 13.4	.000 ± .000
165.9 ± 2.8	.115 ± .012	445.9 ± 14.1	.000 ± .000

TABLE 25.- Continued

(e) Angle of scatter of 50°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.7 ± 1.1	.467 ± .053	168.8 ± 2.9	.072 ± .008
90.8 ± 1.1	.384 ± .044	171.8 ± 3.0	.068 ± .007
91.9 ± 1.1	.329 ± .038	174.9 ± 3.1	.060 ± .007
93.1 ± 1.1	.272 ± .032	178.1 ± 3.2	.073 ± .008
94.3 ± 1.2	.261 ± .030	181.4 ± 3.3	.056 ± .006
95.5 ± 1.2	.242 ± .028	184.8 ± 3.4	.062 ± .007
96.8 ± 1.2	.209 ± .024	188.3 ± 3.5	.059 ± .006
98.0 ± 1.2	.251 ± .028	191.8 ± 3.6	.057 ± .006
99.3 ± 1.3	.185 ± .022	195.5 ± 3.7	.044 ± .005
100.6 ± 1.3	.208 ± .024	199.3 ± 3.8	.056 ± .006
102.0 ± 1.3	.192 ± .022	203.2 ± 3.9	.048 ± .005
103.4 ± 1.3	.188 ± .022	207.3 ± 4.1	.049 ± .005
104.8 ± 1.4	.165 ± .019	211.5 ± 4.2	.059 ± .006
106.2 ± 1.4	.158 ± .018	215.8 ± 4.3	.049 ± .005
107.7 ± 1.4	.162 ± .019	220.2 ± 4.5	.054 ± .005
109.2 ± 1.5	.177 ± .020	224.8 ± 4.6	.060 ± .006
110.7 ± 1.5	.181 ± .020	229.6 ± 4.8	.047 ± .005
112.2 ± 1.5	.181 ± .020	234.5 ± 4.9	.042 ± .004
113.8 ± 1.6	.168 ± .019	239.5 ± 5.1	.045 ± .004
115.5 ± 1.6	.134 ± .016	244.8 ± 5.3	.052 ± .005
117.1 ± 1.6	.139 ± .016	250.2 ± 5.5	.037 ± .004
118.8 ± 1.7	.144 ± .016	255.9 ± 5.7	.036 ± .004
120.6 ± 1.7	.130 ± .015	261.7 ± 5.9	.047 ± .004
122.4 ± 1.8	.149 ± .016	267.8 ± 6.1	.032 ± .003
124.2 ± 1.8	.115 ± .013	274.0 ± 6.4	.044 ± .004
126.1 ± 1.8	.124 ± .014	280.6 ± 6.6	.031 ± .003
128.0 ± 1.9	.131 ± .015	287.3 ± 6.9	.040 ± .004
129.9 ± 1.9	.112 ± .013	294.4 ± 7.1	.027 ± .002
131.9 ± 2.0	.122 ± .013	301.7 ± 7.4	.035 ± .003
134.0 ± 2.0	.113 ± .013	309.3 ± 7.7	.033 ± .003
136.1 ± 2.1	.119 ± .C13	317.3 ± 8.1	.058 ± .005
138.2 ± 2.1	.119 ± .013	325.5 ± 8.4	.032 ± .003
140.4 ± 2.2	.085 ± .010	334.1 ± 8.8	.033 ± .003
142.7 ± 2.2	.099 ± .011	343.1 ± 9.1	.030 ± .003
145.0 ± 2.3	.092 ± .010	352.6 ± 9.6	.039 ± .003
147.4 ± 2.4	.110 ± .012	362.4 ± 10.0	.027 ± .002
149.8 ± 2.4	.092 ± .010	372.7 ± 10.5	.039 ± .003
152.3 ± 2.5	.087 ± .010	383.4 ± 11.0	.000 ± .000
154.9 ± 2.6	.089 ± .010	394.7 ± 11.5	.000 ± .000
157.5 ± 2.6	.079 ± .009	406.6 ± 12.1	.000 ± .000
160.2 ± 2.7	.087 ± .009	419.0 ± 12.7	.000 ± .000
163.0 ± 2.8	.078 ± .008	432.1 ± 13.4	.000 ± .000
165.9 ± 2.8	.066 ± .007	445.9 ± 14.1	.000 ± .000

TABLE 25.- Concluded

(f) Angle of scatter of 60°

Energy, MeV	Cross section, mb/sr-MeV	Energy, MeV	Cross section, mb/sr-MeV
89.7 ± 1.1	.000 ± .000	168.8 ± 2.9	.038 ± .004
90.8 ± 1.1	.245 ± .030	171.8 ± 3.0	.042 ± .005
91.9 ± 1.1	.206 ± .025	174.9 ± 3.1	.034 ± .004
93.1 ± 1.1	.193 ± .023	178.1 ± 3.2	.031 ± .003
94.3 ± 1.2	.184 ± .022	181.4 ± 3.3	.033 ± .004
95.5 ± 1.2	.182 ± .021	184.8 ± 3.4	.026 ± .003
96.8 ± 1.2	.178 ± .020	188.3 ± 3.5	.026 ± .003
98.0 ± 1.2	.135 ± .016	191.8 ± 3.6	.022 ± .003
99.3 ± 1.3	.169 ± .019	195.5 ± 3.7	.027 ± .003
100.6 ± 1.3	.135 ± .016	199.3 ± 3.8	.023 ± .003
102.0 ± 1.3	.117 ± .014	203.2 ± 3.9	.021 ± .002
103.4 ± 1.3	.134 ± .016	207.3 ± 4.1	.021 ± .002
104.8 ± 1.4	.118 ± .014	211.5 ± 4.2	.023 ± .002
106.2 ± 1.4	.128 ± .015	215.8 ± 4.3	.017 ± .002
107.7 ± 1.4	.113 ± .013	220.2 ± 4.5	.017 ± .002
109.2 ± 1.5	.106 ± .013	224.8 ± 4.6	.015 ± .002
110.7 ± 1.5	.110 ± .013	229.6 ± 4.8	.014 ± .001
112.2 ± 1.5	.101 ± .012	234.5 ± 4.9	.012 ± .001
113.8 ± 1.6	.094 ± .011	239.5 ± 5.1	.011 ± .001
115.5 ± 1.6	.091 ± .011	244.8 ± 5.3	.009 ± .001
117.1 ± 1.6	.101 ± .012	250.2 ± 5.5	.008 ± .001
118.8 ± 1.7	.098 ± .011	255.9 ± 5.7	.007 ± .001
120.6 ± 1.7	.092 ± .011	261.7 ± 5.9	.007 ± .001
122.4 ± 1.8	.095 ± .011	267.8 ± 6.1	.004 ± .000
124.2 ± 1.8	.088 ± .010	274.0 ± 6.4	.004 ± .000
126.1 ± 1.8	.071 ± .008	280.6 ± 6.6	.003 ± .000
128.0 ± 1.9	.075 ± .009	287.3 ± 6.9	.002 ± .000
129.9 ± 1.9	.071 ± .008	294.4 ± 7.1	.003 ± .000
131.9 ± 2.0	.065 ± .008	301.7 ± 7.4	.002 ± .000
134.0 ± 2.0	.080 ± .009	309.3 ± 7.7	.003 ± .000
136.1 ± 2.1	.073 ± .008	317.3 ± 8.1	.002 ± .000
138.2 ± 2.1	.078 ± .009	325.5 ± 8.4	.001 ± .000
140.4 ± 2.2	.082 ± .009	334.1 ± 8.8	.000 ± .000
142.7 ± 2.2	.062 ± .007	343.1 ± 9.1	.000 ± .000
145.0 ± 2.3	.063 ± .007	352.6 ± 9.6	.000 ± .000
147.4 ± 2.4	.057 ± .006	362.4 ± 10.0	.001 ± .000
149.8 ± 2.4	.049 ± .006	372.7 ± 10.5	.000 ± .000
152.3 ± 2.5	.059 ± .007	383.4 ± 11.0	.000 ± .000
154.9 ± 2.6	.048 ± .005	394.7 ± 11.5	.000 ± .000
157.5 ± 2.6	.048 ± .005	406.6 ± 12.1	.000 ± .000
160.2 ± 2.7	.047 ± .005	419.0 ± 12.7	.000 ± .000
163.0 ± 2.8	.042 ± .005	432.1 ± 13.4	.000 ± .000
165.9 ± 2.8	.046 ± .005	445.9 ± 14.1	.000 ± .000

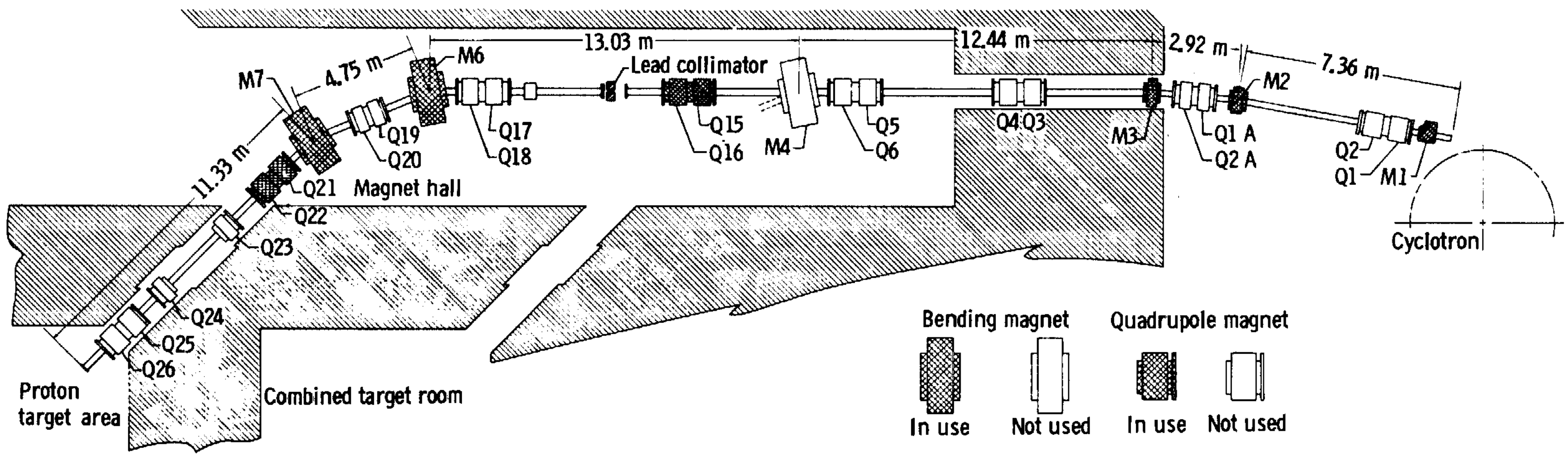


Figure 1.- Beam transport system from synchrocyclotron to proton target area.

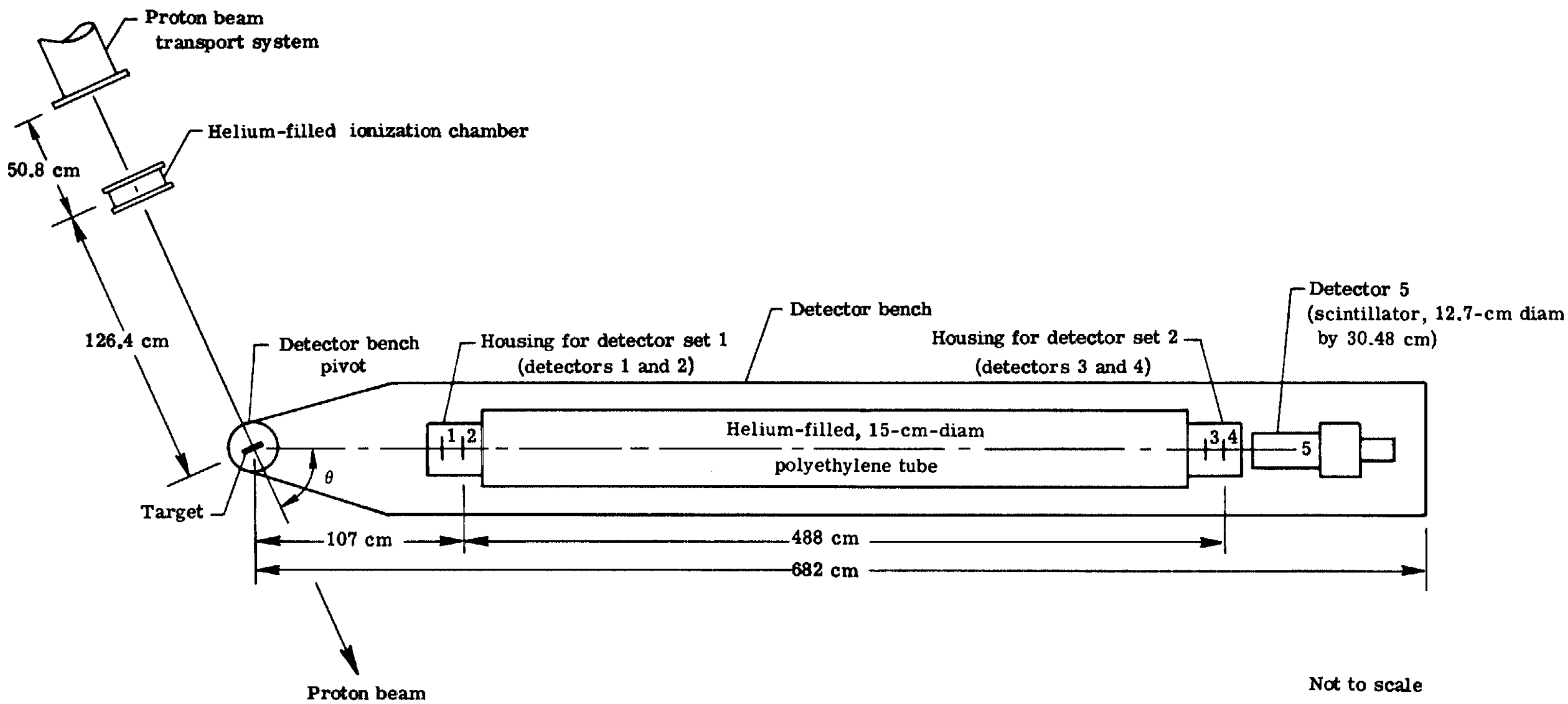
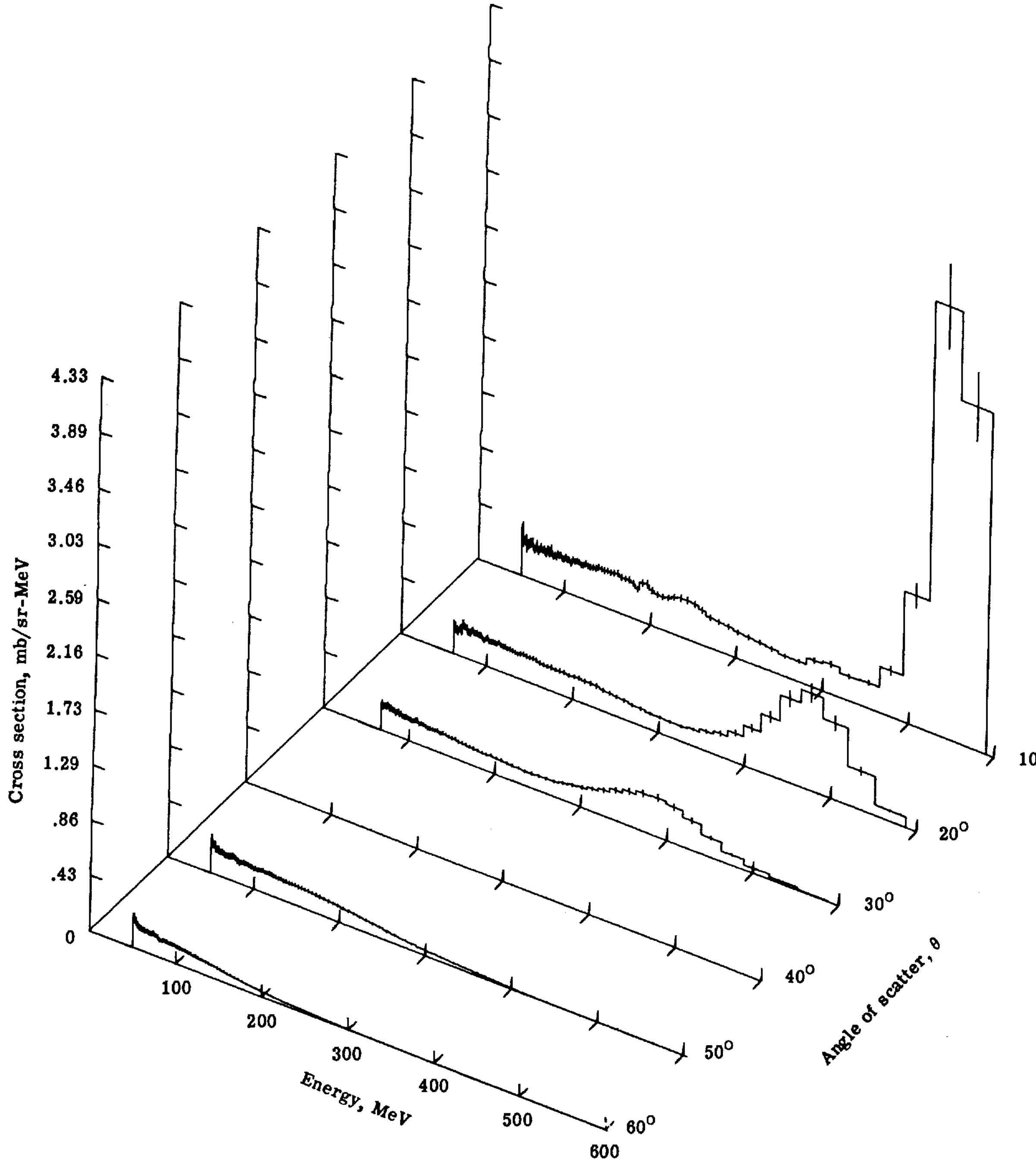
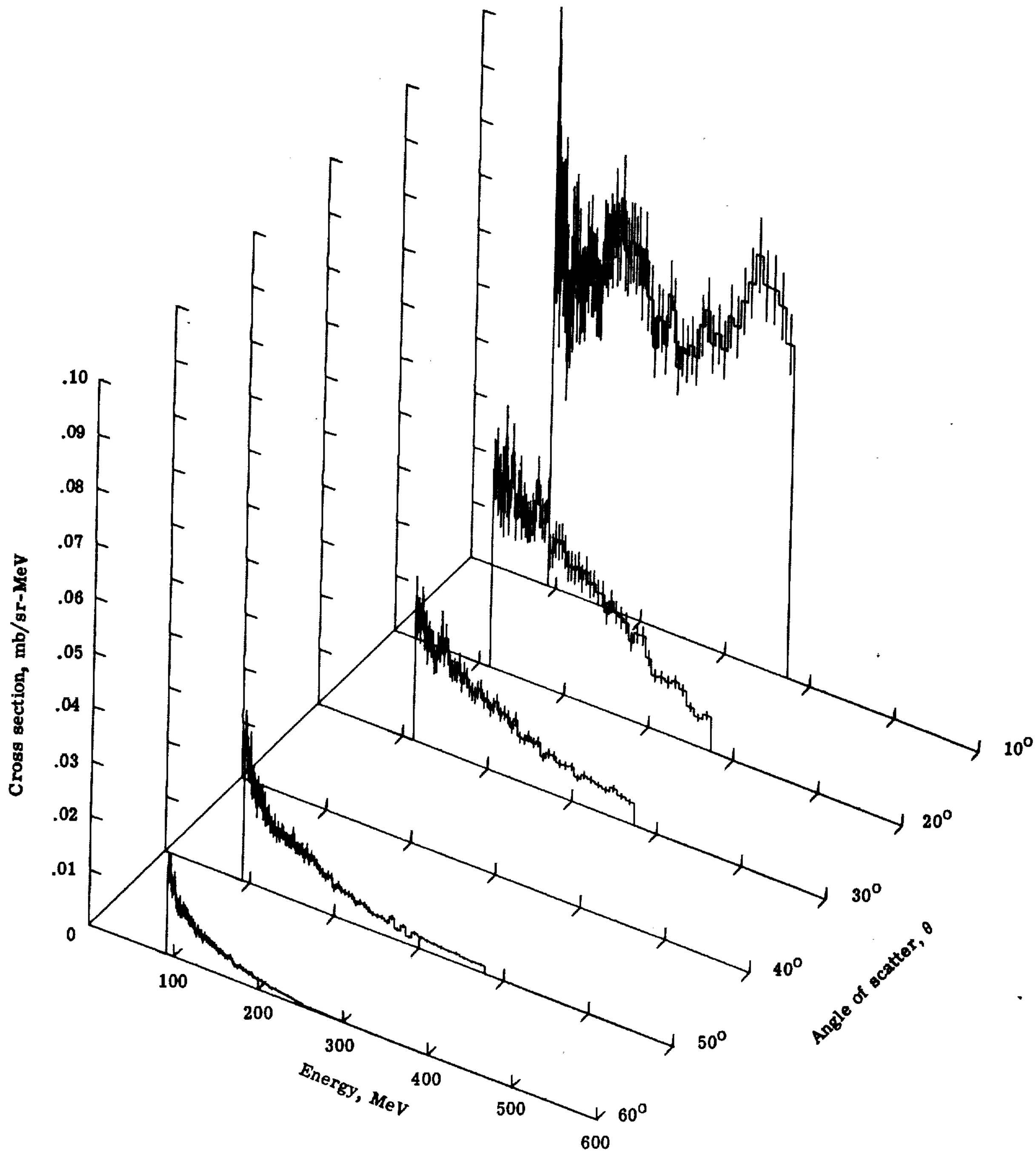


Figure 2.- Diagram of two-parameter scintillation spectrometer system.



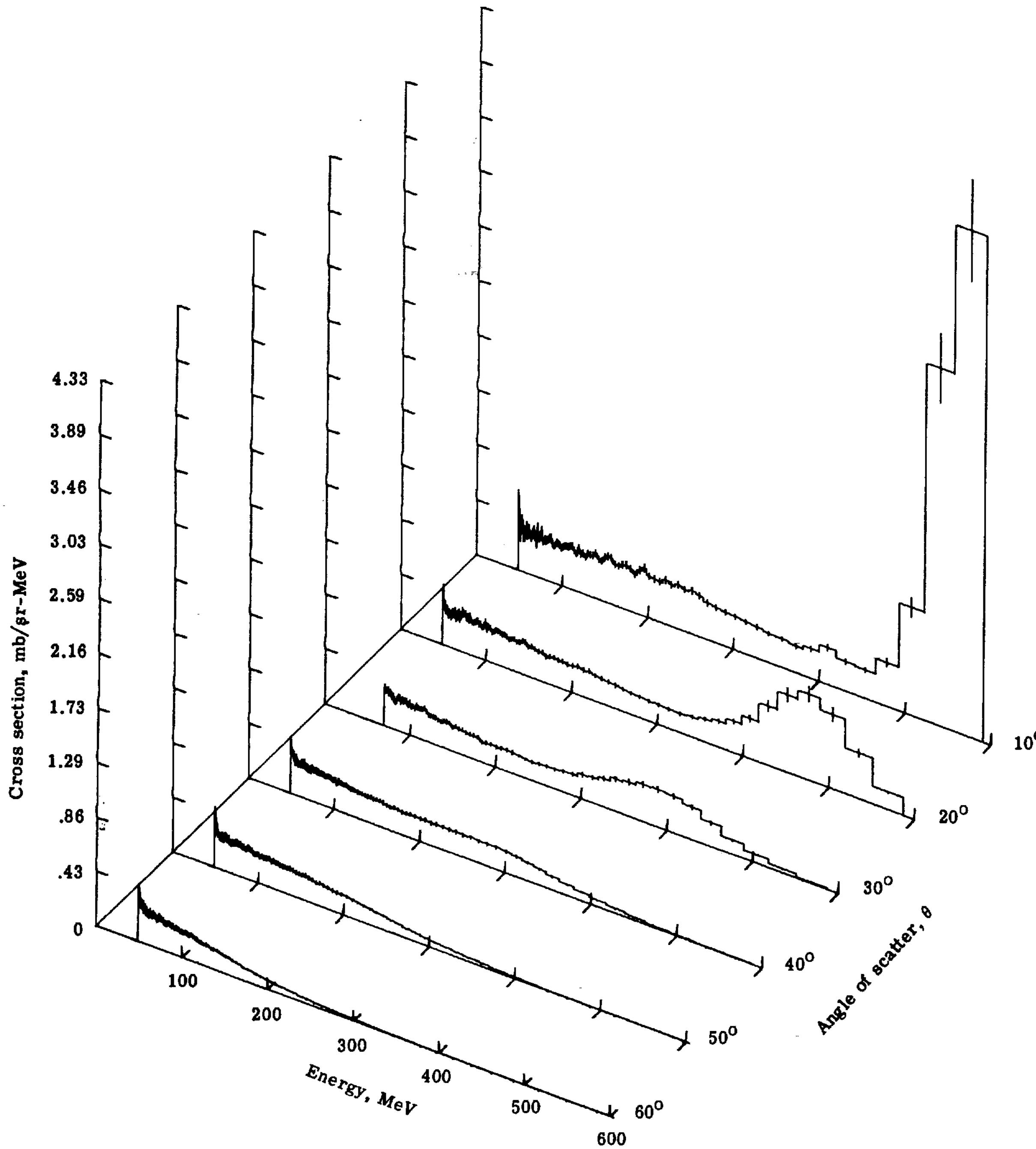
(a) Protons.

Figure 3.- Continuum spectra from beryllium target, 2.35 g/cm^2 thick. Incident proton energy, 558 ±7 MeV.



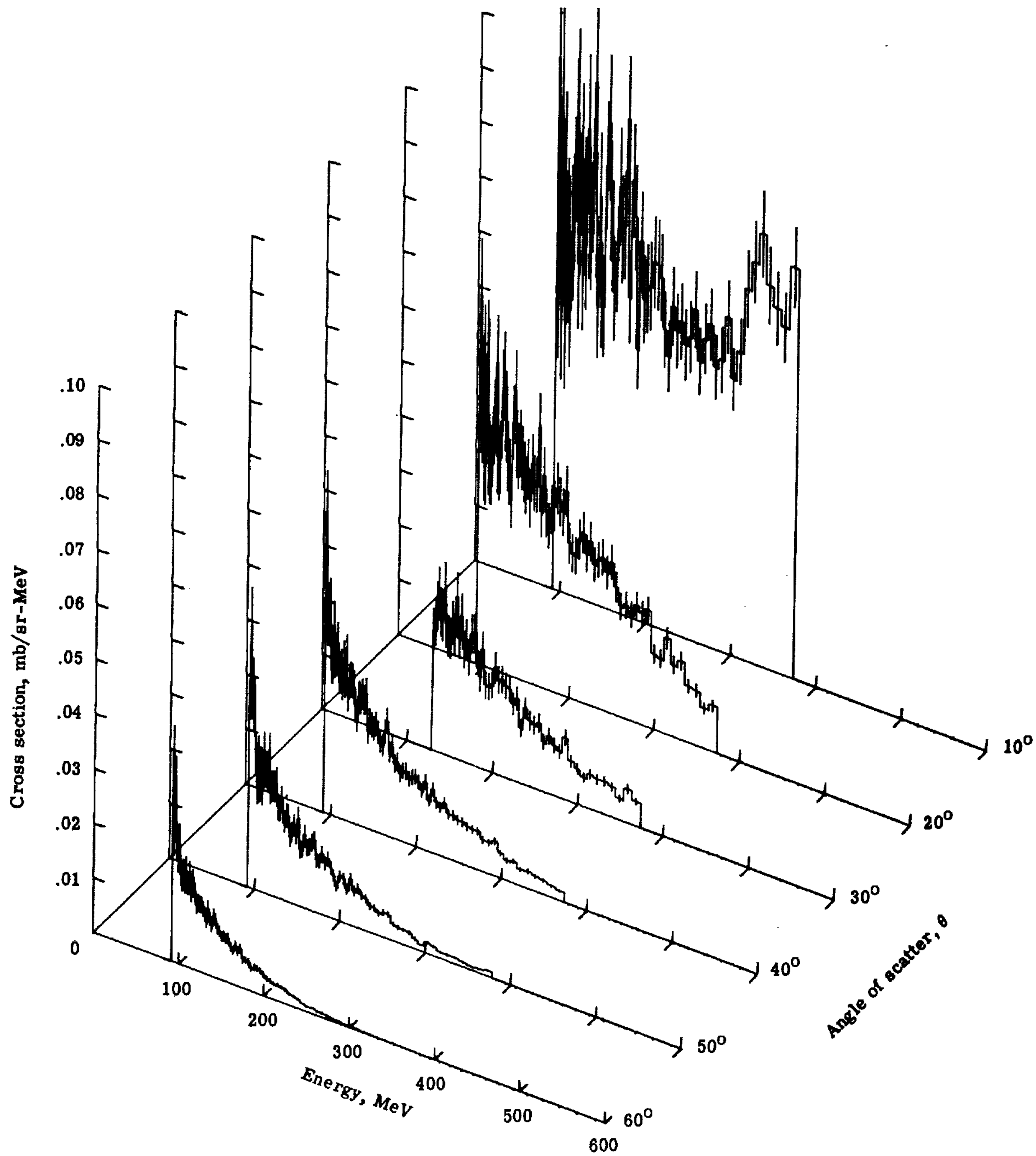
(b) Deuterons.

Figure 3.- Concluded.



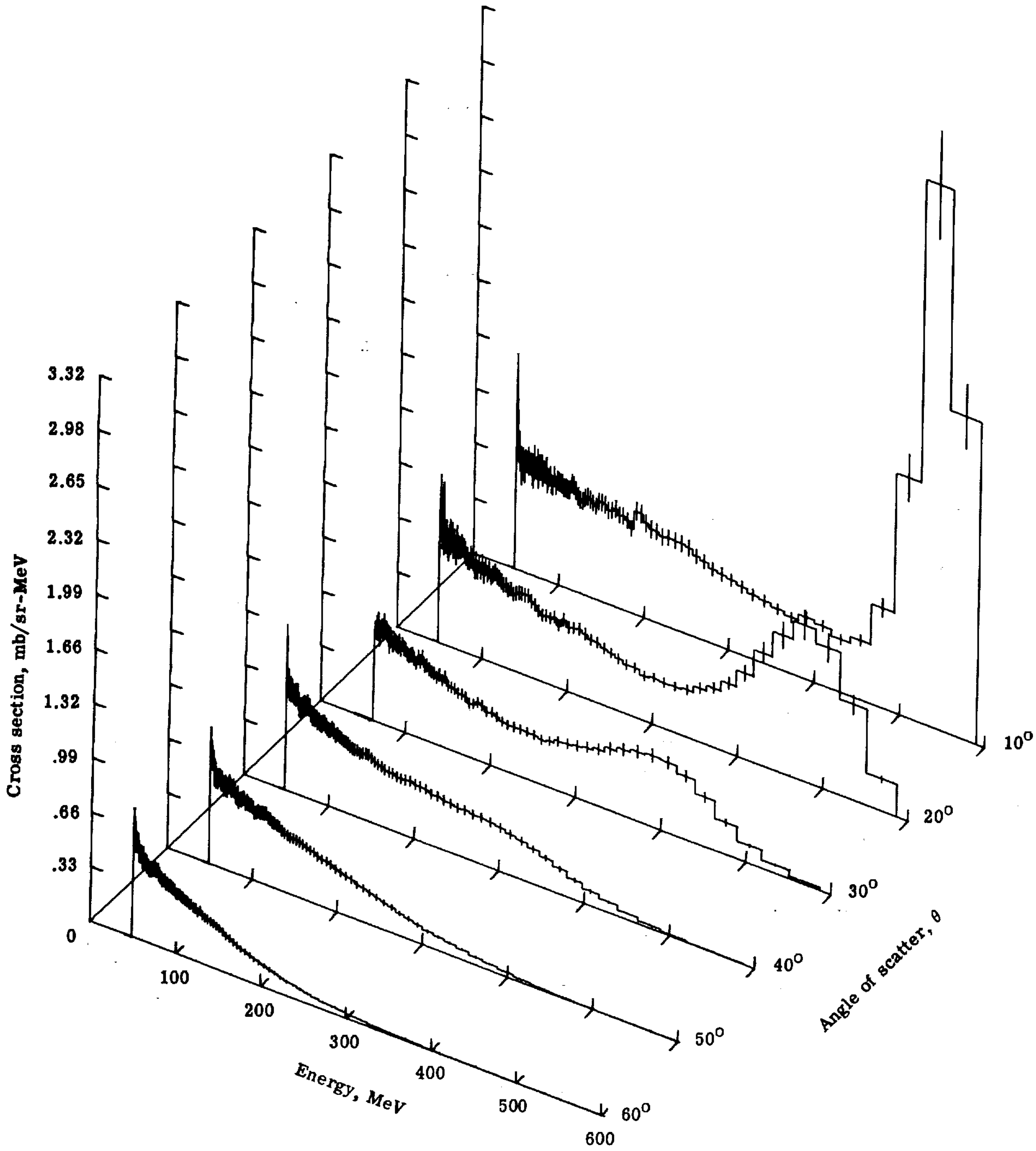
(a) Protons.

Figure 4.- Continuum spectra from carbon target, 0.95 g/cm^2 thick. Incident proton energy, 558 ± 7 MeV.



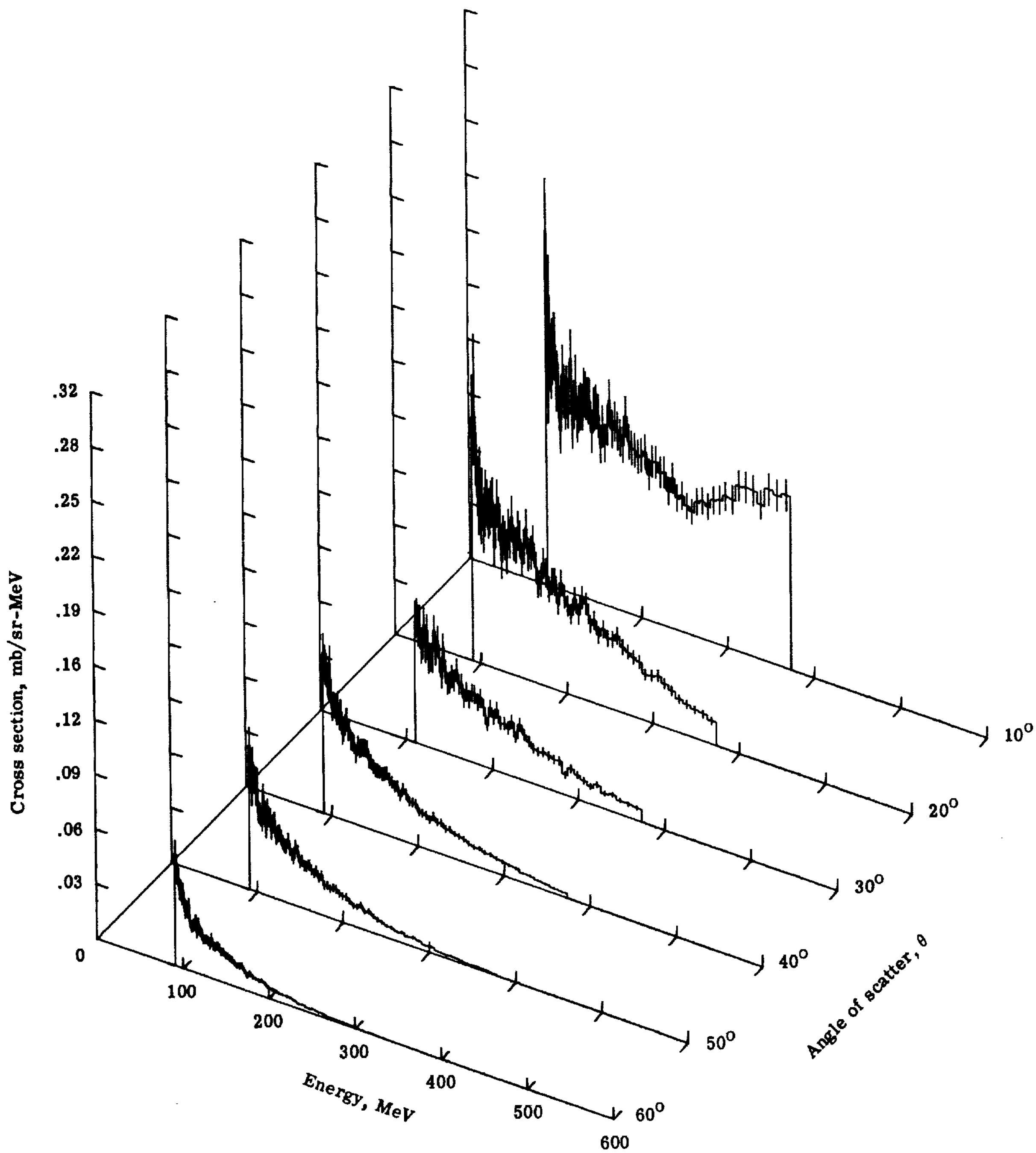
(b) Deuterons.

Figure 4.- Concluded.



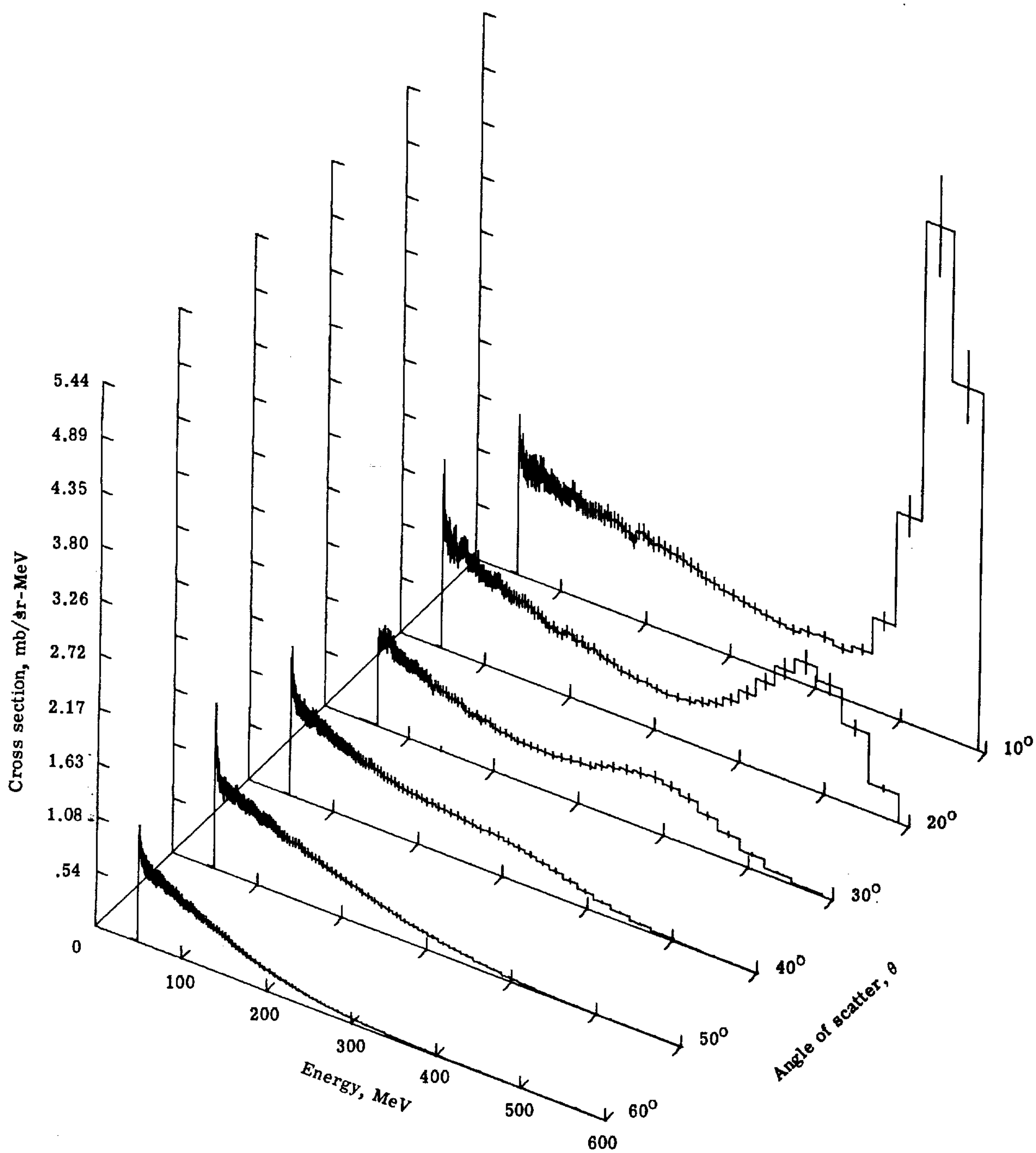
(a) Protons.

Figure 5.- Continuum spectra from aluminum target, 1.82 g/cm^2 thick. Incident proton energy, 558 ± 7 MeV.



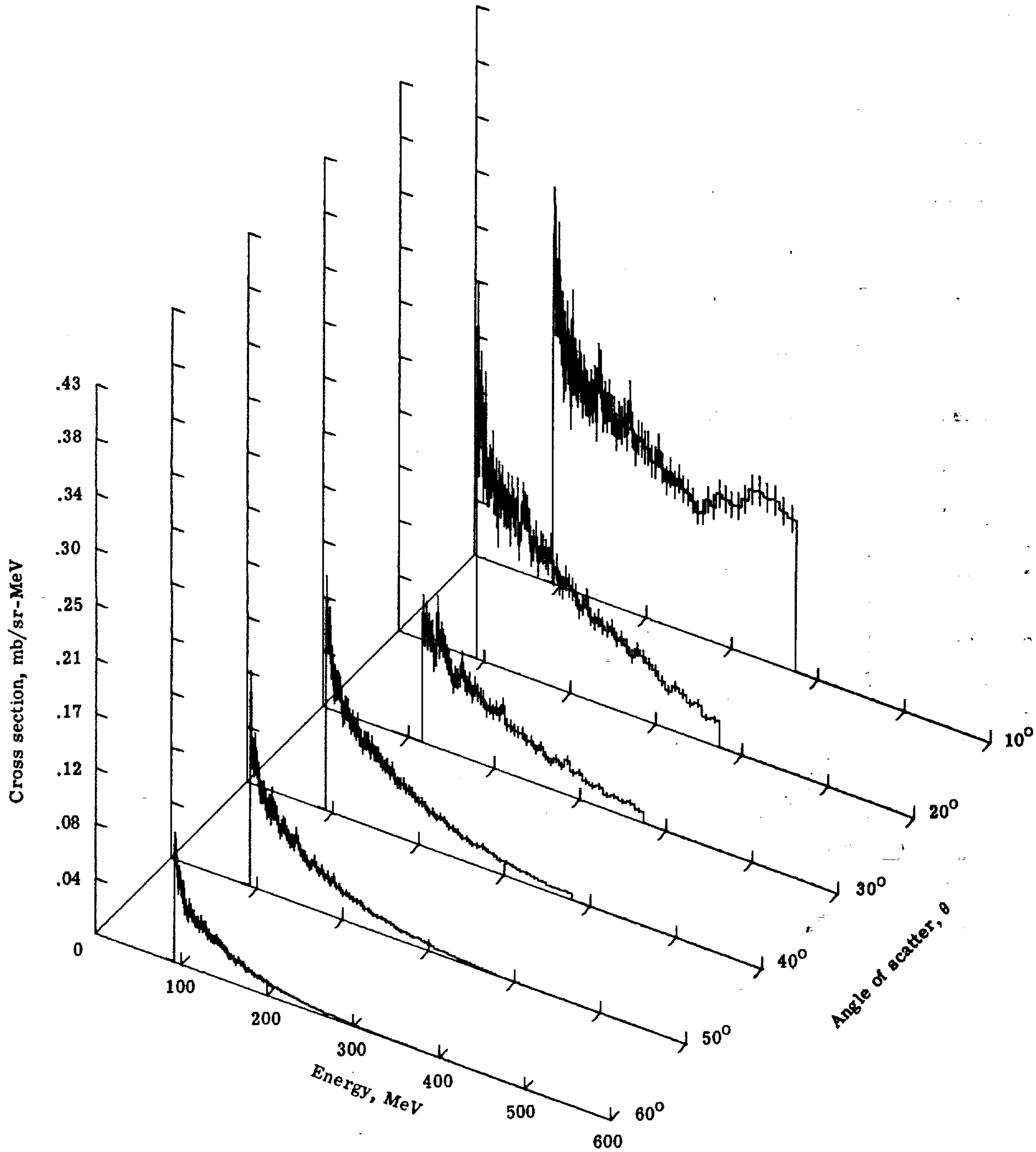
(b) Deuterons.

Figure 5.- Concluded.



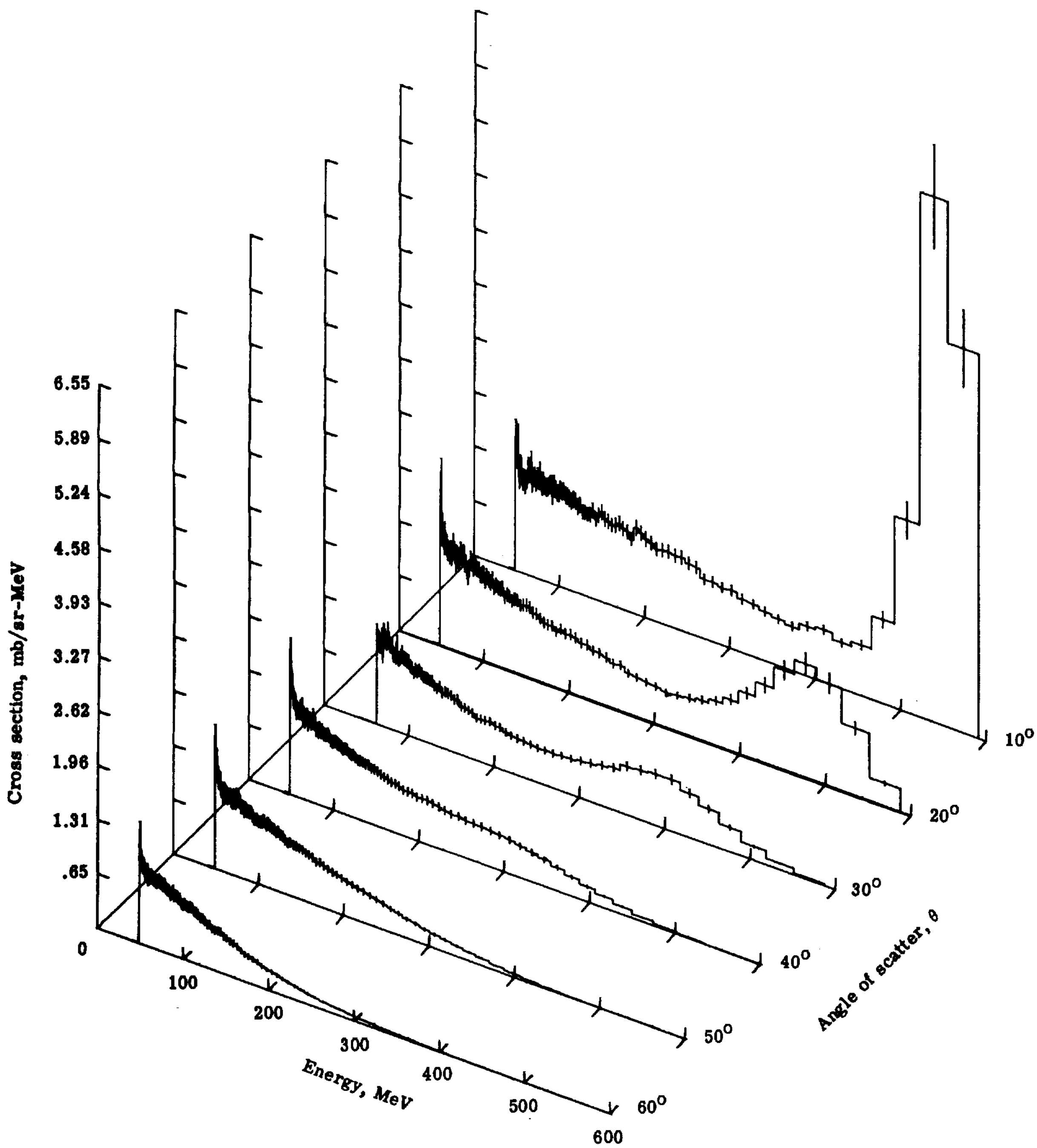
(a) Protons.

Figure 6.- Continuum spectra from iron target, 3.77 g/cm^2 thick. Incident proton energy, 558 ± 7 MeV.



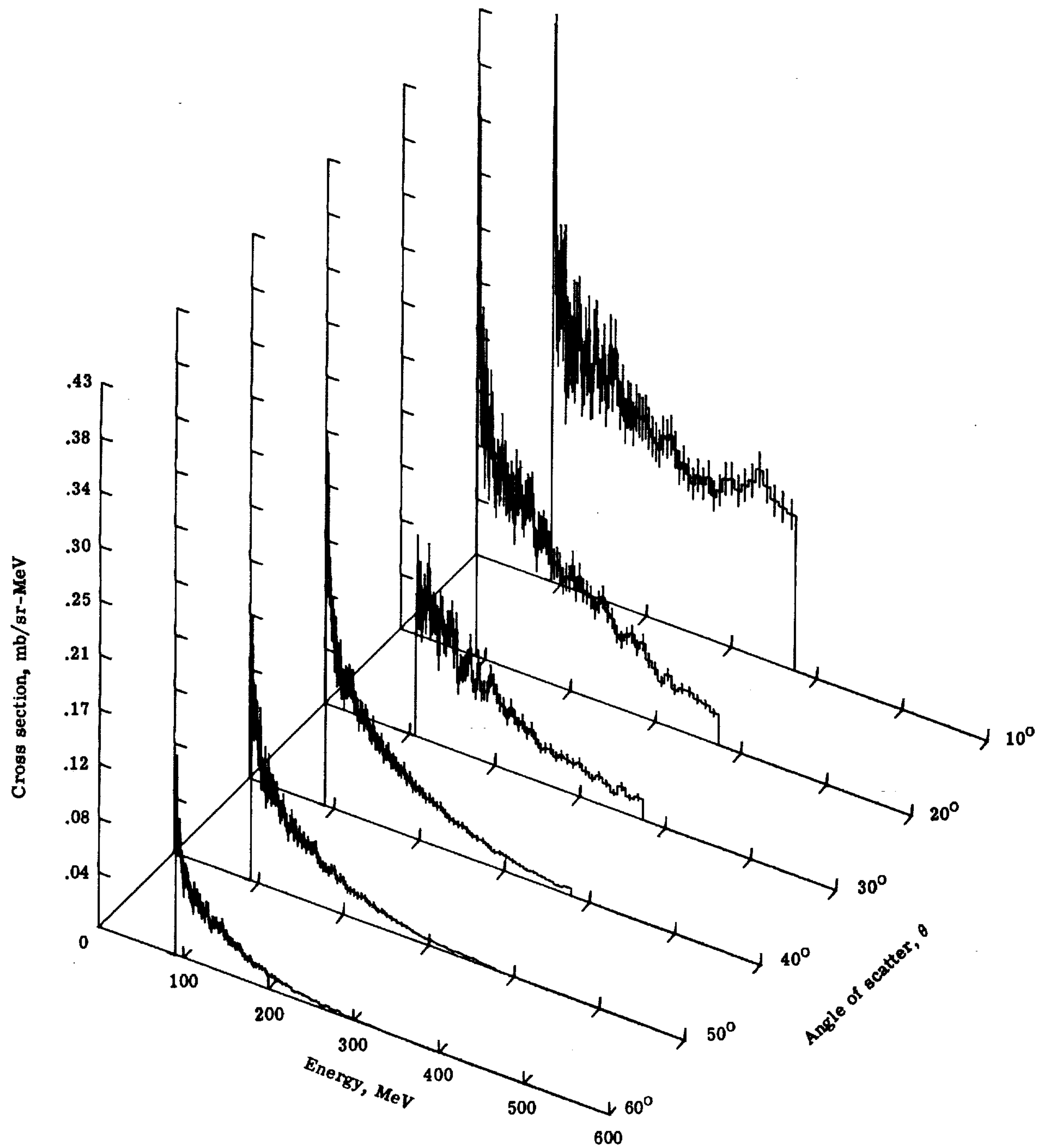
(b) Deuterons.

Figure 6.- Concluded.



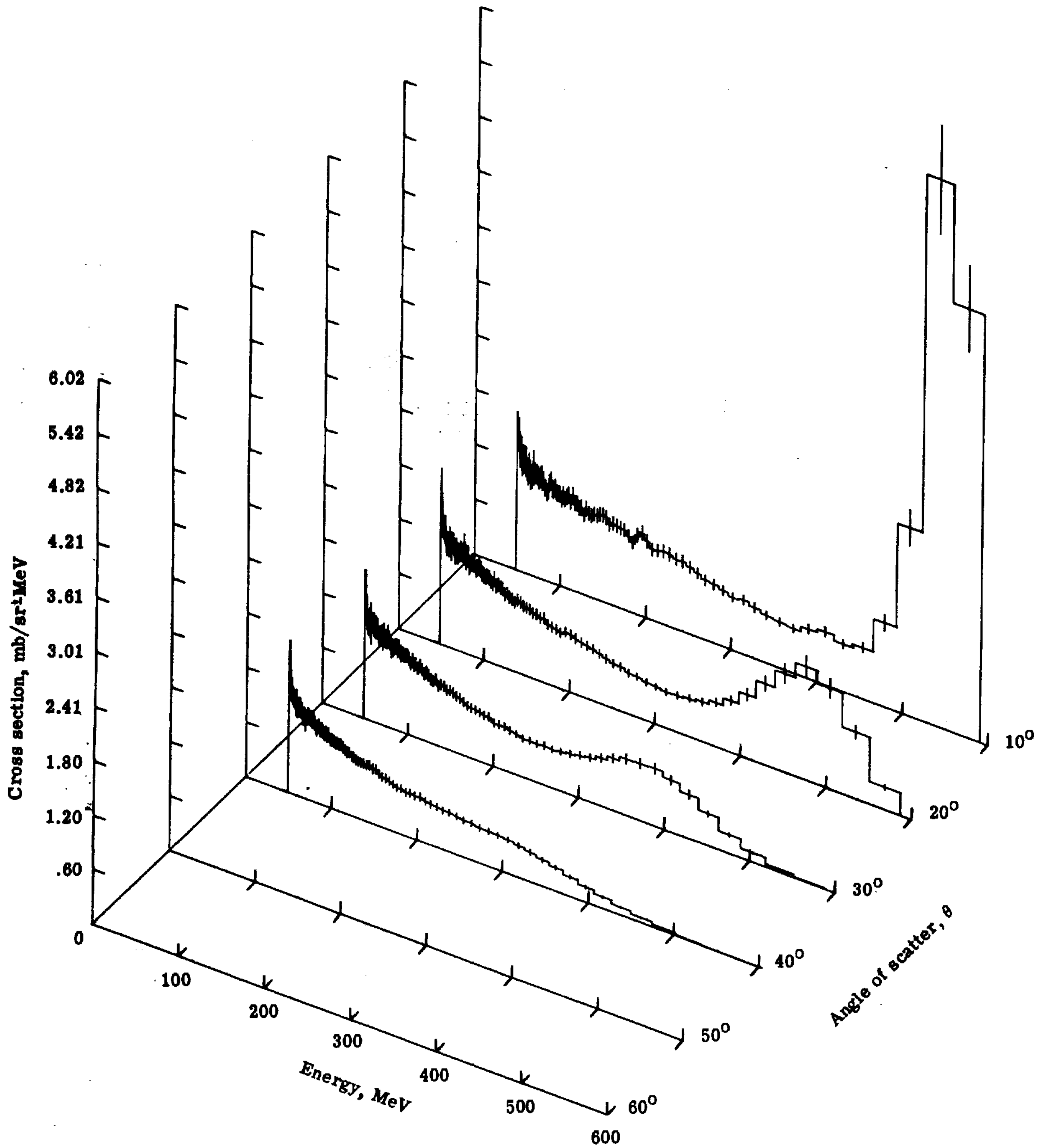
(a) Protons.

Figure 7.- Continuum spectra from copper target, 2.79 g/cm^2 thick. Incident proton energy, 558 ± 7 MeV.



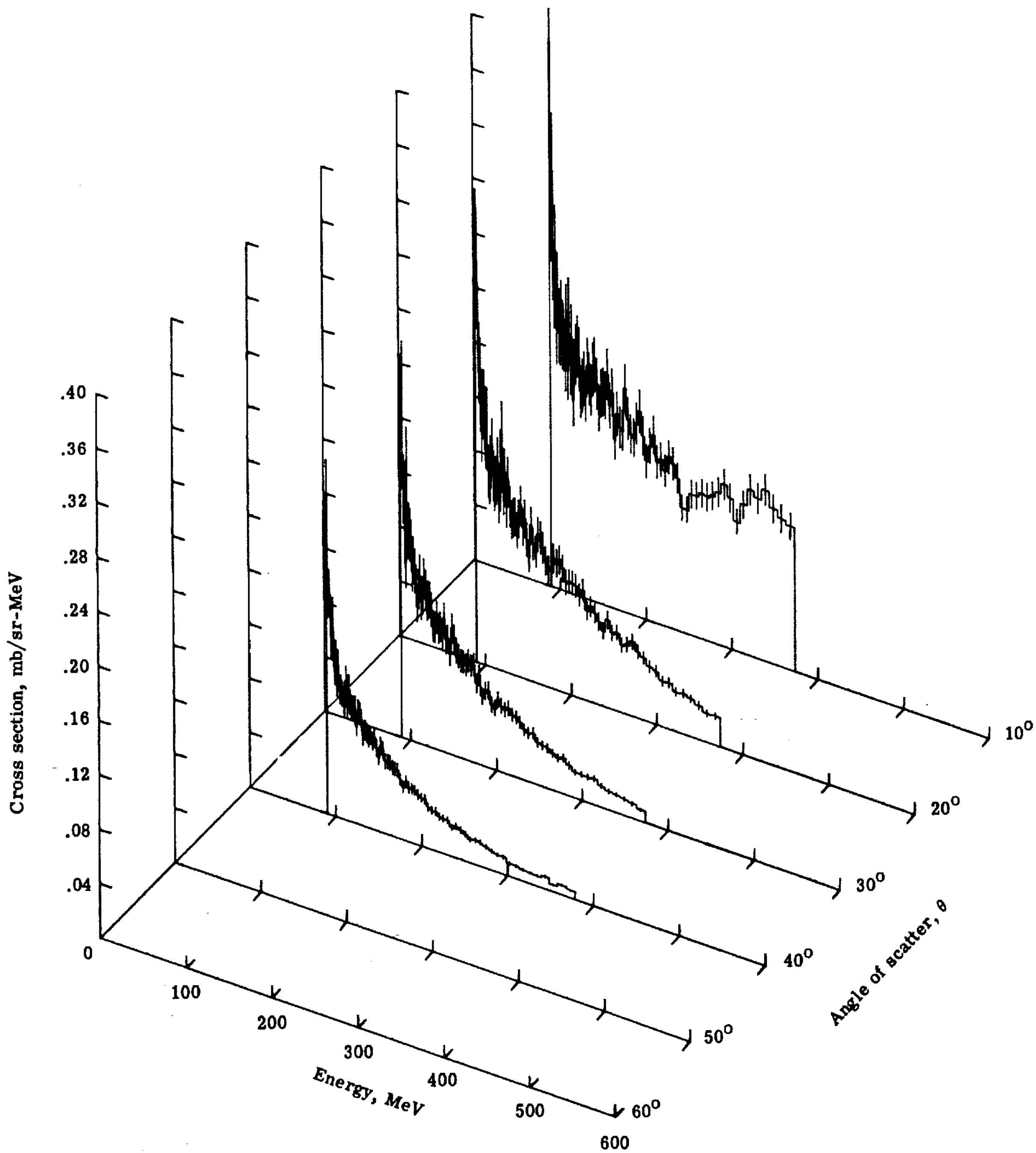
(b) Deuterons.

Figure 7.- Concluded.



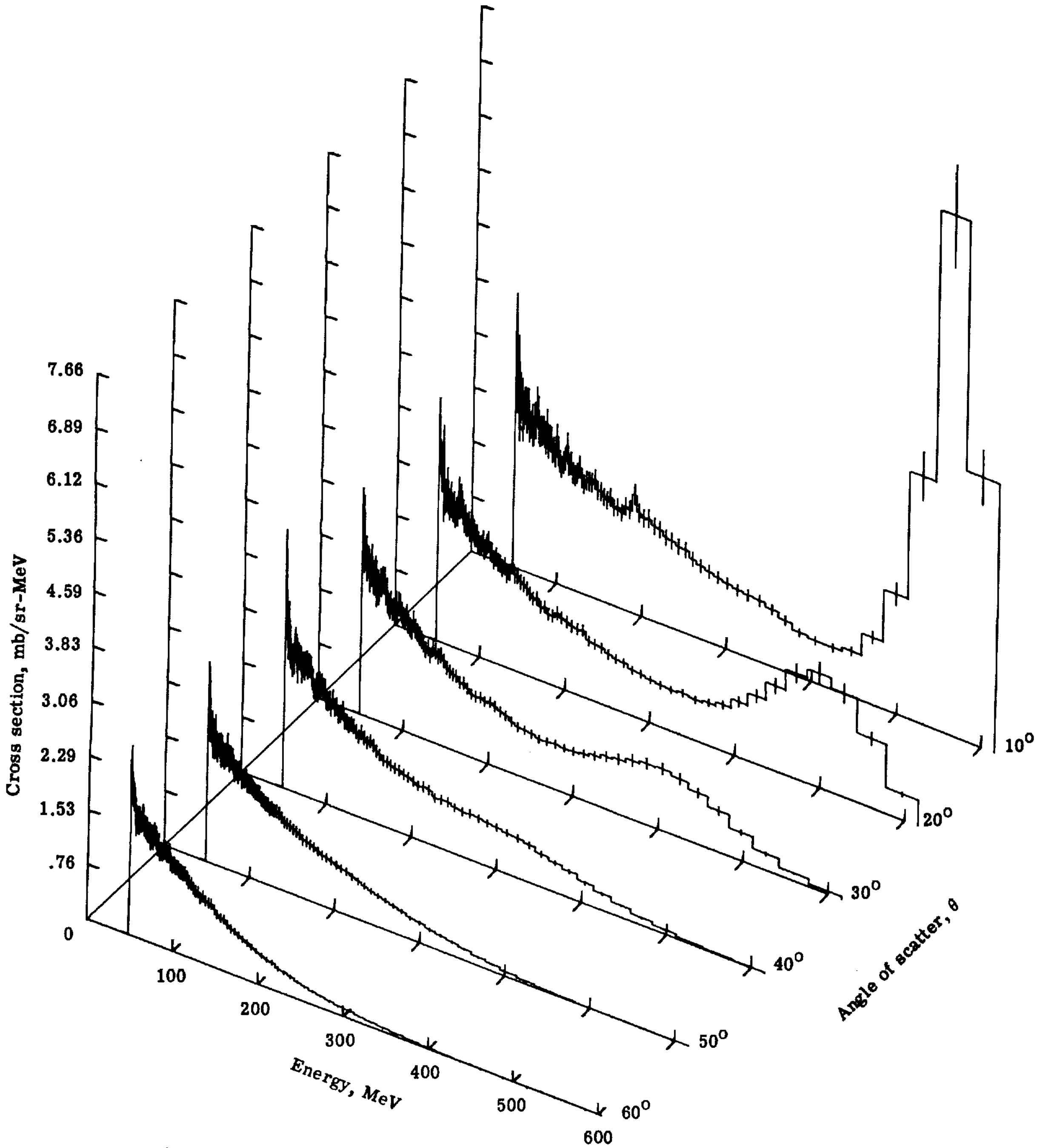
(a) Protons.

Figure 8.- Continuum spectra from germanium target, 5.26 g/cm^2 thick. Incident proton energy, 558 ± 7 MeV.



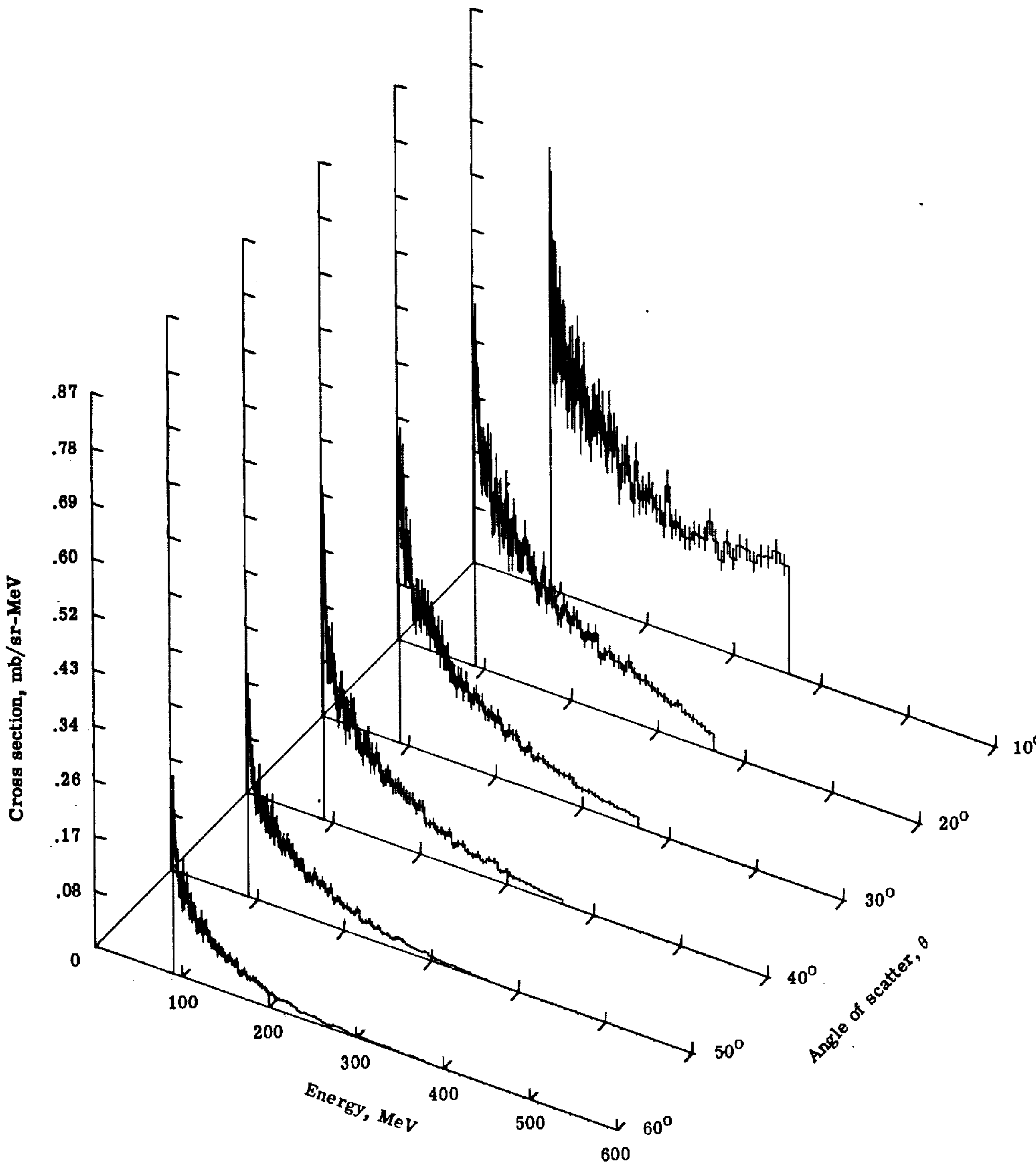
(b) Deuterons.

Figure 8.- Concluded.



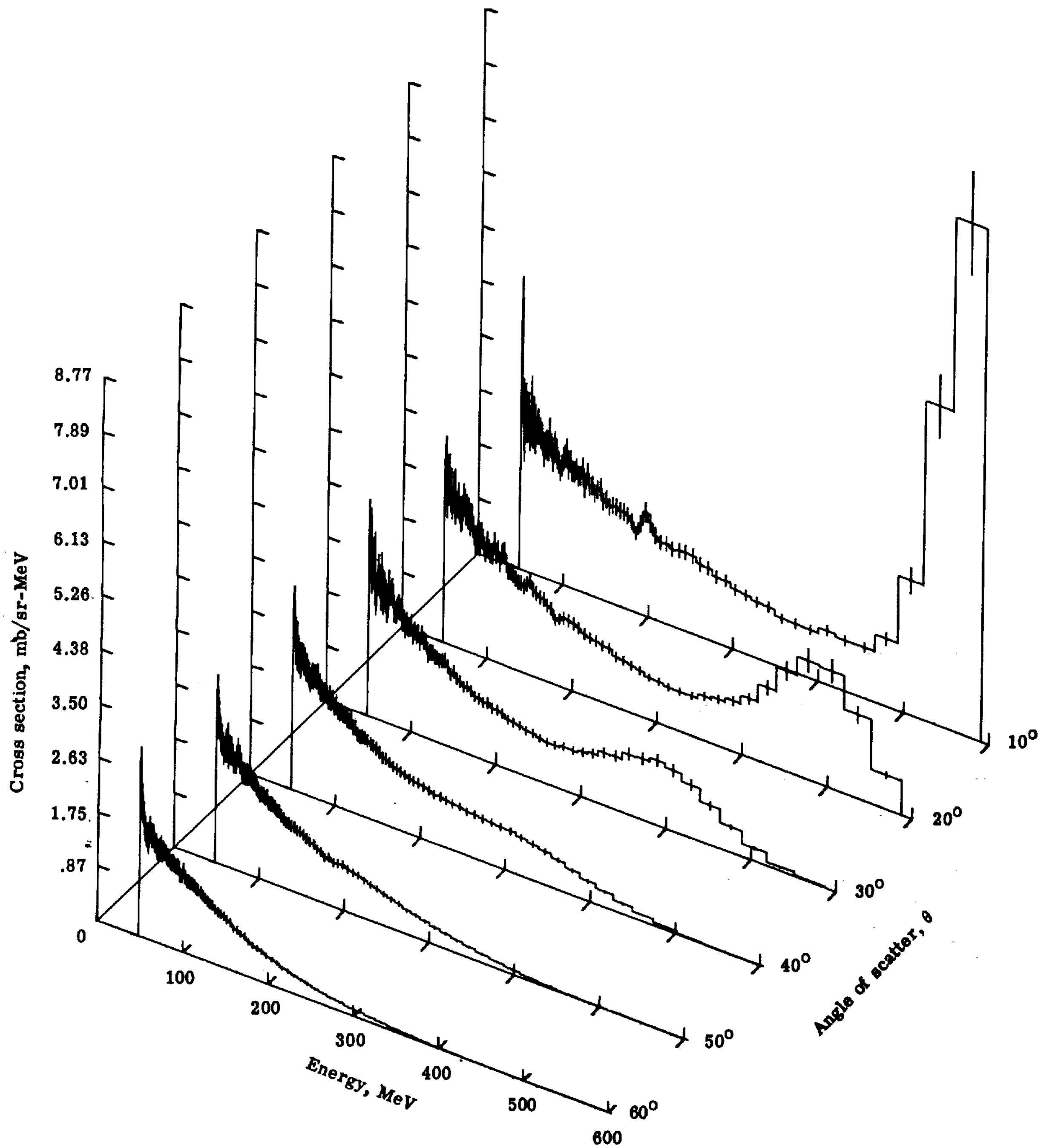
(a) Protons.

Figure 9.- Continuum spectra from tungsten target, 3.05 g/cm^2 thick. Incident proton energy, 558 ± 7 MeV.



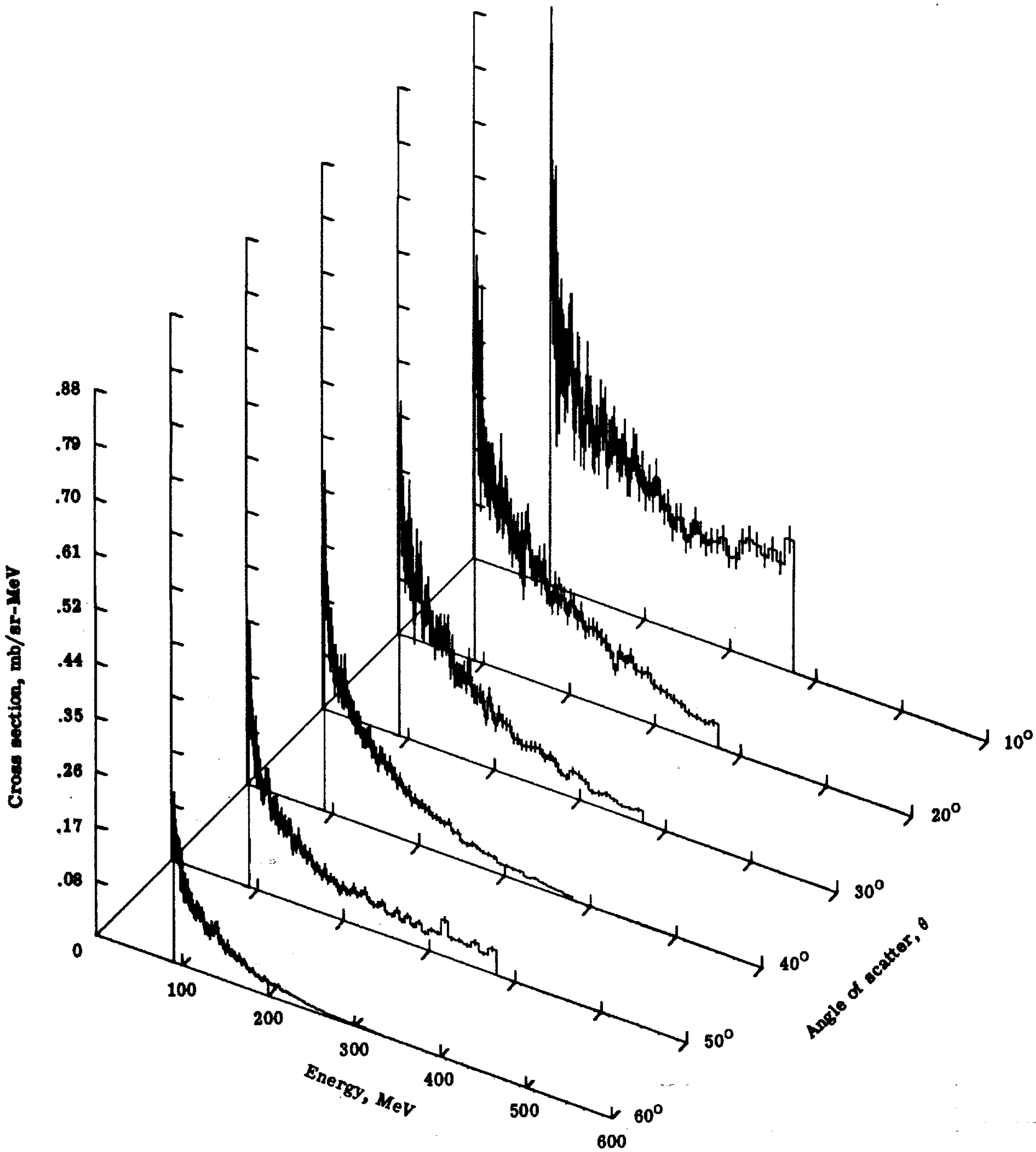
(b) Deuterons.

Figure 9.- Concluded.



(a) Protons.

Figure 10.- Continuum spectra from lead target, 3.91 g/cm^2 thick. Incident proton energy, 558 ±7 MeV.



(b) Deuterons.

Figure 10.- Concluded.

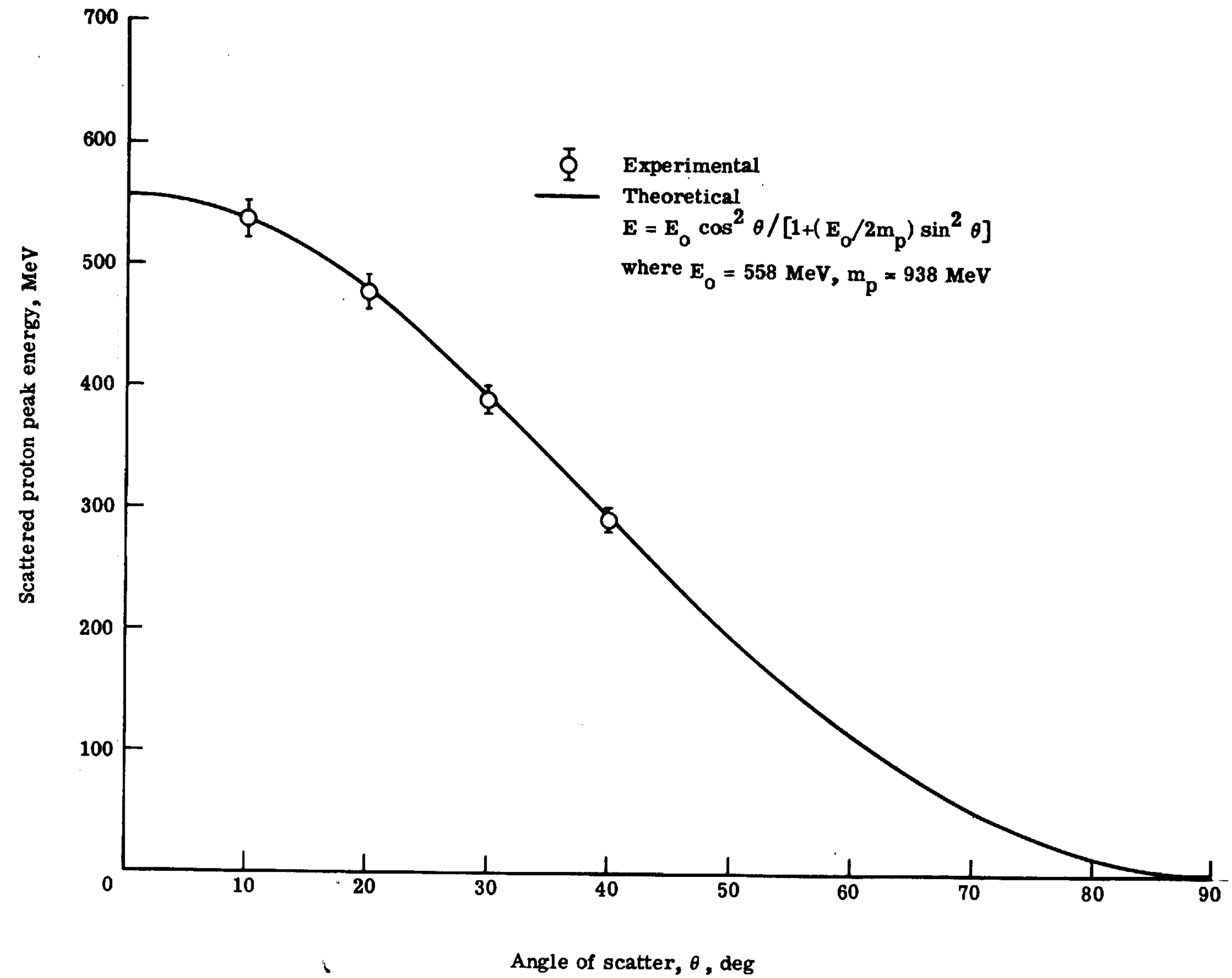


Figure 11.- Quasi-elastic peak energy and calculated energy of elastically scattered proton in free proton-proton interaction. Aluminum target.

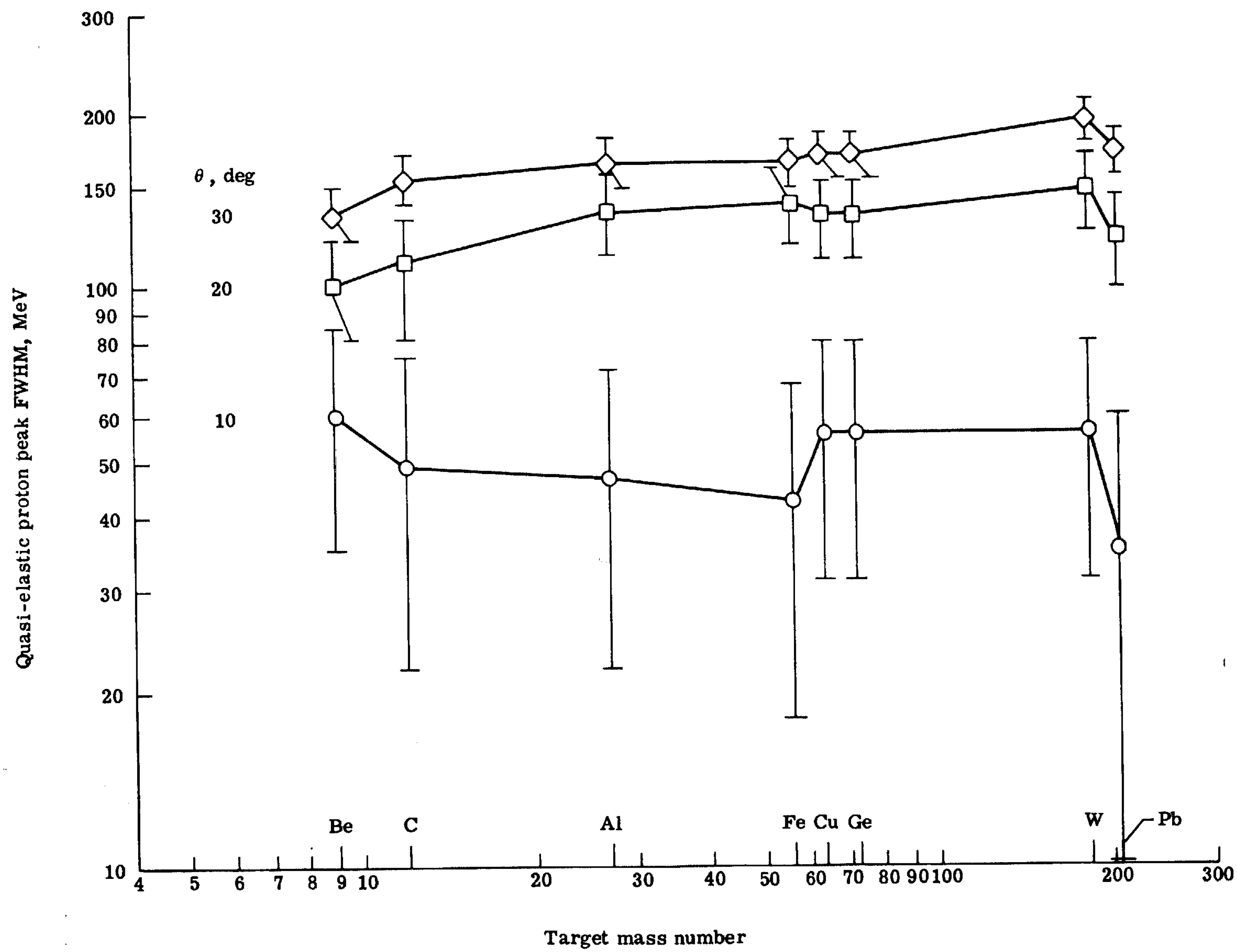


Figure 12.- Quasi-elastic proton peak full width at half maximum. (FWHM) as a function of target mass number. Solid lines are a guide only.

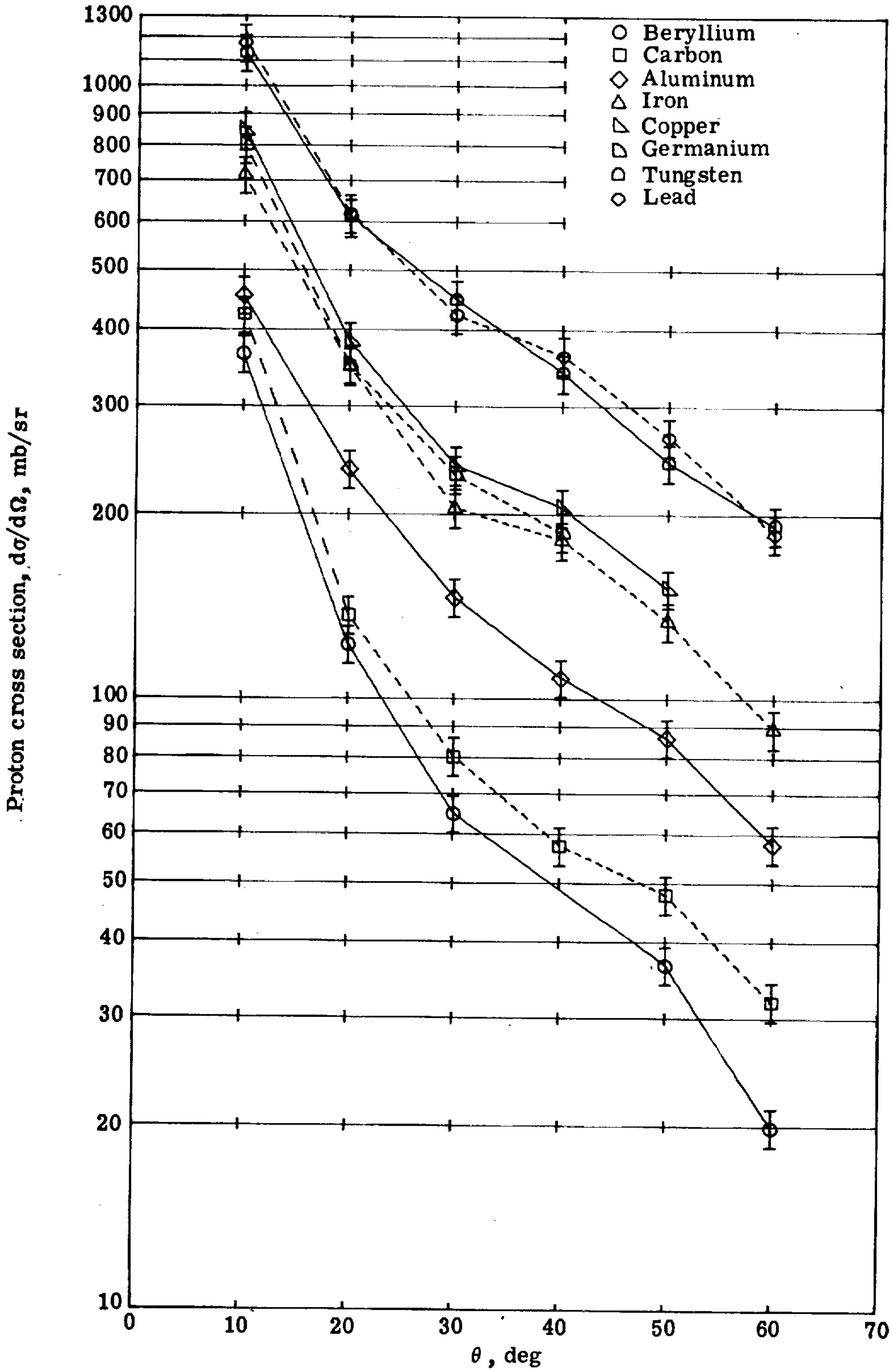


Figure 13.- Angular variations of energy-integrated proton cross sections.

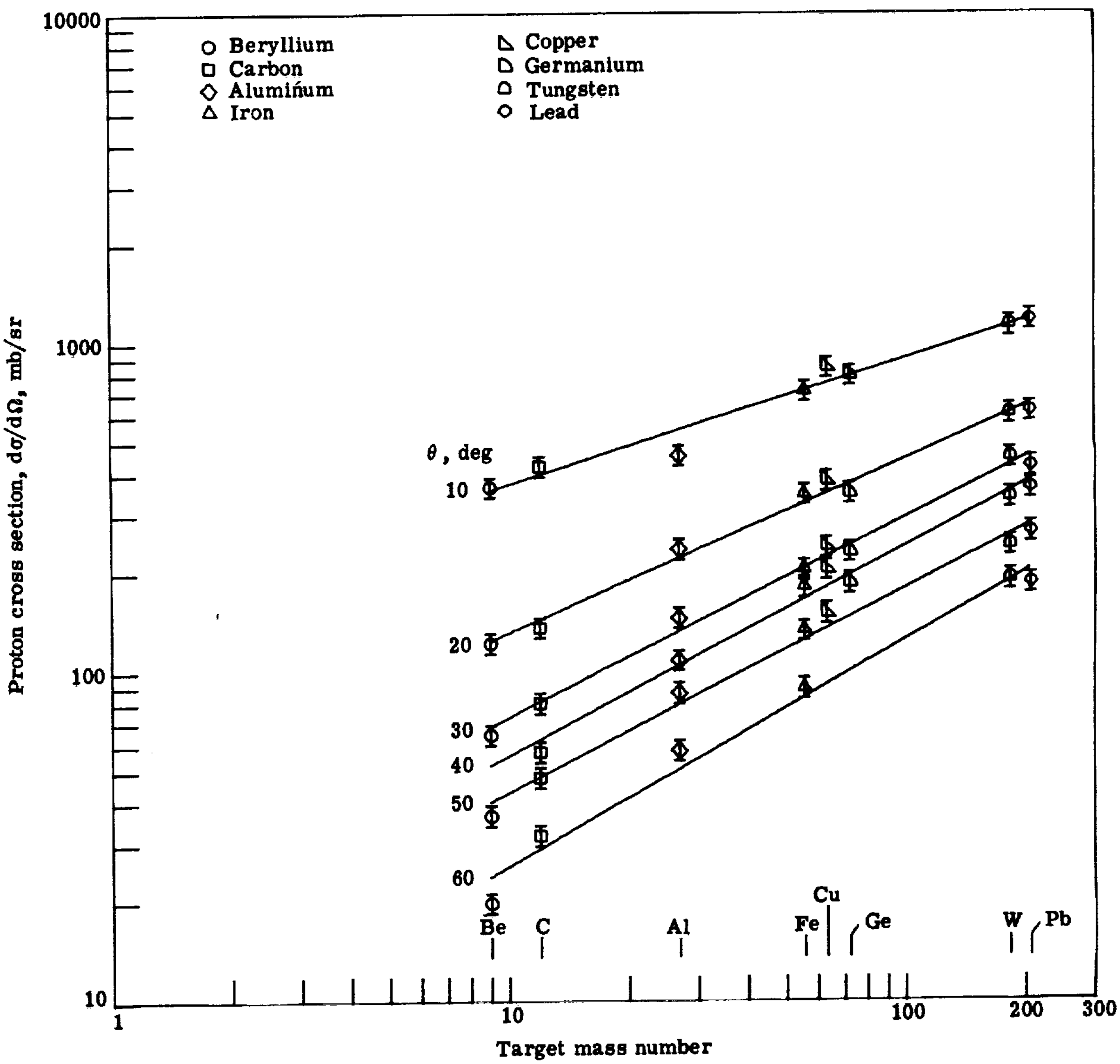


Figure 14.- Variation of energy-integrated proton cross sections with target mass number.

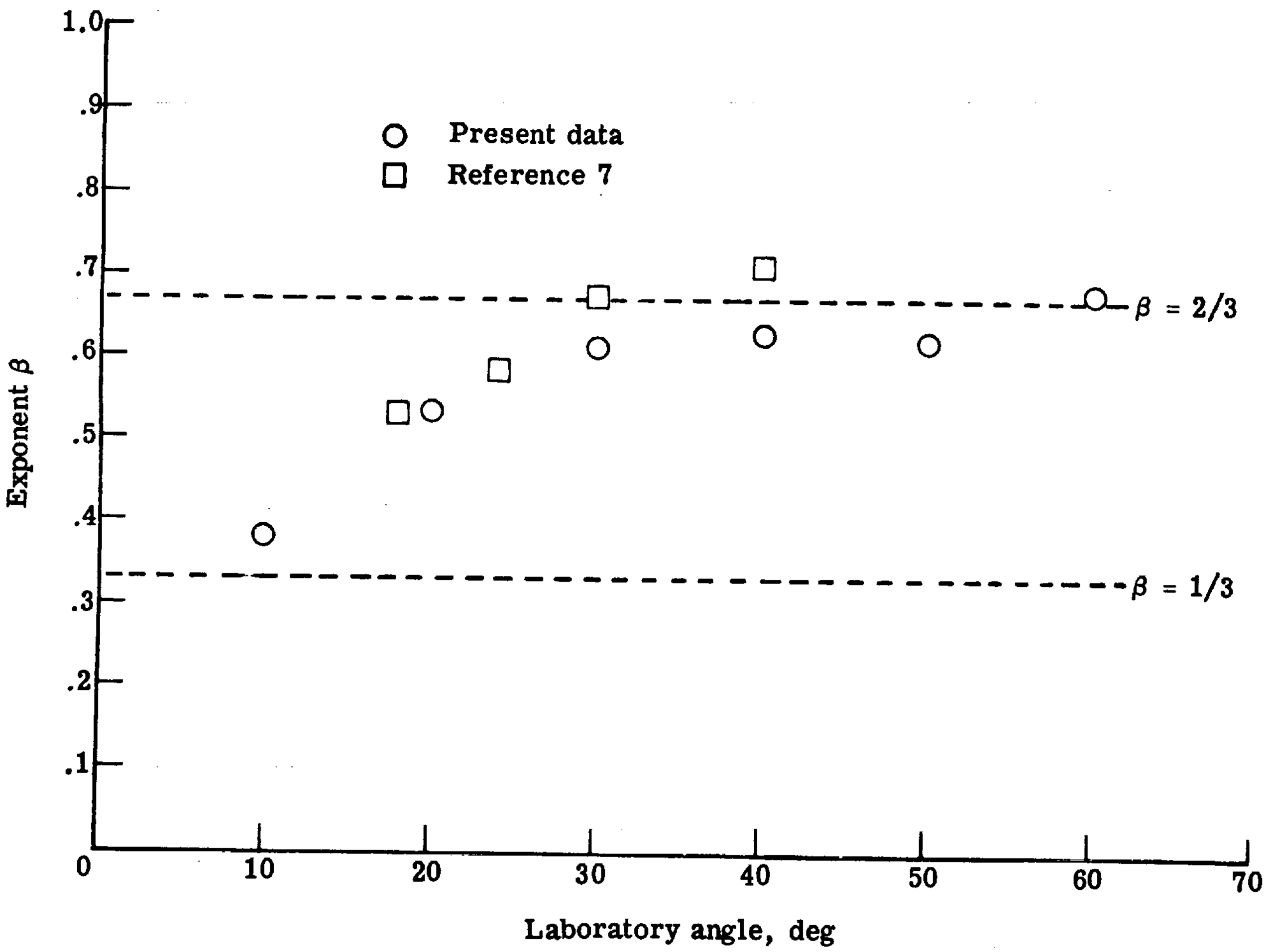


Figure 15.- Dependence of energy-integrated proton cross sections on exponent β as a function of laboratory angle of scatter.

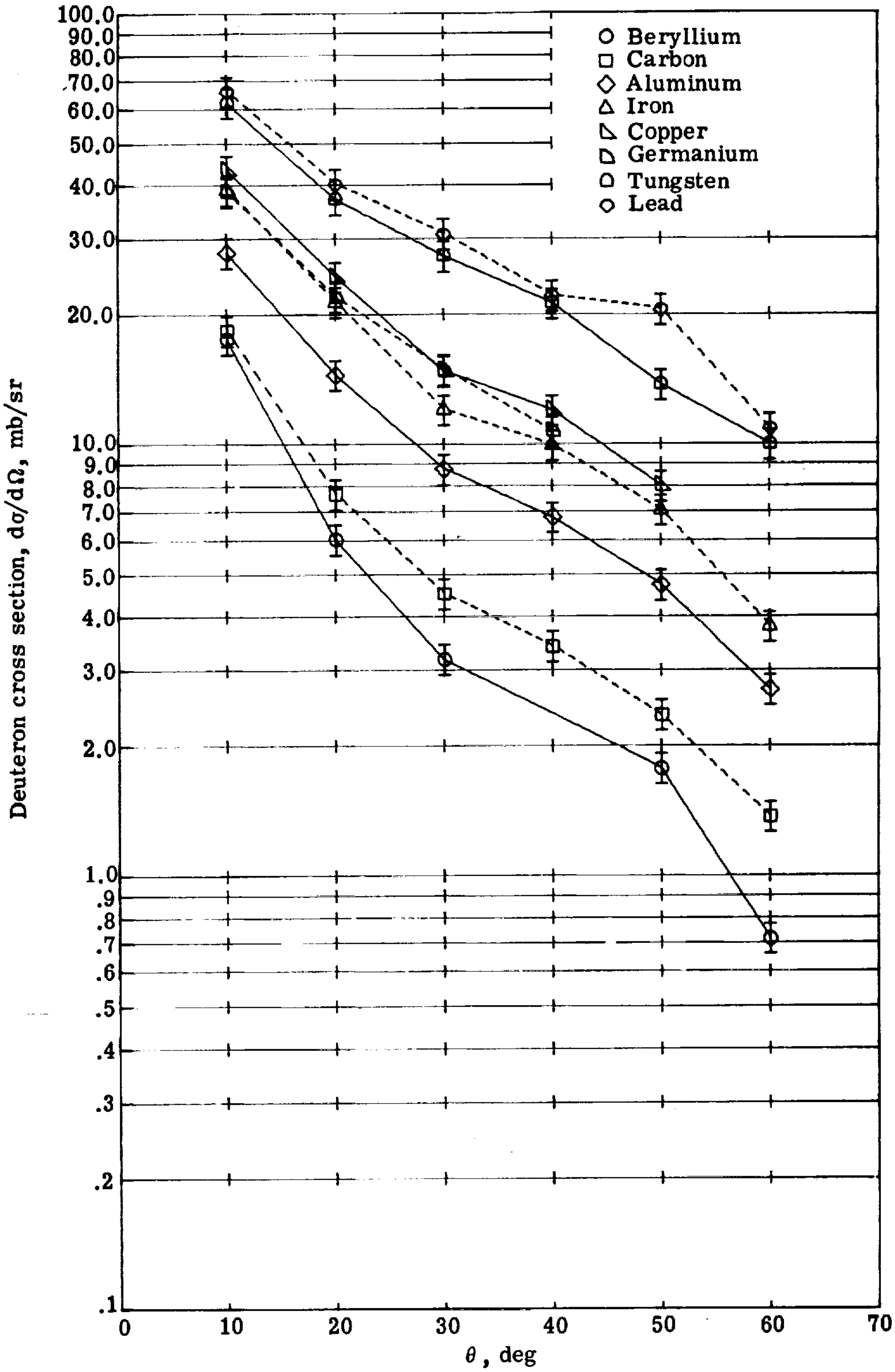


Figure 16.- Angular variation of energy-integrated deuteron cross sections.

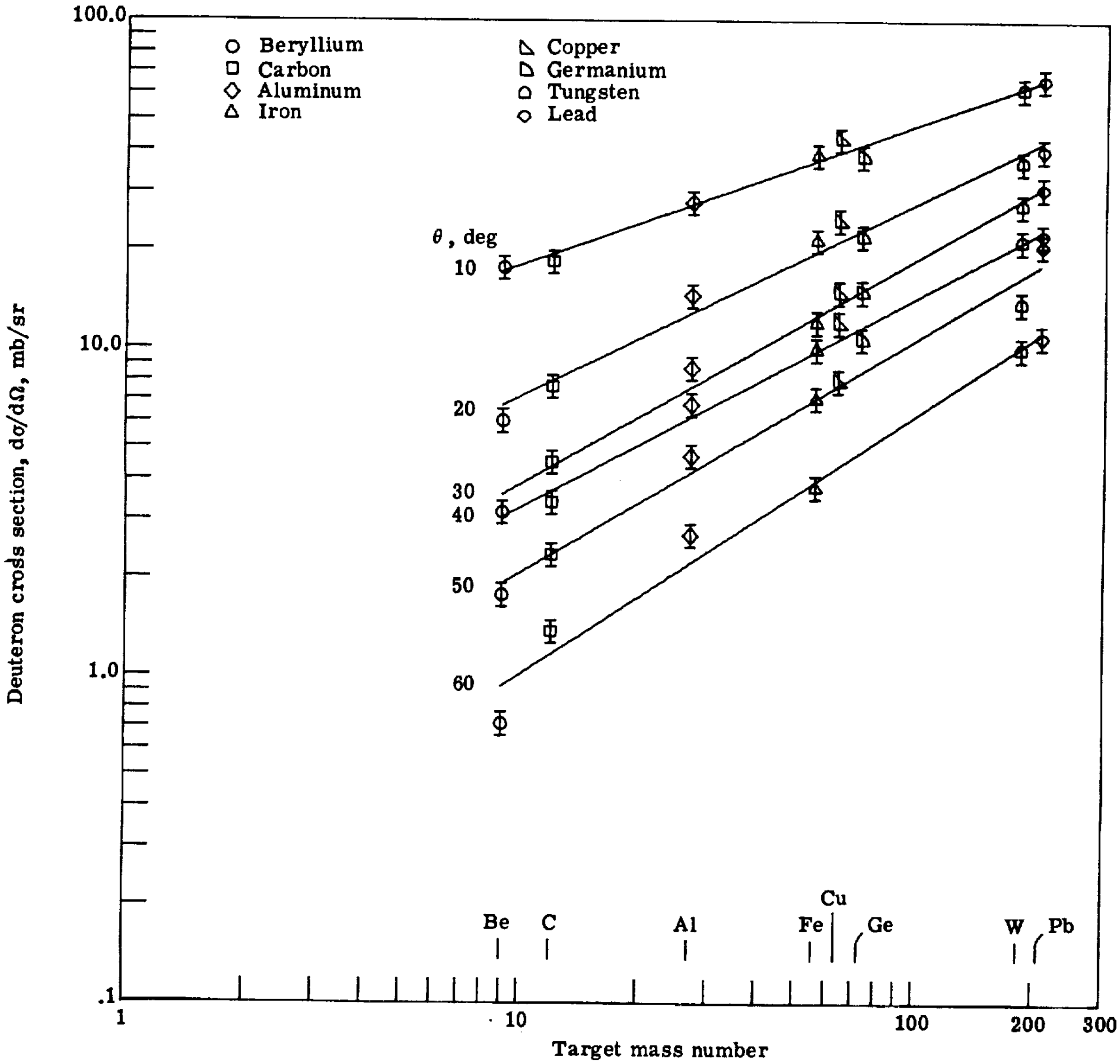


Figure 17.- Variation of energy-integrated deuteron cross sections with target mass number.

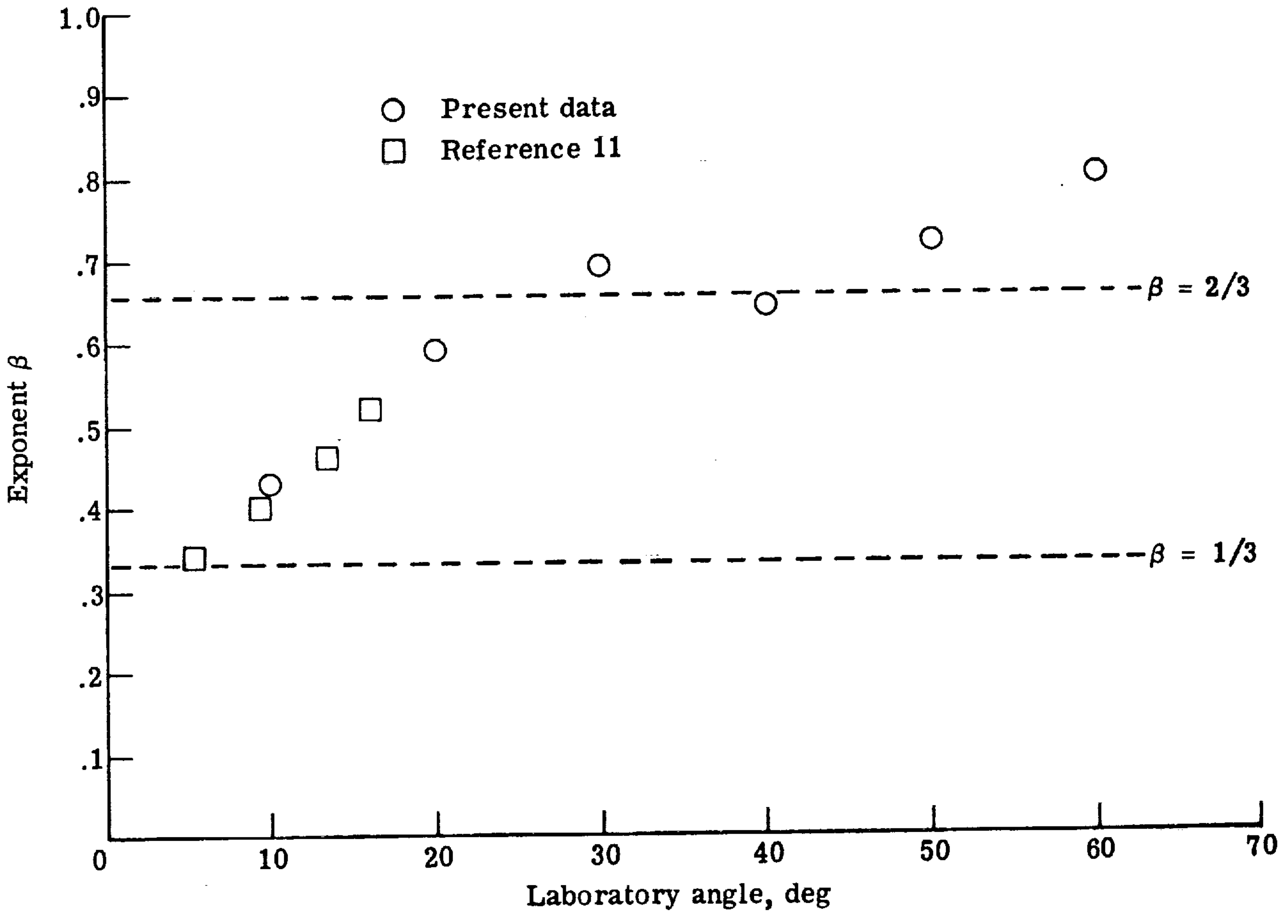


Figure 18.- Dependence of energy-integrated deuteron cross sections on exponent β as a function of laboratory angle of scatter.

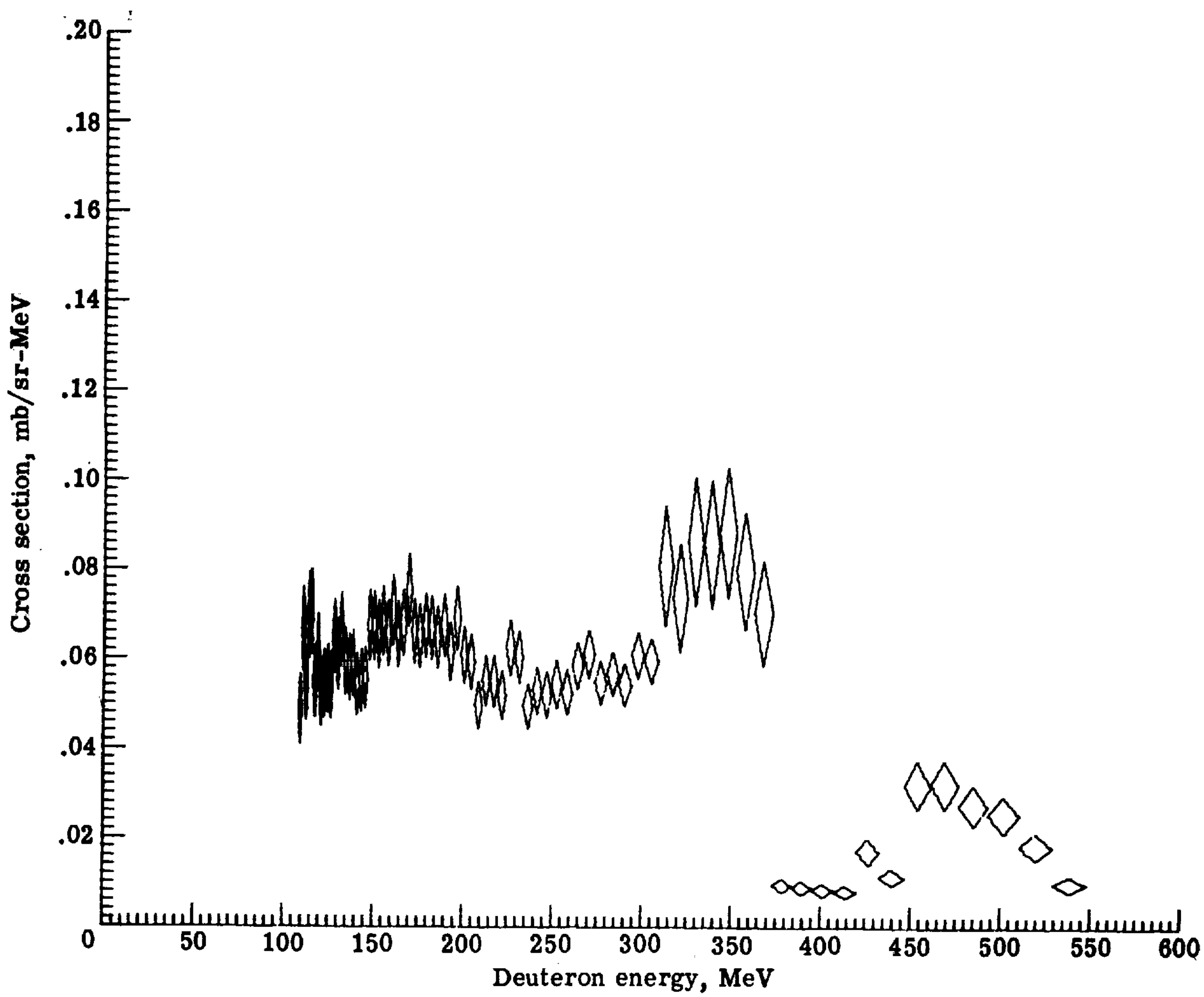


Figure 19.- Experimental cross sections for quasi-elastic deuteron production. Beryllium target, 2.35 g/cm^2 thick; $\theta = 10^{\circ}$; 558-MeV incident protons.

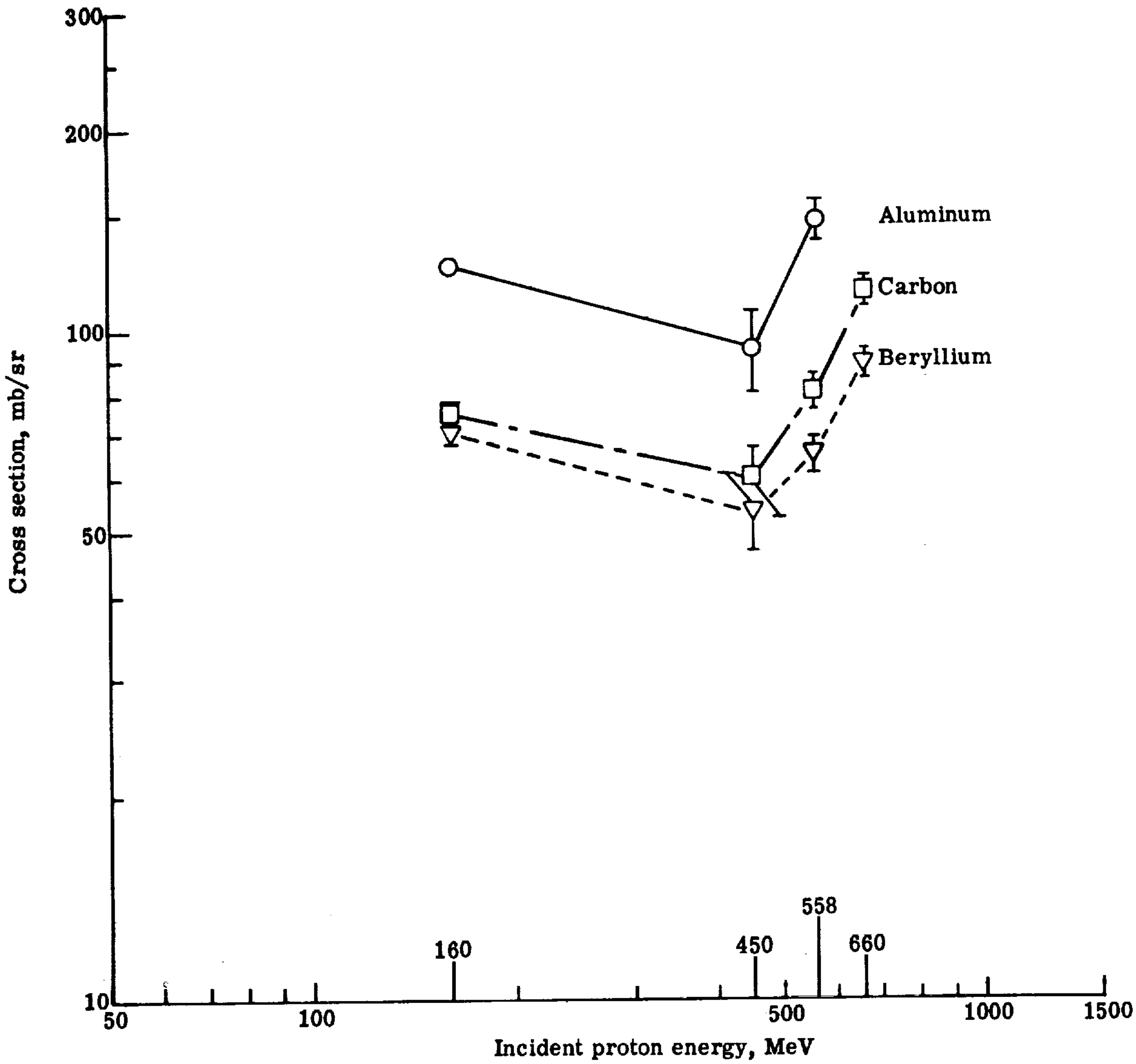
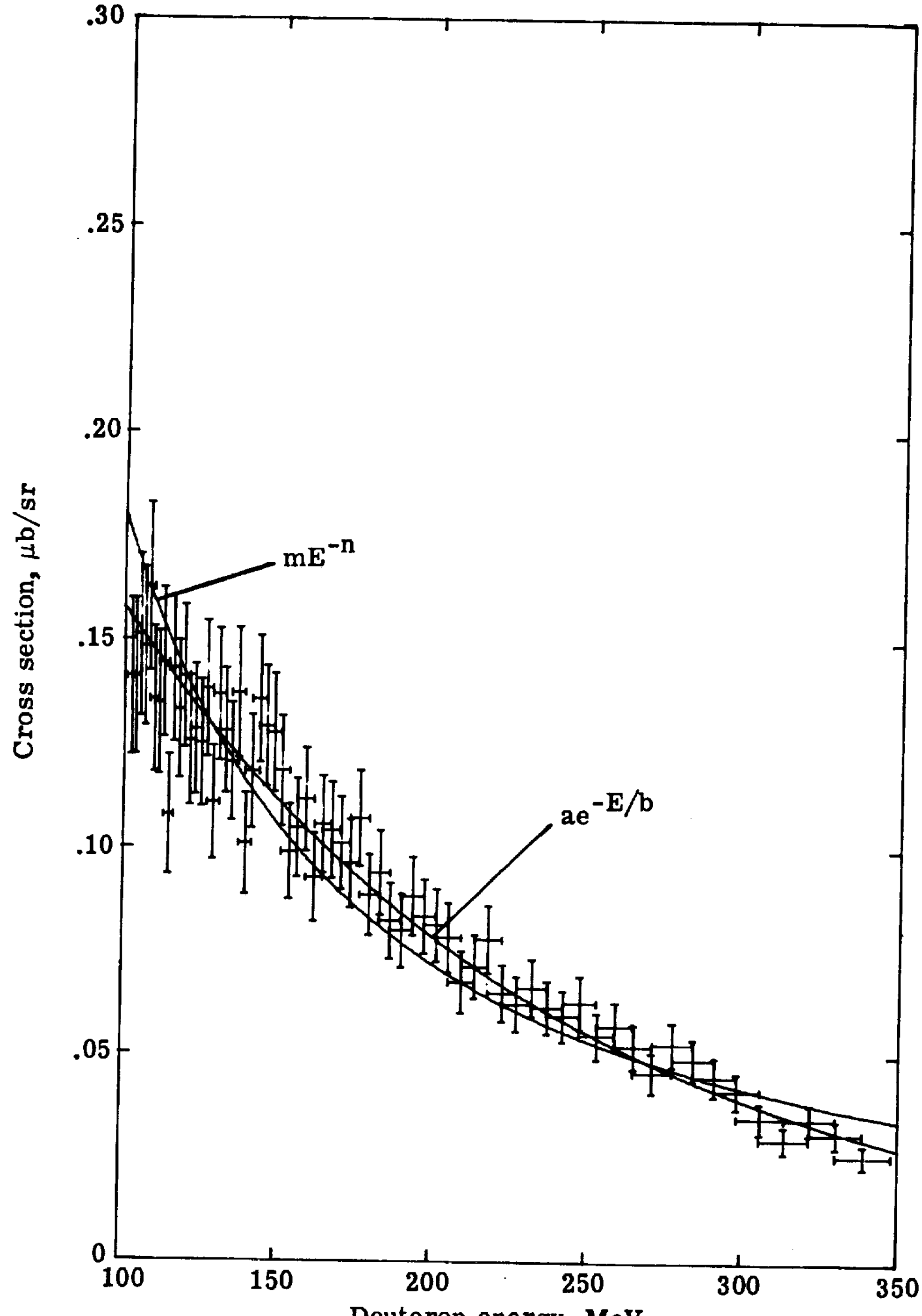
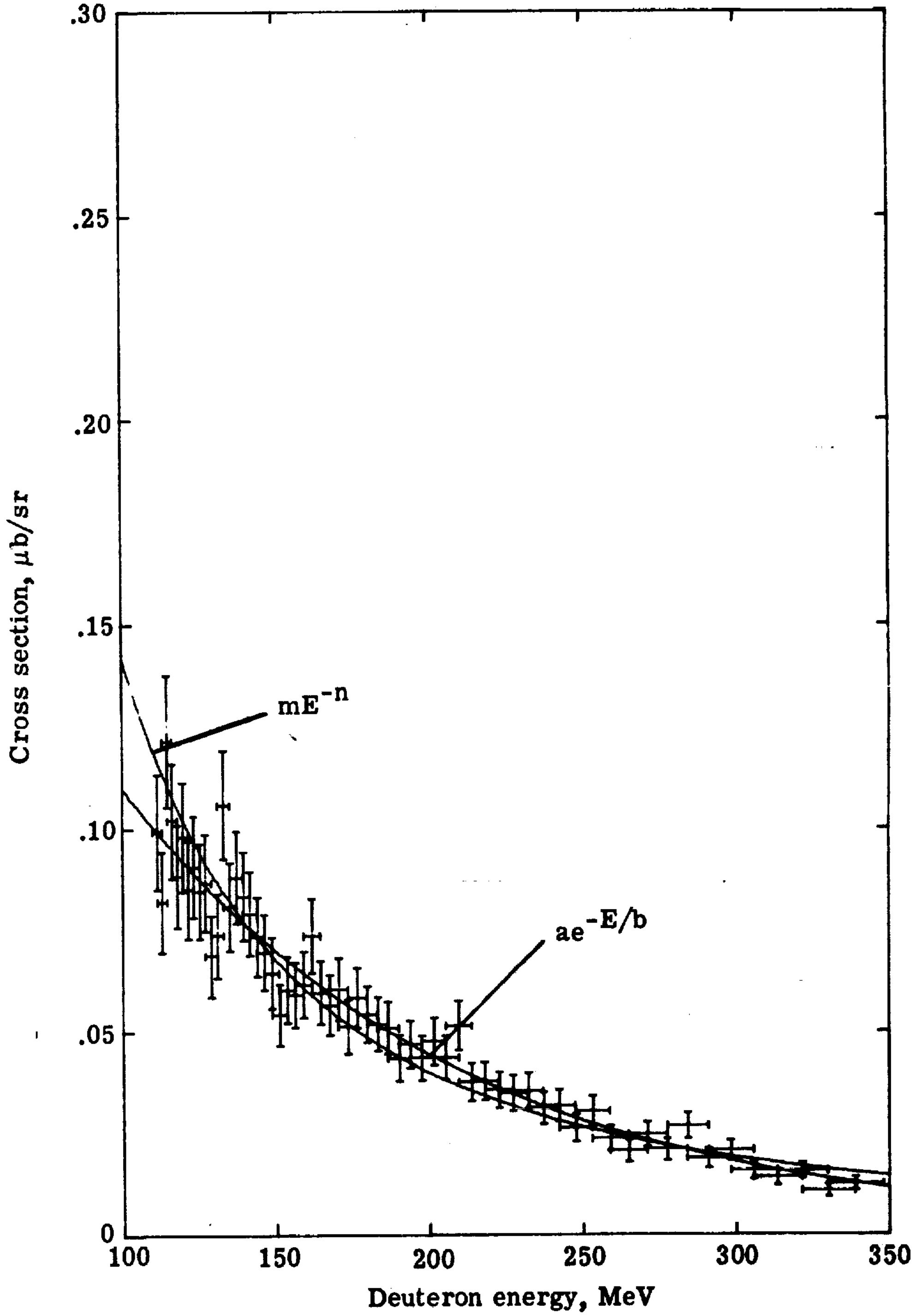


Figure 20.- Variation of energy-integrated proton cross section with incident proton energy. $\theta = 30^{\circ}$.



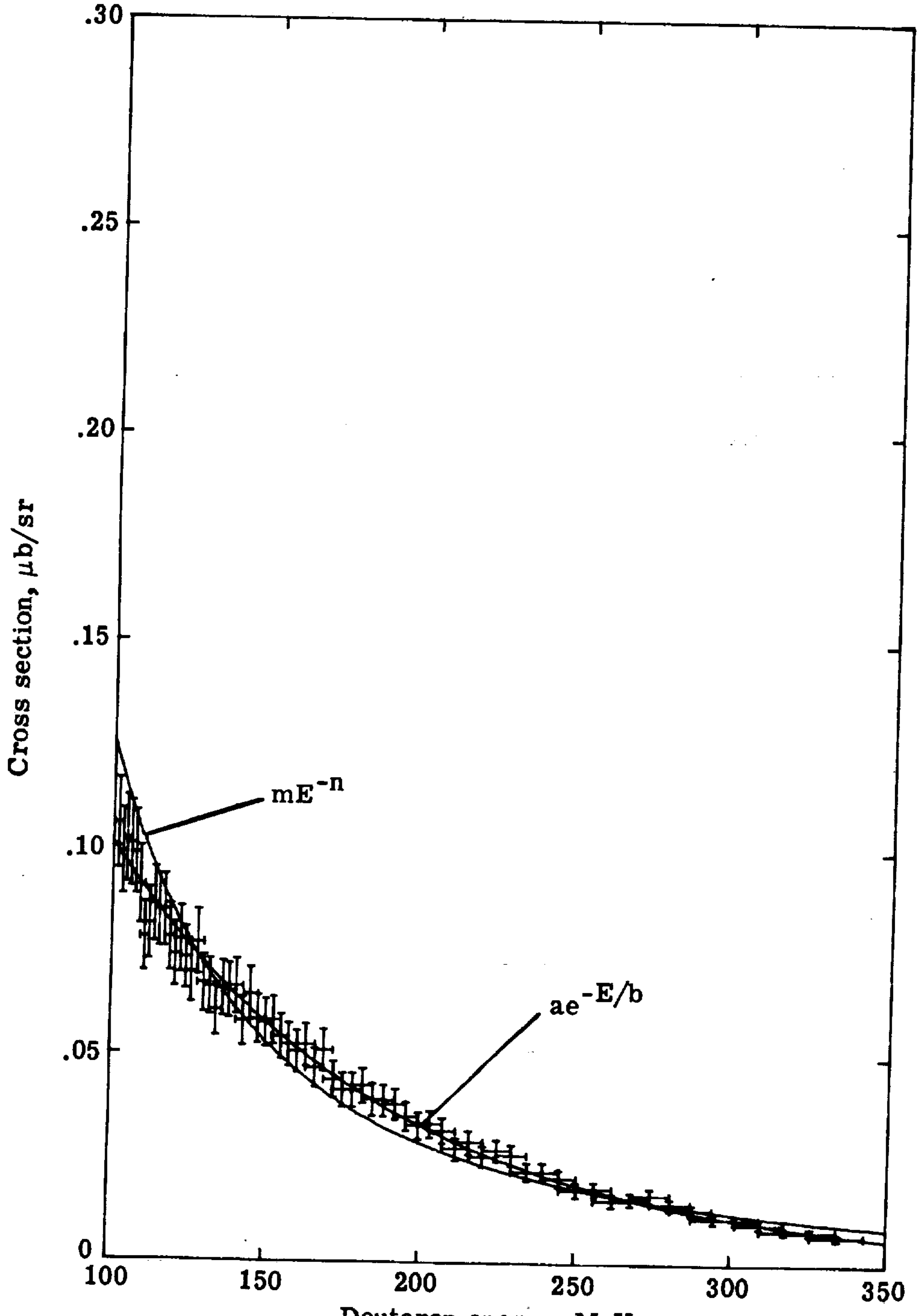
(a) $\theta = 20^{\circ}$.

Figure 21.- Energy dependence of secondary deuteron cross section from iron target, 3.77 g/cm^2 thick. The power-law curve mE^{-n} and the exponential curve $ae^{-E/b}$ were fitted to data by method of least squares. See table 9(b) for values of parameters.



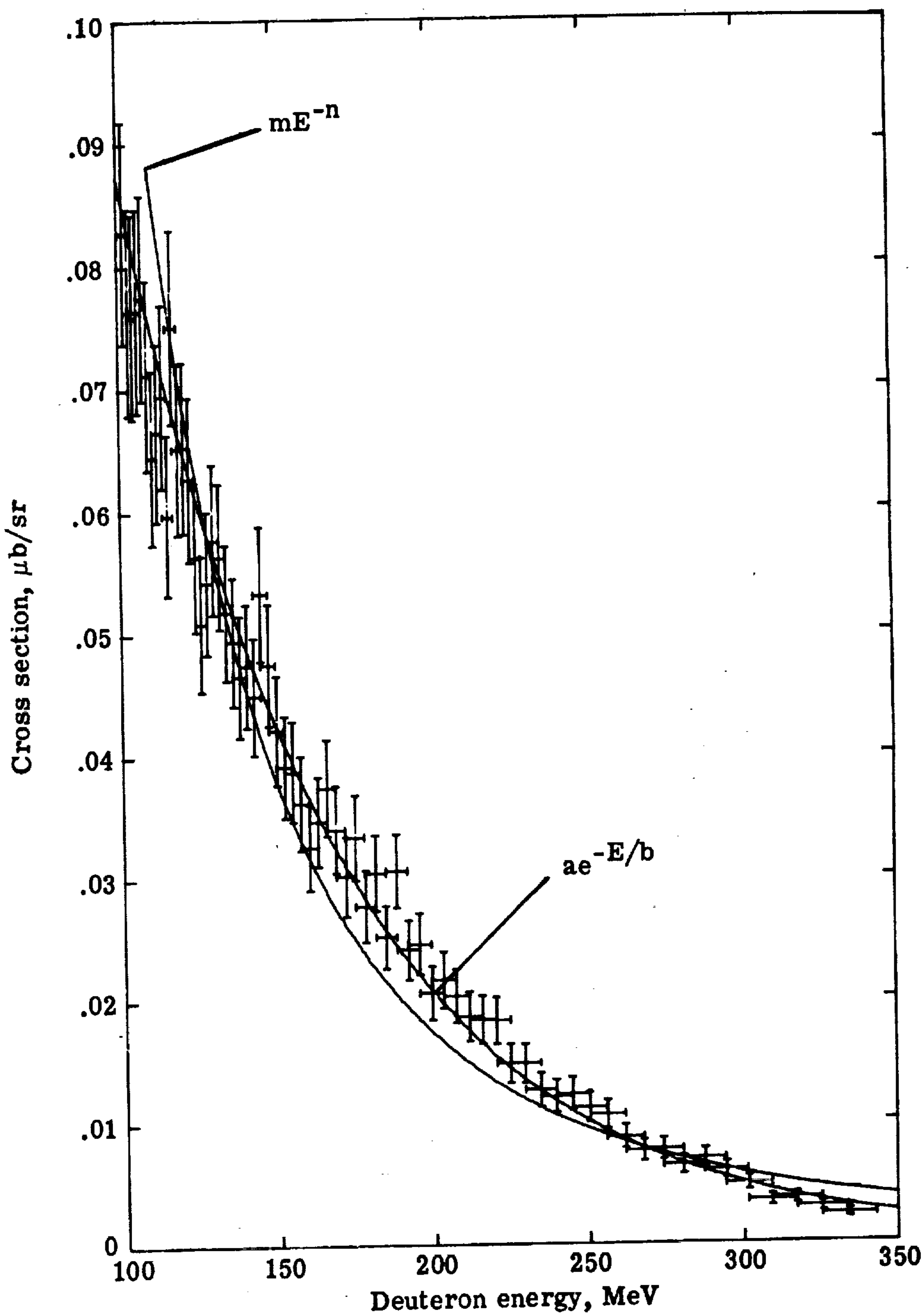
(b) $\theta = 30^{\circ}$.

Figure 21.- Continued.



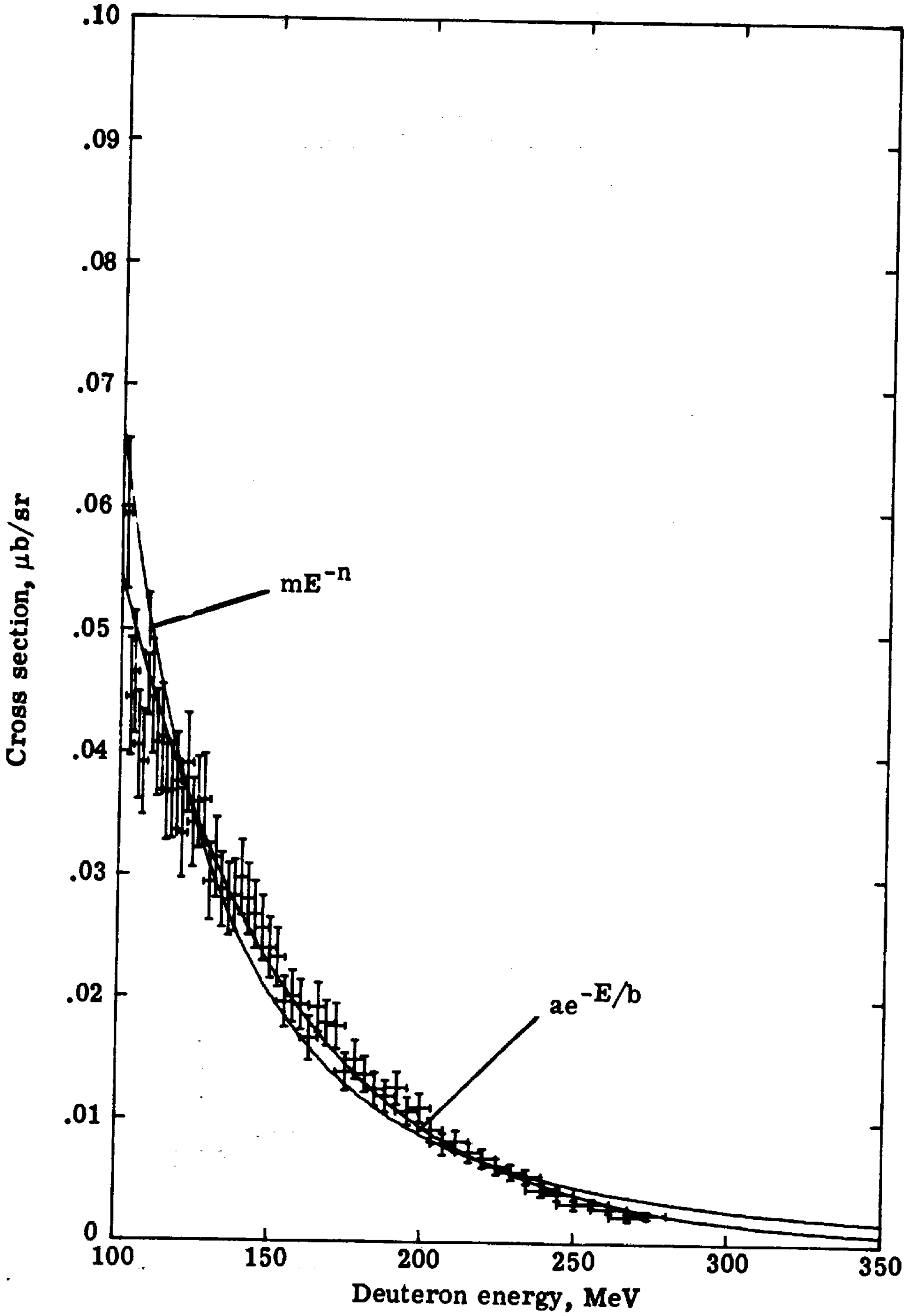
(c) $\theta = 40^{o}$.

Figure 21.- Continued.



(d) $\theta = 50^{\circ}$.

Figure 21.- Continued.



(e) θ = 60°.

Figure 21.- Concluded.

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