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ANALYTIC REPRESENTATION OF NUCLEON- AND PION-EMISSION SPECTRA FROM NUCLEON-NUCLEUS COLLISIONS IN THE ENERGY RANGE 750-2000 MeV

R. G. Alsmiller, Jr., and J. Barish*

Abstract

Analytic fits, obtained by the method of linear least squares, to the intranuclear-cascade data generated by H. W. Bertini are given. For 750-, 1000-, and 2000-MeV protons incident on oxygen, aluminum, and lead, and for 1000-MeV neutrons incident on these same elements, analytic expressions are given for

1. the cascade neutron-, proton-, π^+-, π^0-, and π^--emission spectra in the laboratory angular intervals 0-30°, 30-60°, 60-90°, 90-180°, and 0-180°, and
2. the evaporation neutron- and proton-emission spectra.

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TABLE OF CONTENTS

		Page
I.	INTRODUCTION	4
II.	DESCRIPTION OF TABLES AND DISCUSSION OF FIGURES	5
	REFERENCES	9
Appendix I.	GRAPHS OF PARTICLE SPECTRA FROM 2000-MeV PROTONS ON ALUMINUM	10
Appendix II.	TABLES OF COEFFICIENTS FOR EMITTED CASCADE-PARTICLE SPECTRA	28
Appendix III.	TABLES OF COEFFICIENTS FOR EVAPORATION-PARTICLE SPECTRA	65

I. INTRODUCTION

Using an intranuclear-cascade model, H. W. Bertini[1-5] has generated a large amount of data on the nonelastic cross section and the energy and angular distribution of emitted neutrons and protons when neutrons and protons in the energy range 25 to 400 MeV are incident on a variety of targets. In a previous report, hereinafter referred to as 6, an analytic representation of these data, obtained by fitting the Monte Carlo results using the method of linear least squares, was presented. Recently H. W. Bertini extended his calculations to 2000 MeV and published some preliminary results.[7] In this paper, the fitting procedure used in 6 is applied to the new data, and analytic expressions are given for the particle-emission spectra. The fits obtained are an adequate representation of the Monte Carlo data for many purposes, but, because the energy range to be covered is larger than in 6, they are not always as reliable as those given in 6. For protons of energy 750, 1000, and 2000 MeV incident on oxygen, aluminum, and lead, and for neutrons of energy 1000 MeV incident on oxygen, aluminum, and lead, analytic expressions are given for

1. the cascade neutron-, proton, π^+-, π^0-, and π^--emission spectra in the laboratory angular intervals 0-30°, 30-60°, 60-90°, 90-180°, and 0-180°, and
2. the evaporation neutron- and proton-emission spectra.

Because the total nonelastic cross section is slowly varying and because of the small number of data points, an expression for this cross section is not given.

II. DESCRIPTION OF TABLES AND DISCUSSION OF FIGURES

The fitting procedure used is the same as that described in 6 in every detail, so it will not be discussed here. The energy distribution in a specified angular interval of each type of emitted cascade particle is given in the form

$$F(E) = \frac{1}{E_o} \; EXP[\sum_{j=o}^{\nu} A_j (\frac{E}{E_o})^j], \qquad (1)$$

where E_o is the energy of the incident particle and the A_j's are the coefficients obtained by the method of linear least squares. The coefficients depend, of course, on the energy and type of incident particle, the target nucleus, and the type of emitted particle.

The coefficients to be used in Eq. 1 for all the cases considered here are given in Tables 1-36.* The coefficients for the five types of emitted cascade particles for a given type and energy of incident particle and a given nucleus are contained in three tables. At the top of each table, the type of incident particle and nucleus is given. Above each group of coefficients, the type of emitted particle is specified. The first column in the tables gives the incident energy, the second column gives the angular interval, and columns 3 through 8 contain the coefficients. When these coefficients are used in Eq. 1 the distributions have the units, number per MeV per steradian per interaction, if the angular interval is 0-30°, 30-60°, 60-90°, or 90-180° and number per MeV per interaction if the angular interval is 0-180°. That is, when

*For convenience, all tables and figures are collected in the appendices at the end of the report.

the angular interval 0-180° is used, the distribution has been integrated over all solid angles. At the top of each set of coefficients, E_{min} is specified, and, in the last column in the tables, E_{max} divided by E_o is given. This E_{min} is a parameter that occurs in the calculations of Bertini and represents the energy below which no cascade particles are emitted. The quantity E_{max} is the highest energy considered in doing the fits. The fits are to be used only in the energy range E_{min} to E_{max}, and it must be understood that, if they are used outside of this range, very erratic behavior may occur. Columns 9 and 10 give the number of particles of a given type emitted in a given angular interval and the energy of these particles divided by E_o. The values in these columns are obtained from the equations:

$$\text{No. of Emitted Particles} = 2\pi[\cos\theta_1 - \cos\theta_2] \int_{E_{min}}^{E_{max}} F(E)dE \ , \qquad (2)$$

$$\text{Energy of Emitted Particles}/_{E_o} = \frac{2\pi[\cos\theta_1 - \cos\theta_2]}{E_o} \int_{E_{min}}^{E_{max}} EF(E)dE \ , \qquad (3)$$

when the θ intervals 0-30°, 30-60°, 60-90°, and 90-180° are used, and

$$\text{No. of Emitted Particles} = \int_{E_{min}}^{E_{max}} F(E)dE \ , \qquad (4)$$

$$\text{Energy of Emitted Particles}/_{E_o} = \frac{1}{E_o} \int_{E_{min}}^{E_{max}} EF(E)dE \ , \qquad (5)$$

when the θ interval 0 to 180° is used.

The energy distributions for the emitted evaporation particles are given in the form

$$G(E) = \frac{1}{25} \mathrm{EXP}[\sum_{j=o}^{\nu} A_j \left(\frac{E}{25}\right)^j] \ . \tag{6}$$

The coefficients for all of the cases considered are given in Tables 37-39. When the coefficients given in the tables are used in Eq. 6, the resulting energy distributions have the units, number per MeV per interaction. The quantities E_{min} and E_{max} are again the energy limits, outside of which the fits are not to be used, and columns 8 and 9 are obtained from the equations:

$$\text{No. of Emitted Particles} = \int_{E_{min}}^{E_{max}} G(E)dE \ , \tag{7}$$

$$\text{Energy of Emitted Particles}/_{E_o} = \frac{1}{E_o} \int_{E_{min}}^{E_{max}} EG(E)dE \ . \tag{8}$$

In some cases in the tables, all of the coefficients are shown to be zero. When this occurs, it means that so few particles were emitted that the Monte Carlo results were not considered to be statistically significant and no attempt was made to obtain a fit. In those cases where fits are not given, the number of emitted particles obtained in the Monte Carlo calculations is shown in column 8 for comparison purposes.

Comparisons between the Monte Carlo data and the analytic fits are given in Figs. 1-17. All of the comparisons in the figures are for the

case of 2000-MeV protons incident on aluminum. In Figs. 1-3, the cascade neutron-emission spectra in the angular intervals 0-30°, 30-60°, and 0-180°, respectively, are shown. In Figs. 4-15, similar results are given for the other emitted cascade particles. The evaporation neutron and proton spectra are shown in Figs. 16 and 17.

In some cases, the analytic fit is a very good representation of the Monte Carlo data, but this is by no means always the case. In this regard, Fig. 3 should be particularly noted since it is an example of one of the poorer fits to the data. In the fitting procedure used here, as in 6, the derivative of the fitted curve was tested for changes in sign, and if more than two sign changes occurred the fit was assumed to contain nonphysical oscillations, and a fit with a smaller number of parameters, i.e., with a smaller value of ν, was attempted. This procedure was continued until $\nu = 2$ was reached and the fit with $\nu = 2$ was accepted without further testing. Figure 3 gives an example of the kind of fit which results when this procedure ultimately leads to a three-parameter fit. In those places in the tables where only three nonzero coefficients are given, the fits must be considered to be very approximate. Of course, even when more than three parameters are given, there is no assurance that the fit is a good representation of the Monte Carlo data. It is hoped that the analytic expressions given in this report will be useful, but it must be understood that for some purposes they may not be adequate.

REFERENCES

1. Hugo W. Bertini, Phys. Rev. 131, 1801 (1963), with erratum Phys. Rev. 138, AB2 (1965).

2. Hugo W. Bertini, Results from Low-Energy Intranuclear-Cascade Calculations, ORNL-TM-1225 (1965).

3. Hugo W. Bertini, Hemma E. Francis, and Miriam P. Guthrie, Instructions for the Operation of Codes Associated with the Low-Energy Intranuclear Cascade Calculation, ORNL-3844 (1966).

4. W. A. Gibson, et al., Comparison of Measured Neutron and Proton Spectra with Calculated Spectra in the Energy Region Between 50 and 160 MeV, Proc. Second Symposium on Protection Against Radiations in Space, Gatlinburg, Tennessee, October 12-14, 1964, NASA SP-71, p. 337 (1965).

5. Hugo W. Bertini, Energy Spectra from Inelastic Nuclear Reactions at Energies Below 450 MeV, Trans. Am. Nucl. Soc., Washington, November 15-18, 1965, p. 634.

6. R. G. Alsmiller, Jr., M. Leimdorfer, and J. Barish, Analytic Representation of Nonelastic Cross Sections and Particle-Emission Spectra From Nucleon-Nucleus Collisions in the Energy Range 25 to 400 MeV, ORNL-4046 (1967).

7. Hugo W. Bertini, Preliminary Data From Intranuclear-Cascade Calculations of 0.75-, 1-, and 2-GeV Protons on Oxygen, Aluminum, and Lead, and 1-GeV Neutrons On the Same Elements, ORNL-TM-1996 (1967).

Appendix I. GRAPHS OF PARTICLE SPECTRA FROM 2000-MeV PROTONS ON ALUMINUM

Fig. 1. Cascade Neutrons 0-30° Angular Interval.

Fig. 2. Cascade Neutrons 30-60° Angular Interval.

Fig. 3. Cascade Neutrons 0-180° Angular Interval.

Fig. 4. Cascade Protons 0-30° Angular Interval.

Fig. 5. Cascade Protons 30-60° Angular Interval.

Fig. 6. Cascade Protons 0-180° Angular Interval.

Fig. 7. Positively Charged Pions 0-30° Angular Interval.

Fig. 8. Positively Charged Pions 30-60° Angular Interval.

Fig. 9. Positively Charged Pions 0-180° Angular Interval.

Fig. 10. Neutral Pions 0-30° Angular Interval.

Fig. 11. Neutral Pions 30-60° Angular Interval.

Fig. 12. Neutral Pions 0-180° Angular Interval.

Fig. 13. Negatively Charged Pions 0-30° Angular Interval.

Fig. 14. Negatively Charged Pions 30-60° Angular Interval.

Fig. 15. Negatively Charged Pions 0-180° Angular Interval.

Fig. 16. Evaporation Neutrons.

Fig. 17. Evaporation Protons.

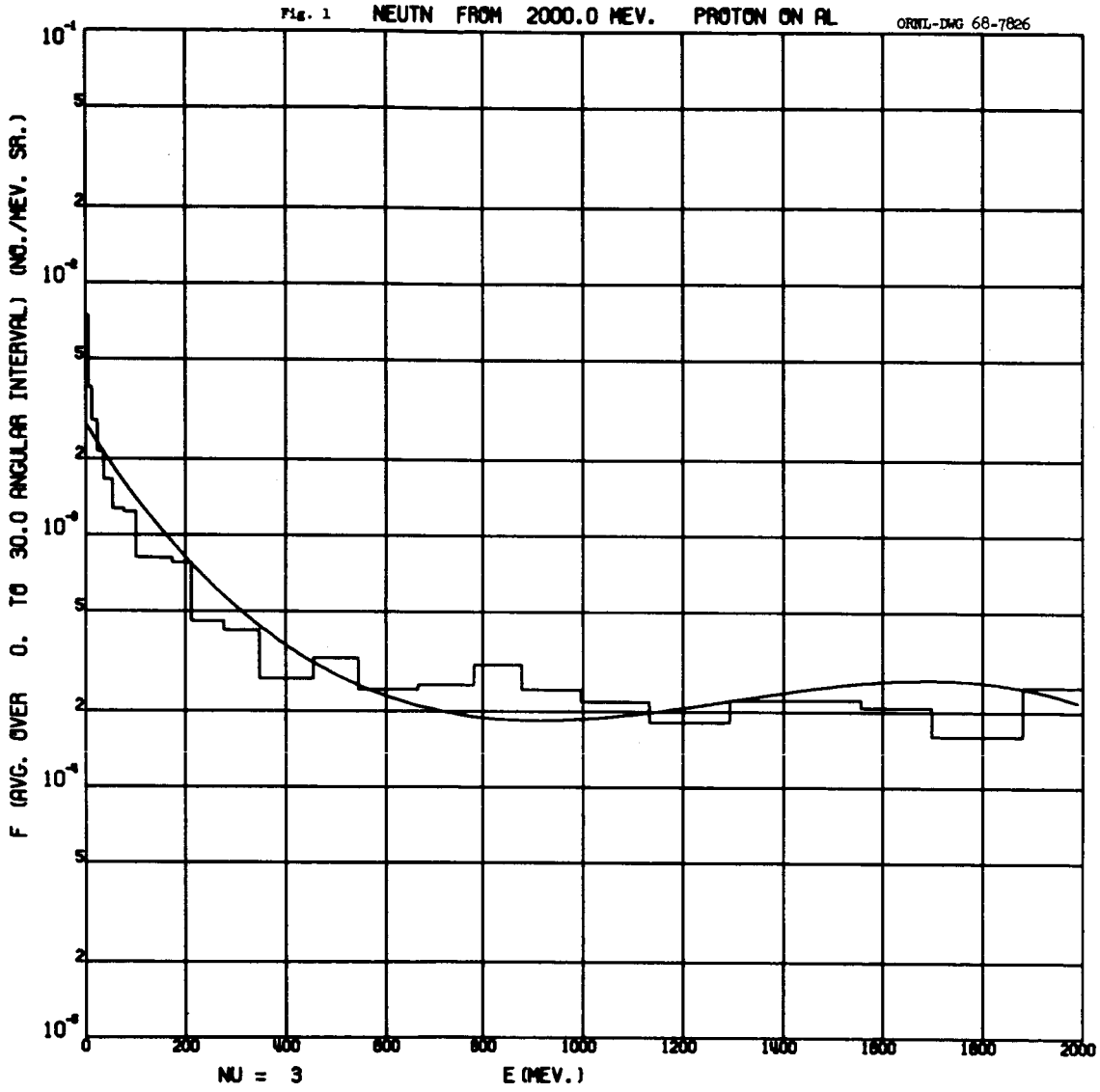


Fig. 1 NEUTN FROM 2000.0 MEV. PROTON ON AL
ORNL-DWG 68-7826
F (AVG. OVER 0. TO 30.0 ANGULAR INTERVAL) (NO./MEV. SR.)
10⁻¹
5
2
10⁻²
5
2
10⁻³
5
2
10⁻⁴
5
2
10⁻⁵
0
200
400
600
800
1000
1200
1400
1600
1800
2000
NU = 3
E (MEV.)

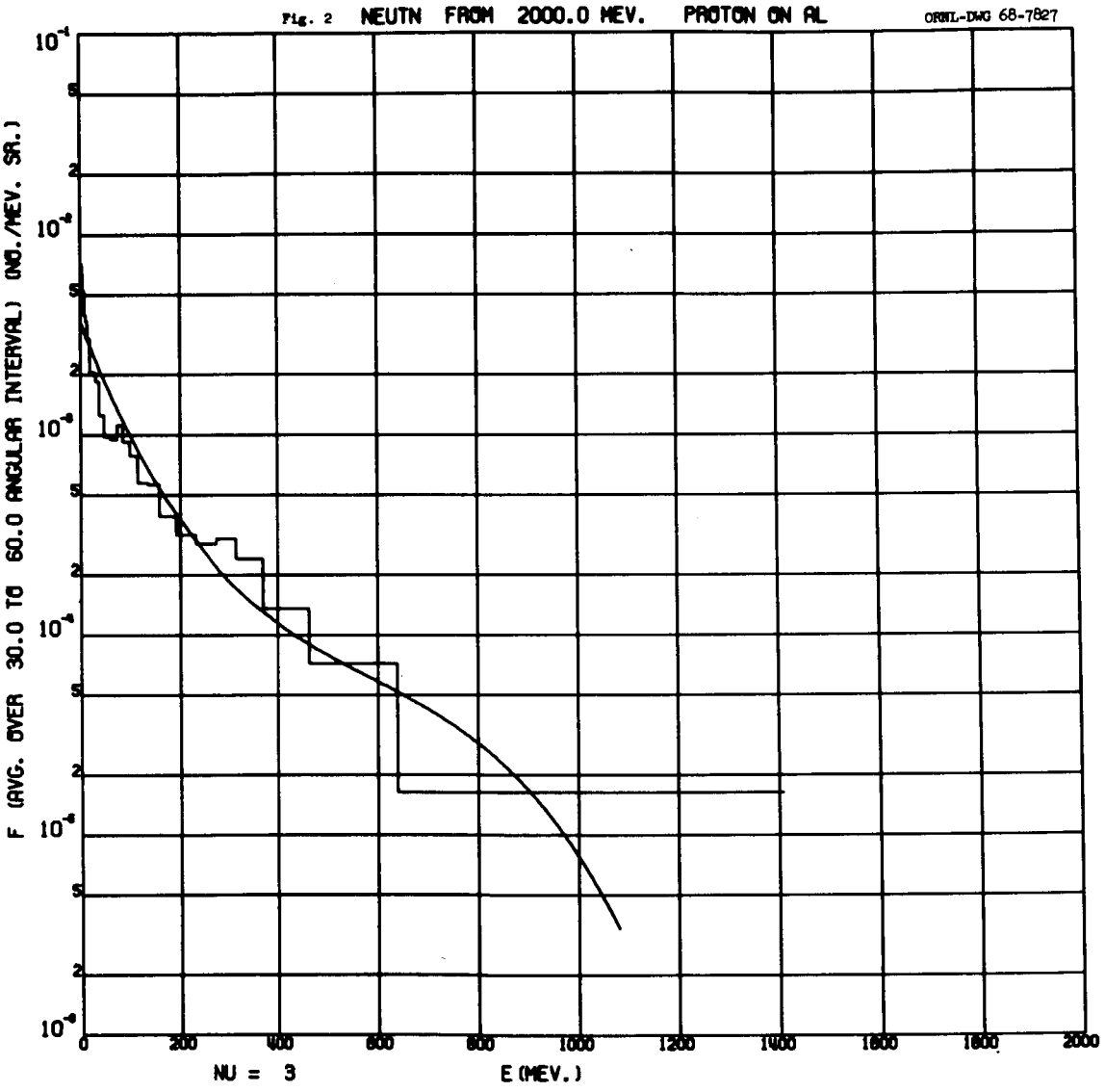


Fig. 2 NEUTN FROM 2000.0 MEV. PROTON ON AL
ORNL-DWG 68-7827
F (AVG. OVER 30.0 TO 60.0 ANGULAR INTERVAL) (NO./MEV. SR.)
E (MEV.)
NU = 3
0
200
400
600
800
1000
1200
1400
1600
1800
2000

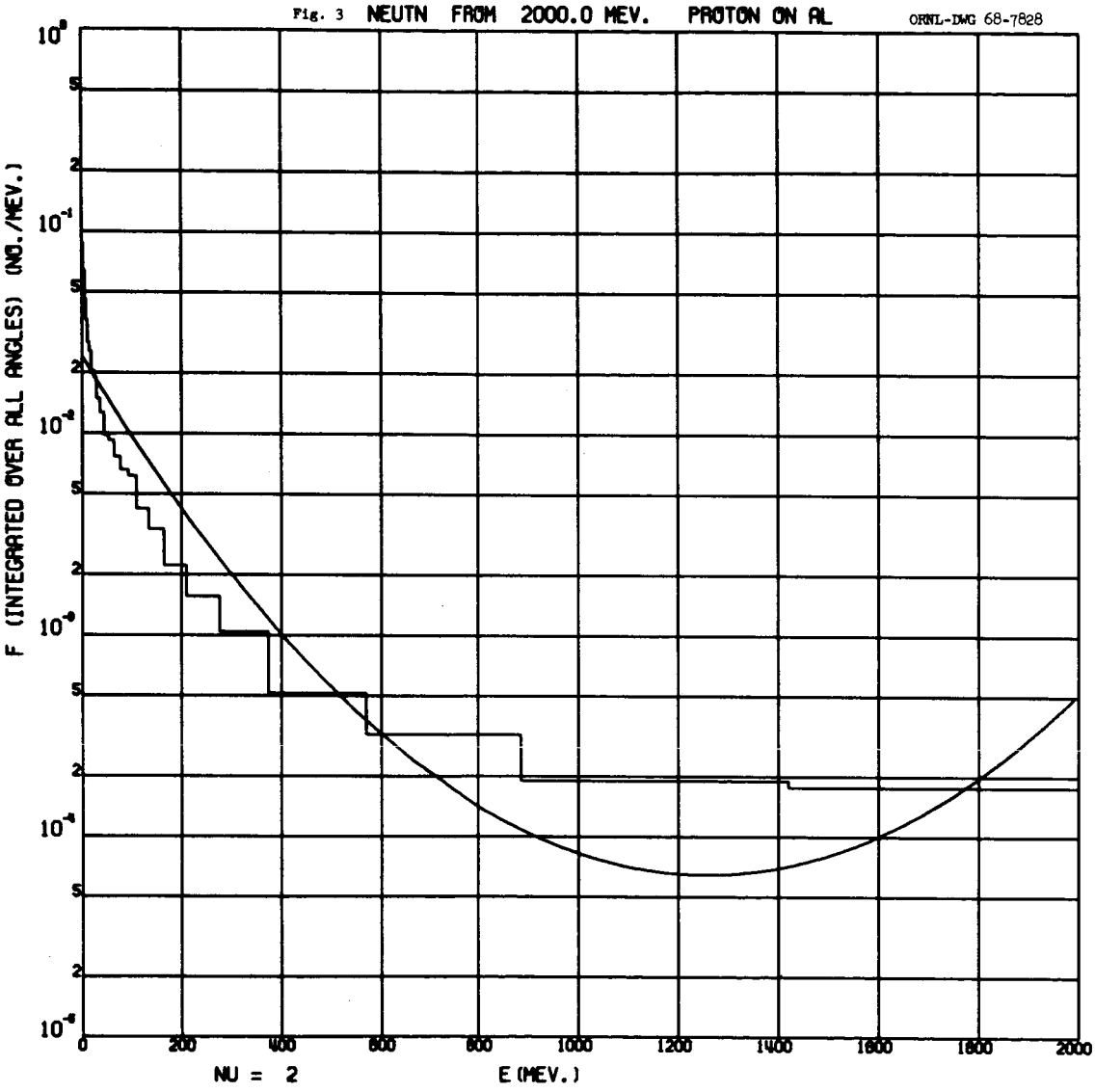


Fig. 3 NEUTN FROM 2000.0 MEV. PROTON ON AL
ORNL-DWG 68-7828
F (INTEGRATED OVER ALL ANGLES) (NO./MEV.)
NU = 2
E (MEV.)
0
200
400
600
800
1000
1200
1400
1600
1800
2000

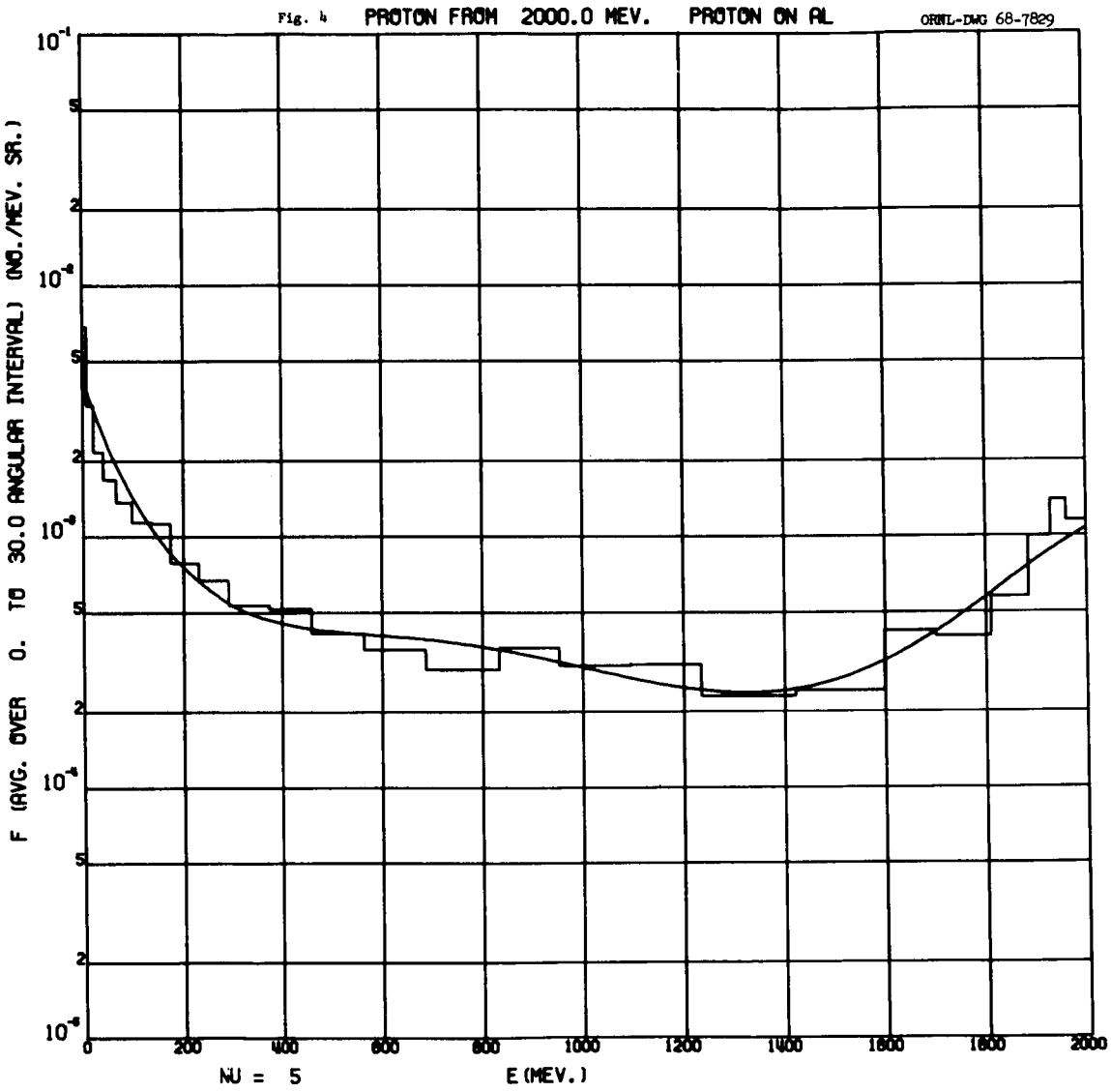


Fig. 4 PROTON FROM 2000.0 MEV. PROTON ON AL
ORNL-DWG 68-7829
F (AVG. OVER 0. TO 30.0 ANGULAR INTERVAL) (NO./MEV. SR.)
NU = 5
E (MEV.)

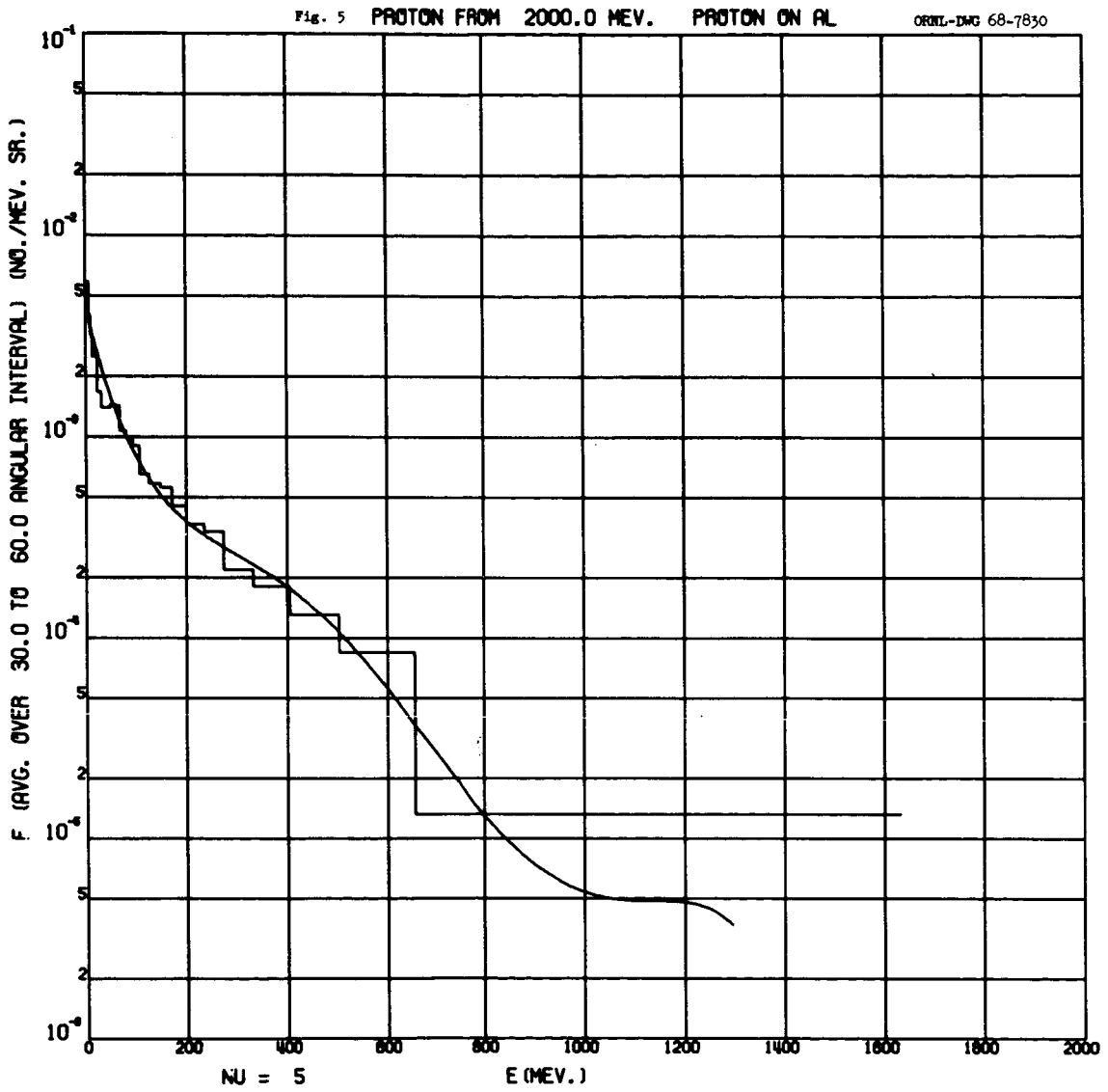


Fig. 5 PROTON FROM 2000.0 MEV. PROTON ON AL
ORNL-DWG 68-7830
F (AVG. OVER 30.0 TO 60.0 ANGULAR INTERVAL) (NO./MEV. SR.)
E (MEV.)
NU = 5
0
200
400
600
800
1000
1200
1400
1600
1800
2000

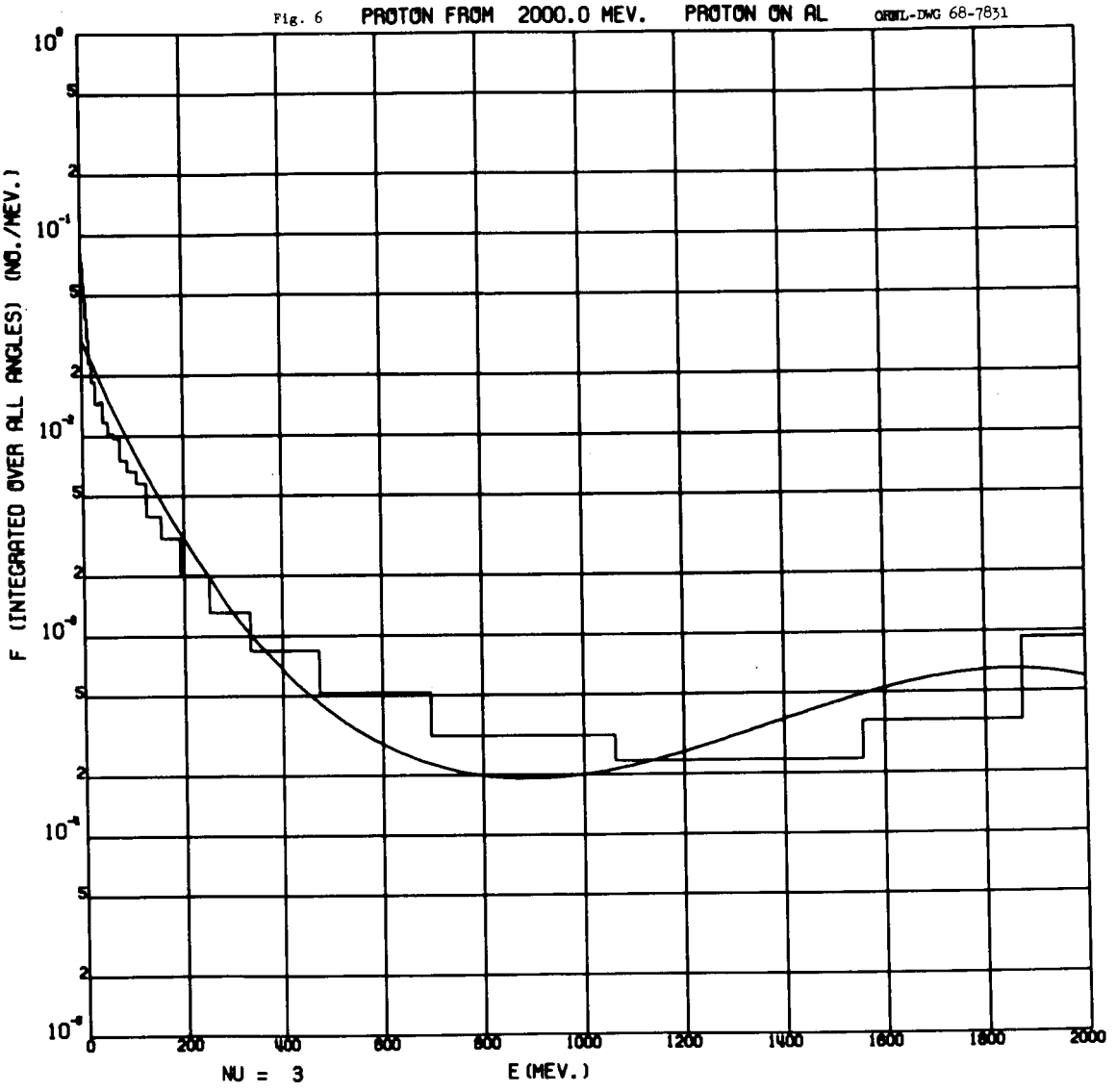


Fig. 6 PROTON FROM 2000.0 MEV. PROTON ON AL
ORNL-DWG 68-7831
F (INTEGRATED OVER ALL ANGLES) (NO./MEV.)
E (MEV.)
NU = 3
0
200
400
600
800
1000
1200
1400
1600
1800
2000

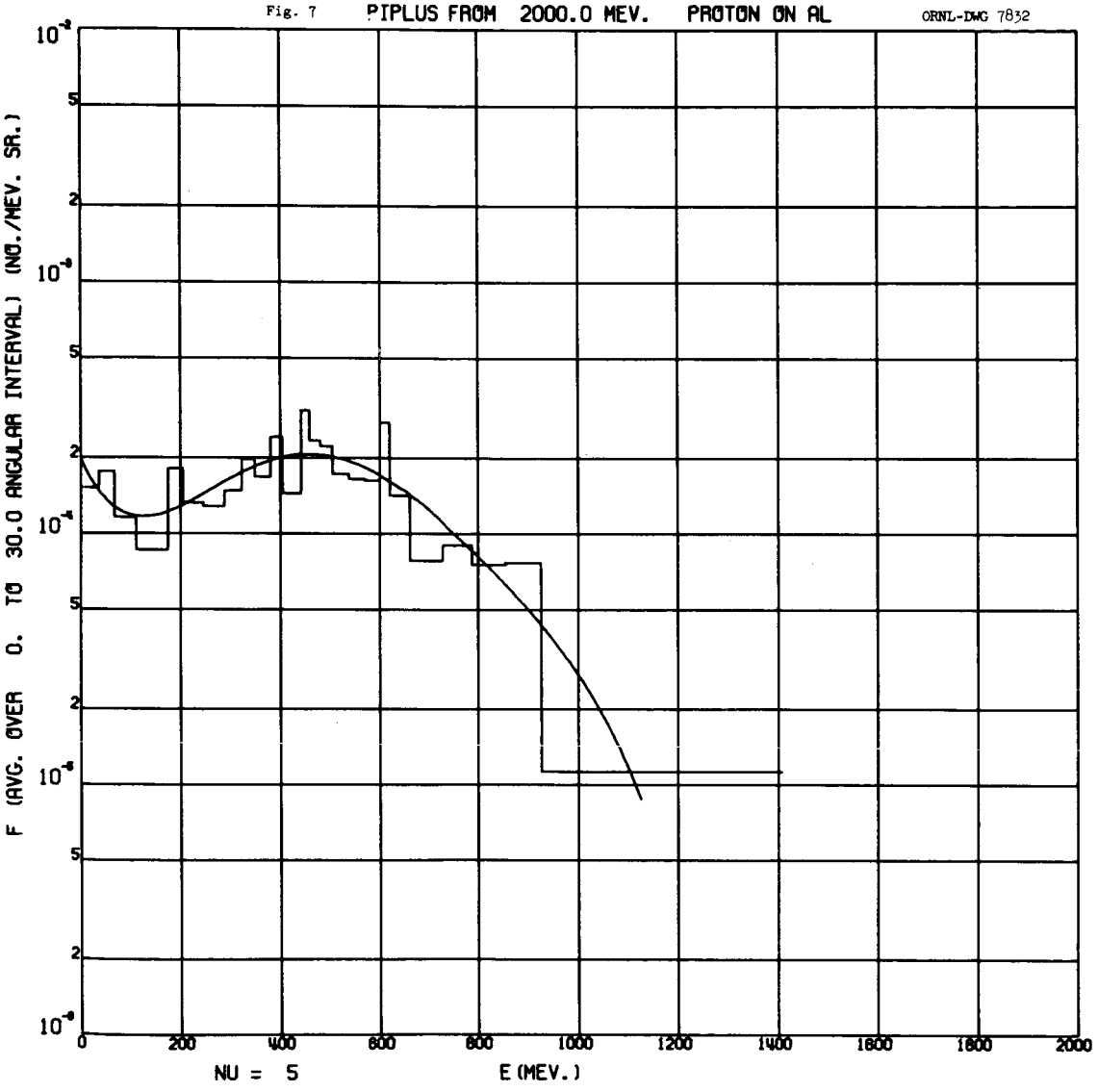
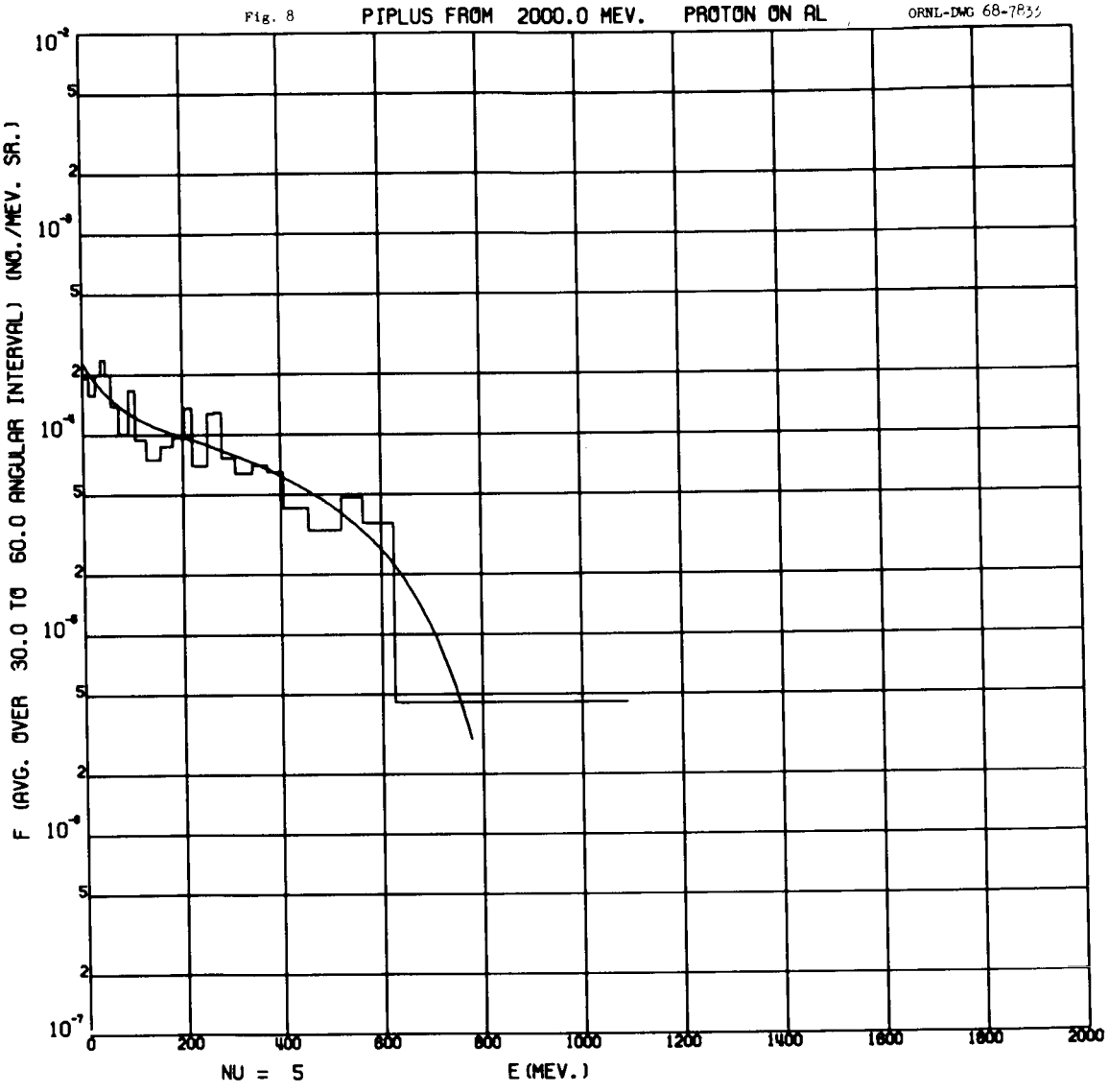


Fig. 7
PIPLUS FROM 2000.0 MEV. PROTON ON AL
ORNL-DWG 7832
F (AVG. OVER 0. TO 30.0 ANGULAR INTERVAL) (NO./MEV. SR.)
E (MEV.)
NU = 5
0
200
400
600
800
1000
1200
1400
1600
1800
2000

Fig. 8 PIPLUS FROM 2000.0 MEV. PROTON ON AL ORNL-DWG 68-7835



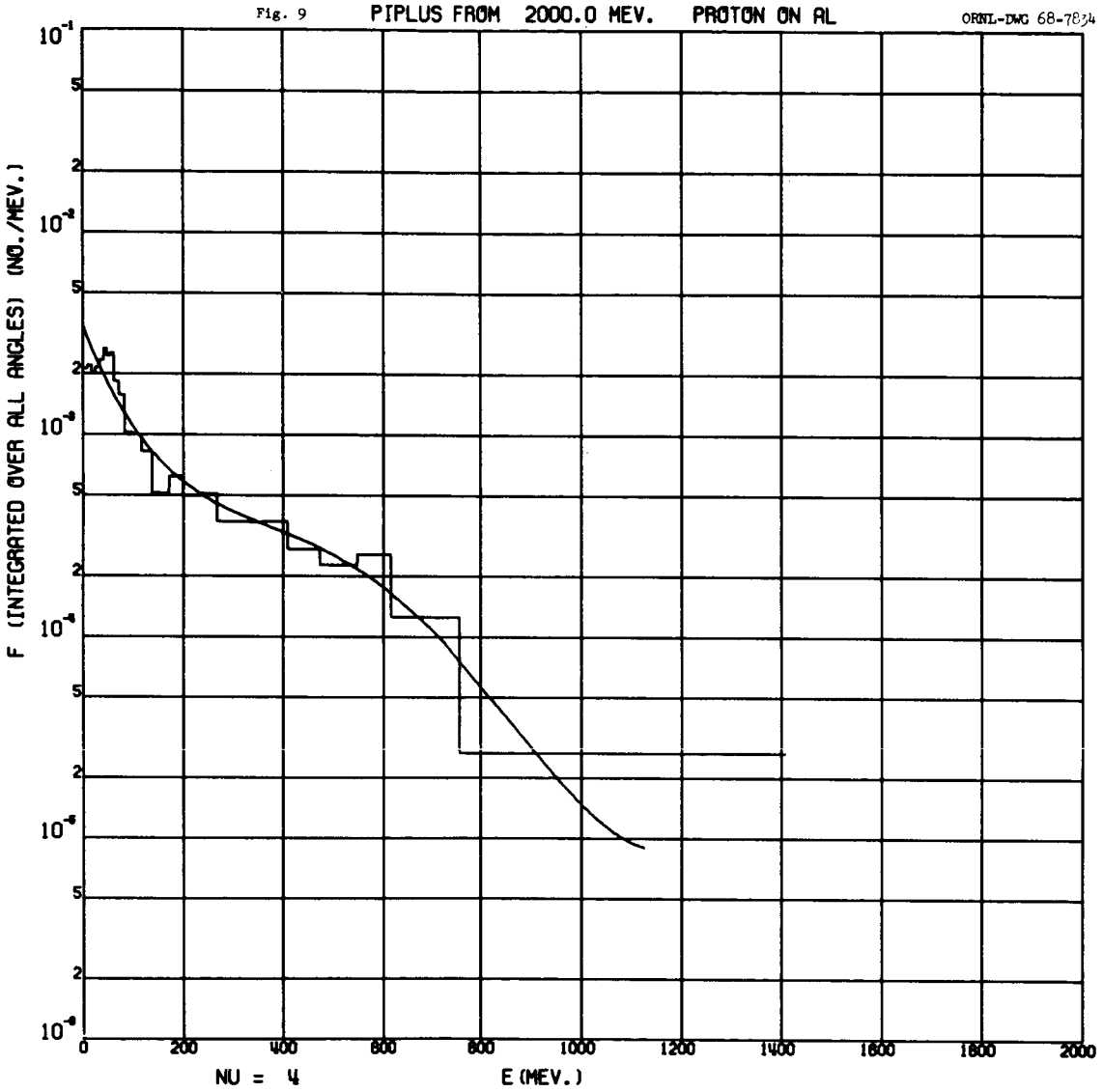


Fig. 9
PIPLUS FROM 2000.0 MEV. PROTON ON AL
ORNL-DWG 68-7834
F (INTEGRATED OVER ALL ANGLES) (NO./MEV.)
NU = 4
E (MEV.)

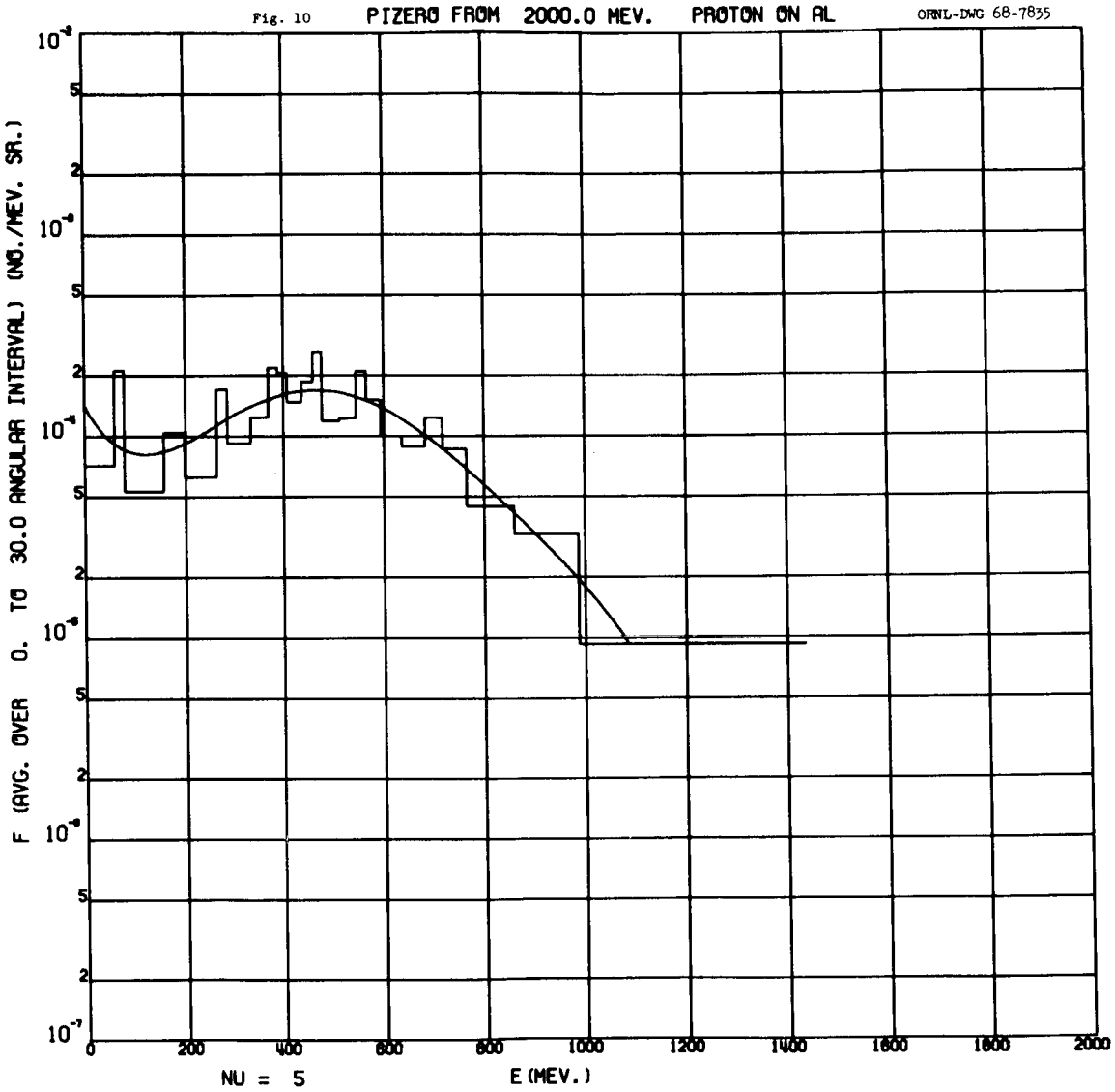


Fig. 10
PIZERO FROM 2000.0 MEV. PROTON ON AL
ORNL-DWG 68-7835
F (AVG. OVER 0. TO 30.0 ANGULAR INTERVAL) (NO./MEV. SR.)
NU = 5
E (MEV.)

Fig. 11 PIZERO FROM 2000.0 MEV. PROTON ON AL ORNL-DWG 68-7836

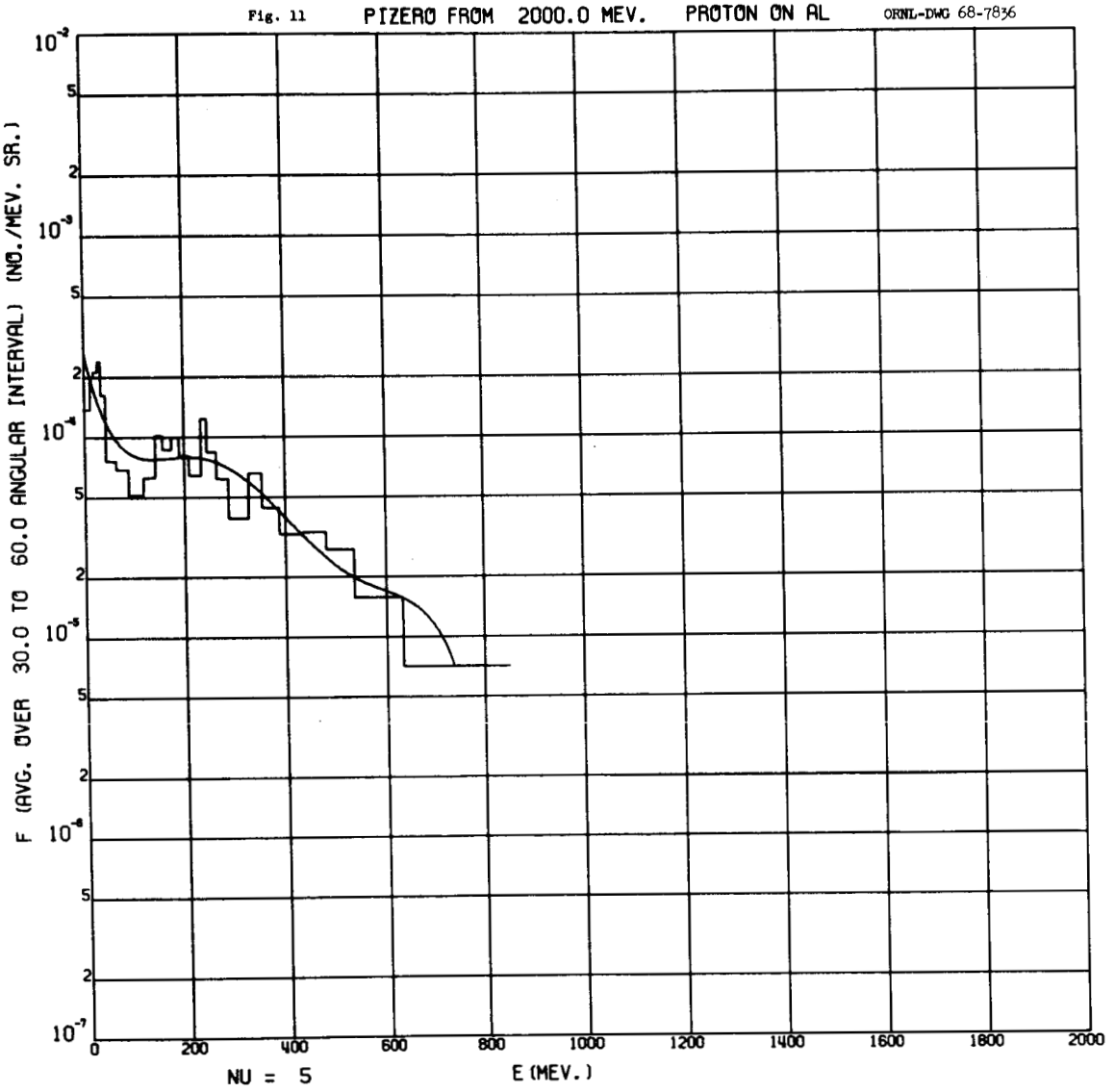


Fig. 12 PIZERO FROM 2000.0 MEV. PROTON ON AL ORNL-DWG 68-7837

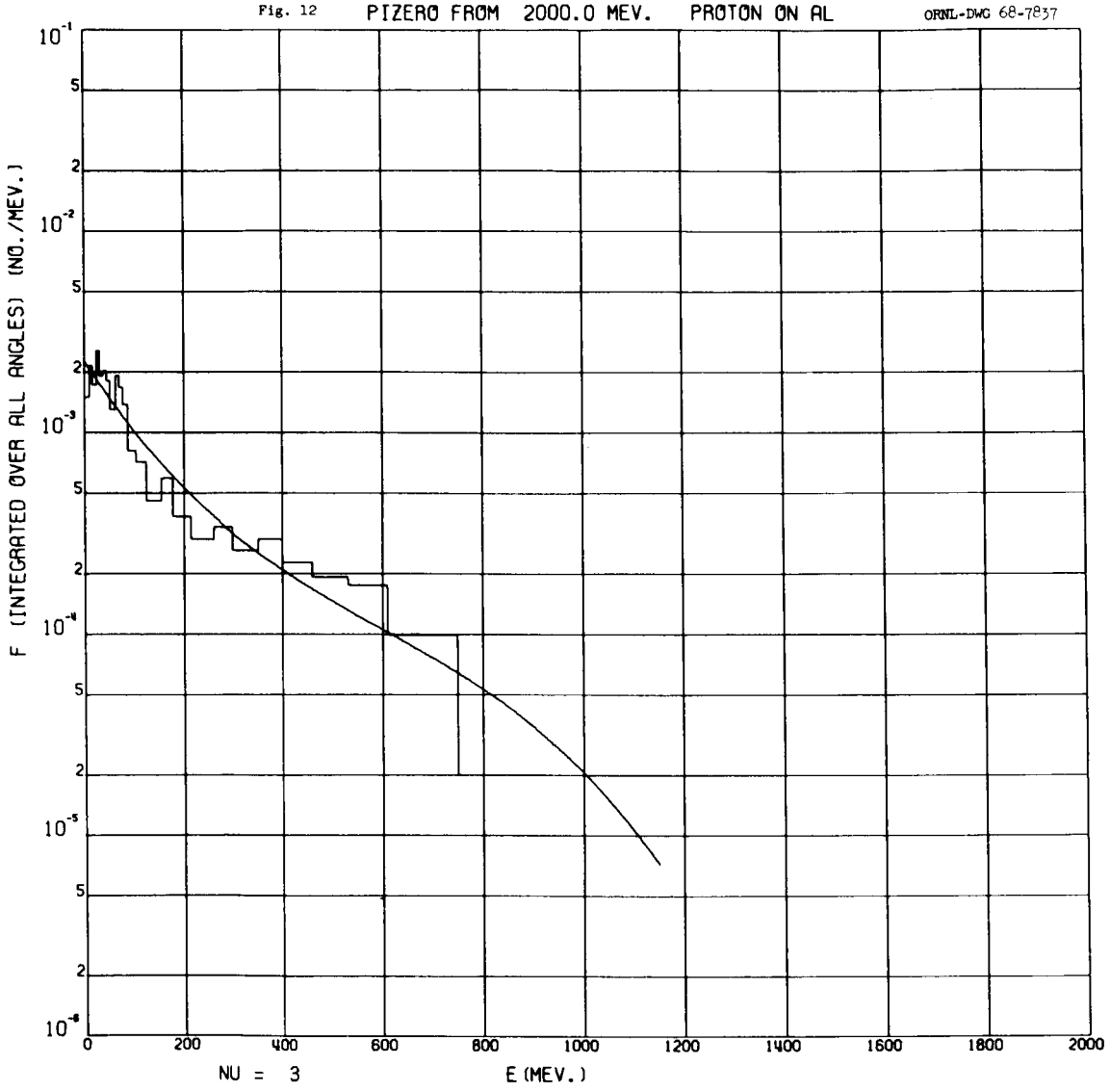
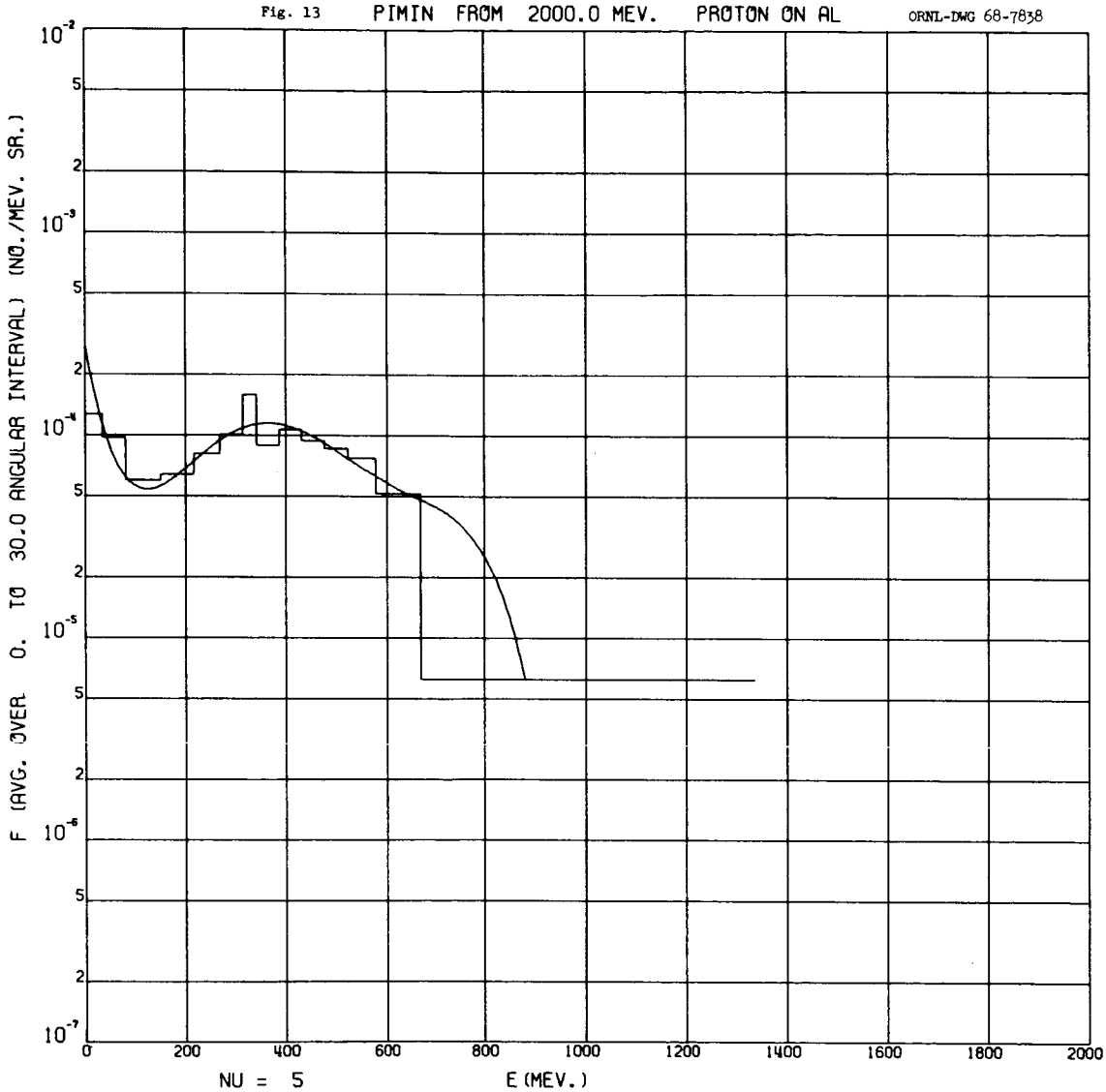


Fig. 13 PIMIN FROM 2000.0 MEV. PROTON ON AL ORNL-DWG 68-7838



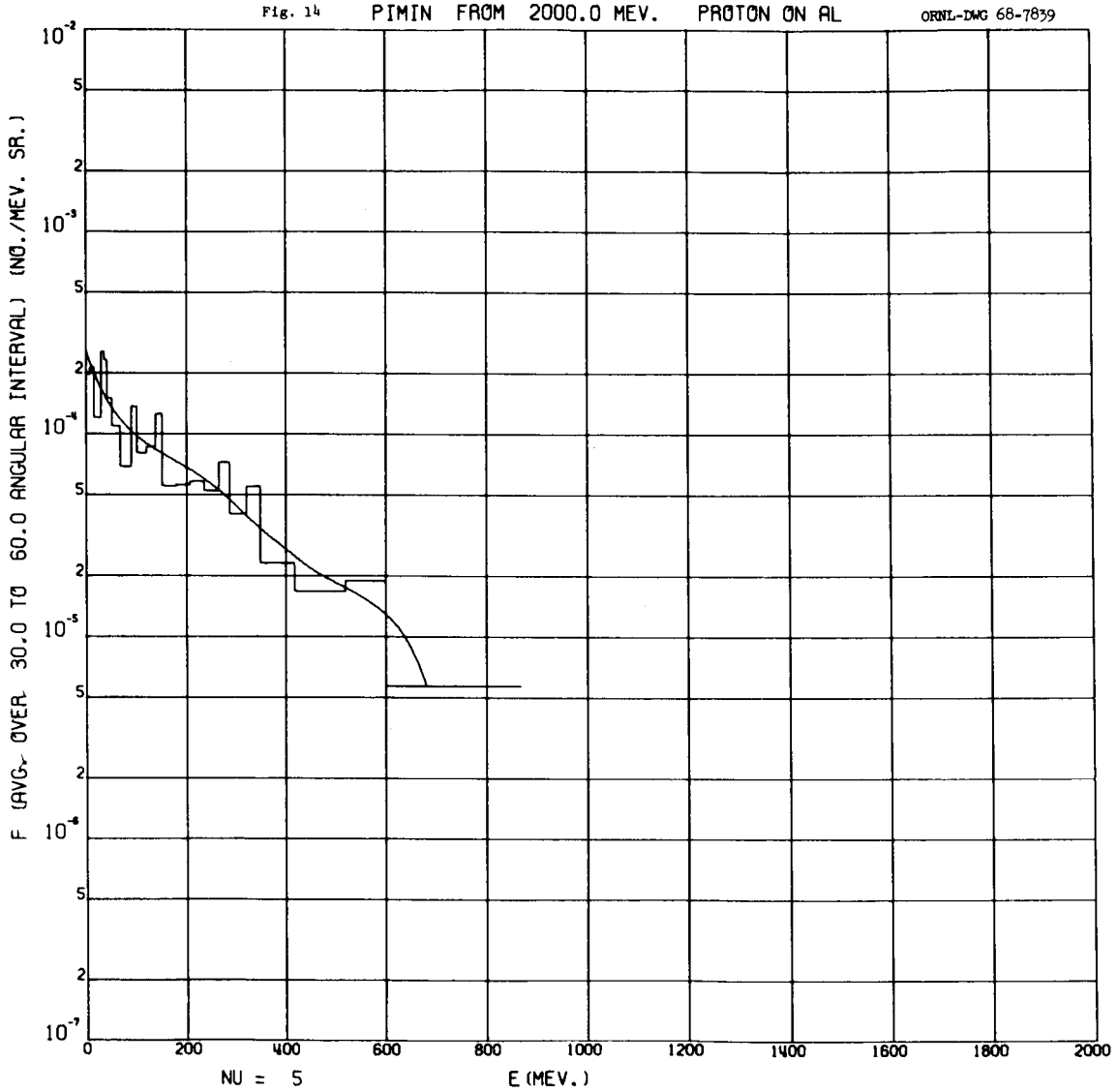


Fig. 14
PIMIN FROM 2000.0 MEV. PROTON ON AL
ORNL-DWG 68-7839
F (AVG. OVER 30.0 TO 60.0 ANGULAR INTERVAL) (NO./MEV. SR.)
10^-2
5
2
10^-3
5
2
10^-4
5
2
10^-5
5
2
10^-6
5
2
10^-7
0
200
400
600
800
1000
1200
1400
1600
1800
2000
NU = 5
E (MEV.)

Fig. 15 PIMIN FROM 2000.0 MEV. PROTON ON AL ORNL-DWG 68-7840

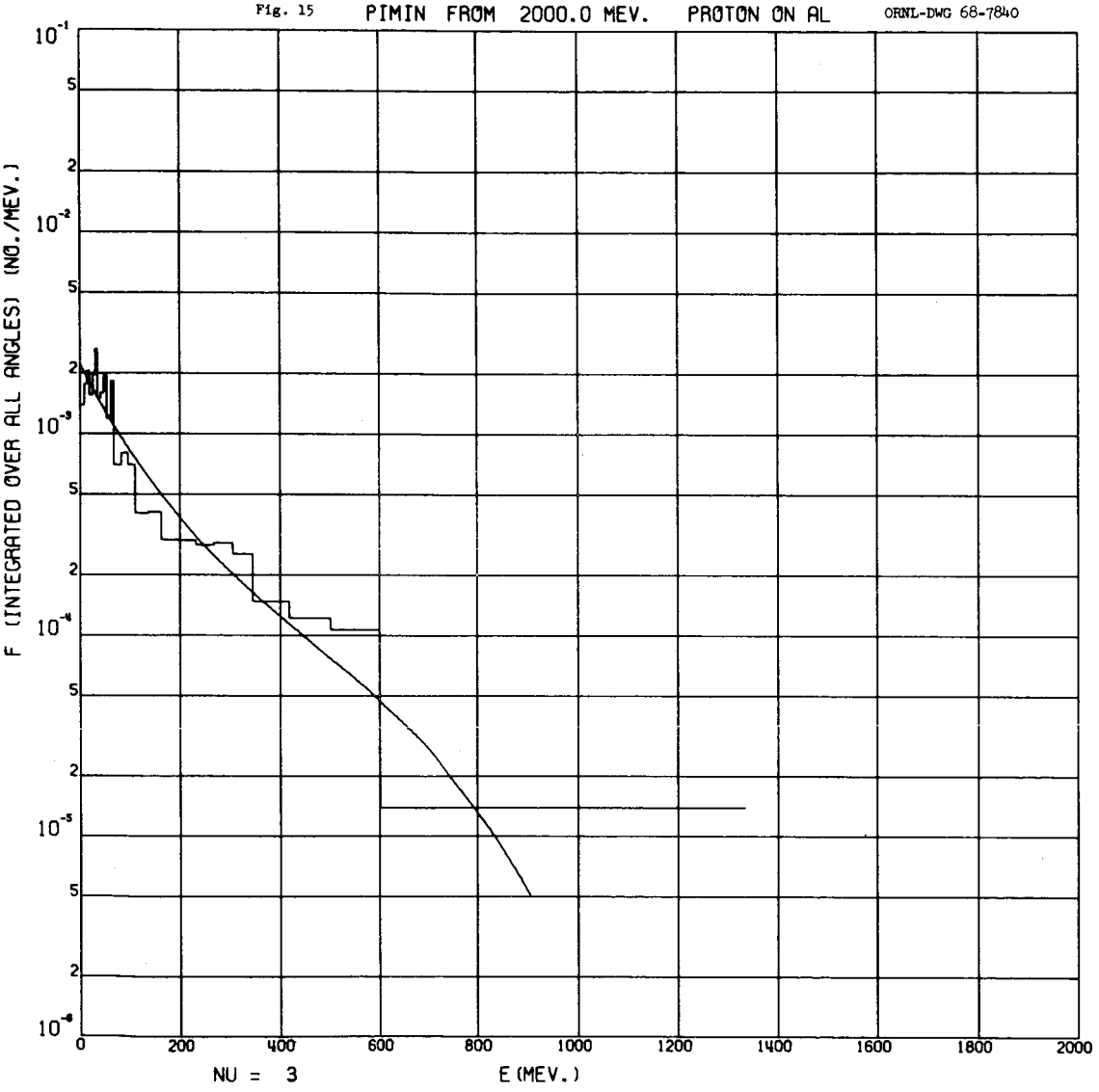


Fig. 16

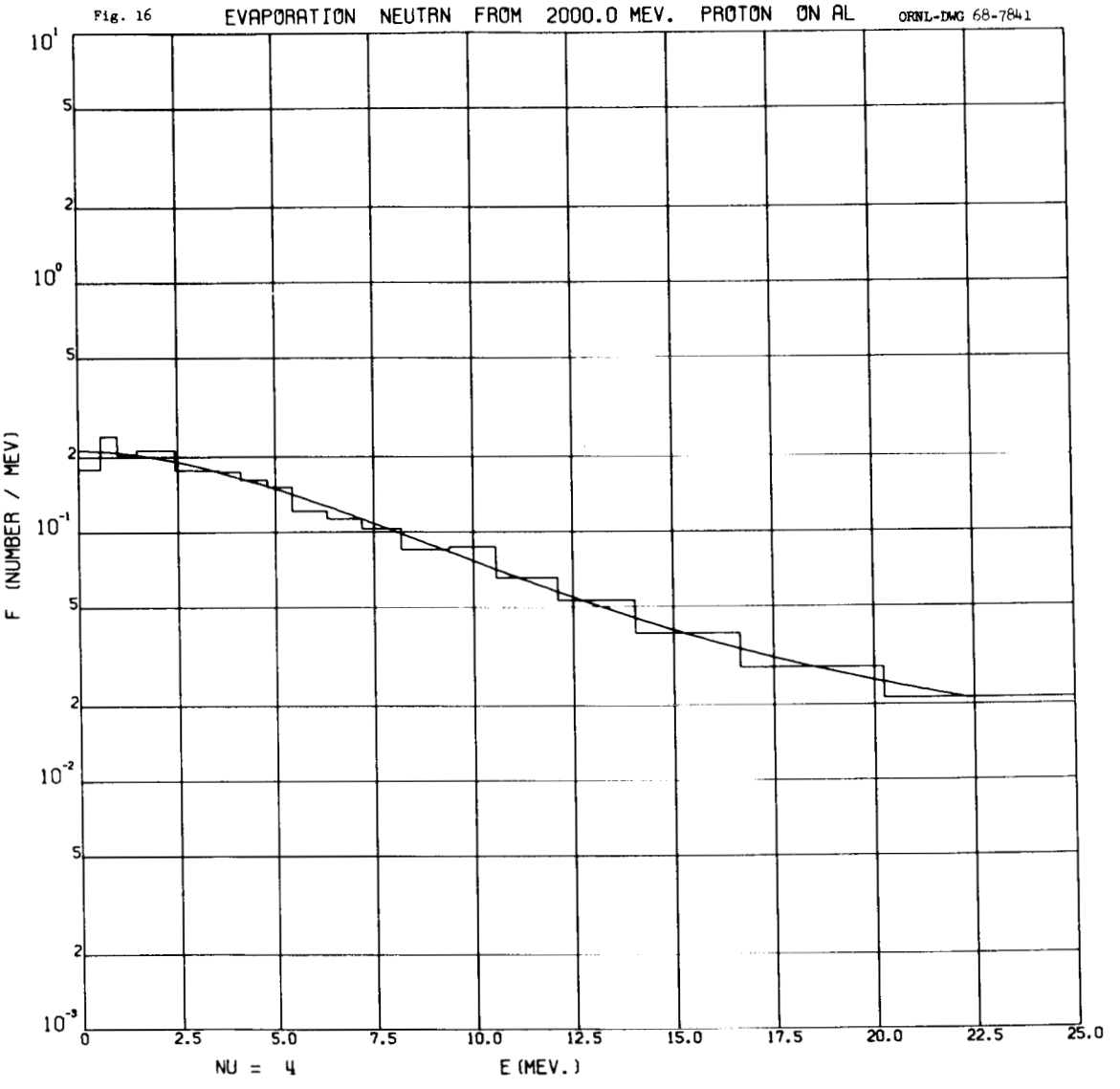
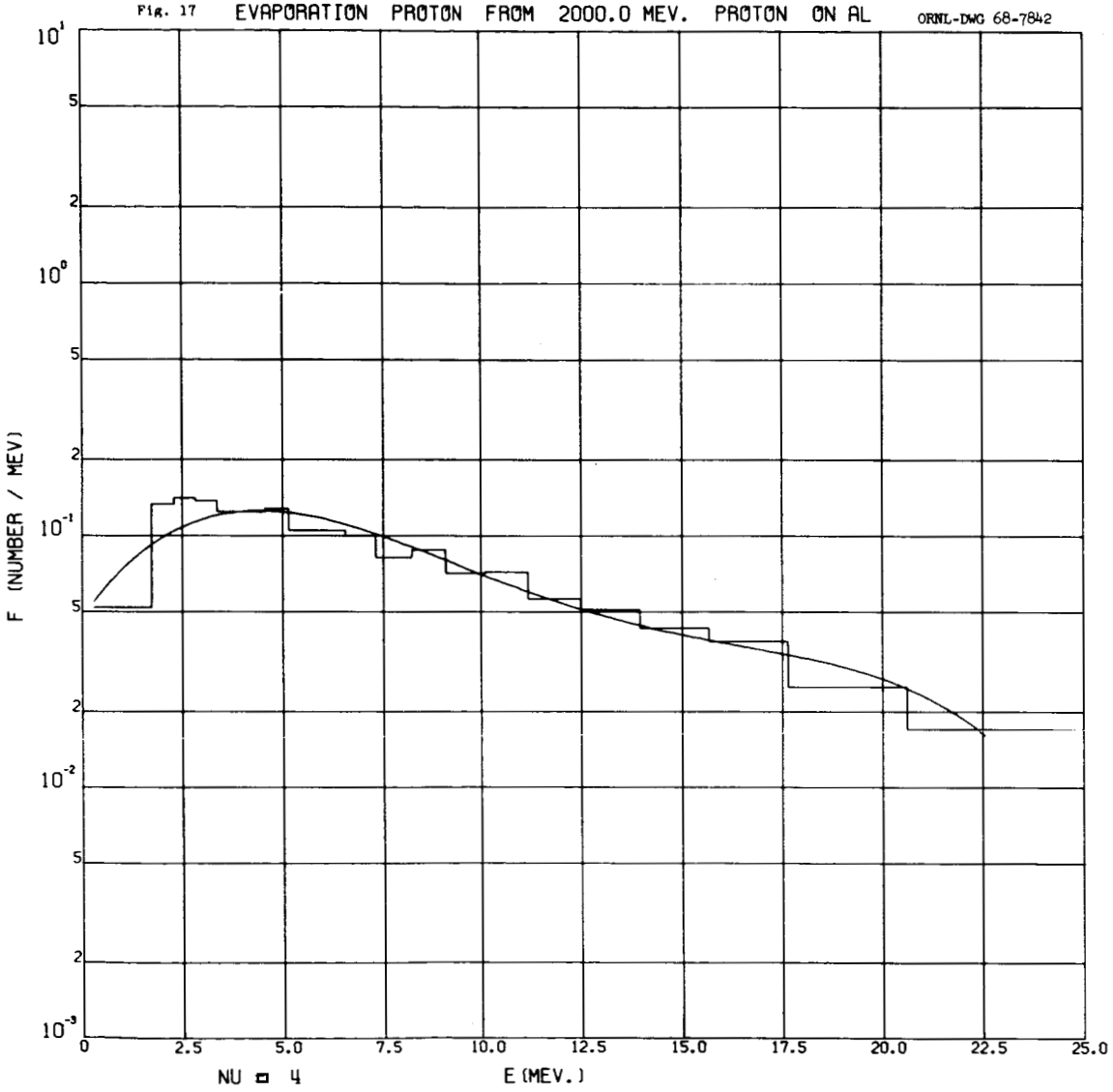

EVAPORATION NEUTRN FROM 2000.0 MEV. PROTON ON AL
ORNL-DWG 68-7841
F (NUMBER / MEV)
E (MEV.)
NU = 4
10^1
10^0
10^-1
10^-2
10^-3
5
2
0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
22.5
25.0

Fig. 17 EVAPORATION PROTON FROM 2000.0 MEV. PROTON ON AL ORNL-DWG 68-7842



Appendix II. TABLES OF COEFFICIENTS FOR EMITTED CASCADE-PARTICLE SPECTRA

Tables 1- 3. 750-MeV Protons on Oxygen.

Tables 4- 6. 1000-MeV Protons on Oxygen.

Tables 7- 9. 2000-MeV Protons on Oxygen.

Tables 10-12. 750-MeV Protons on Aluminum.

Tables 13-15. 1000-MeV Protons on Aluminum.

Tables 16-18. 2000-MeV Protons on Aluminum.

Tables 19-21. 750-MeV Protons on Lead.

Tables 22-24. 1000-MeV Protons on Lead.

Tables 25-27. 2000-MeV Protons on Lead.

Tables 28-30. 1000-MeV Neutrons on Oxygen.

Tables 31-33. 1000-MeV Neutrons on Aluminum.

Tables 34-36. 1000-MeV Neutrons on Lead.

TABLE 1

PROTONS INCIDENT ON O

PROTONS EMITTED

EMIN = 1.107 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
750	0 - 30	5.7587427E-01	-6.2359064E 00	1.0910450E 01	-7.5272527E 00	2.6376630E 00	0.	0.677	0.3346	0.996
	30 - 60	9.3444978E-01	-2.4050696E 01	1.2991689E 02	-3.5276150E 02	4.2871103E 02	-1.9259471E 02	0.629	0.1261	0.803
	60 - 90	1.2454728E 00	-5.8352720E 01	7.0570360E 02	-4.1331173E 03	1.0082113E 04	-8.6478782E 03	0.428	0.0323	0.442
	90 -180	6.6244224E-01	-8.2223399E 01	1.2236904E 03	-1.0402379E 04	4.2218148E 04	-6.8579484E 04	0.266	0.0114	0.214
	0 -180	3.1670833E 00	-2.7665220E 01	1.2456739E 02	-2.9163846E 02	3.1306185E 02	-1.2175353E 02	2.012	0.5103	0.996

NEUTRONS EMITTED

EMIN = 1.107 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
750	0 - 30	5.2812873E-01	-5.9303651E 00	7.5836233E 00	-2.9658293E 00	0.	0.	0.473	0.1858	0.995
	30 - 60	8.5504073E-01	-3.0810093E 01	1.8777101E 02	-5.7966344E 02	7.9969236E 02	-4.0596822E 02	0.414	0.0655	0.747
	60 - 90	4.1431122E-01	-1.9760834E 01	4.7517734E 01	-8.2396983E 01	0.	0.	0.299	0.0225	0.384
	90 -180	4.1305323E-01	-5.9952458E 01	3.0891084E 02	2.3650380E 03	-3.2141415E 04	8.2914493E 04	0.219	0.0084	0.201
	0 -180	2.9593387E 00	-2.8632767E 01	1.1863019E 02	-2.4697925E 02	2.3218397E 02	-7.8961563E 01	1.389	0.2821	0.995

TABLE 2

PROTONS INCIDENT ON O

PI + EMITTED

EMIN = 1.107 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
750	0 - 30	-2.5955324E 00	-6.4219679E-01	-3.1188441E 01	1.8387671E 02	-2.4446132E 02	0.	0.031	0.0083	0.523
	30 - 60	-3.0181521E 00	2.2860550E 00	1.6211647E 02	-1.8087481E 03	6.4797627E 03	-7.7140737E 03	0.058	0.0100	0.394
	60 - 90	-2.8618048E 00	1.4084625E 01	1.4936538E 02	-2.9077651E 03	7.9381022E 03	0.	0.052	0.0044	0.270
	90 -180	-3.0467390E 00	5.5684448E 01	-1.3510847E 03	1.2444022E 04	-4.2196406E 04	0.	0.065	0.0041	0.162
	0 -180	-1.9879017E-01	1.5129653E 01	-1.8262596E 02	5.3094723E 02	-5.1274791E 02	0.	0.218	0.0296	0.523

PI 0 EMITTED

EMIN = 1.107 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
750	0 - 30	-4.6242568E 00	1.3502932E 01	-2.3232376E 01	0.	0.	0.	0.019	0.0050	0.472
	30 - 60	-1.7258687E 00	-5.9693536E 01	7.6336710E 02	-4.5352856E 03	1.2625163E 04	-1.3079309E 04	0.039	0.0076	0.388
	60 - 90	-3.3042505E 00	-6.8325697E 00	1.7586980E 02	-9.0325413E 02	0.	0.	0.021	0.0019	0.212
	90 -180	-2.7863366E 00	1.7558634E 00	-8.2429730E 01	0.	0.	0.	0.041	0.0027	0.204
	0 -180	-2.6410007E-02	-1.2156948E 01	3.9760390E 01	-6.3058491E 01	0.	0.	0.128	0.0181	0.472

TABLE 3

PROTONS INCIDENT ON O

PI - EMITTED

EMIN = 1.107 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
750	0 - 30	0.	0.	0.	0.	0.	0.	0.004		
	30 - 60	0.	0.	0.	0.	0.	0.	0.012		
	60 - 90	0.	0.	0.	0.	0.	0.	0.012		
	90 -180	-3.6793393E 00	-2.5108112E 00	-2.5391101E 01	0.	0.	0.	0.016	0.0009	0.135
	0 -180	-1.6153014E 00	2.5012255E 01	-3.4954807E 02	1.3284648E 03	-1.7424816E 03	0.	0.047	0.0044	0.353

TABLE 4

PROTONS INCIDENT ON O

PROTONS EMITTED

EMIN = 1.107 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	9.3000424E-01	-1.4643368E 01	6.9359835E 01	-1.5854547E 02	1.6348653E 02	-5.9921342E 01	0.738	0.3698	0.996
	30 - 60	1.1360288E 00	-2.9702857E 01	1.9485603E 02	-6.3568378E 02	8.9382873E 02	-4.5295768E 02	0.586	0.0878	0.754
	60 - 90	1.2783310E 00	-5.8449570E 01	8.1464510E 02	-5.5777891E 03	1.5582934E 04	-1.5196201E 04	0.443	0.0286	0.361
	90 -180	1.0455381E 00	-1.0500108E 02	1.8201867E 03	-1.8325023E 04	9.0502225E 04	-1.8039585E 05	0.292	0.0098	0.171
	0 -180	3.2858612E 00	-2.7202007E 01	1.0929046E 02	-2.3581540E 02	2.3697141E 02	-8.6058637E 01	2.080	0.5034	0.996

NEUTRONS EMITTED

EMIN = 1.107 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	9.2927155E-01	-1.0448299E 01	1.8061446E 01	-9.2084073E 00	0.	0.	0.523	0.2139	0.996
	30 - 60	1.0742282E 00	-3.8201614E 01	2.5183663E 02	-7.7649956E 02	1.0232639E 03	-4.8321816E 02	0.418	0.0584	0.731
	60 - 90	1.2426378E 00	-7.1963463E 01	9.8314314E 02	-6.5560327E 03	1.8318281E 04	-1.8171729E 04	0.325	0.0190	0.336
	90 -180	1.0651976E 00	-1.2845478E 02	2.6557430E 03	-3.0330518E 04	1.5786646E 05	-3.0445120E 05	0.244	0.0074	0.185
	0 -180	3.1798144E 00	-2.8377666E 01	8.7021321E 01	-1.1661808E 02	5.4399508E 01	0.	1.503	0.2837	0.996

TABLE 5

PROTONS INCIDENT ON O

PI + EMITTED

EMIN = 1.107 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	-1.7533437E 00	-1.3544739E 01	4.6140690E 01	2.2761876E 01	-1.3293912E 02	0.	0.048	0.0139	0.551
	30 - 60	-2.3589872E 00	-2.2514238E 00	2.6136068E 01	-7.4278283E 01	0.	0.	0.072	0.0127	0.417
	60 - 90	-2.2931472E 00	5.7140486E 00	3.3659569E 01	-1.0152853E 03	2.6892666E 03	0.	0.062	0.0055	0.243
	90 -180	-2.4601677E 00	2.1085781E 01	-2.8625956E 02	3.2000613E 03	-4.0418763E 04	1.2819873E 05	0.084	0.0047	0.147
	0 -180	3.4727667E-01	5.0528980E 00	-1.2109457E 02	4.0688425E 02	-4.1785042E 02	0.	0.266	0.0377	0.551

PI 0 EMITTED

EMIN = 1.107 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	-6.8968019E-01	-6.9555708E 01	7.0935180E 02	-2.9905400E 03	5.6924893E 03	-4.0623036E 03	0.040	0.0100	0.528
	30 - 60	-2.3437361E 00	-3.0834588E 01	4.9575691E 02	-3.2143493E 03	9.0919571E 03	-9.4153064E 03	0.046	0.0081	0.376
	60 - 90	-2.4899084E 00	-3.9872996E 00	-1.7490498E 01	0.	0.	0.	0.032	0.0027	0.237
	90 -180	-2.4662846E 00	1.3393780E 01	-1.8793634E 02	0.	0.	0.	0.065	0.0037	0.165
	0 -180	1.9695472E-01	-2.2133516E 00	-7.1666388E 01	3.0247169E 02	-3.5552014E 02	0.	0.185	0.0266	0.528

TABLE 6

PROTONS INCIDENT ON O

PI - EMITTED

EMIN = 1.107 (MEV)

E0 (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./E0	EMAX /E0
1000	0 - 30	0.	0.	0.	0.	0.	0.	0.013		
	30 - 60	-2.9944035E 00	-3.4879497E 00	-7.1714330E 00	0.	0.	0.	0.018	0.0019	0.282
	60 - 90	-2.4678251E 00	-1.5919838E 01	1.9229663E 01	0.	0.	0.	0.018	0.0013	0.237
	90 -180	-3.9107035E 00	9.0119183E 01	-1.8542345E 03	8.6822350E 03	0.	0.	0.025	0.0010	0.107
	0 -180	-1.3815199E-01	-8.3848231E 00	-2.3493147E 01	5.6942376E 01	0.	0.	0.083	0.0075	0.398

TABLE 7

PROTONS INCIDENT ON O

PROTONS EMITTED

EMIN = 1.107 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
2000	0 - 30	1.7929301E 00	-2.3791770E 01	1.0436282E 02	-2.1291568E 02	1.9292206E 02	-6.1156123E 01	0.862	0.3883	0.998
	30 - 60	1.9505621E 00	-4.9561595E 01	3.4813173E 02	-1.2237218E 03	1.8961129E 03	-1.0679777E 03	0.615	0.0550	0.635
	60 - 90	1.7018911E 00	-3.1983612E 01	1.2859027E 01	1.7806588E 01	0.	0.	0.545	0.0183	0.227
	90 -180	2.1055411E 00	-2.3616341E 02	8.6862599E 03	-1.5579972E 05	1.2057280E 06	-3.3637730E 06	0.423	0.0084	0.112
	0 -180	4.1211590E 00	-4.4294341E 01	1.9449351E 02	-4.1433765E 02	4.0130625E 02	-1.4048515E 02	2.483	0.4734	0.998

NEUTRONS EMITTED

EMIN = 1.107 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
2000	0 - 30	1.3193858E 00	-1.1547491E 01	1.8381568E 01	-8.6194290E 00	0.	0.	0.615	0.2279	0.994
	30 - 60	1.8808465E 00	-5.2688826E 01	3.9318604E 02	-1.4204923E 03	2.2125306E 03	-1.2457305E 03	0.550	0.0461	0.558
	60 - 90	2.0532453E 00	-1.1474534E 02	2.5170662E 03	-2.7554885E 04	1.2477975E 05	-1.9863736E 05	0.437	0.0144	0.217
	90 -180	1.6433617E 00	-1.0815520E 02	1.1276945E 03	-5.5774097E 03	0.	0.	0.381	0.0067	0.113
	0 -180	4.0285355E 00	-4.6190720E 01	2.0058883E 02	-4.1613123E 02	3.9231584E 02	-1.3490368E 02	2.016	0.2986	0.994

TABLE 8

PROTONS INCIDENT ON O

PI + EMITTED

EMIN = 1.107 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
2000	0 - 30	-1.9182890E 00	2.7355421E 00	7.0596465E 01	-4.3765910E 02	8.3336390E 02	-5.6600311E 02	0.117	0.0282	0.585
	30 - 60	-1.0744575E 00	-1.3297254E 01	1.5948433E 02	-7.6229913E 02	9.6133529E 02	0.	0.125	0.0147	0.360
	60 - 90	-1.4141432E 00	3.1692666E 01	-9.8548985E 02	7.5054518E 03	-1.8395428E 04	0.	0.087	0.0054	0.225
	90 -180	-1.6438019E 00	4.4472091E 01	-2.1947017E 03	1.8[illegible]11128E 04	-8.2865655E 04	0.	0.104	0.0030	0.138
	0 -180	1.5863077E 00	-2.1001[illegible]43E 01	1.0562956E 02	-2.8360350E 02	2.3387282E 02	0.	0.428	0.0496	0.585

PI 0 EMITTED

EMIN = 1.107 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
2000	0 - 30	-2.3259726E 00	1.6587709E 01	-1.1146129E 02	3.9050762E 02	-6.5925456E 02	3.5352555E 02	0.088	0.0205	0.540
	30 - 60	-1.0186979E 00	-1.7768639E 01	1.5226789E 02	-6.0325443E 02	8.9358313E 02	-9.5723952E 02	0.098	0.0106	0.329
	60 - 90	-1.5655374E 00	9.5405[illegible]E 00	-4.2676281E 02	3.2192625E 03	-8.3863794E 03	0.	0.064	0.0040	0.197
	90 -180	-1.8640278E 00	4.8551182E 01	-1.0916349E 03	-1.2726170E 04	3.0761385E 05	-1.[illegible]4283297E 06	0.076	0.0024	0.133
	0 -180	1.3155729E 00	-1.9828364E 01	9.4477222E 01	-2.6511799E 02	2.3139515E 02	0.	0.322	0.0352	0.540

TABLE 9

PROTONS INCIDENT ON O

PI - EMITTED

EMIN = 1.107 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
2000	0 - 30	-1.9917884E 00	7.3997813E 00	-4.4952655E 01	9.6868122E 01	-1.1049154E 02	0.	0.053	0.0096	0.439
	30 - 60	-5.5396301E-01	-7.1673455E 01	1.0520397E 03	-6.4994717E 03	1.7035598E 04	-1.6294024E 04	0.067	0.0064	0.292
	60 - 90	-1.7644731E 00	1.0667140E 01	-4.4498612E 02	-1.3965950E 02	2.7604825E 04	-1.0805211E 05	0.036	0.0015	0.145
	90 -180	-1.4233142E 00	-7.7113063E 00	-2.8279774E 02	0.	0.	0.	0.062	0.0018	0.108
	0 -180	1.3170341E 00	-2.9276791E 01	1.5923350E 02	-4.7514138E 02	4.7460237E 02	0.	0.221	0.0196	0.039

TABLE 10

PROTONS INCIDENT ON AL

PROTONS EMITTED

EMIN = 1.037 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
750	0 - 30	8.7614298E-01	-9.8334508E 00	2.3044578E 01	-2.3187945E 01	9.2638513E 00	0.	0.654	0.3029	0.996
	30 - 60	1.1486385E 00	-2.9791099E 01	1.7995195E 02	-5.2212939E 02	6.6680772E 02	-3.1143216E 02	0.642	0.1210	0.820
	60 - 90	1.2501521E 00	-5.0748404E 01	5.6666756E 02	-3.1949707E 03	7.5277705E 03	-6.2522314E 03	0.466	0.0362	0.442
	90 -180	9.6196672E-01	-8.8747725E 01	1.1578421E 03	-7.8470677E 03	2.3477348E 04	-2.5723654E 04	0.304	0.0133	0.224
	0 -180	3.3208568E 00	-2.9148923E 01	1.3344563E 02	-3.1786366E 02	3.4569958E 02	-1.3601880E 02	2.091	0.4846	0.996

NEUTRONS EMITTED

EMIN = 1.437 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
750	0 - 30	7.1421227E-01	-7.6325758E 00	1.1231351E 01	-5.3369831E 00	0.	0.	0.466	0.1730	0.992
	30 - 60	1.2569086E 00	-3.6142583E 01	2.2825047E 02	-7.0010493E 02	9.3673736E 02	-4.5095001E 02	0.513	0.0790	0.783
	60 - 90	1.3636944E 00	-7.1020365E 01	8.3923602E 02	-4.6242051E 03	1.0619819E 04	-8.6104711E 03	0.364	0.0257	0.439
	90 -180	9.4280130E-01	-9.7110478E 01	1.5522728E 03	-1.2996218E 04	4.6648287E 04	-5.9648287E 04	0.282	0.0113	0.249
	0 -180	3.0089561E 00	-1.7655345E 01	2.7712955E 01	-1.4455623E 01	0.	0.	1.686	0.3094	0.992

TABLE 11

PROTONS INCIDENT ON AL

PI + EMITTED

EMIN = 1.637 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
750	0 - 30	-1.5077101E 00	-3.6336803E 01	2.2617868E 02	-5.4669105E 02	6.1498597E 02	-3.2422546E 02	0.028	0.0074	0.529
	30 - 60	-3.4212430E 00	1.0199837E 01	-4.4713776E 01	4.5832775E 01	0.	0.	0.046	0.0087	0.406
	60 - 90	-3.3084653E 00	4.1736881E 01	-6.1721169E 02	3.3547737E 03	-8.1247165E 03	6.9757938E 03	0.043	0.0046	0.299
	90 -180	-2.2415990E 00	-2.4877641E 01	1.5741047E 03	-2.7309019E 04	1.7190248E 05	-3.7349584E 05	0.079	0.0049	0.191
	0 -180	6.5537106E-02	4.7268789E 00	-1.1223403E 02	3.6342717E 02	-3.8001768E 02	0.	0.199	0.0274	0.529

PI 0 EMITTED

EMIN = 1.637 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
750	0 - 30	-3.9870690E 00	6.0191544E 00	-9.6870339E 00	2.3339484E 00	0.	0.	0.019	0.0057	0.549
	30 - 60	-4.0244156E 00	1.9121247E 01	-1.7339328E 02	5.4650346E 02	-5.9399830E 02	0.	0.023	0.0043	0.432
	60 - 90	-3.0766799E 00	6.1046585E 00	9.0272809E 01	-1.5503776E 03	3.8839611E 03	0.	0.032	0.0028	0.241
	90 -180	-4.0994256E 00	7.6450058E 01	-1.0437356E 03	3.3115574E 03	0.	0.	0.041	0.0024	0.155
	0 -180	8.0473031E-02	-9.9947281E 00	7.3697235E 00	0.	0.	0.	0.127	0.0171	0.549

TABLE 12

PROTONS INCIDENT ON AL

PI - EMITTED

EMIN = 1.637 (MEV)

E0 (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./E0	EMAX /E0
750	0 - 30	0.	0.	0.	0.	0.	0.	0.008		
	30 - 60	0.	0.	0.	0.	0.	0.	0.008		
	60 - 90	-3.2824239E 00	-1.4836825E 00	-3.8202471E 01	0.	0.	0.	0.014	0.0010	0.204
	90 -180	-4.1193862E 00	3.4695233E 01	-4.3551711E 02	0.	0.	0.	0.014	0.0007	0.102
	0 -180	-1.0187519E 00	-2.5599580E 00	-6.3013956E 01	2.6108424E 02	-3.8195524E 02	0.	0.046	0.0046	0.362

TABLE 13

PROTONS INCIDENT ON AL

PROTONS EMITTED

EMIN = 1.637 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	1.4488230E 00	-2.4071738E 01	1.3075043E 02	-3.2588646E 02	3.5759680E 02	-1.3985135E 02	0.715	0.3190	0.996
	30 - 60	1.5084139E 00	-3.6227553E 01	2.4648327E 02	-8.3560296E 02	1.2383233E 03	-6.6279619E 02	0.652	0.0885	0.717
	60 - 90	1.1469920E 00	-2.0927016E 01	1.7167346E 01	-2.8157429E 01	0.	0.	0.489	0.0268	0.363
	90 -180	1.6843157E 00	-1.4571555E 02	3.2843696E 03	-3.7432989E 04	1.8828225E 05	-3.4361725E 05	0.417	0.0143	0.203
	0 -180	3.7060201E 00	-3.4225995E 01	1.5594857E 02	-3.7123308E 02	4.0491518E 02	-1.5955936E 02	2.315	0.4627	0.996

NEUTRONS EMITTED

EMIN = 1.637 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	1.0381815E 00	-9.9177748E 00	1.6060677E 01	-8.1100067E 00	0.	0.	0.530	0.1936	0.992
	30 - 60	1.0848139E 00	-1.6334031E 01	2.7491547E 01	-2.0428980E 01	0.	0.	0.565	0.0708	0.775
	60 - 90	1.2891675E 00	-2.9576626E 01	7.3852816E 01	-1.1822094E 02	0.	0.	0.453	0.0236	0.367
	90 -180	1.4321511E 00	-1.2161980E 02	2.2056696E 03	-2.0889078E 04	8.4450798E 04	-1.2091497E 05	0.347	0.0107	0.213
	0 -180	3.3800947E 00	-2.1215438E 01	3.5040036E 01	-1.8486694E 01	0.	0.	1.968	0.3242	0.992

TABLE 14

PROTONS INCIDENT ON AL

PI + EMITTED

EMIN = 1.637 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	-1.8597297E 00	-1.8008235E 01	6.6171494E 01	9.1873838E 01	-5.3123647E 02	4.3293849E 02	0.046	0.0140	0.562
	30 - 60	-2.2439009E 00	5.9381889E 00	-1.1586582E 02	5.2328320E 02	-7.3840286E 02	0.	0.069	0.0117	0.427
	60 - 90	-2.0883015E 00	8.1909555E 00	-1.2192357E 02	1.9143192E 02	0.	0.	0.060	0.0049	0.259
	90 -180	-2.4337168E 00	4.1490897E 01	-6.6709449E 02	1.8435027E 03	0.	0.	0.086	0.0044	0.191
	0 -180	6.8908805E-01	-2.7170262E 00	-6.9518902E 01	2.6300099E 02	-2.7751566E 02	0.	0.271	0.0361	0.562

PI 0 EMITTED

EMIN = 1.637 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	-2.4431174E 00	-8.1963598E 00	3.2567164E 01	-5.0193840E 00	-6.7261850E 01	0.	0.027	0.0071	0.529
	30 - 60	-2.4679024E 00	-1.7066838E 00	-3.4052780E 00	-2.1268089E 01	0.	0.	0.040	0.0055	0.401
	60 - 90	-2.6882749E 00	1.6266594E 01	-3.7262022E 02	2.1179789E 03	-3.9739152E 03	0.	0.035	0.0033	0.272
	90 -180	-2.6384385E 00	-1.0812510E 01	1.9819086E 03	-5.1013216E 04	4.5759754E 05	-1.3899441E 06	0.063	0.0036	0.145
	0 -180	1.8415409E-01	-1.1964406E 00	-7.7072712E 01	2.6147410E 02	-2.5751007E 02	0.	0.167	0.0211	0.554

TABLE 15

PROTONS INCIDENT ON AL

PI - EMITTED

EMIN = 1.637 (MEV)

E0 (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./E0	EMAX /E0
1000	0 - 30	0.	0.	0.	0.	0.	0.	0.014		
	30 - 60	-2.4189447E 00	-1.7926164E 01	5.9983856E 01	-7.0301424E 01	0.	0.	0.019	0.0023	0.339
	60 - 90	-2.7489742E 00	-3.6570388E 00	-9.7997479E 01	3.2472303E 02	0.	0.	0.018	0.0012	0.213
	90 -180	-2.8213884E 00	2.3188947E 01	-6.2925435E 02	2.4022069E 03	0.	0.	0.031	0.0013	0.115
	0 -180	-3.3043580E-02	-5.6080062E 00	-9.8327874E 01	4.5290537E 02	-5.7351910E 02	0.	0.088	0.0080	0.423

TABLE 16

PROTONS INCIDENT ON AL

PROTONS EMITTED

EMIN = 1.637 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
2000	0 - 30	2.1222507E 00	-2.6930363E 01	1.2218884E 02	-2.6363259E 02	2.5675601E 02	-8.9743598E 01	0.910	0.3635	0.998
	30 - 60	2.1653918E 00	-4.8524258E 01	3.5465527E 02	-1.3420120E 03	2.1607100E 03	-1.2285291E 03	0.735	0.0545	0.648
	60 - 90	2.0448664E 00	-3.8528455E 01	4.5787752E 01	-5.7408835E 01	0.	0.	0.652	0.0197	0.245
	90 -180	2.4296058E 00	-2.3204999E 02	8.3815005E 03	-1.4780574E 05	1.0867223E 06	-2.8098102E 06	0.551	0.0101	0.112
	0 -180	4.0917209E 00	-2.7056697E 01	4.5038656E 01	-2.1914957E 01	0.	0.	3.073	0.5174	0.998

NEUTRONS EMITTED

EMIN = 1.637 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
2000	0 - 30	1.7064936E 00	-1.4513476E 01	2.4557876E 01	-1.2594362E 01	0.	0.	0.657	0.2109	0.995
	30 - 60	1.9952131E 00	-3.0032557E 01	8.2012030E 01	-9.3167716E 01	0.	0.	0.748	0.0523	0.540
	60 - 90	2.1841919E 00	-5.1080949E 01	1.9292216E 02	-4.0855449E 02	0.	0.	0.638	0.0194	0.239
	90 -180	2.1402629E 00	-1.1528360E 02	1.1427496E 03	-4.9155014E 03	0.	0.	0.564	0.0098	0.122
	0 -180	3.8773268E 00	-1.8883641E 01	1.5041771E 01	0.	0.	0.	2.950	0.3037	0.995

TABLE 17

PROTONS INCIDENT ON AL

PI + EMITTED

EMIN = 1.637 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
2000	0 - 30	-9.2657664E-01	-2.0061530E 01	2.4210466E 02	-1.0074856E 03	1.7188748E 03	-1.0868923E 03	0.114	0.0255	0.562
	30 - 60	-7.7988154E-01	-1.9273831E 01	1.8953277E 02	-1.0830379E 03	2.9046991E 03	-3.1766002E 03	0.124	0.0148	0.389
	60 - 90	-1.3826272E 00	5.2186251E 01	-1.9635418E 03	2.3100445E 04	-1.2044067E 05	2.2567094E 05	0.083	0.0041	0.194
	90 -180	-1.1612849E 00	3.0761102E 01	-6.9633936E 02	-1.6735892E 04	2.9914645E 05	-1.2263512E 06	0.116	0.0034	0.123
	0 -180	1.9299275E 00	-2.9770912E 01	1.5728401E 02	-4.0052417E 02	3.2278365E 02	0.	0.434	0.0454	0.562

PI 0 EMITTED

EMIN = 1.637 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
2000	0 - 30	-1.2512234E 00	-2.1855364E 01	2.6680008E 02	-1.0886576E 03	1.7922612E 03	-1.0814017E 03	0.086	0.0192	0.575
	30 - 60	-6.2283406E-01	-5.2858899E 01	8.1244543E 02	-5.4466373E 03	1.5515708E 04	-1.5900313E 04	0.091	0.0103	0.374
	60 - 90	-1.1382335E 00	3.0408068E 01	-9.2253081E 02	3.4791243E 03	2.2155800E 04	-1.2165960E 05	0.084	0.0038	0.180
	90 -180	-1.0756783E 00	-5.3228433E 00	-2.6011329E 02	0.	0.	0.	0.097	0.0031	0.128
	0 -180	1.5178793E 00	-1.8035291E 01	3.9043111E 01	-4.3648278E 01	0.	0.	0.345	0.0350	0.575

TABLE 18

PROTONS INCIDENT ON AL

PI - EMITTED

EMIN = 1.637 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
2000	0 - 30	-5.5012189E-01	-6.8032046E 01	9.2832297E 02	-4.9771512E 03	1.1566890E 04	-9.8958281E 03	0.053	0.0095	0.453
	30 - 60	-6.5067217E-01	-3.5320431E 01	4.5663878E 02	-3.3213061E 03	1.0695943E 04	-1.2539857E 04	0.084	0.0078	0.340
	60 - 90	-1.5920752E 00	3.4739131E 01	-2.0563495E 03	3.1173610E 04	-1.9939108E 05	4.5123039E 05	0.047	0.0022	0.161
	90 -180	-1.6297555E 00	5.5335178E 01	-7.7764912E 02	-5.1428308E 04	9.4591475E 05	-4.3475325E 06	0.081	0.0022	0.117
	0 -180	1.4900478E 00	-2.2319739E 01	5.5254605E 01	-7.8865370E 01	0.	0.	0.258	0.0193	0.453

TABLE 19

PROTONS INCIDENT ON PB

PROTONS EMITTED

EMIN = 6.683 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
750	0 - 30	1.0429364E 00	-1.1360694E 01	1.7368878E 01	-7.7850910E 00	0.	0.	0.437	0.1650	0.993
	30 - 60	1.5417430E 00	-3.9669948E 01	2.3662448E 02	-6.6107979E 02	8.0894606E 02	-3.6063361E 02	0.544	0.0924	0.809
	60 - 90	9.7743026E-01	-1.9552676E 01	3.1638083E 01	-2.8347761E 01	0.	0.	0.458	0.0403	0.473
	90 -180	1.0380614E 00	-4.5745992E 01	1.5539922E 02	-2.5954811E 02	0.	0.	0.345	0.0159	0.283
	0 -180	3.2504197E 00	-1.8230726E 01	2.7312984E 01	-1.3492298E 01	0.	0.	1.826	0.3315	0.993

NEUTRONS EMITTED

EMIN = 6.683 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
750	0 - 30	2.2164950E 00	-3.1738829E 01	1.3703264E 02	-2.8672182E 02	2.6924763E 02	-9.1537572E 01	0.466	0.1079	0.991
	30 - 60	1.7991437E 00	-2.0376294E 01	3.5509235E 01	-2.3747639E 01	0.	0.	0.811	0.0998	0.816
	60 - 90	2.3514574E 00	-6.7382443E 01	6.4749441E 02	-3.3134093E 03	7.4666744E 03	-6.0396463E 03	0.639	0.0454	0.474
	90 -180	1.5772637E 00	-4.9806342E 01	1.9858155E 02	-3.9967089E 02	0.	0.	0.542	0.0241	0.282
	0 -180	3.9439979E 00	-2.2327061E 01	3.2856568E 01	-1.6344397E 01	0.	0.	2.527	0.2969	0.991

TABLE 20

PROTONS INCIDENT ON PB

PI + EMITTED

EMIN = 6.683 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
750	0 - 30	-4.0874265E 00	7.9036100E 00	-1.3233839E 01	0.	0.	0.	0.017	0.0044	0.470
	30 - 60	-2.7044069E 00	-7.6010407E 00	-6.8080676E 01	5.8152121E 02	-1.0563774E 03	0.	0.019	0.0026	0.340
	60 - 90	-3.0442339E 00	4.0311890E 01	-6.8116832E 02	3.5609704E 03	-6.6871681E 03	0.	0.033	0.0026	0.247
	90 -180	-2.2436558E 00	4.4574659E 00	-1.4786104E 02	0.	0.	0.	0.054	0.0031	0.187
	0 -180	7.1827427E-01	-1.8874338E 01	4.3518583E 01	-4.5829445E 01	0.	0.	0.138	0.0155	0.470

PI 0 EMITTED

EMIN = 6.683 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
750	0 - 30	0.	0.	0.	0.	0.	0.	0.008		
	30 - 60	-1.9327213E 00	-2.8110186E 01	1.3637003E 02	-2.1151729E 02	-7.4548961E 01	0.	0.021	0.0024	0.346
	60 - 90	-2.2161002E 00	-1.8734545E 01	9.7604002E 01	-3.2758130E 02	0.	0.	0.021	0.0015	0.182
	90 -180	-2.1173029E 00	-1.5090704E 01	6.3488277E 02	-1.2164037E 04	7.6383103E 04	-1.5734147E 05	0.054	0.0032	0.171
	0 -180	4.3417718E-01	-1.2423366E 01	-1.3411551E 01	5.1048855E 01	0.	0.	0.109	0.0103	0.456

TABLE 21

PROTONS INCIDENT ON PB

PI - EMITTED

EMIN = 6.683 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
750	0 - 30	0.	0.	0.	0.	0.	0.	0.006		
	30 - 60	0.	0.	0.	0.	0.	0.	0.010		
	60 - 90	-2.5385334E 00	1.1699031E 01	-4.2513564E 02	0.	0.	0.	0.012	0.0005	0.115
	90 -180	-1.8266850E 00	-3.0687492E 01	2.0938882E 02	-1.0775089E 03	0.	0.	0.030	0.0012	0.123
	0 -180	5.6702099E-01	-2.7272059E 01	4.1802942E 01	0.	0.	0.	0.062	0.0040	0.321

TABLE 22

PROTONS INCIDENT ON PB

PROTONS EMITTED

EMIN = 6.683 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	1.6244923E 00	-1.9913944E 01	5.7341263E 01	-7.2539430E 01	3.3302481E 01	0.	0.509	0.1754	0.992
	30 - 60	1.7411352E 00	-3.9642277E 01	2.5743263E 02	-8.3154280E 02	1.1660450E 03	-5.8879835E 02	0.615	0.0774	0.724
	60 - 90	2.1972686E 00	-7.8587220E 01	8.9483854E 02	-5.2345152E 03	1.3325086E 04	-1.2279665E 04	0.507	0.0303	0.369
	90 -180	1.5560242E 00	-6.1250581E 01	2.9029354E 02	-6.9822601E 02	0.	0.	0.436	0.0152	0.217
	0 -180	3.4100501E 00	-1.5461004E 01	1.1738997E 01	0.	0.	0.	2.170	0.2949	0.992

NEUTRONS EMITTED

EMIN = 6.683 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	2.4752155E 00	-3.2746528E 01	1.3640816E 02	-2.7352085E 02	2.4793353E 02	-8.1759547E 01	0.584	0.1326	0.987
	30 - 60	2.5350715E 00	-4.8721188E 01	3.0562807E 02	-9.6773900E 02	1.3496013E 03	-6.7858590E 02	0.889	0.0892	0.740
	60 - 90	2.2999766E 00	-4.1148373E 01	1.4252838E 02	-2.3215511E 02	0.	0.	0.790	0.0408	0.348
	90 -180	2.7514898E 00	-1.3416319E 02	2.3270781E 03	-2.3117949E 04	1.0311128E 05	-1.6663734E 05	0.704	0.0228	0.205
	0 -180	4.0583159E 00	-1.8403968E 01	1.3554612E 01	0.	0.	0.	3.201	0.2992	0.987

TABLE 23

PROTONS INCIDENT ON PB

PI • EMITTED

EMIN = 6.683 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	-2.1619149E 00	-8.3435427E 00	1.4756701E 01	0.	0.	0.	0.019	0.0041	0.472
	30 - 60	-1.6628426E 00	-3.9128290E 01	2.7383713E 02	-4.4777437E 02	-4.9970520E 02	0.	0.031	0.0040	0.300
	60 - 90	-9.5158092E-01	-9.8435767E 01	2.6173521E 03	-3.1951520E 04	1.6999349E 05	-3.2667007E 05	0.040	0.0030	0.222
	90 -180	-1.6270003E 00	1.8635922E 01	-6.5834301E 02	3.8448012E 03	-9.4827855E 03	0.	0.084	0.0037	0.167
	0 -180	1.1590744E 00	-2.0310374E 01	3.8646666E 01	-4.4377031E 01	2.9856836E 01	0.	0.184	0.0175	0.480

PI 0 EMITTED

EMIN = 6.683 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	0.	0.	0.	0.	0.	0.	0.017		
	30 - 60	-1.9310772E 00	-2.1440647E 01	1.1608512E 02	-2.1340768E 02	0.	0.	0.034	0.0046	0.381
	60 - 90	-2.6876299E 00	4.4025521E 01	-8.9350513E 02	4.9229668E 03	-8.7827801E 03	0.	0.034	0.0022	0.194
	90 -180	-1.6567174E 00	1.4475023E 01	-5.5209308E 02	2.0895012E 03	0.	0.	0.075	0.0033	0.153
	0 -180	9.4939816E-01	-1.3618647E 01	-3.6622950E 01	2.2040305E 02	-2.6168305E 02	0.	0.167	0.0151	0.469

TABLE 24

PROTONS INCIDENT ON PB

PI - EMITTED

EMIN = 6.683 (MEV)

E0 (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./E0	EMAX /E0
1000	0 - 30	0.	0.	0.	0.	0.	0.	0.016		
	30 - 60	-1.9905555E 00	-1.9297416E 01	3.1227146E 01	0.	0.	0.	0.019	0.0016	0.319
	60 - 90	-1.5002733E 00	-1.9279507E 01	-8.3523490E 01	0.	0.	0.	0.023	0.0009	0.116
	90 -180	-2.1570440E 00	7.9750573E 01	-3.7819668E 03	5.0259508E 00	-2.3212900E 05	0.	0.047	0.0016	0.109
	0 -180	1.3126617E 00	-3.0620765E 01	5.0917990E 01	3.3118563E 02	-8.7037574E 02	0.	0.118	0.0085	0.376

TABLE 25

PROTONS INCIDENT ON PB

PROTONS EMITTED

EMIN = 6.683 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
2000	0 - 30	2.5977073E 00	-3.3531134E 01	1.3589087E 02	-2.6498299E 02	2.3248332E 02	-7.2115424E 01	0.711	0.1955	0.997
	30 - 60	2.3941690E 00	-3.0378097E 01	5.9632415E 01	-4.5522770E 01	0.	0.	0.932	0.0580	0.646
	60 - 90	3.2504679E 00	-1.4315348E 02	2.8602308E 03	-2.9592474E 04	1.3268491E 05	-2.1323236E 05	0.780	0.0245	0.226
	90 -180	2.5640121E 00	-1.0166727E 02	7.5362518E 02	-3.2818035E 03	0.	0.	0.732	0.0136	0.122
	0 -180	4.3402460E 00	-2.3218413E 01	1.9278711E 01	0.	0.	0.	3.502	0.3040	0.997

NEUTRONS EMITTED

EMIN = 6.683 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
2000	0 - 30	2.8899666E 00	-2.3154037E 01	4.0994360E 01	-2.2364495E 01	0.	0.	0.947	0.1790	0.984
	30 - 60	3.2175172E 00	-4.1666415E 01	1.1044388E 02	-1.0984025E 02	0.	0.	1.506	0.0732	0.538
	60 - 90	3.2849580E 00	-6.1543366E 01	1.9940115E 02	-2.9303095E 02	0.	0.	1.309	0.0348	0.249
	90 -180	3.1638876E 00	-1.0240140E 02	6.5560288E 02	-2.3321815E 03	0.	0.	1.276	0.0227	0.128
	0 -180	4.9434873E 00	-2.4555237E 01	1.8988879E 01	0.	0.	0.	5.777	0.3436	0.984

TABLE 26

PROTONS INCIDENT ON PB

PI + EMITTED

EMIN = 6.683 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
2000	0 - 30	-4.1624284E-01	-9.5744436E 01	1.1856516E 03	-5.6421781E 03	1.1650385E 04	-8.8253497E 03	0.054	0.0125	0.482
	30 - 60	-7.9976069E-02	-7.0168485E 01	9.4235965E 02	-6.0252842E 03	1.9041501E 04	-2.5322056E 04	0.088	0.0084	0.297
	60 - 90	-2.1624649E-01	-6.0622150E 01	6.6744816E 02	-4.2997817E 03	9.4610370E 03	0.	0.062	0.0027	0.190
	90 -180	-4.4762862E-01	3.4111871E 01	-2.5499160E 03	2.7973994E 04	-9.2412721E 04	0.	0.144	0.0040	0.137
	0 -180	2.5781835E 00	-6.0441563E 01	4.7461340E 02	-1.8362741E 03	3.3026975E 03	-2.1734691E 03	0.358	0.0282	0.482

PI 0 EMITTED

EMIN = 6.683 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
2000	0 - 30	4.3013424E-01	-9.3178850E 01	1.0281768E 03	-4.3816677E 03	7.7454134E 03	-4.7917538E 03	0.057	0.0092	0.414
	30 - 60	-4.9794284E-01	-2.7741746E 01	-9.6616671E 01	2.7826162E 03	-1.1945403E 04	1.3885716E 04	0.077	0.0072	0.318
	60 - 90	-7.5157622E-01	2.7746962E 01	-2.0465840E 03	2.5408373E 04	-9.5795009E 04	0.	0.072	0.0028	0.130
	90 -180	-5.2078187E-01	6.9706072E 01	-5.1484988E 03	8.4294052E 04	-5.3511691E 05	1.0077403E 06	0.136	0.0033	0.131
	0 -180	2.3776005E 00	-4.0099546E 01	1.5311829E 02	-2.2066175E 02	0.	0.	0.352	0.0238	0.424

TABLE 27

PROTONS INCIDENT ON PB

PI - EMITTED

EMIN = 6.683 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
2000	0 - 30	3.6963215E-01	-1.3755367E 02	1.8388200E 03	-9.5080214E 03	2.1034741E 04	-1.6922957E 04	0.041	0.0065	0.385
	30 - 60	3.5564170E-02	-8.0023564E 01	1.0184268E 03	-5.3094192E 03	8.9709959E 03	0.	0.067	0.0048	0.250
	60 - 90	-6.9969780E-01	4.4093151E 01	-3.7734208E 03	6.4185907E 04	-4.3789461E 05	1.0477448E 06	0.060	0.0019	0.143
	90 -180	-4.8164451E-01	3.2462500E 01	-2.1406636E 03	1.3022831E 04	0.	0.	0.126	0.0027	0.100
	0 -180	2.3970656E 00	-4.5575657E 01	1.8735072E 02	-2.9086886E 02	0.	0.	0.303	0.0176	0.385

TABLE 28

NEUTRONS INCIDENT ON O

PROTONS EMITTED

EMIN = 1.107 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	9.4352756E-01	-1.0448481E 01	1.9140787E 01	-1.0675428E 01	0.	0.	0.526	0.2057	0.991
	30 - 60	9.5846633E-01	-3.0605687E 01	1.8604523E 02	-5.6487558E 02	7.2512500E 02	-3.3324434E 02	0.425	0.0545	0.696
	60 - 90	1.2229121E 00	-7.6431530E 01	1.2965402E 03	-1.0662464E 04	3.6537184E 04	-4.4080411E 04	0.331	0.0190	0.316
	90 -180	6.3868690E-01	-6.3497273E 01	3.9897115E 02	-1.1864159E 03	0.	0.	0.238	0.0073	0.192
	0 -180	2.9596640E 00	-1.8943904E 01	3.1134336E 01	-1.6385123E 01	0.	0.	1.560	0.3020	0.991

NEUTRONS EMITTED

EMIN = 1.107 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	1.0524961E 00	-1.2618785E 01	3.2699929E 01	-3.6195530E 01	1.5778840E 01	0.	0.714	0.3543	0.994
	30 - 60	1.1757178E 00	-3.1162998E 01	2.0351727E 02	-6.5177475E 02	9.0055071E 02	-4.4774237E 02	0.587	0.0898	0.765
	60 - 90	7.3175411E-01	-1.1899296E 01	-3.6558912E 01	6.8702039E 01	0.	0.	0.431	0.0265	0.424
	90 -180	6.3429502E-01	-5.4217675E 01	3.5653986E 02	-1.0462751E 03	0.	0.	0.305	0.0122	0.205
	0 -180	3.3120461E 00	-2.8644744E 01	1.2307862E 02	-2.8587666E 02	3.0900435E 02	-1.2090426E 02	2.055	0.4922	0.994

TABLE 29

NEUTRONS INCIDENT ON O

PI + EMITTED

EMIN = 1.107 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	0.	0.	0.	0.	0.	0.	0.013		
	30 - 60	-2.3993662E 00	-1.3316068E 01	3.4955443E 01	-5.2098837E 01	0.	0.	0.021	0.0022	0.326
	60 - 90	0.	0.	0.	0.	0.	0.	0.017		
	90 -180	-4.9310361E 00	1.3664046E 02	-2.4922241E 03	1.1320348E 04	0.	0.	0.022	0.0010	0.109
	0 -180	-7.7391069E-03	-1.3132813E 01	9.2481438E 00	0.	0.	0.	0.083	0.0073	0.379

PI 0 EMITTED

EMIN = 1.107 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	-1.9453343E 00	-1.3045499E 01	6.5856932E 01	-9.2515579E 01	0.	0.	0.032	0.0073	0.491
	30 - 60	-2.9685365E 00	6.3613273E 00	1.0571748E 01	-9.1207461E 02	4.7611097E 03	-7.0831832E 03	0.038	0.0055	0.349
	60 - 90	-2.3807521E 00	-5.7938280E 00	-1.7451215E 01	8.7786232E 00	0.	0.	0.031	0.0025	0.242
	90 -180	-3.8294304E 00	1.2286649E 02	-2.6066491E 03	1.9207628E 04	-5.0804831E 04	0.	0.058	0.0031	0.152
	0 -180	6.7160619E-02	3.8634511E 00	-1.3424587E 02	4.9033781E 02	-5.3846986E 02	0.	0.168	0.0209	0.491

TABLE 30

NEUTRONS INCIDENT ON O

PI - EMITTED

EMIN = 1.207 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	-2.0330552E 00	-2.7620600E 01	2.7618698E 02	-9.8598381E 02	1.5035976E 03	-8.4595226E 02	0.048	0.0144	0.605
	30 - 60	-2.6740286E 00	2.6520366E 01	-2.9116746E 02	1.0840460E 03	-1.3584630E 03	0.	0.082	0.0133	0.412
	60 - 90	-2.6215420E 00	3.1686228E 01	-3.9672473E 02	1.3067061E 03	-1.3698961E 03	0.	0.060	0.0050	0.274
	90 -180	-2.3302958E 00	1.0721879E 01	4.3266410E 02	-1.2972824E 04	9.1757112E 04	-2.0960298E 05	0.090	0.0052	0.189
	0 -180	6.1995658E-01	-2.8122866E 00	-3.9501671E 01	1.1553852E 02	-9.8042614E 01	0.	0.288	0.0404	0.605

TABLE 31

NEUTRONS INCIDENT ON AL

PROTONS EMITTED

EMIN = 1.637 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	1.0454578E 00	-1.1198490E 01	1.9659377E 01	-1.0614362E 01	0.	0.	0.500	0.1841	0.990
	30 - 60	1.0399711E 00	-1.6364775E 01	2.6647134E 01	-1.9567748E 01	0.	0.	0.529	0.0639	0.773
	60 - 90	1.5036615E 00	-6.4759658E 01	7.0594865E 02	-4.0991128E 03	1.0290001E 04	-9.2539816E 03	0.390	0.0219	0.367
	90 -180	1.0178296E 00	-6.4715427E 01	3.7221971E 02	-1.1138203E 03	0.	0.	0.315	0.0087	0.184
	0 -180	3.3076974E 00	-2.1834067E 01	3.6941414E 01	-1.9798119E 01	0.	0.	1.795	0.3014	0.990

NEUTRONS EMITTED

EMIN = 1.637 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	1.5759246E 00	-2.6472729E 01	1.4087304E 02	-3.4579062E 02	3.7678478E 02	-1.4684988E 02	0.728	0.3336	0.996
	30 - 60	1.5753637E 00	-3.3993384E 01	2.0444472E 02	-6.1355720E 02	8.0898463E 02	-3.8636785E 02	0.719	0.1047	0.798
	60 - 90	1.8943828E 00	-8.1890533E 01	1.2539815E 03	-9.2976326E 03	2.9172167E 04	-3.2510372E 04	0.555	0.0323	0.339
	90 -180	1.1623548E 00	-5.7020398E 01	2.8301843E 02	-6.8760377E 02	0.	0.	0.419	0.0135	0.220
	0 -180	3.6240982E 00	-2.4865203E 01	6.1987723E 01	-7.0326282E 01	2.9729533E 01	0.	2.463	0.4764	0.996

TABLE 32

NEUTRONS INCIDENT ON AL

PI + EMITTED

EMIN = 1.637 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	-1.9170305E 00	-1.4599062E 01	2.4288242E 01	0.	0.	0.	0.013	0.0018	0.465
	30 - 60	-2.8797625E 00	-1.2025183E 01	2.7229605E 01	0.	0.	0.	0.017	0.0022	0.330
	60 - 90	-2.9617321E 00	6.8094985E 00	-1.7855723E 02	3.5655742E 02	0.	0.	0.017	0.0010	0.167
	90 -180	-3.9499054E 00	9.1743392E 01	-2.9082491E 03	4.4522851E 04	-2.6428719E 05	0.	0.029	0.0014	0.098
	0 -180	8.0929886E-03	-1.3901639E 01	1.1463831E 01	1.7480354E 00	0.	0.	0.083	0.0079	0.465

PI 0 EMITTED

EMIN = 1.637 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	-1.3416175E 00	-2.1865944E 01	7.7876911E 01	-4.3951968E 01	-8.0385840E 01	0.	0.031	0.0072	0.534
	30 - 60	-2.2986424E 00	-4.6493230E 00	-8.4491372E 00	1.1560636E 02	-2.6985396E 02	0.	0.043	0.0060	0.376
	60 - 90	-3.0754792E 00	4.8108692E 01	-7.1670432E 02	3.0247729E 03	-4.2758517E 03	0.	0.038	0.0027	0.238
	90 -180	-2.4585372E 00	-7.6528618E-01	4.2367840E 02	-9.8139757E 03	4.0377352E 04	0.	0.046	0.0020	0.140
	0 -180	2.6888897E-01	-1.2487458E 00	-9.2984555E 01	3.3664541E 02	-3.5232403E 02	0.	0.164	0.0190	0.534

TABLE 33

NEUTRONS INCIDENT ON AL

PI - EMITTED

EMIN = 1.637 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	-2.2275211E 00	-1.2946847E 01	8.2060217E 01	-2.0425369E 02	3.5536483E 02	-3.5180897E 02	0.043	0.0129	0.550
	30 - 60	-1.8566711E 00	-6.7359098E 00	3.5427197E 01	-7.7228180E 01	0.	0.	0.079	0.0127	0.420
	60 - 90	-3.1768153E 00	6.5600352E 01	-7.8764126E 02	2.2430319E 03	2.7176475E 03	-1.3799185E 04	0.071	0.0062	0.288
	90 -180	-1.5816473E 00	-4.5226662E 01	1.9167524E 03	-3.3067113E 04	2.1374907E 05	-4.7028384E 05	0.080	0.0041	0.190
	0 -180	6.4049233E-01	-9.7011302E-01	-8.7831453E 01	3.3409252E 02	-3.6116151E 02	0.	0.273	0.0370	0.550

TABLE 34

NEUTRONS INCIDENT ON PB

PROTONS EMITTED

EMIN = 6.683 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	1.6611287E 00	-2.5420409E 01	8.8338395E 01	-1.3868265E 02	9.3048795E 01	-2.0444944E 01	0.386	0.1082	0.982
	30 - 60	2.0700758E 00	-5.6363660E 01	4.2729443E 02	-1.5530290E 03	2.4548585E 03	-1.3975914E 03	0.535	0.0558	0.646
	60 - 90	2.1144411E 00	-8.6746961E 01	1.0096580E 03	-5.8075116E 03	1.3634812E 04	-1.0376776E 04	0.392	0.0208	0.285
	90 -180	2.0975564E 00	-1.4290285E 02	2.7630564E 03	-2.8949241E 04	1.3462074E 05	-2.2626422E 05	0.374	0.0133	0.212
	0 -180	3.3092107E 00	-1.5960443E 01	1.1471056E 01	0.	0.	0.	1.818	0.2041	0.982

NEUTRONS EMITTED

EMIN = 6.683 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	2.3493155E 00	-2.4119810E 01	6.8869720E 01	-8.6718072E 01	3.9552163E 01	0.	0.704	0.1986	0.991
	30 - 60	2.1262401E 00	-2.2202789E 01	4.3434934E 01	-3.7544140E 01	0.	0.	1.021	0.0970	0.686
	60 - 90	2.8722687E 00	-8.9228679E 01	1.1846136E 03	-8.0009618E 03	2.2954698E 04	-2.3301769E 04	0.863	0.0463	0.381
	90 -180	2.8361202E 00	-1.3664585E 02	2.3426353E 03	-2.1760996E 04	8.7698606E 04	-1.2627091E 05	0.756	0.0248	0.198
	0 -180	4.1282896E 00	-1.8151090E 01	1.3807515E 01	0.	0.	0.	3.550	0.3684	0.991

TABLE 35

NEUTRONS INCIDENT ON PB

PI • EMITTED

EMIN = 6.683 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	0.	0.	0.	0.	0.	0.	0.009		
	30 - 60	0.	0.	0.	0.	0.	0.	0.013		
	60 - 90	0.	0.	0.	0.	0.	0.	0.009		
	90 -180	-2.4793891E 00	-1.3000760E 01	-1.4729308E 02	0.	0.	0.	0.019	0.0007	0.094
	0 -180	2.4254630E-01	-2.4691226E 01	3.6262882E 01	0.	0.	0.	0.054	0.0037	0.372

PI 0 EMITTED

EMIN = 6.683 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	0.	0.	0.	0.	0.	0.	0.018		
	30 - 60	-2.2451391E 00	-7.1271681E 00	-9.0025688E 01	6.4697596E 02	-1.0331855E 03	0.	0.032	0.0051	0.384
	60 - 90	-2.0139760E 00	-9.0531290E-01	-1.7278697E 02	4.9148245E 02	0.	0.	0.029	0.0016	0.174
	90 -180	-1.2001160E 00	-4.3384680E 01	7.4000040E 02	-7.6292079E 03	2.3268373E 04	0.	0.064	0.0030	0.160
	0 -180	7.0937672E-01	-8.3968679E 00	-1.2273210E 02	6.5962478E 02	-8.6842319E 02	0.	0.152	0.0164	0.448

TABLE 36

NEUTRONS INCIDENT ON PB

PI - EMITTED

EMIN = 6.583 (MEV)

EO (MEV)	ANG. INT.	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO
1000	0 - 30	-1.6698927E 00	-2.9039221E 01	1.9649900E 02	-4.7026466E 02	3.6682812E 02	0.	0.027	0.0065	0.466
	30 - 60	-1.2827629E 00	-2.2220977E 01	6.0300015E 01	1.1646584E 02	-4.8185782E 02	0.	0.050	0.0066	0.395
	60 - 90	-9.1178695E-01	-2.2605294E 01	3.9362672E 01	-8.5245613E 00	0.	0.	0.059	0.0040	0.257
	90 -180	-3.8714390E 00	2.4324936E 02	-7.3518144E 03	8.8311228E 04	-4.5597025E 05	7.6293905E 05	0.108	0.0052	0.143
	0 -180	1.3626526E 00	-1.3900239E 01	-5.6455393E 01	3.8000685E 02	-5.1936581E 02	0.	0.251	0.0246	0.479

Appendix III. TABLES OF COEFFICIENTS FOR EVAPORATION-PARTICLE SPECTRA

Tables 37-39. All cases for which cascade-particle spectra are given.

TABLE 37

PROTONS INCIDENT ON O

EVAPORATION PROTONS EMITTED

EO (MEV)	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO	EMIN /EO
750	7.0462192E-01	3.0989680E 00	-2.9542013E 01	4.8854325E 01	-2.6534551E 01	0.	0.762	0.0067	0.028	.00067
1000	3.6511182E-01	8.7024821E 00	-5.3911663E 01	9.0442251E 01	-5.0018193E 01	0.	0.823	0.0057	0.021	.00030
2000	5.9273875E-01	4.9903666E 00	-3.3670486E 01	5.0514924E 01	-2.4494185E 01	0.	0.884	0.0031	0.011	.00010

EVAPORATION NEUTRONS EMITTED

EO (MEV)	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO	EMIN /EO
750	1.3079022E 00	-4.4138600E 00	1.1301736E 00	0.	0.	0.	0.904	0.0071	0.029	0.
1000	1.5375394E 00	-5.0791309E 00	3.4108701E 00	-2.0236553E 00	-1.2639868E-02	0.	1.090	0.0063	0.021	0.
2000	9.8607168E-01	-2.4615223E 00	-1.3760336E 00	1.7030591E 00	-2.7164695E-01	0.	0.912	0.0033	0.011	0.

NEUTRONS INCIDENT ON O

EVAPORATION PROTONS EMITTED

EO (MEV)	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO	EMIN /EO
1000	4.6614221E-01	7.5529273E 00	-4.5413597E 01	6.9129997E 01	-3.4871339E 01	0.	0.857	0.0056	0.021	.00010

NEUTRONS INCIDENT ON O

EVAPORATION NEUTRONS EMITTED

EO (MEV)	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO	EMIN /EO
1000	8.0751963E-01	-2.1275093E 00	1.9429341E 00	-2.3249510E 01	4.8366355E 01	-2.9200244E 01	0.778	0.0054	0.022	0.

TABLE 38

PROTONS INCIDENT ON AL

EVAPORATION PROTONS EMITTED

EO (MEV)	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO	EMIN /EO
750	-7.4138494E 01	5.1311954E 02	-1.2745654E 03	1.3603593E 03	-5.3556252E 02	0.	0.379	0.0062	0.027	.01187
1000	4.2915379E-01	1.1891571E 01	-5.6586720E 01	8.1630642E 01	-3.9535142E 01	0.	1.355	0.0102	0.022	.00030
2000	1.6116658E-01	1.3094337E 01	-5.5189609E 01	7.7275953E 01	-3.7298043E 01	0.	1.462	0.0062	0.011	.00015

EVAPORATION NEUTRONS EMITTED

EO (MEV)	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO	EMIN /EO
750	4.0448077E 00	1.3179551E 01	-2.0101409E 02	7.2412848E 02	-9.0736041E 02	0.	11.849	0.0428	0.014	0.
1000	1.3941570E 00	-5.7601853E-01	-1.2857937E 01	1.1157469E 01	1.5745763E 01	-1.8013957E 01	1.255	0.0077	0.021	0.
2000	1.6723852E 00	-1.7424850E-01	-1.0533595E 01	1.3430468E 01	-5.2134901E 00	0.	1.976	0.0067	0.011	0.

NEUTRONS INCIDENT ON AL

EVAPORATION PROTONS EMITTED

EO (MEV)	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO	EMIN /EO
1000	2.1335946E-01	1.4727638E 01	-6.9533995E 01	1.0335490E 02	-5.1599771E 01	0.	1.283	0.0097	0.022	.00040

NEUTRONS INCIDENT ON AL

EVAPORATION NEUTRONS EMITTED

EO (MEV)	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO	EMIN /EO
1000	1.4649414E 00	-1.3754718E 00	-1.3355261E 01	2.7803641E 01	-1.7031523E 01	0.	1.312	0.0084	0.022	0.

TABLE 39

PROTONS INCIDENT ON PB

EVAPORATION PROTONS EMITTED

EO (MEV)	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO	EMIN /EO
750	-3.9789888E 01	2.9039399E 02	-7.3119202E 02	7.8708530E 02	-3.1201289E 02	0.	1.523	0.0254	0.029	.01067
1000	-4.4068592E 01	3.1877601E 02	-7.9296625E 02	8.4153306E 02	-3.2707694E 02	0.	2.163	0.0277	0.022	.00760
2000	-3.0715379E 01	2.2669419E 02	-5.5414574E 02	5.7632899E 02	-2.1898485E 02	0.	4.553	0.0305	0.012	.00315

EVAPORATION NEUTRONS EMITTED

EO (MEV)	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO	EMIN /EO
750	3.9001705E 00	8.4244034E 00	-9.5963811E 01	2.3658829E 02	-2.0186034E 02	0.	13.280	0.0645	0.019	0.
1000	3.8884355E 00	8.5402986E 00	-8.8631036E 01	2.0850318E 02	-1.6584713E 02	0.	14.893	0.0613	0.015	0.
2000	3.8745976E 00	6.6033615E 00	-5.1298170E 01	9.1644832E 01	-5.5613145E 01	0.	19.511	0.0522	0.009	0.

NEUTRONS INCIDENT ON PB

EVAPORATION PROTONS EMITTED

EO (MEV)	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO	EMIN /EO
1000	-4.1088898E 01	2.9767592E 02	-7.3928690E 02	7.8146695E 02	-3.0193637E 02	0.	2.042	0.0263	0.023	.00760

NEUTRONS INCIDENT ON PB

EVAPORATION NEUTRONS EMITTED

EO (MEV)	A0	A1	A2	A3	A4	A5	NO. EMIT.	ENERGY EMIT./EO	EMAX /EO	EMIN /EO
1000	3.8941478E 00	8.1019615E 00	-8.2246753E 01	1.8675126E 02	-1.4410304E 02	0.	15.161	0.0632	0.016	0.

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